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Investigating Region-wise Sensitivities for Nuclear Criticality Safety Validation

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Introduction

Whisper 1.1 Benchmark Selection

Whisper is a criticality safety statistical analysis package that uses the sensitivity profile data developed by MCNP6 for a given application and the covariance files for the nuclear data to determine a baseline Upper-Subcritical-Limit (USL) for a given application [1]. Whisper is designed to give a quantifiable basis for the selection of criticality benchmarks used to determine the appropriate calculational margin.

MCNP6 is used to generate sensitivity profiles for an application problem. Whisper then selects benchmarks, based on various SU methods, from a catalog of over 1100 ICSBEP benchmarks [1]. Using these selected benchmarks, Whisper computes a calculational margin from an extreme value distribution. Whisper attempts to quantify the errors in the software and the uncertainties in the nuclear data which are a portion of the margin of subcriticality (MOS) [1]. The calculational margin and the Whisper-calculated MOS can be used in a nuclear criticality safety evaluation to set the baseline USL for a given application [2]. While the baseline USL may not be be the final number used in a nuclear criticality safety evaluation, the use of MCNP6-Whisper produces repeatable, quantitative, and physics-based calculations which can be used to determine a USL [2]. These MCNP6-Whisper calculations can effectively replace much of what a nuclear criticality safety evaluation relied solely on expert judgment [2].

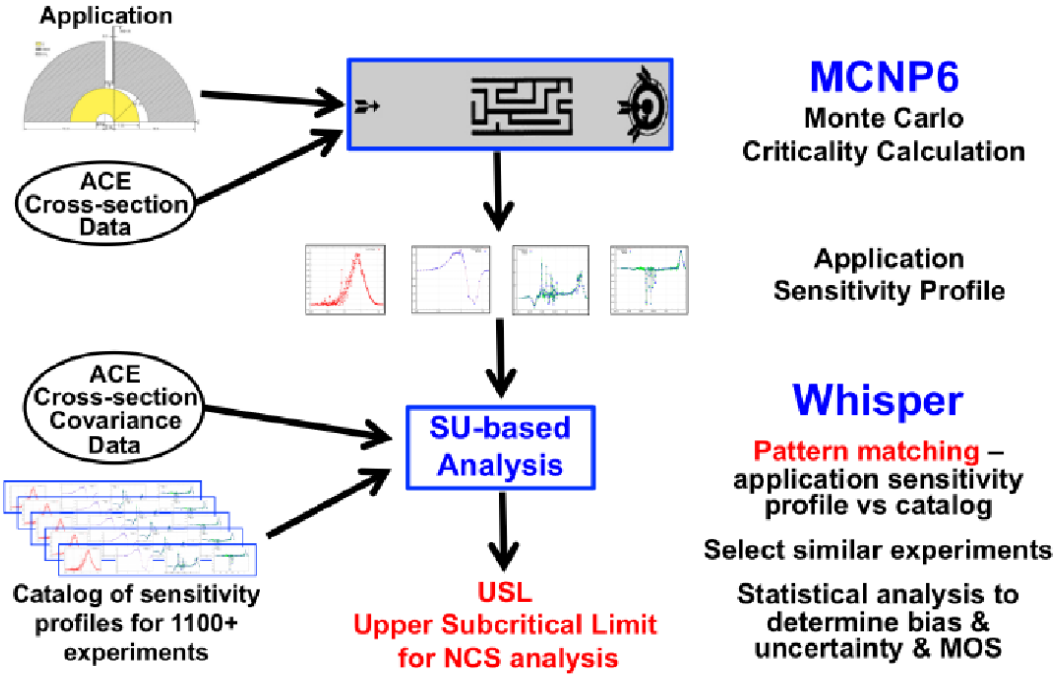

Figure 1. The MCNP6-Whisper calculational method for computing a baseline USL value.

While the MCNP6-Whisper calculational methods have been demonstrated for single critical unit applications, many practical nuclear criticality safety calculations involve more than one loosely-coupled critical unit. With a collection of loosely-coupled units, the sensitivity profiles for each unit are influenced by the leakage from other units in the system. Analyzing single units ignores these interactions between units, while using a single calculation for the overall system only provides a

sensitivity profile that represents a sort of average for the system. It is not clear such an average would be conservative for nuclear criticality safety applications. This study addresses how to apply the MCNP6-Whisper calculational methods to these loosely-coupled systems.

The present study investigates the application of the MCNP6-Whisper calculational methods to loosely-coupled systems comprised of two units. This study makes use of a relatively obscure MCNP6 capability, the calculation of region-dependent sensitivity profiles. MCNP6 can compute, in a single calculation, the region-wise sensitivity profiles for each unit, as influenced by the leakage of the other unit, and the sensitivity profile of the overall loosely-coupled system.

This report provides results from an initial investigation of the use of region-wise sensitivity profiles for loosely-coupled system in the MCNP6-Whisper calculational methods. This investigation deliberately focused on small, simple systems to aid in the discovery of the physical and computational issues involved in these types of systems. Three basic highly enriched uranium (HEU) and plutonium units are used in the loosely-coupled models: bare fast metal sphere, water-reflected fast metal sphere, and thermal solution. These three different units for HEU and plutonium are paired in various combinations and the MCNP6-Whisper calculational methods are conducted using the region-wise and overall sensitivity profiles for these loosely-coupled systems. These MCNP6-Whisper calculations are done over a range of separating distances between the loosely-coupled critical units. The results evaluated in this study are Whisper-selected benchmark profiles and calculated baseline USL values for each calculated sensitivity profile at each separation distance for a given loosely-coupled system. These results are used to provide nuclear criticality safety practitioners with greater insight into the behavior of these loosely-coupled systems and provide some preliminary recommendations for the determination of the appropriate baseline USL values with regards to nuclear criticality safety applications.

Methodology

Modifications to Whisper scripts

The normal use of MCNP6 and Whisper for analyzing nuclear criticality safety (NCS) applications is described in Reference [1]. The *whisper_mcnp.pl* script is used to insert the required input for the KSEN card, specifying the reactions and energy bins for sensitivities, into the user input and then run MCNP6. The *whisper_usl.pl* script is used to extract sensitivity profiles from the MCNP6 output files and then run the Whisper program for benchmark selection and statistical analysis. These scripts assume that only 1 sensitivity profile for the entire problem is desired and do not permit sensitivity profiles to be obtained for different regions in the problem.

The scripts were modified and saved as *whisper_mcnp2.pl* and *whisper_usl2.pl*. These modified scripts permit users to specify regions for obtaining sensitivities in a single MCNP6 calculation. For example, if there are 2 interacting assemblies in a problem, assembly A consisting of cells 10, 11, 12, and assembly B consisting of cells 20, 21, then the following lines in the user's input file would result in MCNP6 obtaining separate sensitivity profiles for assembly A, assembly B, and the combined system:

```
KSEN1   xs   cell= (10 11 12)          $ compute sensitivities for assembly A
KSEN2   xs   cell= (20 21)             $ compute sensitivities for assembly B
KSEN3   xs   cell= (10 11 12 20 21)    $ compute sensitivities for entire problem
```

It is important to note that only 1 MCNP6 calculation is performed, containing both assemblies A and B. The region-wise sensitivity profile (KSEN1) for assembly A includes the effects of interacting with assembly B; the region-wise sensitivity profile (KSEN2) for assembly B includes the effects of interacting with assembly A; and the sensitivity profile for the entire system (KSEN3) is what would normally be produced by MCNP6 using the *whisper_mcnp.pl* script. All 3 sensitivity profiles are obtained in the single MCNP6 calculation of the entire system. The whisper_usl2.pl script runs all 3 sensitivity profiles separately through Whisper (i.e., 3 Whisper calculations). In the discussion of results below, the region-wise Whisper results for the assemblies are presented and compared to the conventional Whisper results for the overall system.

Analysis of Test Problems

Four models were created with two benchmark critical assemblies in each model. A parametric study of five separating distances between the centers of the two assemblies was conducted for each model. Region-wise sensitivity profiles for each of the two interacting assemblies and the overall system were calculated using MCNP6.2 in a single combined calculation. These sensitivities were used by Whisper 1.1 to select benchmark populations and determine the baseline USL for each assembly and for the overall coupled system.

The ten benchmarks with the highest weighting were compared at each separating distance for each assembly and the overall coupled system for a given model. The baseline USL at each separating distance, for each assembly and the overall coupled system, was compared to determine the differences between the regional and overall baseline USL determined by Whisper.

Model Descriptions

Bare Fast Metal Model

An HEU assembly was taken from the ICSBEP benchmark heu-met-fast-051-015.i and a Plutonium assembly was taken from the ICSBEP benchmark pu-met-fast-001-001.i and were placed together into this application model. The following table characterizes the material, energy spectrum, and dimensions of the two assemblies in the model.

Table 1. Bare Fast Metal Model Assembly Description

Assembly Material	Energy Spectra	Density [g/cc]	Assembly Radius [cm]	Calculated Regional k_{eff}
HEU	Fast	18.74	8.7407	0.9998+/-0.0001
Plutonium	Fast	15.61	6.3849	1.0001+/- 0.0001

The separating distance for this model spans from 20 to 100 centimeters with 20-centimeter increments. The following figure illustrates the x-y geometry of the model at a separating distance of 20 centimeters from the center of the HEU unit to the center of the Pu unit.

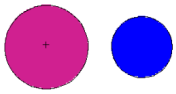

Figure 1. The Bare-Fast Metal Model with a 20 cm separating distance.

This model used 100,000 neutrons per cycle, 100 inactive cycles, and 500 active cycles.

Water-Reflected Fast Metal Model

An HEU assembly was taken from the ICSBEP benchmark heu-met-fast-004-001.i and a Plutonium assembly was taken from the ICSBEP benchmark pu-met-fast-011-001.i and were placed together into this application. The following table characterizes the material, energy spectrum, and dimensions of the two assemblies in the model.

Table 2. Reflected Fast Metal Model Assembly Description

Assembly Material	Energy Spectra	Density [g/cc]	Reflector Thickness [cm]	Assembly Radius [cm]	Calculated Regional k_{eff}
HEU	Fast	19.74	25.400	8.7407	0.99406 +- 0.00011
Plutonium	Fast	18.74	26.9180	6.3849	1.00014 +- 0.00011

The separating distance for this model spans from 70 to 150 centimeters with 20-centimeter increments. The following figure illustrates the x-y geometry of the model at a separating distance of 70 centimeters from the center of the HEU unit to the center of the Pu unit.

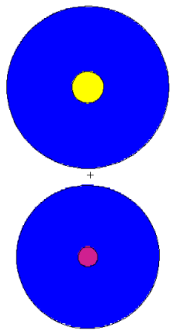

Figure 2. Water-Reflected Fast Metal Model with a separating distance of 70 cm.

This model used 100,000 neutrons per cycle, 500 inactive cycles, and 500 active cycles.

Thermal Solution Model

An HEU assembly was taken from the ICSBEP benchmark heu-sol-therm-050-010.i and a Plutonium assembly was taken from the ICSBEP benchmark pu-sol-therm-001-001.i and were placed together

into this application model. The following table characterizes the material, energy spectrum, and dimensions of the two assemblies in the model.

Table 3. Thermal Solution Assembly Description

Assembly Material	Energy Spectra	Density [atoms/b-cm]	Aluminum Canister Thickness [cm]	Reflector Thickness [cm]	Inner Canister Radius [cm]	Calculated Regional k_{eff}
HEU Solution	Thermal	9.82964005e-2	0.1587	23.3236	11.5177	1.00578 +-0 .00013
Plutonium Solution	Thermal	1.0087e-1	0.1245	30.0000	14.5151	0.99113 +- 0.00015

The separating distance for this model spans from 80 to 160 centimeters with 20 centimeter increments. The following figure illustrates the x-y geometry of the model at a separating distance of 80 centimeters from the center of the HEU unit to the center of the Pu unit.

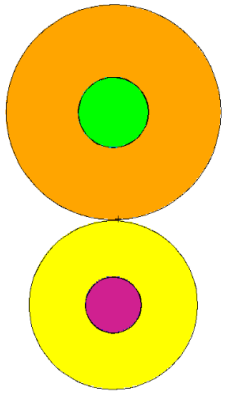

Figure 3. Thermal Solution Model with an 80 cm separating distance.

This model used 100,000 neutrons per cycle, 500 inactive cycles, and 500 active cycles.

Mixed Plutonium Model

A fast, metal Plutonium assembly was taken from the ICSBEP benchmark pu-met-fast-011-001.i and a thermal, solution Plutonium assembly was taken from the ICSBEP benchmark pu-sol-therm-001-001.i and were placed together into this application model. The following table characterizes the material, energy spectrum, and dimensions of the two assemblies in the model.

Table 4. Mixed Plutonium Model Assembly Description

Assembly Material	Energy Spectra	Density	Canister Thickness [cm]	Reflector Thickness [cm]	Assembly Radius [cm]	Calculated Regional k_{eff}
Plutonium Solution	Thermal	1.0087e-1 [atoms/b-cm]	0.1245	25.4000	4.1217	1.00578 +- 0.00013
Plutonium Metal	Fast	19.74 [g/cc]	N/A	30.0000	14.5151	1.00002 +- 0.00010

The separating distance for this model spans from 80 to 160 centimeters with 20-centimeter increments. The following figure illustrates the x-y geometry of the model at a separating distance of 80 centimeters from the center of the 1st unit to the center of the 2nd unit.

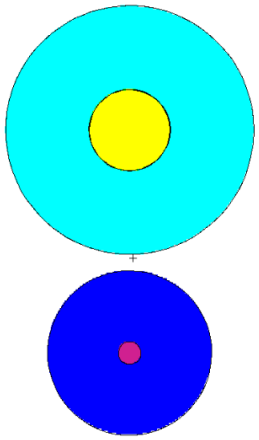

Figure 4. Mixed Plutonium Model with an 80 cm separating distance.

This model used 100,000 neutrons per cycle, 500 inactive cycles, and 500 active cycles.

Results

Truncated benchmark profiles and baseline USL calculations were made using MCNP6.2 and Whisper-1.1 for the regional and overall sensitivity profiles at each separating distance for a given model. ENDF/B-VII.1 nuclear data were used in all calculations and the standard 44-group "low-fidelity" covariance data were used in all Whisper calculations in this study.

Bare Fast Metal Model

The following tables display the truncated benchmark rankings for each assembly and the overall coupled system.

Table 5. Bare Fast HEU Metal Assembly Truncated Benchmark Rankings

Bare Fast Metal HEU Assembly	Separating Distance [cm]				
Ranked Benchmark	20	40	60	80	100
1	heu-met-fast-051-015.i	heu-met-fast-051-015.i	heu-met-fast-051-015.i	heu-met-fast-051-015.i	heu-met-fast-051-015.i
2	heu-met-fast-100-002.i	heu-met-fast-100-002.i	heu-met-fast-100-002.i	heu-met-fast-100-002.i	heu-met-fast-100-002.i
3	heu-met-fast-051-014.i	heu-met-fast-051-014.i	heu-met-fast-051-014.i	heu-met-fast-051-014.i	heu-met-fast-051-014.i
4	heu-met-fast-100-001.i	heu-met-fast-100-001.i	heu-met-fast-100-001.i	heu-met-fast-100-001.i	heu-met-fast-100-001.i
5	heu-met-fast-065-002.i	heu-met-fast-065-002.i	heu-met-fast-065-002.i	heu-met-fast-065-002.i	heu-met-fast-065-002.i
6	heu-met-fast-044-001.i	heu-met-fast-044-001.i	heu-met-fast-044-001.i	heu-met-fast-044-001.i	heu-met-fast-044-001.i
7	heu-met-fast-001-001.i	heu-met-fast-001-001.i	heu-met-fast-001-001.i	heu-met-fast-001-001.i	heu-met-fast-001-001.i
8	heu-met-fast-015-001.i	heu-met-fast-015-001.i	heu-met-fast-015-001.i	heu-met-fast-015-001.i	heu-met-fast-015-001.i
9	heu-met-fast-008-001.i	heu-met-fast-008-001.i	heu-met-fast-008-001.i	heu-met-fast-008-001.i	heu-met-fast-008-001.i
10	heu-met-fast-044-002.i	heu-met-fast-044-002.i	heu-met-fast-044-002.i	heu-met-fast-044-002.i	heu-met-fast-044-002.i

Table 6. Bare Fast Metal Plutonium Assembly Truncated Benchmark Rankings

Bare Fast Plutonium Assembly	Separating Distance [cm]				
Ranked Benchmark	20	40	60	80	100
1	pu-met-fast-001-001.i	pu-met-fast-001-001.i	pu-met-fast-001-001.i	pu-met-fast-001-001.i	pu-met-fast-001-001.i
2	pu-met-fast-022-001.i	pu-met-fast-022-001.i	pu-met-fast-022-001.i	pu-met-fast-022-001.i	pu-met-fast-022-001.i
3	pu-met-fast-029-001.i	pu-met-fast-029-001.i	pu-met-fast-029-001.i	pu-met-fast-029-001.i	pu-met-fast-029-001.i
4	mix-met-fast-009-001.i	mix-met-fast-009-001.i	mix-met-fast-009-001.i	mix-met-fast-009-001.i	mix-met-fast-009-001.i
5	pu-met-fast-023-001.i	pu-met-fast-023-001.i	pu-met-fast-023-001.i	pu-met-fast-023-001.i	pu-met-fast-023-001.i
6	pu-met-fast-035-001.i	pu-met-fast-035-001.i	pu-met-fast-035-001.i	pu-met-fast-035-001.i	pu-met-fast-035-001.i
7	pu-met-fast-039-001.i	pu-met-fast-039-001.i	pu-met-fast-039-001.i	pu-met-fast-039-001.i	pu-met-fast-039-001.i
8	pu-met-fast-030-001.i	pu-met-fast-030-001.i	pu-met-fast-030-001.i	pu-met-fast-030-001.i	pu-met-fast-030-001.i
9	pu-met-fast-009-001.i	pu-met-fast-009-001.i	pu-met-fast-009-001.i	pu-met-fast-009-001.i	pu-met-fast-009-001.i
10	pu-met-fast-025-001.i	pu-met-fast-025-001.i	pu-met-fast-025-001.i	pu-met-fast-025-001.i	pu-met-fast-025-001.i

Table 7. Bare Fast Metal System Truncated Benchmark Rankings

Bare Fast Metal System	Separating Distance [cm]				
Ranked Benchmark	20	40	60	80	100
1	mix-met-fast-007-013.i	mix-met-fast-007-013.i	mix-met-fast-007-013.i	mix-met-fast-007-013.i	mix-met-fast-007-013.i
2	mix-met-fast-007-012.i	mix-met-fast-007-012.i	mix-met-fast-007-012.i	mix-met-fast-007-012.i	mix-met-fast-007-012.i
3	mix-met-fast-007-018.i	mix-met-fast-007-018.i	mix-met-fast-007-018.i	mix-met-fast-007-018.i	mix-met-fast-007-018.i
4	mix-met-fast-007-011.i	mix-met-fast-007-011.i	mix-met-fast-007-011.i	mix-met-fast-007-011.i	mix-met-fast-007-011.i
5	mix-met-fast-010-001.i	mix-met-fast-010-001.i	mix-met-fast-010-001.i	mix-met-fast-010-001.i	mix-met-fast-010-001.i
6	mix-met-fast-007-006.i	mix-met-fast-007-006.i	mix-met-fast-007-006.i	mix-met-fast-007-006.i	mix-met-fast-007-006.i
7	mix-met-fast-007-017.i	mix-met-fast-007-017.i	mix-met-fast-007-017.i	mix-met-fast-007-017.i	mix-met-fast-007-017.i
8	mix-met-fast-007-005.i	mix-met-fast-007-005.i	mix-met-fast-007-005.i	mix-met-fast-007-005.i	mix-met-fast-007-005.i
9	mix-met-fast-007-010.i	mix-met-fast-007-010.i	mix-met-fast-007-010.i	mix-met-fast-007-010.i	mix-met-fast-007-010.i
10	mix-met-fast-007-021.i	mix-met-fast-007-021.i	mix-met-fast-007-021.i	mix-met-fast-007-021.i	mix-met-fast-007-021.i

The following figure illustrates the baseline USL values for the individual assemblies and the overall coupled system with respect to separating distance.

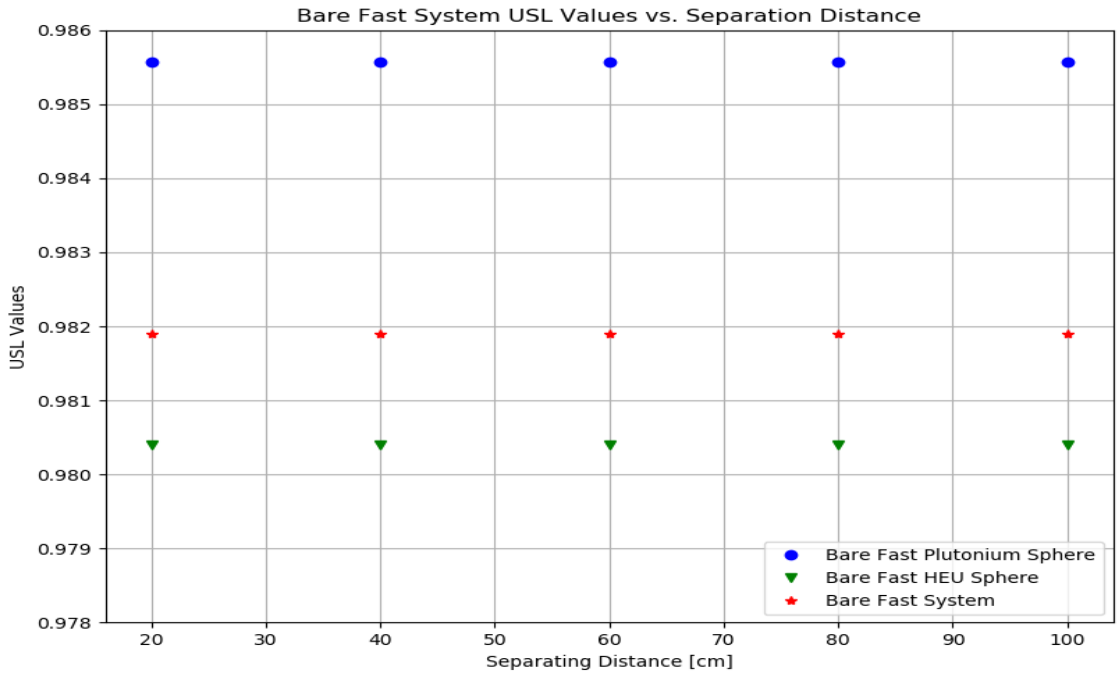

Figure 5. Baseline USL values that characterize the Bare Fast Metal Model.

Water-Reflected Fast Metal Model

The following tables display the truncated benchmark rankings for each assembly and the overall coupled system.

Table 8. Reflected Fast Plutonium Metal Truncated Benchmark Rankings

Reflected Fast Metal Plutonium Assembly	Separating Distance [cm]				
Ranked Benchmark	40	60	80	100	120
1	pu-met-fast-011-001.i	pu-met-fast-011-001.i	pu-met-fast-011-001.i	pu-met-fast-011-001.i	pu-met-fast-011-001.i
2	pu-met-fast-044-004.i	pu-met-fast-042-001.i	pu-met-fast-042-001.i	pu-met-fast-044-004.i	pu-met-fast-044-004.i
3	pu-met-fast-042-001.i	pu-met-fast-044-004.i	pu-met-fast-044-004.i	pu-met-fast-042-001.i	pu-met-fast-042-001.i
4	pu-met-fast-027-001.i	pu-met-fast-027-001.i	pu-met-fast-042-002.i	pu-met-fast-027-001.i	pu-met-fast-027-001.i
5	pu-met-fast-042-002.i	pu-met-fast-042-002.i	pu-met-fast-027-001.i	pu-met-fast-042-002.i	pu-met-fast-042-002.i
6	pu-met-fast-031-001.i	pu-met-fast-031-001.i	pu-met-fast-031-001.i	pu-met-fast-031-001.i	pu-met-fast-031-001.i
7	pu-met-fast-044-005.i	pu-met-fast-044-005.i	pu-met-fast-044-005.i	pu-met-fast-044-005.i	pu-met-fast-044-005.i
8	pu-met-fast-042-003.i	pu-met-fast-042-003.i	pu-met-fast-042-003.i	pu-met-fast-042-003.i	pu-met-fast-042-003.i
9	pu-met-fast-042-004.i	pu-met-fast-042-004.i	pu-met-fast-042-004.i	pu-met-fast-042-004.i	pu-met-fast-042-004.i
10	pu-met-fast-036-001.i	pu-met-fast-036-001.i	pu-met-fast-036-001.i	pu-met-fast-036-001.i	pu-met-fast-036-001.i

Table 9. Reflected Fast HEU Metal Truncated Benchmark Rankings

Reflected Fast Metal HEU Assembly	Separating Distance [cm]				
Ranked Benchmark	40	60	80	100	120
1	heu-met-fast-004-001.i	heu-met-fast-004-001.i	heu-met-fast-004-001.i	heu-met-fast-004-001.i	heu-met-fast-004-001.i
2	heu-met-fast-078-001.i	heu-met-fast-078-001.i	heu-met-fast-078-001.i	heu-met-fast-078-001.i	heu-met-fast-078-001.i
3	heu-met-fast-011-001.i	heu-met-fast-011-001.i	heu-met-fast-011-001.i	heu-met-fast-007-035.i	heu-met-fast-084-011.i
4	heu-met-fast-007-035.i	heu-met-fast-084-011.i	heu-met-fast-007-035.i	heu-met-fast-011-001.i	heu-met-fast-011-001.i
5	heu-met-fast-078-011.i	heu-met-fast-007-035.i	heu-met-fast-078-011.i	heu-met-fast-091-001.i	heu-met-fast-016-002.i
6	heu-met-fast-078-009.i	heu-met-fast-016-002.i	heu-met-fast-078-017.i	heu-met-fast-078-011.i	heu-met-fast-084-002.i
7	heu-met-fast-078-017.i	heu-met-fast-091-001.i	heu-met-fast-078-009.i	heu-met-fast-078-017.i	heu-met-fast-078-005.i
8	heu-met-fast-078-005.i	heu-met-fast-078-005.i	heu-met-fast-078-005.i	heu-met-fast-078-009.i	heu-met-fast-009-002.i
9	heu-met-fast-078-015.i	heu-met-fast-078-017.i	heu-met-fast-078-015.i	heu-met-fast-078-005.i	heu-met-fast-078-017.i
10	heu-met-fast-078-013.i	heu-met-fast-078-011.i	heu-met-fast-078-013.i	heu-met-fast-078-015.i	heu-met-fast-010-002.i

Table 10. Reflected Fast Metal System Truncated Benchmark Rankings

Reflected Fast Metal System	Separating Distance [cm]				
Ranked Benchmark	40	60	80	100	120
1	pu-met-fast-011-001.i	pu-met-fast-011-001.i	pu-met-fast-011-001.i	pu-met-fast-011-001.i	pu-met-fast-011-001.i
2	pu-met-fast-042-001.i	pu-met-fast-042-001.i	pu-met-fast-042-001.i	pu-met-fast-044-004.i	pu-met-fast-042-001.i
3	pu-met-fast-044-004.i	pu-met-fast-027-001.i	pu-met-fast-027-001.i	pu-met-fast-042-001.i	pu-met-fast-044-004.i
4	pu-met-fast-027-001.i	pu-met-fast-044-004.i	pu-met-fast-044-004.i	pu-met-fast-027-001.i	pu-met-fast-027-001.i
5	pu-met-fast-042-002.i	pu-met-fast-042-002.i	pu-met-fast-042-002.i	pu-met-fast-042-002.i	pu-met-fast-042-002.i
6	pu-met-fast-031-001.i	pu-met-fast-031-001.i	pu-met-fast-031-001.i	pu-met-fast-031-001.i	pu-met-fast-031-001.i
7	pu-met-fast-044-005.i	pu-met-fast-044-005.i	pu-met-fast-044-005.i	pu-met-fast-044-005.i	pu-met-fast-044-005.i
8	pu-met-fast-042-003.i	pu-met-fast-042-003.i	pu-met-fast-042-003.i	pu-met-fast-042-003.i	pu-met-fast-042-003.i
9	pu-met-fast-042-004.i	pu-met-fast-042-004.i	pu-met-fast-042-004.i	pu-met-fast-042-004.i	pu-met-fast-042-004.i
10	pu-met-fast-036-001.i	pu-met-fast-036-001.i	pu-met-fast-036-001.i	pu-met-fast-036-001.i	pu-met-fast-036-001.i

The following figure illustrates the baseline USL values for the individual assemblies and the overall coupled system with respect to separating distance.

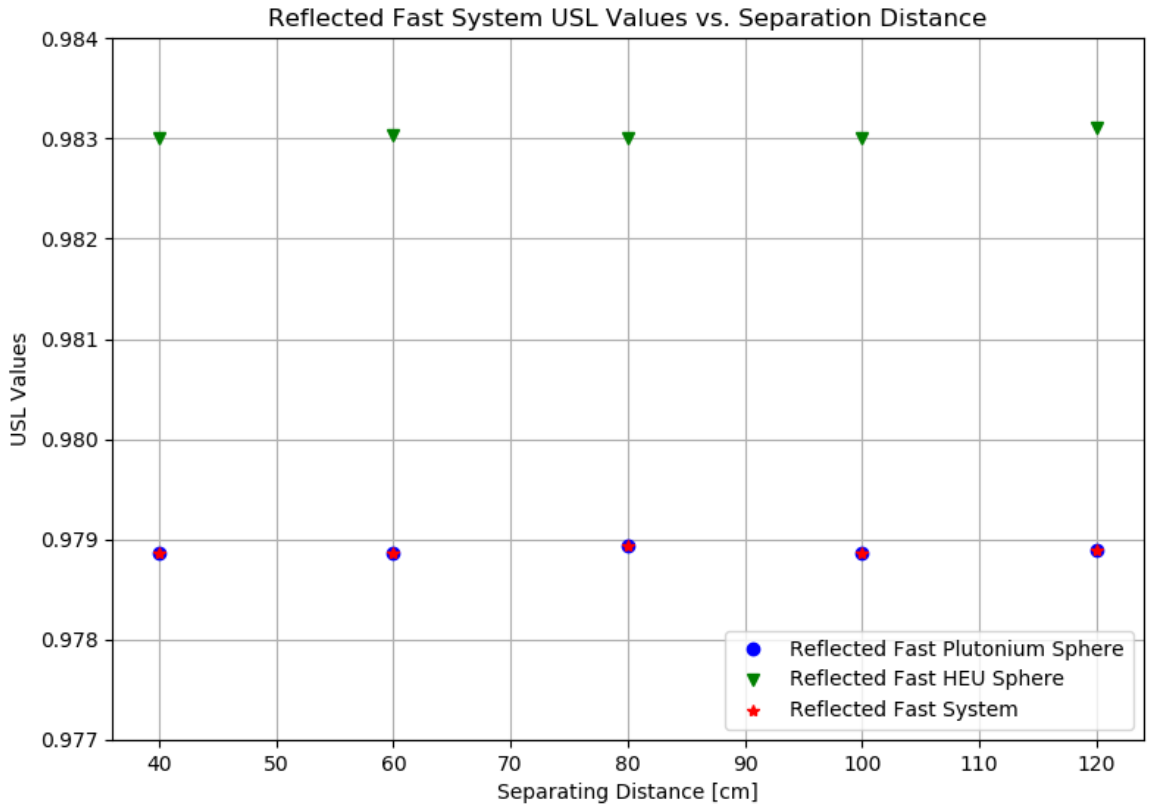

Figure 6. Baseline USL values that characterizes the Reflected Fast Metal Model.

Thermal Solution Model

The following tables display the truncated benchmark rankings for each assembly and the overall coupled system.

Table 11. Thermal HEU Solution Truncated Benchmark Rankings

Thermal HEU Solution	Separating Distance [cm]				
Ranked Benchmark	45	65	85	105	125
1	heu-sol-therm-050-010.i	heu-sol-therm-050-010.i	heu-sol-therm-050-010.i	heu-sol-therm-050-010.i	heu-sol-therm-050-010.i
2	heu-sol-therm-050-001.i	heu-sol-therm-050-001.i	heu-sol-therm-050-001.i	heu-sol-therm-050-001.i	heu-sol-therm-050-001.i
3	heu-sol-therm-050-008.i	heu-sol-therm-050-008.i	heu-sol-therm-050-008.i	heu-sol-therm-050-008.i	heu-sol-therm-050-008.i
4	heu-sol-therm-050-002.i	heu-sol-therm-050-002.i	heu-sol-therm-050-002.i	heu-sol-therm-050-002.i	heu-sol-therm-050-002.i
5	heu-sol-therm-050-004.i	heu-sol-therm-050-004.i	heu-sol-therm-050-004.i	heu-sol-therm-050-004.i	heu-sol-therm-050-004.i
6	heu-sol-therm-050-006.i	heu-sol-therm-050-006.i	heu-sol-therm-050-006.i	heu-sol-therm-050-006.i	heu-sol-therm-050-006.i
7	heu-sol-therm-009-001.i	heu-sol-therm-009-001.i	heu-sol-therm-009-001.i	heu-sol-therm-009-001.i	heu-sol-therm-009-001.i
8	heu-sol-therm-009-002.i	heu-sol-therm-050-011.i	heu-sol-therm-009-002.i	heu-sol-therm-050-011.i	heu-sol-therm-050-011.i
9	heu-sol-therm-050-011.i	heu-sol-therm-009-002.i	heu-sol-therm-050-011.i	heu-sol-therm-009-002.i	heu-sol-therm-009-002.i
10	heu-sol-therm-050-003.i	heu-sol-therm-050-005.i	heu-sol-therm-050-009.i	heu-sol-therm-050-005.i	heu-sol-therm-050-005.i

Table 12. Thermal Plutonium Solution Truncated Benchmark Rankings

Thermal Plutonium Solution	Separating Distance [cm]				
Ranked Benchmark	45	65	85	105	125
1	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i
2	pu-sol-therm-002-005.i	pu-sol-therm-011-165.i	pu-sol-therm-011-165.i	pu-sol-therm-002-005.i	pu-sol-therm-010-009.i
3	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i	pu-sol-therm-002-005.i
4	pu-sol-therm-011-165.i	pu-sol-therm-002-005.i	pu-sol-therm-002-005.i	pu-sol-therm-010-002.i	pu-sol-therm-011-165.i
5	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i	pu-sol-therm-011-165.i	pu-sol-therm-010-002.i
6	pu-sol-therm-002-006.i	pu-sol-therm-002-006.i	pu-sol-therm-002-004.i	pu-sol-therm-002-006.i	pu-sol-therm-002-004.i
7	pu-sol-therm-002-007.i	pu-sol-therm-002-004.i	pu-sol-therm-002-006.i	pu-sol-therm-002-007.i	pu-sol-therm-002-006.i
8	pu-sol-therm-002-004.i	pu-sol-therm-002-007.i	pu-sol-therm-002-007.i	pu-sol-therm-002-004.i	pu-sol-therm-002-007.i
9	pu-sol-therm-002-003.i	pu-sol-therm-002-003.i	pu-sol-therm-002-003.i	pu-sol-therm-002-003.i	pu-sol-therm-002-003.i
10	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i

Table 13. Thermal Solution System Truncated Benchmark Rankings

Thermal Solution System	Separating Distance [cm]				
Ranked Benchmark	45	65	85	105	125
1	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i
2	pu-sol-therm-007-010.i	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i
3	pu-sol-therm-010-002.i	pu-sol-therm-007-010.i	pu-sol-therm-007-010.i	pu-sol-therm-007-010.i	pu-sol-therm-007-010.i
4	pu-sol-therm-002-006.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i
5	pu-sol-therm-010-009.i	pu-sol-therm-002-006.i	pu-sol-therm-002-006.i	pu-sol-therm-002-006.i	pu-sol-therm-002-006.i
6	pu-sol-therm-002-005.i	pu-sol-therm-002-005.i	pu-sol-therm-002-005.i	pu-sol-therm-002-005.i	pu-sol-therm-002-005.i
7	pu-sol-therm-007-005.i	pu-sol-therm-007-005.i	pu-sol-therm-002-004.i	pu-sol-therm-002-004.i	pu-sol-therm-007-005.i
8	pu-sol-therm-007-009.i	pu-sol-therm-002-004.i	pu-sol-therm-007-005.i	pu-sol-therm-001-002.i	pu-sol-therm-002-004.i
9	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i	pu-sol-therm-007-005.i	pu-sol-therm-001-002.i
10	pu-sol-therm-007-007.i	pu-sol-therm-007-009.i	pu-sol-therm-007-007.i	pu-sol-therm-007-007.i	pu-sol-therm-007-009.i

The following figure illustrates the baseline USL values for the individual assemblies and the overall coupled system with respect to separating distance.

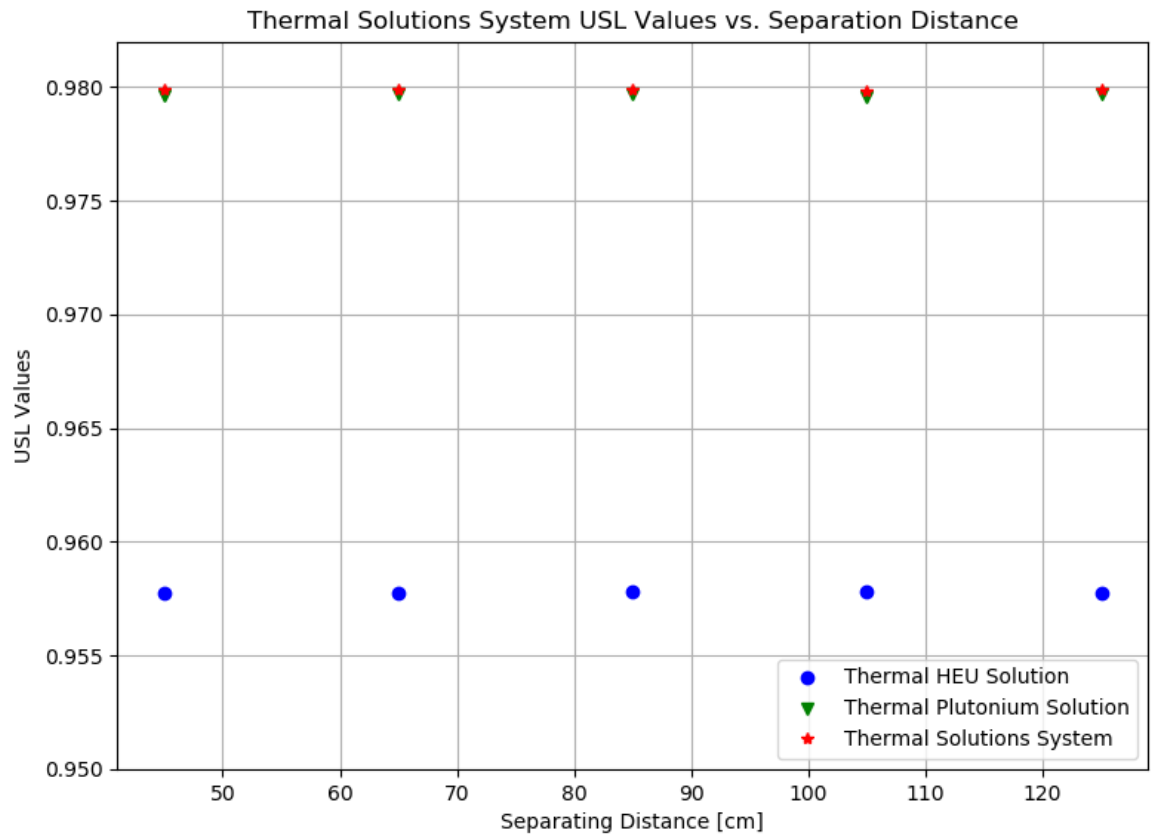

Figure 7. Baseline USL values that characterizes the Thermal Solution Model.

Mixed Plutonium Model

The following tables display the truncated benchmark rankings for each assembly and the overall coupled system.

Table 14. Reflected Fast Plutonium Metal Truncated Benchmark Rankings

Reflected Fast Plutonium System	Separating Distance [cm]				
Ranked Benchmark	50	70	90	110	130
1	pu-met-fast-044-004.i	pu-met-fast-042-002.i	pu-met-fast-044-004.i	pu-met-fast-044-004.i	pu-met-fast-044-004.i
2	pu-met-fast-044-005.i	pu-met-fast-042-003.i	pu-met-fast-044-005.i	pu-met-fast-044-005.i	pu-met-fast-044-005.i
3	pu-met-fast-024-001.i	pu-met-fast-044-005.i	pu-met-fast-042-002.i	pu-met-fast-042-002.i	pu-met-fast-031-001.i
4	pu-met-fast-036-001.i	pu-met-fast-027-001.i	pu-met-fast-042-001.i	pu-met-fast-031-001.i	pu-met-fast-024-001.i
5	pu-met-fast-031-001.i	pu-met-fast-044-004.i	pu-met-fast-031-001.i	pu-met-fast-042-001.i	pu-met-fast-036-001.i
6	pu-met-fast-044-003.i	pu-met-fast-042-001.i	pu-met-fast-042-003.i	pu-met-fast-042-003.i	pu-met-fast-042-001.i
7	pu-met-fast-042-002.i	pu-met-fast-042-004.i	pu-met-fast-027-001.i	pu-met-fast-027-001.i	pu-met-fast-044-003.i
8	pu-met-fast-042-001.i	pu-met-fast-011-001.i	pu-met-fast-011-001.i	pu-met-fast-042-004.i	pu-met-fast-042-002.i
9	pu-met-fast-027-001.i	pu-met-fast-042-005.i	pu-met-fast-042-004.i	pu-met-fast-036-001.i	pu-met-fast-027-001.i
10	pu-met-fast-042-004.i	pu-met-fast-031-001.i	pu-met-fast-036-001.i	pu-met-fast-011-001.i	pu-met-fast-011-001.i

Table 15. Thermal Plutonium Solution Truncated Benchmark Rankings

Thermal Plutonium Solution	Separating Distance [cm]				
Ranked Benchmark	50	70	90	110	130
1	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i
2	pu-sol-therm-010-009.i	pu-sol-therm-011-165.i	pu-sol-therm-011-165.i	pu-sol-therm-011-165.i	pu-sol-therm-011-165.i
3	pu-sol-therm-011-165.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i
4	pu-sol-therm-010-002.i	pu-sol-therm-002-005.i	pu-sol-therm-002-005.i	pu-sol-therm-002-005.i	pu-sol-therm-002-005.i
5	pu-sol-therm-002-005.i	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i
6	pu-sol-therm-002-004.i	pu-sol-therm-002-004.i	pu-sol-therm-002-006.i	pu-sol-therm-002-004.i	pu-sol-therm-002-004.i
7	pu-sol-therm-002-006.i	pu-sol-therm-002-006.i	pu-sol-therm-002-004.i	pu-sol-therm-002-006.i	pu-sol-therm-002-006.i
8	pu-sol-therm-002-007.i	pu-sol-therm-002-007.i	pu-sol-therm-002-007.i	pu-sol-therm-002-003.i	pu-sol-therm-002-003.i
9	pu-sol-therm-002-003.i	pu-sol-therm-002-003.i	pu-sol-therm-002-003.i	pu-sol-therm-002-007.i	pu-sol-therm-002-007.i
10	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i	pu-sol-therm-011-163.i	pu-sol-therm-011-163.i

Table 16. Mixed Plutonium System Truncated Benchmark Rankings

Mixed Plutonium System	Separating Distance [cm]				
Ranked Benchmark	50 cm	70 cm	90 cm	110 cm	130 cm
1	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i	pu-sol-therm-001-001.i
2	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i	pu-sol-therm-010-002.i
3	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i	pu-sol-therm-010-009.i
4	pu-sol-therm-002-006.i	pu-sol-therm-002-005.i	pu-sol-therm-002-006.i	pu-sol-therm-002-005.i	pu-sol-therm-002-005.i
5	pu-sol-therm-002-005.i	pu-sol-therm-002-006.i	pu-sol-therm-002-005.i	pu-sol-therm-002-006.i	pu-sol-therm-002-004.i
6	pu-sol-therm-007-010.i	pu-sol-therm-002-004.i	pu-sol-therm-007-010.i	pu-sol-therm-002-004.i	pu-sol-therm-002-006.i
7	pu-sol-therm-002-004.i	pu-sol-therm-007-010.i	pu-sol-therm-002-004.i	pu-sol-therm-007-010.i	pu-sol-therm-007-010.i
8	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i	pu-sol-therm-002-003.i	pu-sol-therm-002-003.i
9	pu-sol-therm-007-005.i	pu-sol-therm-007-005.i	pu-sol-therm-002-003.i	pu-sol-therm-001-002.i	pu-sol-therm-001-002.i
10	pu-sol-therm-002-003.i	pu-sol-therm-002-003.i	pu-sol-therm-002-007.i	pu-sol-therm-002-007.i	pu-sol-therm-007-005.i

The following figure illustrates the baseline USL values for the individual assemblies and the overall coupled system with respect to separating distance.

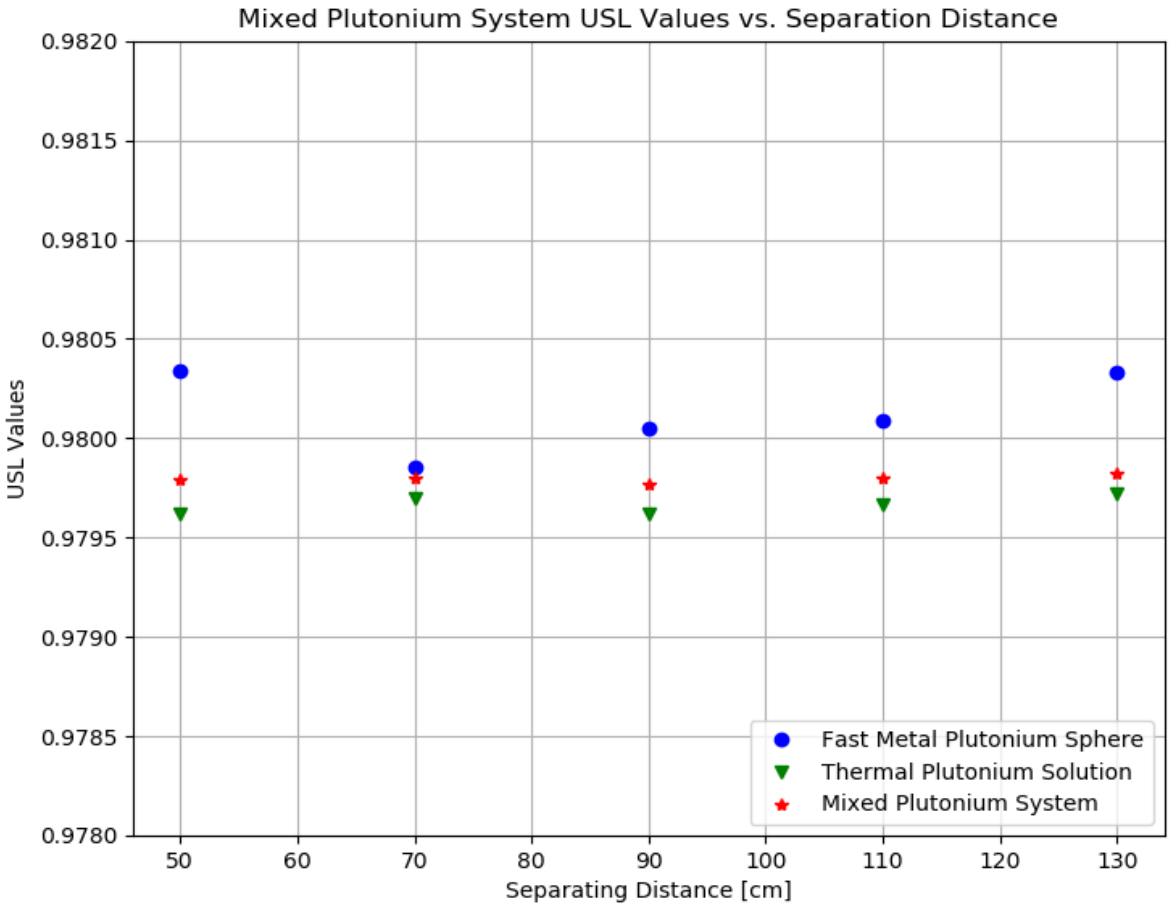

Figure 8. Baseline USL values that characterizes the Mixed Plutonium Model.

Discussion

The qualitative information given by the truncated benchmark rankings and the quantitative comparison of the baseline USL values give insight into the problem of using Whisper to construct an overall sensitivity profile to a loosely coupled system. While creating an accurate benchmark profile is important, calculating a conservative baseline USL is of paramount importance to criticality safety analysis. It has been demonstrated within this exploratory numerical experiment that Whisper doesn't necessarily calculate the most conservative baseline USL for the overall system. This is important to note and requires care of a criticality safety analyst to ensure that the baseline USL values for each region within the overall system are calculated.

The greater dominance of one region on the benchmark profile of the overall system seems to coincide with the region with the greater reactivity. This would suggest that the neutrons escaping from the dominant region and entering the other region are relatively more important than the local neutrons. It also suggests that the neutrons leaving the dominant system and causing fission in the other region are relatively more important than those leaving the less reactive region and entering the dominant region.

Bare Fast Metal Model

The bare fast model has a unique system benchmark profile because this profile is not dominated by either assembly in the system. Based the similar calculated reactivity of both benchmarks, 0.9998+/- 0.0001 for the HEU assembly and 1.0001+/- 0.0001 for the plutonium assembly, it can be suggested in this case the systems have relatively the same amount of influence on the other respective region. This would mean the sensitivity profiles for the system are not dominated by one region allowing for Whisper to select benchmarks populations that accurately represent the system.

The baseline USL determined by Whisper for this model was between the baseline USL values for the two regions, and therefore not the most conservative estimate.

Water-Reflected Fast Metal Model

The water-reflected fast metal model has an overall system benchmark profile that is dominated by the reflected plutonium assembly. The calculated effective multiplication factors of the reflected HEU and plutonium assemblies are 0.99406+/-0.00011 and 1.00014+/-0.00011, respectively. It can be suggested that the difference in reactivity in this model between the two assemblies lead the benchmark rankings and the baseline USL values to be dominated by the plutonium assembly. The sensitivity profile for the whole system is dominated by a single region.

The baseline USL determined by Whisper for this model closely matches the baseline USL of the reflected fast plutonium assembly, which has the lower baseline USL. Therefore, the overall baseline USL values for the system are conservative calculations.

Thermal Solution Model

The thermal solution model has a benchmark profile that is dominated by the thermal plutonium solution assembly. The calculated effective multiplication factors of the thermal plutonium and HEU

solutions are 1.00578+/-0.00013 and 0.99113+/-0.00015, respectively. This is consistent with the idea that the idea that the significantly more reactive region in a coupled system will dominate the sensitivity profile, and therefore the selected benchmark population.

For this case, the baseline USL determined by Whisper is of great interest. The overall system is dominated by the plutonium solution, and therefore the baseline USL values of the coupled system closely match that of the plutonium solution. However, this model shows that the two regions can have baseline USL values that differ significantly from one another and the coupled system's baseline USL values can match the non-conservative baseline USL values.

Mixed Plutonium Model

This model illustrates the interaction between assemblies of different energy spectra. The benchmark profile of the coupled system is somewhat controlled by the thermal plutonium solution. The calculated effective multiplication factors of thermal plutonium solution and the reflected fast plutonium sphere are 1.00578+/-0.00013 and 1.00002+/-0.00010, respectively. This relatively small difference in reactivities is consistent with the thermal plutonium solution's control over the selected benchmark population, but the baseline USL values for the coupled system are bounded by the regional baseline USL values. This illustrates an incomplete dominance of the thermal plutonium solution over the baseline USL of the overall model.

Conclusions and Future Work

This numerical experiment highlights that nonconservative USL values are being calculated for multi-regional critical models when only a single, overall sensitivity profile is calculated. It can be suggested that to calculate a conservative USL, region-wise sensitivity profiles must be calculated and utilized by Whisper 1.1. This study also suggests a relationship between the calculated k_{eff} of the individual assemblies, the sensitivity profile domination of the overall model, and the baseline USL values.
Systems where the two assemblies have similar neutron energy spectra there is little variation in the region-wise USL values or the overall system USL values with respect to separation distance between assemblies. For the mixed plutonium system there is noticeable variation in the USL values for the fast reflected metal plutonium assembly with respect to separation distance. This suggests that the energy spectra of the neutron leakage from each assembly, as a function of separation distance between assemblies, may be of influence in systems with assemblies of dissimilar neutron energy spectra and of negligible influence in systems where assemblies are of similar neutron energy spectra.

The future work being considered is quantifying the underlying relationship between the assembly interactions. This includes quantifying S_k as a function of the energy spectra of the interacting neutrons and the solid angle between assemblies and quantifying the relationship between the difference in calculated k_{eff} values of the individual regions and sensitivity profile dominance. Quantifying and articulating the physical relationships between critical regions and how the regions affect the overall model is important, so it can be determined whether the phenomena seen when determining the sensitivity profiles for the models are physical.

A comparison of different methods used for calculating baseline USL values will be studied to determine how other methods model multi-region critical systems, and determine which methods are

more accurate and/or conservative. This study could determine the need for possibly developing a new method for calculating baseline USL values for multi-region critical systems.

Acknowledgements

This work was supported and encouraged by the DOE/NNSA Nuclear Criticality Safety program. The original version of Whisper-1.0 was developed by Dr. B.C Kiedrowski, professor at the University of Michigan.

References

1. Brown, F. B., Rising, M. E., and Alwin, J. L., *User manual for whisper-1.1,* LA-UR-17-20567 (2017).

2. Brown, F. B., Rising, M. E., and Alwin, J. L., *Release Notes for whisper-1.1,* LA-UR-17-23504 (2017).

Appendix A – Bare Fast Metal Model

```
@@@ HEU-MET-FAST-001-001 @@@
c @@@ PU-MET-FAST-001-001 @@@
C @@@ X=20 40 60 80 100
1    1    -18.74    -1              imp:n=1
10    2    -15.61      -2             imp:n=1
20    0              1 2 -3         imp:n=1
30    0              3             imp:n=0

30    0              3             imp:n=0

1    sph 0 0 0  8.7407
2    sph 0 0 20  6.3849
3    sph 0 0 0  500

m1   92234.80c 0.00049184
     92235.80c 0.044994
     92238.80c 0.0024984
m2   94239.80c 0.037047
     94240.80c 0.0017512
     94241.80c 0.00011674
     31069.80c 0.000826605216
     31071.80c 0.000548594784
c
c ---------------------------------------------------------------------------
KCODE  100000  1.0  100  600
c KOPTS  blocksize = 5 ksental=mctal
c PRDMP  j   99999999
c ---------------------------------------------------------------------------
c
ksrc  0 0 0  0 0 20
c kopts blocksize=5 ksental=mctal
c
c ---------------------------------------------------------------------------
  ksen1 xs cell=1
c       rxn = +2 +4 -6 +16 102 103 104 105 106 107 -7 -1018
c       erg =
c          1.0000e-11 3.0000e-09 7.5000e-09 1.0000e-08 2.5300e-08 3.0000e-08
c          4.0000e-08 5.0000e-08 7.0000e-08 1.0000e-07 1.5000e-07 2.0000e-07
c          2.2500e-07 2.5000e-07 2.7500e-07 3.2500e-07 3.5000e-07 3.7500e-07
c          4.0000e-07 6.2500e-07 1.0000e-06 1.7700e-06 3.0000e-06 4.7500e-06
c          6.0000e-06 8.1000e-06 1.0000e-05 3.0000e-05 1.0000e-04 5.5000e-04
c          3.0000e-03 1.7000e-02 2.5000e-02 1.0000e-01 4.0000e-01 9.0000e-01
c          1.4000e+00 1.8500e+00 2.3540e+00 2.4790e+00 3.0000e+00 4.8000e+00
c          6.4340e+00 8.1873e+00 2.0000e+01
c ---------------------------------------------------------------------------
c
c
c ---------------------------------------------------------------------------
 ksen2 xs cell=10
c       rxn = +2 +4 -6 +16 102 103 104 105 106 107 -7 -1018
c       erg =
c          1.0000e-11 3.0000e-09 7.5000e-09 1.0000e-08 2.5300e-08 3.0000e-08
c          4.0000e-08 5.0000e-08 7.0000e-08 1.0000e-07 1.5000e-07 2.0000e-07
c          2.2500e-07 2.5000e-07 2.7500e-07 3.2500e-07 3.5000e-07 3.7500e-07
c          4.0000e-07 6.2500e-07 1.0000e-06 1.7700e-06 3.0000e-06 4.7500e-06
```

```
c          6.0000e-06 8.1000e-06 1.0000e-05 3.0000e-05 1.0000e-04 5.5000e-04
c          3.0000e-03 1.7000e-02 2.5000e-02 1.0000e-01 4.0000e-01 9.0000e-01
c          1.4000e+00 1.8500e+00 2.3540e+00 2.4790e+00 3.0000e+00 4.8000e+00
c          6.4340e+00 8.1873e+00 2.0000e+01
c ---------------------------------------------------------------------------
c
print
```

Appendix B – Bare Fast Metal Model Benchmark Profile and USL Calculation Studies

Calculating application nuclear data uncertainties ...

application	adjusted	prior
inp_case001_1	0.00008	0.00482
inp_case001_2	0.00029	0.00755
inp_case002_1	0.00008	0.00482
inp_case002_2	0.00029	0.00755
inp_case003_1	0.00008	0.00482
inp_case003_2	0.00029	0.00755
inp_case004_1	0.00008	0.00482
inp_case004_2	0.00029	0.00755
inp_case005_1	0.00008	0.00482
inp_case005_2	0.00029	0.00755

Calculating upper subcritical limits ...

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_1	0.00922	0.00008	0.98557	0.03863

Benchmark population = 40
Population weight = 25.05920
Maximum similarity = 0.99952

Bias = 0.00568
Bias uncertainty = 0.00354
Nuc Data uncert margin = 0.00008
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-met-fast-100-002.i	0.9995	1.0000
heu-met-fast-100-001.i	0.9993	0.9766
heu-met-fast-065-002.i	0.9993	0.9714
heu-met-fast-044-001.i	0.9993	0.9693
heu-met-fast-001-001.i	0.9992	0.9634
heu-met-fast-015-001.i	0.9992	0.9604
heu-met-fast-008-001.i	0.9990	0.9413
heu-met-fast-044-002.i	0.9990	0.9334
heu-met-fast-051-002.i	0.9990	0.9319
heu-met-fast-018-002.i	0.9989	0.9228
heu-met-fast-079-001.i	0.9987	0.9023
heu-met-fast-007-019.i	0.9985	0.8770
heu-met-fast-044-003.i	0.9983	0.8444
heu-met-fast-051-004.i	0.9981	0.8251
heu-met-fast-012-001.i	0.9980	0.8134
heu-met-fast-043-001.i	0.9980	0.8093
heu-met-fast-044-005.i	0.9976	0.7657
heu-met-fast-084-001.i	0.9975	0.7572
heu-met-fast-089-001.i	0.9975	0.7503
heu-met-fast-044-004.i	0.9974	0.7378
heu-met-fast-084-017.i	0.9973	0.7285
heu-met-fast-079-002.i	0.9973	0.7225
heu-met-fast-007-001.i	0.9973	0.7218

heu-met-fast-084-015.i	0.9963	0.6070
heu-met-fast-078-041.i	0.9962	0.5892
heu-met-fast-022-002.i	0.9961	0.5828
heu-met-fast-084-004.i	0.9954	0.4958
heu-met-fast-027-001.i	0.9926	0.1550
heu-met-fast-078-023.i	0.9926	0.1440
heu-met-fast-043-003.i	0.9923	0.1081
heu-met-fast-084-016.i	0.9918	0.0469
heu-met-fast-019-001.i	0.9915	0.0157

[case001_2, case002_1, case002_2, case003_1 would appear here]

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case003_2	0.01384	0.00029	0.98040	0.04381

Benchmark population = 51
Population weight = 25.01890
Maximum similarity = 0.99983

Bias = 0.00690
Bias uncertainty = 0.00694
Nuc Data uncert margin = 0.00029
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-001-001.i	0.9998	1.0000
pu-met-fast-022-001.i	0.9989	0.9773
pu-met-fast-029-001.i	0.9971	0.9331
mix-met-fast-009-001.i	0.9959	0.9056
pu-met-fast-023-001.i	0.9950	0.8844
pu-met-fast-035-001.i	0.9943	0.8662
pu-met-fast-030-001.i	0.9932	0.8395
pu-met-fast-009-001.i	0.9930	0.8350
pu-met-fast-025-001.i	0.9925	0.8236
pu-met-fast-036-001.i	0.9924	0.8202
pu-met-fast-024-001.i	0.9923	0.8193
pu-met-fast-044-003.i	0.9873	0.6986
pu-met-fast-044-005.i	0.9872	0.6948
pu-met-fast-044-002.i	0.9863	0.6740
pu-met-fast-021-001.i	0.9843	0.6250
pu-met-fast-021-002.i	0.9838	0.6126
pu-met-fast-044-004.i	0.9833	0.6010
pu-met-fast-031-001.i	0.9817	0.5637
pu-met-fast-003-103.i	0.9801	0.5246
mix-met-fast-007-022.i	0.9776	0.4646
pu-met-fast-042-009.i	0.9771	0.4531
pu-met-fast-042-006.i	0.9771	0.4520
pu-met-fast-042-012.i	0.9770	0.4510
pu-met-fast-042-007.i	0.9770	0.4506
pu-met-fast-042-015.i	0.9765	0.4373
mix-met-fast-007-023.i	0.9764	0.4360
pu-met-fast-042-010.i	0.9764	0.4354
pu-met-fast-042-008.i	0.9764	0.4348
pu-met-fast-042-011.i	0.9762	0.4307
pu-met-fast-042-013.i	0.9762	0.4299
pu-met-fast-042-014.i	0.9758	0.4221
pu-met-fast-042-004.i	0.9758	0.4214

pu-met-fast-042-005.i	0.9753	0.4094
pu-met-fast-018-001.i	0.9751	0.4034
mix-met-fast-001-001.i	0.9745	0.3902
pu-met-fast-042-003.i	0.9740	0.3787
pu-met-fast-032-001.i	0.9737	0.3713
pu-met-fast-044-001.i	0.9726	0.3438
pu-met-fast-042-002.i	0.9709	0.3039
pu-met-fast-011-001.i	0.9709	0.3023
pu-met-fast-002-001.i	0.9687	0.2491
mix-met-fast-005-001.i	0.9686	0.2475
pu-met-fast-008-001.i	0.9681	0.2363
pu-met-fast-027-001.i	0.9669	0.2071
pu-met-fast-019-001.i	0.9648	0.1563
mix-met-fast-003-001.i	0.9648	0.1549
pu-met-fast-045-005.i	0.9643	0.1447
pu-met-fast-042-001.i	0.9633	0.1191
pu-met-fast-040-001.i	0.9620	0.0887
pu-met-fast-026-001.i	0.9620	0.0877
mix-met-fast-007-019.i	0.9586	0.0071

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004_1	0.00922	0.00008	0.98557	0.03863

Benchmark population = 40
Population weight = 25.05920
Maximum similarity = 0.99952

Bias = 0.00568
Bias uncertainty = 0.00354
Nuc Data uncert margin = 0.00008
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-met-fast-100-002.i	0.9995	1.0000
heu-met-fast-100-001.i	0.9993	0.9766
heu-met-fast-065-002.i	0.9993	0.9714
heu-met-fast-044-001.i	0.9993	0.9693
heu-met-fast-001-001.i	0.9992	0.9634
heu-met-fast-015-001.i	0.9992	0.9604
heu-met-fast-008-001.i	0.9990	0.9413
heu-met-fast-044-002.i	0.9990	0.9334
heu-met-fast-051-002.i	0.9990	0.9319
heu-met-fast-018-002.i	0.9989	0.9228
heu-met-fast-079-001.i	0.9987	0.9023
heu-met-fast-007-019.i	0.9985	0.8770
heu-met-fast-044-003.i	0.9983	0.8444
heu-met-fast-051-004.i	0.9981	0.8251
heu-met-fast-012-001.i	0.9980	0.8134
heu-met-fast-043-001.i	0.9980	0.8093
heu-met-fast-044-005.i	0.9976	0.7657
heu-met-fast-084-001.i	0.9975	0.7572
heu-met-fast-089-001.i	0.9975	0.7503
heu-met-fast-044-004.i	0.9974	0.7378
heu-met-fast-084-017.i	0.9973	0.7285
heu-met-fast-079-002.i	0.9973	0.7225
heu-met-fast-007-001.i	0.9973	0.7218
heu-met-fast-084-015.i	0.9963	0.6070

heu-met-fast-078-041.i	0.9962	0.5892
heu-met-fast-022-002.i	0.9961	0.5828
heu-met-fast-084-004.i	0.9954	0.4958
heu-met-fast-043-002.i	0.9953	0.4815
heu-met-fast-084-023.i	0.9946	0.3977
heu-met-fast-079-003.i	0.9942	0.3505
heu-met-fast-084-019.i	0.9939	0.3142
heu-met-fast-084-022.i	0.9939	0.3063
heu-met-fast-020-002.i	0.9935	0.2601
heu-met-fast-025-001.i	0.9929	0.1908
heu-met-fast-084-005.i	0.9929	0.1880
heu-met-fast-027-001.i	0.9926	0.1550
heu-met-fast-078-023.i	0.9926	0.1440
heu-met-fast-043-003.i	0.9923	0.1081
heu-met-fast-084-016.i	0.9918	0.0469
heu-met-fast-019-001.i	0.9915	0.0157

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004_2	0.01384	0.00029	0.98040	0.04381

Benchmark population = 51
Population weight = 25.01890
Maximum similarity = 0.99983

Bias = 0.00690
Bias uncertainty = 0.00694
Nuc Data uncert margin = 0.00029
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-001-001.i	0.9998	1.0000
pu-met-fast-022-001.i	0.9989	0.9773
pu-met-fast-029-001.i	0.9971	0.9331
mix-met-fast-009-001.i	0.9959	0.9056
pu-met-fast-023-001.i	0.9950	0.8844
pu-met-fast-035-001.i	0.9943	0.8662
pu-met-fast-030-001.i	0.9932	0.8395
pu-met-fast-009-001.i	0.9930	0.8350
pu-met-fast-025-001.i	0.9925	0.8236
pu-met-fast-036-001.i	0.9924	0.8202
pu-met-fast-024-001.i	0.9923	0.8193
pu-met-fast-044-003.i	0.9873	0.6986
pu-met-fast-044-005.i	0.9872	0.6948
pu-met-fast-044-002.i	0.9863	0.6740
pu-met-fast-021-001.i	0.9843	0.6250
pu-met-fast-021-002.i	0.9838	0.6126
pu-met-fast-044-004.i	0.9833	0.6010
pu-met-fast-031-001.i	0.9817	0.5637
pu-met-fast-003-103.i	0.9801	0.5246
mix-met-fast-007-022.i	0.9776	0.4646
pu-met-fast-042-009.i	0.9771	0.4531
pu-met-fast-042-006.i	0.9771	0.4520
pu-met-fast-042-012.i	0.9770	0.4510
pu-met-fast-042-007.i	0.9770	0.4506
pu-met-fast-042-015.i	0.9765	0.4373

mix-met-fast-007-023.i	0.9764	0.4360
pu-met-fast-042-010.i	0.9764	0.4354
pu-met-fast-042-008.i	0.9764	0.4348
pu-met-fast-042-011.i	0.9762	0.4307
pu-met-fast-042-013.i	0.9762	0.4299
pu-met-fast-042-014.i	0.9758	0.4221
pu-met-fast-042-004.i	0.9758	0.4214
pu-met-fast-042-005.i	0.9753	0.4094
pu-met-fast-018-001.i	0.9751	0.4034
mix-met-fast-001-001.i	0.9745	0.3902
pu-met-fast-042-003.i	0.9740	0.3787
pu-met-fast-032-001.i	0.9737	0.3713
pu-met-fast-044-001.i	0.9726	0.3438
pu-met-fast-042-002.i	0.9709	0.3039
pu-met-fast-011-001.i	0.9709	0.3023
pu-met-fast-002-001.i	0.9687	0.2491
mix-met-fast-005-001.i	0.9686	0.2475
pu-met-fast-008-001.i	0.9681	0.2363
pu-met-fast-027-001.i	0.9669	0.2071
pu-met-fast-019-001.i	0.9648	0.1563
mix-met-fast-003-001.i	0.9648	0.1549
pu-met-fast-045-005.i	0.9643	0.1447
pu-met-fast-042-001.i	0.9633	0.1191
pu-met-fast-040-001.i	0.9620	0.0887
pu-met-fast-026-001.i	0.9620	0.0877
mix-met-fast-007-019.i	0.9586	0.0071

1982,5 92%

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case005_1	0.00922	0.00008	0.98557	0.03863

Benchmark population = 40
Population weight = 25.05920
Maximum similarity = 0.99952

Bias = 0.00568
Bias uncertainty = 0.00354
Nuc Data uncert margin = 0.00008
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-met-fast-100-002.i	0.9995	1.0000
heu-met-fast-100-001.i	0.9993	0.9766
heu-met-fast-065-002.i	0.9993	0.9714
heu-met-fast-044-001.i	0.9993	0.9693
heu-met-fast-001-001.i	0.9992	0.9634
heu-met-fast-015-001.i	0.9992	0.9604
heu-met-fast-008-001.i	0.9990	0.9413
heu-met-fast-044-002.i	0.9990	0.9334
heu-met-fast-051-002.i	0.9990	0.9319
heu-met-fast-018-002.i	0.9989	0.9228
heu-met-fast-079-001.i	0.9987	0.9023
heu-met-fast-007-019.i	0.9985	0.8770
heu-met-fast-044-003.i	0.9983	0.8444
heu-met-fast-051-004.i	0.9981	0.8251

heu-met-fast-012-001.i	0.9980	0.8134
heu-met-fast-043-001.i	0.9980	0.8093
heu-met-fast-044-005.i	0.9976	0.7657
heu-met-fast-084-001.i	0.9975	0.7572
heu-met-fast-089-001.i	0.9975	0.7503
heu-met-fast-044-004.i	0.9974	0.7378
heu-met-fast-084-017.i	0.9973	0.7285
heu-met-fast-079-002.i	0.9973	0.7225
heu-met-fast-007-001.i	0.9973	0.7218
heu-met-fast-084-015.i	0.9963	0.6070
heu-met-fast-078-041.i	0.9962	0.5892
heu-met-fast-022-002.i	0.9961	0.5828
heu-met-fast-084-004.i	0.9954	0.4958
heu-met-fast-043-002.i	0.9953	0.4815
heu-met-fast-084-023.i	0.9946	0.3977
heu-met-fast-079-003.i	0.9942	0.3505
heu-met-fast-084-019.i	0.9939	0.3142
heu-met-fast-084-022.i	0.9939	0.3063
heu-met-fast-020-002.i	0.9935	0.2601
heu-met-fast-025-001.i	0.9929	0.1908
heu-met-fast-084-005.i	0.9929	0.1880
heu-met-fast-027-001.i	0.9926	0.1550
heu-met-fast-078-023.i	0.9926	0.1440
heu-met-fast-043-003.i	0.9923	0.1081
heu-met-fast-084-016.i	0.9918	0.0469
heu-met-fast-084-016.i	0.9918	0.0469
heu-met-fast-019-001.i	0.9915	0.0157

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case005_2	0.01384	0.00029	0.98040	0.04381

Benchmark population = 51
Population weight = 25.01890
Maximum similarity = 0.99983

Bias = 0.00690
Bias uncertainty = 0.00694
Nuc Data uncert margin = 0.00029
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-001-001.i	0.9998	1.0000
pu-met-fast-022-001.i	0.9989	0.9773
pu-met-fast-029-001.i	0.9971	0.9331
mix-met-fast-009-001.i	0.9959	0.9056
pu-met-fast-023-001.i	0.9950	0.8844
pu-met-fast-035-001.i	0.9943	0.8662
pu-met-fast-030-001.i	0.9932	0.8395
pu-met-fast-009-001.i	0.9930	0.8350
pu-met-fast-025-001.i	0.9925	0.8236
pu-met-fast-036-001.i	0.9924	0.8202
pu-met-fast-024-001.i	0.9923	0.8193
pu-met-fast-044-003.i	0.9873	0.6986
pu-met-fast-044-005.i	0.9872	0.6948
pu-met-fast-044-002.i	0.9863	0.6740

pu-met-fast-021-001.i	0.9843	0.6250
pu-met-fast-021-002.i	0.9838	0.6126
pu-met-fast-044-004.i	0.9833	0.6010
pu-met-fast-031-001.i	0.9817	0.5637
pu-met-fast-003-103.i	0.9801	0.5246
mix-met-fast-007-022.i	0.9776	0.4646
pu-met-fast-042-009.i	0.9771	0.4531
pu-met-fast-042-006.i	0.9771	0.4520
pu-met-fast-042-012.i	0.9770	0.4510
pu-met-fast-042-007.i	0.9770	0.4506
pu-met-fast-042-015.i	0.9765	0.4373
mix-met-fast-007-023.i	0.9764	0.4360
pu-met-fast-042-010.i	0.9764	0.4354
pu-met-fast-042-008.i	0.9764	0.4348
pu-met-fast-042-011.i	0.9762	0.4307
pu-met-fast-042-013.i	0.9762	0.4299
pu-met-fast-042-014.i	0.9758	0.4221
pu-met-fast-042-004.i	0.9758	0.4214
pu-met-fast-042-005.i	0.9753	0.4094
pu-met-fast-018-001.i	0.9751	0.4034
mix-met-fast-001-001.i	0.9745	0.3902
pu-met-fast-042-003.i	0.9740	0.3787
pu-met-fast-032-001.i	0.9737	0.3713
pu-met-fast-044-001.i	0.9726	0.3438
pu-met-fast-042-002.i	0.9709	0.3039
pu-met-fast-011-001.i	0.9709	0.3023
pu-met-fast-002-001.i	0.9687	0.2491
mix-met-fast-005-001.i	0.9686	0.2475
pu-met-fast-008-001.i	0.9681	0.2363
pu-met-fast-027-001.i	0.9669	0.2071
pu-met-fast-019-001.i	0.9648	0.1563
mix-met-fast-003-001.i	0.9648	0.1549
pu-met-fast-045-005.i	0.9643	0.1447
pu-met-fast-042-001.i	0.9633	0.1191
pu-met-fast-040-001.i	0.9620	0.0887
pu-met-fast-026-001.i	0.9620	0.0877
mix-met-fast-007-019.i	0.9586	0.0071

USL Summary Table

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_1	0.00922	0.00008	0.98557	0.03863
inp_case001_2	0.01384	0.00029	0.98040	0.04381
inp_case002_1	0.00922	0.00008	0.98557	0.03863
inp_case002_2	0.01384	0.00029	0.98040	0.04381
inp_case003_1	0.00922	0.00008	0.98557	0.03863
inp_case003_2	0.01384	0.00029	0.98040	0.04381
inp_case004_1	0.00922	0.00008	0.98557	0.03863
inp_case004_2	0.01384	0.00029	0.98040	0.04381
inp_case005_1	0.00922	0.00008	0.98557	0.03863
inp_case005_2	0.01384	0.00029	0.98040	0.04381

Calculating application nuclear data uncertainties ...

application	adjusted	prior
inp_case001	0.00027	0.00896
inp_case002	0.00027	0.00896
inp_case003	0.00027	0.00896
inp_case004	0.00027	0.00896
inp_case005	0.00027	0.00896

Calculating upper subcritical limits ...

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001	0.01239	0.00027	0.98190	0.04231

Benchmark population = 80
Population weight = 27.74792
Maximum similarity = 0.97253

Bias = 0.00513
Bias uncertainty = 0.00726
Nuc Data uncert margin = 0.00027
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
mix-met-fast-007-013.i	0.9725	1.0000
mix-met-fast-007-012.i	0.9714	0.9938
mix-met-fast-007-018.i	0.9614	0.9385
mix-met-fast-007-011.i	0.9579	0.9194
mix-met-fast-010-001.i	0.9569	0.9136
mix-met-fast-007-006.i	0.9518	0.8857
mix-met-fast-007-017.i	0.9464	0.8557
mix-met-fast-007-005.i	0.9445	0.8455
mix-met-fast-007-010.i	0.9406	0.8241
mix-met-fast-007-021.i	0.9362	0.7995
mix-met-fast-007-004.i	0.9296	0.7635
mix-met-fast-007-016.i	0.9274	0.7513
mix-met-fast-007-020.i	0.9252	0.7388
mix-met-fast-007-003.i	0.9214	0.7184
mix-met-fast-003-001.i	0.9146	0.6804
mix-met-fast-005-001.i	0.9084	0.6467
mix-met-fast-001-001.i	0.9077	0.6425
mix-met-fast-007-019.i	0.9049	0.6272
mix-met-fast-007-023.i	0.9044	0.6245
mix-met-fast-007-009.i	0.8930	0.5613
mix-met-fast-007-001.i	0.8895	0.5421
mix-met-fast-007-022.i	0.8828	0.5052
mix-met-fast-007-015.i	0.8691	0.4296
mix-met-fast-007-008.i	0.8668	0.4172
mix-met-fast-009-001.i	0.8659	0.4123
mix-met-fast-002-001.i	0.8496	0.3222
pu-met-fast-001-001.i	0.8431	0.2864
pu-met-fast-022-001.i	0.8421	0.2809
pu-met-fast-029-001.i	0.8413	0.2763
mix-met-fast-002-002.i	0.8408	0.2737
pu-met-fast-023-001.i	0.8388	0.2629
pu-met-fast-035-001.i	0.8382	0.2594
pu-met-fast-030-001.i	0.8379	0.2581
pu-met-fast-009-001.i	0.8373	0.2547
pu-met-fast-025-001.i	0.8367	0.2512
pu-met-fast-036-001.i	0.8366	0.2505

pu-met-fast-024-001.i	0.8365	0.2504
mix-met-fast-007-014.i	0.8359	0.2467
pu-met-fast-044-003.i	0.8326	0.2284
pu-met-fast-044-005.i	0.8324	0.2277
mix-met-fast-007-007.i	0.8319	0.2249
pu-met-fast-044-002.i	0.8317	0.2237
pu-met-fast-021-001.i	0.8299	0.2139
pu-met-fast-021-002.i	0.8295	0.2116
pu-met-fast-044-004.i	0.8292	0.2096
pu-met-fast-031-001.i	0.8283	0.2047
pu-met-fast-003-103.i	0.8265	0.1949
pu-met-fast-042-009.i	0.8240	0.1814
pu-met-fast-042-006.i	0.8240	0.1812
pu-met-fast-042-012.i	0.8240	0.1810
pu-met-fast-042-007.i	0.8239	0.1809
pu-met-fast-042-015.i	0.8235	0.1784
pu-met-fast-042-010.i	0.8234	0.1780
pu-met-fast-042-008.i	0.8234	0.1779
pu-met-fast-042-011.i	0.8233	0.1771
pu-met-fast-042-013.i	0.8232	0.1769
pu-met-fast-042-014.i	0.8230	0.1754
pu-met-fast-042-004.i	0.8229	0.1753
pu-met-fast-042-005.i	0.8225	0.1730
pu-met-fast-018-001.i	0.8222	0.1714
pu-met-fast-032-001.i	0.8216	0.1678
pu-met-fast-042-003.i	0.8214	0.1670
pu-met-fast-044-001.i	0.8201	0.1599
pu-met-fast-042-002.i	0.8188	0.1526
pu-met-fast-011-001.i	0.8187	0.1520
pu-met-fast-002-001.i	0.8184	0.1503
pu-met-fast-008-001.i	0.8164	0.1392
pu-met-fast-027-001.i	0.8157	0.1355
pu-met-fast-019-001.i	0.8139	0.1257
pu-met-fast-045-005.i	0.8128	0.1196
pu-met-fast-042-001.i	0.8123	0.1169
pu-met-fast-040-001.i	0.8110	0.1094
pu-met-fast-026-001.i	0.8109	0.1092
pu-met-fast-038-001.i	0.8030	0.0656
pu-met-fast-028-001.i	0.8011	0.0552
pu-met-fast-015-001.i	0.7983	0.0393
pu-met-fast-012-001.i	0.7938	0.0147
pu-met-fast-014-001.i	0.7923	0.0064
pu-met-fast-045-006.i	0.7915	0.0023
pu-met-fast-045-007.i	0.7915	0.0018

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case002	0.01239	0.00027	0.98190	0.04231

Benchmark population = 80
Population weight = 27.74792
Maximum similarity = 0.97253

Bias = 0.00513
Bias uncertainty = 0.00726
Nuc Data uncert margin = 0.00027
Software/method margin = 0.00500

Non-coverage penalty = 0.00000

benchmark	ck	weight
mix-met-fast-007-013.i	0.9725	1.0000
mix-met-fast-007-012.i	0.9714	0.9938
mix-met-fast-007-018.i	0.9614	0.9385
mix-met-fast-007-011.i	0.9579	0.9194
mix-met-fast-010-001.i	0.9569	0.9136
mix-met-fast-007-006.i	0.9518	0.8857
mix-met-fast-007-017.i	0.9464	0.8557
mix-met-fast-007-005.i	0.9445	0.8455
mix-met-fast-007-010.i	0.9406	0.8241
mix-met-fast-007-021.i	0.9362	0.7995
mix-met-fast-007-004.i	0.9296	0.7635
mix-met-fast-007-016.i	0.9274	0.7513
mix-met-fast-007-020.i	0.9252	0.7388
mix-met-fast-007-003.i	0.9214	0.7184
mix-met-fast-003-001.i	0.9146	0.6804
mix-met-fast-005-001.i	0.9084	0.6467
mix-met-fast-001-001.i	0.9077	0.6425
mix-met-fast-007-019.i	0.9049	0.6272
mix-met-fast-007-023.i	0.9044	0.6245
mix-met-fast-007-009.i	0.8930	0.5613
mix-met-fast-007-001.i	0.8895	0.5421
mix-met-fast-007-022.i	0.8828	0.5052
mix-met-fast-007-015.i	0.8691	0.4296
mix-met-fast-007-008.i	0.8668	0.4172
mix-met-fast-009-001.i	0.8659	0.4123
mix-met-fast-002-001.i	0.8496	0.3222
pu-met-fast-001-001.i	0.8431	0.2864
pu-met-fast-022-001.i	0.8421	0.2809
pu-met-fast-029-001.i	0.8413	0.2763
mix-met-fast-002-002.i	0.8408	0.2737
pu-met-fast-023-001.i	0.8388	0.2629
pu-met-fast-035-001.i	0.8382	0.2594
pu-met-fast-030-001.i	0.8379	0.2581
pu-met-fast-009-001.i	0.8373	0.2547
pu-met-fast-025-001.i	0.8367	0.2512
pu-met-fast-036-001.i	0.8366	0.2505
pu-met-fast-024-001.i	0.8365	0.2504
mix-met-fast-007-014.i	0.8359	0.2467
pu-met-fast-044-003.i	0.8326	0.2284
pu-met-fast-044-005.i	0.8324	0.2277
mix-met-fast-007-007.i	0.8319	0.2249
pu-met-fast-044-002.i	0.8317	0.2237
pu-met-fast-021-001.i	0.8299	0.2139
pu-met-fast-021-002.i	0.8295	0.2116
pu-met-fast-044-004.i	0.8292	0.2096
pu-met-fast-031-001.i	0.8283	0.2047
pu-met-fast-003-103.i	0.8265	0.1949
pu-met-fast-042-009.i	0.8240	0.1814
pu-met-fast-042-006.i	0.8240	0.1812
pu-met-fast-042-012.i	0.8240	0.1810
pu-met-fast-042-007.i	0.8239	0.1809
pu-met-fast-042-015.i	0.8235	0.1784
pu-met-fast-042-010.i	0.8234	0.1780
pu-met-fast-042-008.i	0.8234	0.1779
pu-met-fast-042-011.i	0.8233	0.1771
pu-met-fast-042-013.i	0.8232	0.1769

pu-met-fast-042-014.i	0.8230	0.1754
pu-met-fast-042-004.i	0.8229	0.1753
pu-met-fast-042-005.i	0.8225	0.1730
pu-met-fast-018-001.i	0.8222	0.1714
pu-met-fast-032-001.i	0.8216	0.1678
pu-met-fast-042-003.i	0.8214	0.1670
pu-met-fast-044-001.i	0.8201	0.1599
pu-met-fast-042-002.i	0.8188	0.1526
pu-met-fast-011-001.i	0.8187	0.1520
pu-met-fast-002-001.i	0.8184	0.1503
pu-met-fast-008-001.i	0.8164	0.1392
pu-met-fast-027-001.i	0.8157	0.1355
pu-met-fast-019-001.i	0.8139	0.1257
pu-met-fast-045-005.i	0.8128	0.1196
pu-met-fast-042-001.i	0.8123	0.1169
pu-met-fast-040-001.i	0.8110	0.1094
pu-met-fast-026-001.i	0.8109	0.1092
pu-met-fast-038-001.i	0.8030	0.0656
pu-met-fast-028-001.i	0.8011	0.0552
pu-met-fast-015-001.i	0.7983	0.0393
pu-met-fast-012-001.i	0.7938	0.0147
pu-met-fast-014-001.i	0.7923	0.0064
pu-met-fast-045-006.i	0.7915	0.0023
pu-met-fast-045-007.i	0.7915	0.0018

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case003	0.01239	0.00027	0.98190	0.04231

Benchmark population = 80
Population weight = 27.74792
Maximum similarity = 0.97253

Bias = 0.00513
Bias uncertainty = 0.00726
Nuc Data uncert margin = 0.00027
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
mix-met-fast-007-013.i	0.9725	1.0000
mix-met-fast-007-012.i	0.9714	0.9938
mix-met-fast-007-018.i	0.9614	0.9385
mix-met-fast-007-011.i	0.9579	0.9194
mix-met-fast-010-001.i	0.9569	0.9136
mix-met-fast-007-006.i	0.9518	0.8857
mix-met-fast-007-017.i	0.9464	0.8557
mix-met-fast-007-005.i	0.9445	0.8455
mix-met-fast-007-010.i	0.9406	0.8241
mix-met-fast-007-021.i	0.9362	0.7995
mix-met-fast-007-004.i	0.9296	0.7635
mix-met-fast-007-016.i	0.9274	0.7513
mix-met-fast-007-020.i	0.9252	0.7388
mix-met-fast-007-003.i	0.9214	0.7184
mix-met-fast-003-001.i	0.9146	0.6804
mix-met-fast-005-001.i	0.9084	0.6467
mix-met-fast-001-001.i	0.9077	0.6425

mix-met-fast-007-019.i	0.9049	0.6272
mix-met-fast-007-023.i	0.9044	0.6245
mix-met-fast-007-009.i	0.8930	0.5613
mix-met-fast-007-001.i	0.8895	0.5421
mix-met-fast-007-022.i	0.8828	0.5052
mix-met-fast-007-015.i	0.8691	0.4296
mix-met-fast-007-008.i	0.8668	0.4172
mix-met-fast-009-001.i	0.8659	0.4123
mix-met-fast-002-001.i	0.8496	0.3222
pu-met-fast-001-001.i	0.8431	0.2864
pu-met-fast-022-001.i	0.8421	0.2809
pu-met-fast-029-001.i	0.8413	0.2763
mix-met-fast-002-002.i	0.8408	0.2737
pu-met-fast-023-001.i	0.8388	0.2629
pu-met-fast-035-001.i	0.8382	0.2594
pu-met-fast-030-001.i	0.8379	0.2581
pu-met-fast-009-001.i	0.8373	0.2547
pu-met-fast-025-001.i	0.8367	0.2512
pu-met-fast-036-001.i	0.8366	0.2505
pu-met-fast-024-001.i	0.8365	0.2504
mix-met-fast-007-014.i	0.8359	0.2467
pu-met-fast-044-003.i	0.8326	0.2284
pu-met-fast-044-005.i	0.8324	0.2277
mix-met-fast-007-007.i	0.8319	0.2249
pu-met-fast-044-002.i	0.8317	0.2237
pu-met-fast-021-001.i	0.8299	0.2139
pu-met-fast-021-002.i	0.8295	0.2116
pu-met-fast-044-004.i	0.8292	0.2096
pu-met-fast-031-001.i	0.8283	0.2047
pu-met-fast-003-103.i	0.8265	0.1949
pu-met-fast-042-009.i	0.8240	0.1814
pu-met-fast-042-006.i	0.8240	0.1812
pu-met-fast-042-012.i	0.8240	0.1810
pu-met-fast-042-007.i	0.8239	0.1809
pu-met-fast-042-015.i	0.8235	0.1784
pu-met-fast-042-010.i	0.8234	0.1780
pu-met-fast-042-008.i	0.8234	0.1779
pu-met-fast-042-011.i	0.8233	0.1771
pu-met-fast-042-013.i	0.8232	0.1769
pu-met-fast-042-014.i	0.8230	0.1754
pu-met-fast-042-004.i	0.8229	0.1753
pu-met-fast-042-005.i	0.8225	0.1730
pu-met-fast-018-001.i	0.8222	0.1714
pu-met-fast-032-001.i	0.8216	0.1678
pu-met-fast-042-003.i	0.8214	0.1670
pu-met-fast-044-001.i	0.8201	0.1599
pu-met-fast-042-002.i	0.8188	0.1526
pu-met-fast-011-001.i	0.8187	0.1520
pu-met-fast-002-001.i	0.8184	0.1503
pu-met-fast-008-001.i	0.8164	0.1392
pu-met-fast-027-001.i	0.8157	0.1355
pu-met-fast-019-001.i	0.8139	0.1257
pu-met-fast-045-005.i	0.8128	0.1196
pu-met-fast-042-001.i	0.8123	0.1169
pu-met-fast-040-001.i	0.8110	0.1094
pu-met-fast-026-001.i	0.8109	0.1092
pu-met-fast-038-001.i	0.8030	0.0656
pu-met-fast-028-001.i	0.8011	0.0552
pu-met-fast-015-001.i	0.7983	0.0393

pu-met-fast-012-001.i	0.7938	0.0147
pu-met-fast-014-001.i	0.7923	0.0064
pu-met-fast-045-006.i	0.7915	0.0023
pu-met-fast-045-007.i	0.7915	0.0018

1685,1 87%

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004	0.01239	0.00027	0.98190	0.04231

Benchmark population = 80
Population weight = 27.74792
Maximum similarity = 0.97253

Bias = 0.00513
Bias uncertainty = 0.00726
Nuc Data uncert margin = 0.00027
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
mix-met-fast-007-013.i	0.9725	1.0000
mix-met-fast-007-012.i	0.9714	0.9938
mix-met-fast-007-018.i	0.9614	0.9385
mix-met-fast-007-011.i	0.9579	0.9194
mix-met-fast-010-001.i	0.9569	0.9136
mix-met-fast-007-006.i	0.9518	0.8857
mix-met-fast-007-017.i	0.9464	0.8557
mix-met-fast-007-005.i	0.9445	0.8455
mix-met-fast-007-010.i	0.9406	0.8241
mix-met-fast-007-021.i	0.9362	0.7995
mix-met-fast-007-004.i	0.9296	0.7635
mix-met-fast-007-016.i	0.9274	0.7513
mix-met-fast-007-020.i	0.9252	0.7388
mix-met-fast-007-003.i	0.9214	0.7184
mix-met-fast-003-001.i	0.9146	0.6804
mix-met-fast-005-001.i	0.9084	0.6467
mix-met-fast-001-001.i	0.9077	0.6425
mix-met-fast-007-019.i	0.9049	0.6272
mix-met-fast-007-023.i	0.9044	0.6245
mix-met-fast-007-009.i	0.8930	0.5613
mix-met-fast-007-001.i	0.8895	0.5421
mix-met-fast-007-022.i	0.8828	0.5052
mix-met-fast-007-015.i	0.8691	0.4296
mix-met-fast-007-008.i	0.8668	0.4172
mix-met-fast-009-001.i	0.8659	0.4123
mix-met-fast-002-001.i	0.8496	0.3222
pu-met-fast-001-001.i	0.8431	0.2864
pu-met-fast-022-001.i	0.8421	0.2809
pu-met-fast-029-001.i	0.8413	0.2763
mix-met-fast-002-002.i	0.8408	0.2737
pu-met-fast-023-001.i	0.8388	0.2629
pu-met-fast-035-001.i	0.8382	0.2594
pu-met-fast-030-001.i	0.8379	0.2581
pu-met-fast-009-001.i	0.8373	0.2547
pu-met-fast-025-001.i	0.8367	0.2512
pu-met-fast-036-001.i	0.8366	0.2505
pu-met-fast-024-001.i	0.8365	0.2504
mix-met-fast-007-014.i	0.8359	0.2467

pu-met-fast-044-003.i	0.8326	0.2284
pu-met-fast-044-005.i	0.8324	0.2277
mix-met-fast-007-007.i	0.8319	0.2249
pu-met-fast-044-002.i	0.8317	0.2237
pu-met-fast-021-001.i	0.8299	0.2139
pu-met-fast-021-002.i	0.8295	0.2116
pu-met-fast-044-004.i	0.8292	0.2096
pu-met-fast-031-001.i	0.8283	0.2047
pu-met-fast-003-103.i	0.8265	0.1949
pu-met-fast-042-009.i	0.8240	0.1814
pu-met-fast-042-006.i	0.8240	0.1812
pu-met-fast-042-012.i	0.8240	0.1810
pu-met-fast-042-007.i	0.8239	0.1809
pu-met-fast-042-015.i	0.8235	0.1784
pu-met-fast-042-010.i	0.8234	0.1780
pu-met-fast-042-008.i	0.8234	0.1779
pu-met-fast-042-011.i	0.8233	0.1771
pu-met-fast-042-013.i	0.8232	0.1769
pu-met-fast-042-014.i	0.8230	0.1754
pu-met-fast-042-004.i	0.8229	0.1753
pu-met-fast-042-005.i	0.8225	0.1730
pu-met-fast-018-001.i	0.8222	0.1714
pu-met-fast-032-001.i	0.8216	0.1678
pu-met-fast-042-003.i	0.8214	0.1670
pu-met-fast-044-001.i	0.8201	0.1599
pu-met-fast-042-002.i	0.8188	0.1526
pu-met-fast-011-001.i	0.8187	0.1520
pu-met-fast-002-001.i	0.8184	0.1503
pu-met-fast-008-001.i	0.8164	0.1392
pu-met-fast-027-001.i	0.8157	0.1355
pu-met-fast-019-001.i	0.8139	0.1257
pu-met-fast-045-005.i	0.8128	0.1196
pu-met-fast-042-001.i	0.8123	0.1169
pu-met-fast-040-001.i	0.8110	0.1094
pu-met-fast-026-001.i	0.8109	0.1092
pu-met-fast-038-001.i	0.8030	0.0656
pu-met-fast-028-001.i	0.8011	0.0552
pu-met-fast-015-001.i	0.7983	0.0393
pu-met-fast-012-001.i	0.7938	0.0147
pu-met-fast-014-001.i	0.7923	0.0064
pu-met-fast-045-006.i	0.7915	0.0023
pu-met-fast-045-007.i	0.7915	0.0018

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case005	0.01239	0.00027	0.98190	0.04231

Benchmark population = 80
Population weight = 27.74792
Maximum similarity = 0.97253

Bias = 0.00513
Bias uncertainty = 0.00726
Nuc Data uncert margin = 0.00027
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
mix-met-fast-007-013.i	0.9725	1.0000
mix-met-fast-007-012.i	0.9714	0.9938
mix-met-fast-007-018.i	0.9614	0.9385
mix-met-fast-007-011.i	0.9579	0.9194
mix-met-fast-010-001.i	0.9569	0.9136
mix-met-fast-007-006.i	0.9518	0.8857
mix-met-fast-007-017.i	0.9464	0.8557
mix-met-fast-007-005.i	0.9445	0.8455
mix-met-fast-007-010.i	0.9406	0.8241
mix-met-fast-007-021.i	0.9362	0.7995
mix-met-fast-007-004.i	0.9296	0.7635
mix-met-fast-007-016.i	0.9274	0.7513
mix-met-fast-007-020.i	0.9252	0.7388
mix-met-fast-007-003.i	0.9214	0.7184
mix-met-fast-003-001.i	0.9146	0.6804
mix-met-fast-005-001.i	0.9084	0.6467
mix-met-fast-001-001.i	0.9077	0.6425
mix-met-fast-007-019.i	0.9049	0.6272
mix-met-fast-007-023.i	0.9044	0.6245
mix-met-fast-007-009.i	0.8930	0.5613
mix-met-fast-007-001.i	0.8895	0.5421
mix-met-fast-007-022.i	0.8828	0.5052
mix-met-fast-007-015.i	0.8691	0.4296
mix-met-fast-007-008.i	0.8668	0.4172
mix-met-fast-009-001.i	0.8659	0.4123
mix-met-fast-002-001.i	0.8496	0.3222
pu-met-fast-001-001.i	0.8431	0.2864
pu-met-fast-022-001.i	0.8421	0.2809
pu-met-fast-029-001.i	0.8413	0.2763
mix-met-fast-002-002.i	0.8408	0.2737
pu-met-fast-023-001.i	0.8388	0.2629
pu-met-fast-035-001.i	0.8382	0.2594
pu-met-fast-030-001.i	0.8379	0.2581
pu-met-fast-009-001.i	0.8373	0.2547
pu-met-fast-025-001.i	0.8367	0.2512
pu-met-fast-036-001.i	0.8366	0.2505
pu-met-fast-024-001.i	0.8365	0.2504
mix-met-fast-007-014.i	0.8359	0.2467
pu-met-fast-044-003.i	0.8326	0.2284
pu-met-fast-044-005.i	0.8324	0.2277
mix-met-fast-007-007.i	0.8319	0.2249
pu-met-fast-044-002.i	0.8317	0.2237
pu-met-fast-021-001.i	0.8299	0.2139
pu-met-fast-021-002.i	0.8295	0.2116
pu-met-fast-044-004.i	0.8292	0.2096
pu-met-fast-031-001.i	0.8283	0.2047
pu-met-fast-003-103.i	0.8265	0.1949
pu-met-fast-042-009.i	0.8240	0.1814
pu-met-fast-042-006.i	0.8240	0.1812
pu-met-fast-042-012.i	0.8240	0.1810
pu-met-fast-042-007.i	0.8239	0.1809
pu-met-fast-042-015.i	0.8235	0.1784
pu-met-fast-042-010.i	0.8234	0.1780
pu-met-fast-042-008.i	0.8234	0.1779
pu-met-fast-042-011.i	0.8233	0.1771
pu-met-fast-042-013.i	0.8232	0.1769
pu-met-fast-042-014.i	0.8230	0.1754
pu-met-fast-042-004.i	0.8229	0.1753

pu-met-fast-042-005.i	0.8225	0.1730
pu-met-fast-018-001.i	0.8222	0.1714
pu-met-fast-032-001.i	0.8216	0.1678
pu-met-fast-042-003.i	0.8214	0.1670
pu-met-fast-044-001.i	0.8201	0.1599
pu-met-fast-042-002.i	0.8188	0.1526
pu-met-fast-011-001.i	0.8187	0.1520
pu-met-fast-002-001.i	0.8184	0.1503
pu-met-fast-008-001.i	0.8164	0.1392
pu-met-fast-027-001.i	0.8157	0.1355
pu-met-fast-019-001.i	0.8139	0.1257
pu-met-fast-045-005.i	0.8128	0.1196
pu-met-fast-042-001.i	0.8123	0.1169
pu-met-fast-040-001.i	0.8110	0.1094
pu-met-fast-026-001.i	0.8109	0.1092
pu-met-fast-038-001.i	0.8030	0.0656
pu-met-fast-028-001.i	0.8011	0.0552
pu-met-fast-015-001.i	0.7983	0.0393
pu-met-fast-012-001.i	0.7938	0.0147
pu-met-fast-014-001.i	0.7923	0.0064
pu-met-fast-045-006.i	0.7915	0.0023
pu-met-fast-045-007.i	0.7915	0.0018

USL Summary Table

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001	0.01239	0.00027	0.98190	0.04231
inp_case002	0.01239	0.00027	0.98190	0.04231
inp_case003	0.01239	0.00027	0.98190	0.04231
inp_case004	0.01239	0.00027	0.98190	0.04231
inp_case005	0.01239	0.00027	0.98190	0.04231

Appendix C – Water-Reflected Fast Metal Model

```
@@@ PU-MET-FAST-011-001 @@@
c @@@ HEU-MET-FAST-004-001 @@@
c @@@ X=70 90 110 130 150
1    100    -19.74     -1            imp:n=1
2    200    0.100149   1 -2          imp:n=1
10   1000  -18.794     -3            imp:n=1
20   200   -0.999       3 -4         imp:n=1
30   0                  2 4 -5       imp:n=1
40   0                  5            imp:n=0

1    so   4.1217
2    so   29.5217
3    sph 0 0 X 6.5537
c           65
4    sph 0 0 X 33.4717
5    sph 0 0 0  1000

m100    94239.80c 0.046982
        94240.80c 0.0025852
        94241.80c 0.00014915
        94242.80c 9.9432e-06
m200    1001.80c  0.066766
        8016.80c  0.033383
mt200   lwtr.20t
m1000   92234.80c 0.00053678
        92235.80c 0.047033
        92236.80c 0.00095896
        92238.80c 0.00047782
kcode 100000 1.0 500 1000
ksrc 0 0 0  0 0 X
c kopts blocksize=5 ksental=mctal
c
c ---------------------------------------------------------------------------
 ksen1 xs cell=(1 2)
c       rxn = +2 +4 -6 +16 102 103 104 105 106 107 -7 -1018
c       erg =
c           1.0000e-11 3.0000e-09 7.5000e-09 1.0000e-08 2.5300e-08 3.0000e-08
c           4.0000e-08 5.0000e-08 7.0000e-08 1.0000e-07 1.5000e-07 2.0000e-07
c           2.2500e-07 2.5000e-07 2.7500e-07 3.2500e-07 3.5000e-07 3.7500e-07
c           4.0000e-07 6.2500e-07 1.0000e-06 1.7700e-06 3.0000e-06 4.7500e-06
c           6.0000e-06 8.1000e-06 1.0000e-05 3.0000e-05 1.0000e-04 5.5000e-04
c           3.0000e-03 1.7000e-02 2.5000e-02 1.0000e-01 4.0000e-01 9.0000e-01
c           1.4000e+00 1.8500e+00 2.3540e+00 2.4790e+00 3.0000e+00 4.8000e+00
c           6.4340e+00 8.1873e+00 2.0000e+01
c ---------------------------------------------------------------------------
c
c
c ---------------------------------------------------------------------------
 ksen2 xs cell=(10 20)
c       rxn = +2 +4 -6 +16 102 103 104 105 106 107 -7 -1018
c       erg =
c           1.0000e-11 3.0000e-09 7.5000e-09 1.0000e-08 2.5300e-08 3.0000e-08
c           4.0000e-08 5.0000e-08 7.0000e-08 1.0000e-07 1.5000e-07 2.0000e-07
c           2.2500e-07 2.5000e-07 2.7500e-07 3.2500e-07 3.5000e-07 3.7500e-07
```

```
c          4.0000e-07 6.2500e-07 1.0000e-06 1.7700e-06 3.0000e-06 4.7500e-06
c          6.0000e-06 8.1000e-06 1.0000e-05 3.0000e-05 1.0000e-04 5.5000e-04
c          3.0000e-03 1.7000e-02 2.5000e-02 1.0000e-01 4.0000e-01 9.0000e-01
c          1.4000e+00 1.8500e+00 2.3540e+00 2.4790e+00 3.0000e+00 4.8000e+00
c          6.4340e+00 8.1873e+00 2.0000e+01
c ---------------------------------------------------------------------------
print
```

Appendix D – Water-Reflected Fast Metal Model Benchmark Profile and USL Calculation Studies

Calculating application nuclear data uncertainties ...

application	adjusted	prior
inp_case001_1	0.00055	0.01186
inp_case001_2	0.00002	0.00023
inp_case002_1	0.00055	0.01182
inp_case002_2	0.00002	0.00025
inp_case003_1	0.00052	0.01186
inp_case003_2	0.00002	0.00021
inp_case004_1	0.00055	0.01192
inp_case004_2	0.00002	0.00022
inp_case005_1	0.00054	0.01197
inp_case005_2	0.00001	0.00014

Calculating upper subcritical limits ...

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_1	0.01470	0.00055	0.97886	0.02129

Benchmark population = 43
Population weight = 25.02271
Maximum similarity = 0.99977

Bias = 0.00674
Bias uncertainty = 0.00796
Nuc Data uncert margin = 0.00055
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-011-001.i	0.9998	1.0000
pu-met-fast-044-004.i	0.9916	0.8556
pu-met-fast-042-001.i	0.9915	0.8547
pu-met-fast-027-001.i	0.9914	0.8520
pu-met-fast-042-002.i	0.9912	0.8489
pu-met-fast-031-001.i	0.9904	0.8352
pu-met-fast-044-005.i	0.9900	0.8276
pu-met-fast-042-003.i	0.9891	0.8116
pu-met-fast-042-004.i	0.9879	0.7909
pu-met-fast-036-001.i	0.9864	0.7653
pu-met-fast-044-003.i	0.9852	0.7436
pu-met-fast-024-001.i	0.9847	0.7340
pu-met-fast-042-005.i	0.9844	0.7287
pu-met-fast-042-006.i	0.9839	0.7200
pu-met-fast-042-007.i	0.9822	0.6916
pu-met-fast-021-002.i	0.9820	0.6866
pu-met-fast-044-002.i	0.9814	0.6768
pu-met-fast-042-008.i	0.9813	0.6746
pu-met-fast-042-009.i	0.9802	0.6547
pu-met-fast-042-010.i	0.9797	0.6459

pu-met-fast-042-011.i	0.9789	0.6334
pu-met-fast-042-012.i	0.9781	0.6185
pu-met-fast-042-013.i	0.9773	0.6046
pu-met-fast-042-014.i	0.9773	0.6038
pu-met-fast-042-015.i	0.9769	0.5970
pu-met-fast-023-001.i	0.9745	0.5550
pu-met-fast-009-001.i	0.9730	0.5290
pu-met-fast-022-001.i	0.9722	0.5140
pu-met-fast-001-001.i	0.9704	0.4837
pu-met-fast-044-001.i	0.9696	0.4688
pu-met-fast-035-001.i	0.9691	0.4610
pu-met-fast-021-001.i	0.9688	0.4554
mix-met-fast-009-001.i	0.9685	0.4501
pu-met-fast-030-001.i	0.9684	0.4484
pu-met-fast-025-001.i	0.9659	0.4035
pu-met-fast-029-001.i	0.9658	0.4029
pu-met-fast-018-001.i	0.9646	0.3806
mix-met-fast-007-022.i	0.9585	0.2745
pu-met-fast-019-001.i	0.9552	0.2153
pu-met-fast-045-005.i	0.9542	0.1975
mix-met-fast-007-023.i	0.9532	0.1797
pu-met-fast-038-001.i	0.9490	0.1064
mix-met-fast-001-001.i	0.9453	0.0414

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_2	0.01194	0.00002	0.98301	0.01714

Benchmark population = 87
Population weight = 25.17704
Maximum similarity = 0.99834

Bias = 0.00712
Bias uncertainty = 0.00482
Nuc Data uncert margin = 0.00002
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-met-fast-004-001.i	0.9983	1.0000
heu-met-fast-078-001.i	0.9883	0.7523
heu-met-fast-011-001.i	0.9827	0.6146
heu-met-fast-007-035.i	0.9816	0.5862
heu-met-fast-078-011.i	0.9810	0.5726
heu-met-fast-078-009.i	0.9809	0.5701
heu-met-fast-078-017.i	0.9809	0.5697
heu-met-fast-078-005.i	0.9808	0.5681
heu-met-fast-078-015.i	0.9807	0.5640
heu-met-fast-078-013.i	0.9805	0.5600
heu-met-fast-084-011.i	0.9798	0.5441
heu-met-fast-091-001.i	0.9789	0.5211
heu-met-fast-016-002.i	0.9787	0.5167
heu-met-fast-026-011.i	0.9783	0.5053
heu-met-fast-009-002.i	0.9769	0.4722
heu-met-fast-007-024.i	0.9769	0.4712
heu-met-fast-007-023.i	0.9768	0.4702
heu-met-fast-010-002.i	0.9765	0.4616

heu-met-fast-007-027.i	0.9762	0.4542
heu-met-fast-007-003.i	0.9755	0.4369
heu-met-fast-007-020.i	0.9753	0.4319
heu-met-fast-007-002.i	0.9753	0.4315
heu-met-fast-007-021.i	0.9752	0.4292
heu-met-fast-007-022.i	0.9751	0.4271
heu-met-fast-031-001.i	0.9751	0.4267
heu-met-fast-007-028.i	0.9746	0.4150
heu-met-fast-078-003.i	0.9746	0.4146
heu-met-fast-084-002.i	0.9742	0.4059
heu-met-fast-007-004.i	0.9734	0.3847
heu-met-fast-078-007.i	0.9733	0.3828
heu-met-fast-007-025.i	0.9730	0.3760
heu-met-fast-007-026.i	0.9730	0.3756
heu-met-fast-007-009.i	0.9727	0.3679
heu-met-fast-084-023.i	0.9717	0.3434
heu-met-fast-007-029.i	0.9710	0.3267
heu-met-fast-007-005.i	0.9710	0.3266
heu-met-fast-020-002.i	0.9704	0.3114
heu-met-fast-007-007.i	0.9704	0.3109
heu-met-fast-034-002.i	0.9700	0.3005
heu-met-fast-034-001.i	0.9698	0.2976
heu-met-fast-007-008.i	0.9695	0.2890
heu-met-fast-041-004.i	0.9688	0.2715
heu-met-fast-078-039.i	0.9684	0.2610
heu-met-fast-041-005.i	0.9682	0.2582
heu-met-fast-010-001.i	0.9682	0.2567
heu-met-fast-078-043.i	0.9679	0.2502
heu-met-fast-078-037.i	0.9679	0.2497
heu-met-fast-078-031.i	0.9679	0.2496
heu-met-fast-084-015.i	0.9678	0.2485
heu-met-fast-078-027.i	0.9675	0.2409
heu-met-fast-088-001.i	0.9675	0.2397
heu-met-fast-078-035.i	0.9675	0.2388
heu-met-fast-034-003.i	0.9674	0.2387
heu-met-fast-041-006.i	0.9673	0.2339
heu-met-fast-041-003.i	0.9672	0.2333
heu-met-fast-007-030.i	0.9663	0.2097
heu-met-fast-007-010.i	0.9653	0.1853
heu-met-fast-019-001.i	0.9650	0.1783
heu-met-fast-084-004.i	0.9642	0.1575
heu-met-fast-063-002.i	0.9639	0.1502
heu-met-fast-078-025.i	0.9639	0.1501
heu-met-fast-084-026.i	0.9630	0.1290
heu-met-fast-009-001.i	0.9627	0.1210
heu-met-fast-084-027.i	0.9626	0.1200
heu-met-fast-089-001.i	0.9626	0.1189
heu-met-fast-084-005.i	0.9619	0.1029
heu-met-fast-016-001.i	0.9617	0.0969
heu-met-fast-084-016.i	0.9617	0.0964
heu-met-fast-063-001.i	0.9617	0.0961
heu-met-mixed-002-001.i	0.9614	0.0902
heu-met-mixed-003-001.i	0.9609	0.0780
heu-met-fast-058-005.i	0.9606	0.0696
heu-met-fast-084-003.i	0.9604	0.0654
heu-met-fast-078-029.i	0.9601	0.0587
heu-met-fast-022-002.i	0.9601	0.0577
heu-met-mixed-001-001.i	0.9600	0.0564
heu-met-fast-084-001.i	0.9600	0.0550

heu-met-fast-084-017.i	0.9600	0.0549
heu-met-fast-078-033.i	0.9599	0.0516
heu-met-fast-078-023.i	0.9591	0.0318
heu-met-fast-033-001.i	0.9590	0.0312
heu-met-fast-044-005.i	0.9590	0.0294
heu-met-fast-044-004.i	0.9589	0.0276
heu-met-fast-084-022.i	0.9587	0.0237
heu-met-fast-012-001.i	0.9584	0.0160

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case002_1	0.01470	0.00055	0.97886	0.02138

Benchmark population = 45
Population weight = 25.01139
Maximum similarity = 0.99990

Bias = 0.00675
Bias uncertainty = 0.00795
Nuc Data uncert margin = 0.00055
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-011-001.i	0.9999	1.0000
pu-met-fast-042-001.i	0.9915	0.8506
pu-met-fast-044-004.i	0.9914	0.8495
pu-met-fast-027-001.i	0.9914	0.8486
pu-met-fast-042-002.i	0.9913	0.8471
pu-met-fast-031-001.i	0.9904	0.8316
pu-met-fast-044-005.i	0.9900	0.8236
pu-met-fast-042-003.i	0.9893	0.8115
pu-met-fast-042-004.i	0.9881	0.7902
pu-met-fast-036-001.i	0.9864	0.7601
pu-met-fast-044-003.i	0.9851	0.7369
pu-met-fast-042-005.i	0.9848	0.7318
pu-met-fast-024-001.i	0.9845	0.7255
pu-met-fast-042-006.i	0.9843	0.7221
pu-met-fast-042-007.i	0.9827	0.6941
pu-met-fast-021-002.i	0.9824	0.6897
pu-met-fast-042-008.i	0.9817	0.6772
pu-met-fast-044-002.i	0.9817	0.6771
pu-met-fast-042-009.i	0.9807	0.6580
pu-met-fast-042-010.i	0.9802	0.6492
pu-met-fast-042-011.i	0.9795	0.6373
pu-met-fast-042-012.i	0.9787	0.6223
pu-met-fast-042-013.i	0.9779	0.6089
pu-met-fast-042-014.i	0.9779	0.6080
pu-met-fast-042-015.i	0.9775	0.6013
pu-met-fast-023-001.i	0.9749	0.5551
pu-met-fast-009-001.i	0.9734	0.5287
pu-met-fast-022-001.i	0.9723	0.5098
pu-met-fast-001-001.i	0.9708	0.4822
pu-met-fast-035-001.i	0.9696	0.4613
pu-met-fast-044-001.i	0.9696	0.4613
pu-met-fast-021-001.i	0.9693	0.4551
pu-met-fast-030-001.i	0.9691	0.4525
mix-met-fast-009-001.i	0.9691	0.4521
pu-met-fast-025-001.i	0.9665	0.4052

pu-met-fast-029-001.i	0.9664	0.4041
pu-met-fast-018-001.i	0.9648	0.3756
mix-met-fast-007-022.i	0.9591	0.2747
pu-met-fast-019-001.i	0.9556	0.2130
pu-met-fast-045-005.i	0.9545	0.1934
mix-met-fast-007-023.i	0.9539	0.1822
pu-met-fast-038-001.i	0.9493	0.0995
mix-met-fast-001-001.i	0.9463	0.0459

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case002_2	0.01190	0.00002	0.98304	0.01720

Benchmark population = 93
Population weight = 25.11956
Maximum similarity = 0.99887

Bias = 0.00702
Bias uncertainty = 0.00488
Nuc Data uncert margin = 0.00002
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-met-fast-004-001.i	0.9989	1.0000
heu-met-fast-078-001.i	0.9839	0.6756
heu-met-fast-011-001.i	0.9792	0.5724
heu-met-fast-084-011.i	0.9781	0.5494
heu-met-fast-007-035.i	0.9781	0.5491
heu-met-fast-016-002.i	0.9766	0.5158
heu-met-fast-091-001.i	0.9765	0.5144
heu-met-fast-078-005.i	0.9764	0.5124
heu-met-fast-078-017.i	0.9763	0.5099
heu-met-fast-078-011.i	0.9761	0.5064
heu-met-fast-078-009.i	0.9759	0.5008
heu-met-fast-078-015.i	0.9759	0.5003
heu-met-fast-078-013.i	0.9754	0.4903
heu-met-fast-009-002.i	0.9743	0.4654
heu-met-fast-084-002.i	0.9739	0.4586
heu-met-fast-026-011.i	0.9737	0.4529
heu-met-fast-010-002.i	0.9736	0.4516
heu-met-fast-007-024.i	0.9735	0.4487
heu-met-fast-007-023.i	0.9734	0.4472
heu-met-fast-031-001.i	0.9711	0.3977
heu-met-fast-007-020.i	0.9710	0.3942
heu-met-fast-007-027.i	0.9708	0.3913
heu-met-fast-007-021.i	0.9708	0.3905
heu-met-fast-007-022.i	0.9708	0.3895
heu-met-fast-007-003.i	0.9704	0.3818
heu-met-fast-084-023.i	0.9702	0.3767
heu-met-fast-007-002.i	0.9702	0.3766
heu-met-fast-007-028.i	0.9697	0.3675
heu-met-fast-007-025.i	0.9697	0.3666
heu-met-fast-007-026.i	0.9697	0.3653
heu-met-fast-078-003.i	0.9696	0.3648
heu-met-fast-078-007.i	0.9689	0.3485
heu-met-fast-007-004.i	0.9680	0.3296
heu-met-fast-020-002.i	0.9680	0.3293

heu-met-fast-007-009.i	0.9675	0.3191
heu-met-fast-084-015.i	0.9672	0.3117
heu-met-fast-034-002.i	0.9671	0.3090
heu-met-fast-034-001.i	0.9667	0.3004
heu-met-fast-041-004.i	0.9660	0.2859
heu-met-fast-041-003.i	0.9656	0.2774
heu-met-fast-007-005.i	0.9655	0.2761
heu-met-fast-007-029.i	0.9655	0.2758
heu-met-fast-010-001.i	0.9652	0.2687
heu-met-fast-041-005.i	0.9651	0.2674
heu-met-fast-007-007.i	0.9647	0.2580
heu-met-fast-034-003.i	0.9640	0.2416
heu-met-fast-007-008.i	0.9639	0.2411
heu-met-fast-041-006.i	0.9637	0.2365
heu-met-fast-078-039.i	0.9630	0.2210
heu-met-fast-088-001.i	0.9626	0.2129
heu-met-fast-089-001.i	0.9625	0.2091
heu-met-fast-084-004.i	0.9624	0.2087
heu-met-fast-078-037.i	0.9623	0.2057
heu-met-fast-078-031.i	0.9622	0.2038
heu-met-fast-007-030.i	0.9622	0.2035
heu-met-fast-078-027.i	0.9620	0.1996
heu-met-fast-078-043.i	0.9617	0.1934
heu-met-fast-078-035.i	0.9617	0.1934
heu-met-fast-084-026.i	0.9614	0.1869
heu-met-fast-019-001.i	0.9614	0.1856
heu-met-fast-084-027.i	0.9609	0.1759
heu-met-fast-007-010.i	0.9608	0.1724
heu-met-fast-084-016.i	0.9606	0.1679
heu-met-fast-009-001.i	0.9597	0.1503
heu-met-fast-063-002.i	0.9596	0.1460
heu-met-fast-084-005.i	0.9595	0.1458
heu-met-fast-084-001.i	0.9590	0.1349
heu-met-fast-058-005.i	0.9589	0.1321
heu-met-fast-078-025.i	0.9588	0.1291
heu-met-fast-016-001.i	0.9586	0.1255
heu-met-fast-044-005.i	0.9585	0.1242
heu-met-fast-044-004.i	0.9584	0.1219
heu-met-fast-063-001.i	0.9583	0.1198
heu-met-fast-084-003.i	0.9583	0.1197
heu-met-fast-022-002.i	0.9583	0.1194
heu-met-fast-084-017.i	0.9583	0.1184
heu-met-fast-084-022.i	0.9579	0.1108
heu-met-fast-044-003.i	0.9577	0.1065
heu-met-mixed-002-001.i	0.9572	0.0952
heu-met-fast-012-001.i	0.9568	0.0870
heu-met-mixed-003-001.i	0.9563	0.0757
heu-met-fast-044-002.i	0.9558	0.0637
heu-met-fast-058-004.i	0.9556	0.0606
heu-met-fast-084-010.i	0.9556	0.0600
heu-met-mixed-001-001.i	0.9552	0.0509
heu-met-fast-007-019.i	0.9548	0.0427
heu-met-fast-033-001.i	0.9546	0.0391
heu-met-fast-087-001.i	0.9544	0.0332
heu-met-fast-044-001.i	0.9542	0.0288
heu-met-fast-078-029.i	0.9541	0.0278
heu-met-fast-078-023.i	0.9540	0.0244
heu-met-fast-078-033.i	0.9539	0.0238
heu-met-fast-079-002.i	0.9530	0.0029

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case003_1	0.01471	0.00052	0.97893	0.02129

Benchmark population = 43
Population weight = 25.02844
Maximum similarity = 0.99974

Bias = 0.00675
Bias uncertainty = 0.00796
Nuc Data uncert margin = 0.00052
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-011-001.i	0.9997	1.0000
pu-met-fast-042-001.i	0.9916	0.8556
pu-met-fast-044-004.i	0.9914	0.8529
pu-met-fast-042-002.i	0.9914	0.8521
pu-met-fast-027-001.i	0.9914	0.8520
pu-met-fast-031-001.i	0.9904	0.8344
pu-met-fast-044-005.i	0.9898	0.8249
pu-met-fast-042-003.i	0.9893	0.8153
pu-met-fast-042-004.i	0.9880	0.7933
pu-met-fast-036-001.i	0.9862	0.7602
pu-met-fast-044-003.i	0.9850	0.7392
pu-met-fast-042-005.i	0.9847	0.7339
pu-met-fast-024-001.i	0.9842	0.7257
pu-met-fast-042-006.i	0.9840	0.7230
pu-met-fast-042-007.i	0.9826	0.6972
pu-met-fast-021-002.i	0.9822	0.6900
pu-met-fast-042-008.i	0.9816	0.6792
pu-met-fast-044-002.i	0.9814	0.6768
pu-met-fast-042-009.i	0.9805	0.6596
pu-met-fast-042-010.i	0.9799	0.6507
pu-met-fast-042-011.i	0.9792	0.6382
pu-met-fast-042-012.i	0.9784	0.6230
pu-met-fast-042-013.i	0.9776	0.6099
pu-met-fast-042-014.i	0.9775	0.6084
pu-met-fast-042-015.i	0.9772	0.6015
pu-met-fast-023-001.i	0.9745	0.5553
pu-met-fast-009-001.i	0.9728	0.5239
pu-met-fast-022-001.i	0.9718	0.5061
pu-met-fast-001-001.i	0.9700	0.4755
pu-met-fast-044-001.i	0.9694	0.4651
pu-met-fast-035-001.i	0.9691	0.4598
pu-met-fast-021-001.i	0.9688	0.4540
pu-met-fast-030-001.i	0.9685	0.4486
mix-met-fast-009-001.i	0.9685	0.4482
pu-met-fast-025-001.i	0.9658	0.4016
pu-met-fast-029-001.i	0.9654	0.3944
pu-met-fast-018-001.i	0.9644	0.3770
mix-met-fast-007-022.i	0.9587	0.2753
pu-met-fast-019-001.i	0.9551	0.2128
pu-met-fast-045-005.i	0.9544	0.2003
mix-met-fast-007-023.i	0.9534	0.1828
pu-met-fast-038-001.i	0.9490	0.1044

mix-met-fast-001-001.i 0.9457 0.0462

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case003_2	0.01194	0.00002	0.98301	0.01721

Benchmark population = 86
Population weight = 25.11716
Maximum similarity = 0.99884

Bias = 0.00712
Bias uncertainty = 0.00482
Nuc Data uncert margin = 0.00002
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-met-fast-004-001.i	0.9988	1.0000
heu-met-fast-078-001.i	0.9889	0.7568
heu-met-fast-011-001.i	0.9818	0.5857
heu-met-fast-007-035.i	0.9812	0.5698
heu-met-fast-078-011.i	0.9812	0.5692
heu-met-fast-078-017.i	0.9811	0.5688
heu-met-fast-078-009.i	0.9810	0.5658
heu-met-fast-078-005.i	0.9810	0.5652
heu-met-fast-078-015.i	0.9809	0.5626
heu-met-fast-078-013.i	0.9808	0.5609
heu-met-fast-016-002.i	0.9800	0.5403
heu-met-fast-084-011.i	0.9794	0.5261
heu-met-fast-091-001.i	0.9789	0.5143
heu-met-fast-026-011.i	0.9780	0.4917
heu-met-fast-009-002.i	0.9772	0.4716
heu-met-fast-010-002.i	0.9767	0.4607
heu-met-fast-007-023.i	0.9767	0.4599
heu-met-fast-007-024.i	0.9767	0.4599
heu-met-fast-007-027.i	0.9767	0.4595
heu-met-fast-007-003.i	0.9758	0.4394
heu-met-fast-007-002.i	0.9756	0.4337
heu-met-fast-007-020.i	0.9754	0.4286
heu-met-fast-007-022.i	0.9753	0.4254
heu-met-fast-007-021.i	0.9752	0.4245
heu-met-fast-078-003.i	0.9751	0.4212
heu-met-fast-007-028.i	0.9750	0.4191
heu-met-fast-084-002.i	0.9746	0.4104
heu-met-fast-031-001.i	0.9739	0.3913
heu-met-fast-007-004.i	0.9738	0.3889
heu-met-fast-078-007.i	0.9731	0.3728
heu-met-fast-007-009.i	0.9730	0.3707
heu-met-fast-007-025.i	0.9726	0.3604
heu-met-fast-007-026.i	0.9726	0.3601
heu-met-fast-007-005.i	0.9714	0.3325
heu-met-fast-007-029.i	0.9714	0.3315
heu-met-fast-084-023.i	0.9713	0.3286
heu-met-fast-007-007.i	0.9707	0.3147
heu-met-fast-034-002.i	0.9701	0.2994
heu-met-fast-034-001.i	0.9700	0.2976

heu-met-fast-007-008.i	0.9699	0.2938
heu-met-fast-041-004.i	0.9694	0.2823
heu-met-fast-020-002.i	0.9693	0.2798
heu-met-fast-078-039.i	0.9691	0.2760
heu-met-fast-078-043.i	0.9689	0.2696
heu-met-fast-041-005.i	0.9688	0.2691
heu-met-fast-078-037.i	0.9686	0.2633
heu-met-fast-078-031.i	0.9685	0.2612
heu-met-fast-078-035.i	0.9682	0.2544
heu-met-fast-078-027.i	0.9682	0.2541
heu-met-fast-088-001.i	0.9681	0.2506
heu-met-fast-084-015.i	0.9679	0.2470
heu-met-fast-041-006.i	0.9679	0.2467
heu-met-fast-010-001.i	0.9679	0.2451
heu-met-fast-034-003.i	0.9677	0.2412
heu-met-fast-041-003.i	0.9673	0.2321
heu-met-fast-007-030.i	0.9664	0.2095
heu-met-fast-007-010.i	0.9652	0.1804
heu-met-fast-019-001.i	0.9646	0.1668
heu-met-fast-078-025.i	0.9644	0.1622
heu-met-fast-063-002.i	0.9644	0.1619
heu-met-fast-084-004.i	0.9641	0.1541
heu-met-fast-084-026.i	0.9631	0.1289
heu-met-fast-084-027.i	0.9627	0.1191
heu-met-fast-089-001.i	0.9627	0.1191
heu-met-fast-016-001.i	0.9625	0.1142
heu-met-fast-009-001.i	0.9622	0.1066
heu-met-fast-063-001.i	0.9620	0.1033
heu-met-fast-084-005.i	0.9620	0.1031
heu-met-fast-084-016.i	0.9616	0.0921
heu-met-fast-078-029.i	0.9612	0.0837
heu-met-fast-078-033.i	0.9608	0.0740
heu-met-fast-058-005.i	0.9606	0.0689
heu-met-fast-084-003.i	0.9606	0.0685
heu-met-mixed-001-001.i	0.9605	0.0656
heu-met-mixed-002-001.i	0.9604	0.0645
heu-met-fast-084-017.i	0.9599	0.0520
heu-met-fast-078-023.i	0.9599	0.0502
heu-met-mixed-003-001.i	0.9598	0.0491
heu-met-fast-084-001.i	0.9597	0.0473
heu-met-fast-033-001.i	0.9593	0.0359
heu-met-fast-022-002.i	0.9592	0.0332
heu-met-fast-044-005.i	0.9591	0.0326
heu-met-fast-044-004.i	0.9591	0.0316
heu-met-fast-084-022.i	0.9585	0.0170
heu-met-fast-044-003.i	0.9582	0.0087
heu-met-fast-058-004.i	0.9581	0.0069

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004_1	0.01469	0.00055	0.97887	0.02114

Benchmark population = 43
Population weight = 25.06614
Maximum similarity = 0.99936

Bias = 0.00672
Bias uncertainty = 0.00797
Nuc Data uncert margin = 0.00055
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-011-001.i	0.9994	1.0000
pu-met-fast-044-004.i	0.9917	0.8672
pu-met-fast-042-001.i	0.9913	0.8606
pu-met-fast-027-001.i	0.9911	0.8568
pu-met-fast-042-002.i	0.9909	0.8529
pu-met-fast-031-001.i	0.9904	0.8443
pu-met-fast-044-005.i	0.9899	0.8357
pu-met-fast-042-003.i	0.9886	0.8130
pu-met-fast-042-004.i	0.9875	0.7936
pu-met-fast-036-001.i	0.9864	0.7753
pu-met-fast-044-003.i	0.9853	0.7553
pu-met-fast-024-001.i	0.9850	0.7498
pu-met-fast-042-005.i	0.9835	0.7243
pu-met-fast-042-006.i	0.9831	0.7173
pu-met-fast-042-007.i	0.9815	0.6892
pu-met-fast-021-002.i	0.9810	0.6808
pu-met-fast-044-002.i	0.9808	0.6780
pu-met-fast-042-008.i	0.9804	0.6710
pu-met-fast-042-009.i	0.9792	0.6501
pu-met-fast-042-010.i	0.9787	0.6408
pu-met-fast-042-011.i	0.9779	0.6267
pu-met-fast-042-012.i	0.9771	0.6128
pu-met-fast-042-013.i	0.9762	0.5979
pu-met-fast-042-014.i	0.9762	0.5965
pu-met-fast-042-015.i	0.9758	0.5900
pu-met-fast-023-001.i	0.9739	0.5566
pu-met-fast-009-001.i	0.9722	0.5278
pu-met-fast-022-001.i	0.9719	0.5234
pu-met-fast-001-001.i	0.9699	0.4886
pu-met-fast-044-001.i	0.9695	0.4804
pu-met-fast-035-001.i	0.9685	0.4628
pu-met-fast-021-001.i	0.9680	0.4541
mix-met-fast-009-001.i	0.9677	0.4489
pu-met-fast-030-001.i	0.9673	0.4433
pu-met-fast-029-001.i	0.9650	0.4022
pu-met-fast-025-001.i	0.9649	0.4015
pu-met-fast-018-001.i	0.9640	0.3852
mix-met-fast-007-022.i	0.9576	0.2735
pu-met-fast-019-001.i	0.9541	0.2136
pu-met-fast-045-005.i	0.9533	0.1996
mix-met-fast-007-023.i	0.9520	0.1761
pu-met-fast-038-001.i	0.9483	0.1129
mix-met-fast-001-001.i	0.9439	0.0359

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004_2	0.01194	0.00002	0.98301	0.01699

Benchmark population = 85
Population weight = 25.13800
Maximum similarity = 0.99868

Bias = 0.00707
Bias uncertainty = 0.00487
Nuc Data uncert margin = 0.00002
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-met-fast-004-001.i	0.9987	1.0000
heu-met-fast-078-001.i	0.9866	0.7158
heu-met-fast-007-035.i	0.9818	0.6024
heu-met-fast-011-001.i	0.9805	0.5717
heu-met-fast-091-001.i	0.9798	0.5555
heu-met-fast-078-011.i	0.9789	0.5347
heu-met-fast-078-017.i	0.9788	0.5326
heu-met-fast-078-009.i	0.9787	0.5286
heu-met-fast-078-005.i	0.9787	0.5282
heu-met-fast-078-015.i	0.9785	0.5242
heu-met-fast-016-002.i	0.9784	0.5229
heu-met-fast-078-013.i	0.9784	0.5223
heu-met-fast-084-011.i	0.9783	0.5202
heu-met-fast-007-024.i	0.9782	0.5181
heu-met-fast-007-023.i	0.9781	0.5159
heu-met-fast-031-001.i	0.9758	0.4611
heu-met-fast-007-022.i	0.9756	0.4548
heu-met-fast-007-021.i	0.9755	0.4548
heu-met-fast-007-020.i	0.9755	0.4545
heu-met-fast-007-025.i	0.9751	0.4446
heu-met-fast-007-026.i	0.9751	0.4437
heu-met-fast-007-027.i	0.9750	0.4420
heu-met-fast-007-028.i	0.9748	0.4369
heu-met-fast-009-002.i	0.9748	0.4367
heu-met-fast-007-003.i	0.9745	0.4312
heu-met-fast-026-011.i	0.9745	0.4306
heu-met-fast-078-007.i	0.9742	0.4223
heu-met-fast-010-002.i	0.9741	0.4201
heu-met-fast-007-002.i	0.9738	0.4133
heu-met-fast-007-009.i	0.9731	0.3971
heu-met-fast-007-004.i	0.9729	0.3930
heu-met-fast-034-002.i	0.9728	0.3905
heu-met-fast-084-002.i	0.9724	0.3797
heu-met-fast-034-001.i	0.9721	0.3729
heu-met-fast-007-029.i	0.9720	0.3709
heu-met-fast-007-005.i	0.9713	0.3558
heu-met-fast-078-003.i	0.9713	0.3553
heu-met-fast-007-007.i	0.9708	0.3439
heu-met-fast-007-008.i	0.9701	0.3252
heu-met-fast-007-030.i	0.9696	0.3144
heu-met-fast-034-003.i	0.9695	0.3116
heu-met-fast-084-023.i	0.9690	0.2995
heu-met-fast-041-005.i	0.9679	0.2746
heu-met-fast-041-004.i	0.9678	0.2733
heu-met-fast-007-010.i	0.9678	0.2724
heu-met-fast-088-001.i	0.9674	0.2618
heu-met-fast-041-006.i	0.9671	0.2555
heu-met-fast-020-002.i	0.9671	0.2547

heu-met-fast-078-039.i	0.9661	0.2328
heu-met-fast-078-037.i	0.9655	0.2175
heu-met-fast-010-001.i	0.9654	0.2158
heu-met-fast-078-031.i	0.9653	0.2141
heu-met-fast-041-003.i	0.9652	0.2106
heu-met-fast-078-035.i	0.9650	0.2061
heu-met-fast-084-015.i	0.9649	0.2042
heu-met-fast-078-027.i	0.9649	0.2041
heu-met-fast-078-043.i	0.9639	0.1814
heu-met-mixed-002-001.i	0.9634	0.1683
heu-met-mixed-003-001.i	0.9627	0.1521
heu-met-fast-033-001.i	0.9622	0.1406
heu-met-mixed-001-001.i	0.9620	0.1344
heu-met-fast-019-001.i	0.9617	0.1292
heu-met-fast-084-004.i	0.9613	0.1198
heu-met-fast-084-026.i	0.9608	0.1070
heu-met-fast-063-002.i	0.9607	0.1058
heu-met-fast-078-029.i	0.9607	0.1048
heu-met-fast-016-001.i	0.9605	0.1003
heu-met-fast-078-033.i	0.9604	0.0984
heu-met-fast-084-027.i	0.9604	0.0974
heu-met-fast-089-001.i	0.9603	0.0955
heu-met-fast-078-025.i	0.9602	0.0933
heu-met-fast-009-001.i	0.9598	0.0839
heu-met-fast-084-016.i	0.9591	0.0670
heu-met-fast-084-003.i	0.9590	0.0636
heu-met-fast-084-005.i	0.9588	0.0602
heu-met-fast-058-005.i	0.9587	0.0572
heu-met-fast-063-001.i	0.9585	0.0539
heu-met-fast-007-038.i	0.9582	0.0470
heu-met-fast-007-015.i	0.9579	0.0391
heu-met-fast-007-016.i	0.9577	0.0332
heu-met-fast-007-013.i	0.9572	0.0222
heu-met-fast-084-001.i	0.9568	0.0141
heu-met-fast-058-004.i	0.9567	0.0100
heu-met-fast-084-017.i	0.9565	0.0058
heu-met-fast-022-002.i	0.9565	0.0054

application	margin	(1-sigma)	USL	> USL
inp_case005_1	0.01470	0.00054	0.97890	0.02117

Benchmark population = 43
Population weight = 25.03247
Maximum similarity = 0.99969

Bias = 0.00674
Bias uncertainty = 0.00796
Nuc Data uncert margin = 0.00054
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-011-001.i	0.9997	1.0000
pu-met-fast-044-004.i	0.9916	0.8572
pu-met-fast-042-001.i	0.9915	0.8568
pu-met-fast-027-001.i	0.9914	0.8538
pu-met-fast-042-002.i	0.9913	0.8520
pu-met-fast-031-001.i	0.9904	0.8375

pu-met-fast-044-005.i	0.9899	0.8282
pu-met-fast-042-003.i	0.9891	0.8142
pu-met-fast-042-004.i	0.9879	0.7930
pu-met-fast-036-001.i	0.9863	0.7644
pu-met-fast-044-003.i	0.9851	0.7442
pu-met-fast-024-001.i	0.9845	0.7324
pu-met-fast-042-005.i	0.9844	0.7306
pu-met-fast-042-006.i	0.9838	0.7212
pu-met-fast-042-007.i	0.9823	0.6944
pu-met-fast-021-002.i	0.9819	0.6875
pu-met-fast-044-002.i	0.9813	0.6772
pu-met-fast-042-008.i	0.9813	0.6765
pu-met-fast-042-009.i	0.9802	0.6563
pu-met-fast-042-010.i	0.9797	0.6475
pu-met-fast-042-011.i	0.9789	0.6346
pu-met-fast-042-012.i	0.9781	0.6198
pu-met-fast-042-013.i	0.9773	0.6062
pu-met-fast-042-014.i	0.9772	0.6049
pu-met-fast-042-015.i	0.9768	0.5981
pu-met-fast-023-001.i	0.9744	0.5554
pu-met-fast-009-001.i	0.9727	0.5257
pu-met-fast-022-001.i	0.9718	0.5102
pu-met-fast-001-001.i	0.9700	0.4786
pu-met-fast-044-001.i	0.9695	0.4695
pu-met-fast-035-001.i	0.9690	0.4602
pu-met-fast-021-001.i	0.9687	0.4540
mix-met-fast-009-001.i	0.9683	0.4478
pu-met-fast-030-001.i	0.9683	0.4473
pu-met-fast-025-001.i	0.9656	0.4010
pu-met-fast-029-001.i	0.9654	0.3965
pu-met-fast-018-001.i	0.9644	0.3798
mix-met-fast-007-022.i	0.9585	0.2747
pu-met-fast-019-001.i	0.9550	0.2138
pu-met-fast-045-005.i	0.9542	0.2001
mix-met-fast-007-023.i	0.9531	0.1805
pu-met-fast-038-001.i	0.9489	0.1067
mix-met-fast-001-001.i	0.9452	0.0422

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case005_2	0.01185	0.00001	0.98311	0.01696

Benchmark population = 105
Population weight = 25.36661
Maximum similarity = 0.99634

Bias = 0.00697
Bias uncertainty = 0.00488
Nuc Data uncert margin = 0.00001
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-met-fast-004-001.i	0.9963	1.0000
heu-met-fast-078-001.i	0.9826	0.6776
heu-met-fast-084-011.i	0.9788	0.5868
heu-met-fast-011-001.i	0.9779	0.5652

heu-met-fast-016-002.i	0.9772	0.5487
heu-met-fast-084-002.i	0.9767	0.5377
heu-met-fast-078-005.i	0.9755	0.5099
heu-met-fast-009-002.i	0.9755	0.5085
heu-met-fast-078-017.i	0.9752	0.5015
heu-met-fast-010-002.i	0.9749	0.4966
heu-met-fast-078-015.i	0.9746	0.4894
heu-met-fast-078-011.i	0.9746	0.4881
heu-met-fast-078-009.i	0.9745	0.4860
heu-met-fast-078-013.i	0.9738	0.4706
heu-met-fast-026-011.i	0.9733	0.4571
heu-met-fast-007-035.i	0.9731	0.4526
heu-met-fast-084-023.i	0.9730	0.4500
heu-met-fast-091-001.i	0.9724	0.4355
heu-met-fast-084-015.i	0.9708	0.4000
heu-met-fast-020-002.i	0.9704	0.3906
heu-met-fast-078-003.i	0.9702	0.3858
heu-met-fast-007-023.i	0.9699	0.3785
heu-met-fast-007-024.i	0.9699	0.3771
heu-met-fast-007-027.i	0.9696	0.3700
heu-met-fast-007-002.i	0.9694	0.3652
heu-met-fast-007-003.i	0.9693	0.3637
heu-met-fast-007-020.i	0.9687	0.3504
heu-met-fast-007-022.i	0.9683	0.3393
heu-met-fast-007-021.i	0.9681	0.3363
heu-met-fast-007-028.i	0.9676	0.3245
heu-met-fast-041-003.i	0.9675	0.3222
heu-met-fast-010-001.i	0.9666	0.3003
heu-met-fast-007-004.i	0.9662	0.2913
heu-met-fast-041-004.i	0.9662	0.2899
heu-met-fast-031-001.i	0.9661	0.2884
heu-met-fast-089-001.i	0.9659	0.2837
heu-met-fast-084-004.i	0.9651	0.2657
heu-met-fast-007-025.i	0.9650	0.2635
heu-met-fast-007-026.i	0.9650	0.2622
heu-met-fast-007-009.i	0.9647	0.2562
heu-met-fast-041-005.i	0.9644	0.2475
heu-met-fast-084-026.i	0.9638	0.2347
heu-met-fast-084-016.i	0.9635	0.2275
heu-met-fast-084-027.i	0.9634	0.2248
heu-met-fast-078-007.i	0.9634	0.2239
heu-met-fast-019-001.i	0.9629	0.2135
heu-met-fast-007-005.i	0.9629	0.2122
heu-met-fast-078-039.i	0.9628	0.2104
heu-met-fast-084-001.i	0.9627	0.2093
heu-met-fast-078-043.i	0.9627	0.2081
heu-met-fast-044-005.i	0.9624	0.2017
heu-met-fast-041-006.i	0.9624	0.2003
heu-met-fast-034-001.i	0.9622	0.1957
heu-met-fast-044-004.i	0.9621	0.1952
heu-met-fast-034-002.i	0.9621	0.1943
heu-met-fast-078-037.i	0.9621	0.1942
heu-met-fast-078-031.i	0.9620	0.1924
heu-met-fast-084-005.i	0.9620	0.1924
heu-met-fast-007-029.i	0.9620	0.1921
heu-met-fast-078-027.i	0.9619	0.1902
heu-met-fast-084-017.i	0.9618	0.1870
heu-met-fast-044-003.i	0.9616	0.1830
heu-met-fast-078-035.i	0.9616	0.1821

heu-met-fast-022-002.i	0.9616	0.1819
heu-met-fast-084-022.i	0.9614	0.1785
heu-met-fast-007-007.i	0.9614	0.1782
heu-met-fast-009-001.i	0.9612	0.1742
heu-met-fast-063-002.i	0.9611	0.1712
heu-met-fast-007-008.i	0.9610	0.1678
heu-met-fast-058-005.i	0.9609	0.1651
heu-met-fast-063-001.i	0.9607	0.1616
heu-met-fast-012-001.i	0.9606	0.1579
heu-met-fast-044-002.i	0.9604	0.1540
heu-met-fast-078-025.i	0.9601	0.1461
heu-met-fast-034-003.i	0.9595	0.1340
heu-met-fast-084-003.i	0.9595	0.1337
heu-met-fast-016-001.i	0.9595	0.1325
heu-met-fast-088-001.i	0.9590	0.1206
heu-met-fast-044-001.i	0.9586	0.1119
heu-met-fast-007-019.i	0.9584	0.1078
heu-met-fast-084-010.i	0.9579	0.0945
heu-met-fast-079-002.i	0.9577	0.0916
heu-met-fast-100-001.i	0.9574	0.0839
heu-met-fast-087-001.i	0.9573	0.0819
heu-met-fast-079-001.i	0.9572	0.0780
heu-met-fast-001-001.i	0.9568	0.0694
heu-met-fast-043-001.i	0.9566	0.0644
heu-met-fast-079-003.i	0.9565	0.0621
heu-met-fast-058-004.i	0.9565	0.0620
heu-met-fast-100-002.i	0.9564	0.0611
heu-met-fast-027-001.i	0.9561	0.0529
heu-met-fast-078-023.i	0.9561	0.0521
heu-met-fast-007-030.i	0.9560	0.0512
heu-met-fast-008-001.i	0.9560	0.0501
heu-met-fast-065-002.i	0.9555	0.0397
heu-met-fast-007-010.i	0.9552	0.0329
heu-met-fast-079-004.i	0.9552	0.0313
heu-met-fast-018-002.i	0.9550	0.0283
heu-met-fast-015-001.i	0.9548	0.0236
heu-met-fast-043-002.i	0.9548	0.0227
heu-met-fast-051-002.i	0.9548	0.0220
heu-met-fast-079-005.i	0.9548	0.0215
heu-met-fast-007-001.i	0.9544	0.0139
heu-met-fast-084-019.i	0.9544	0.0127
heu-met-fast-025-001.i	0.9541	0.0070

USL Summary Table

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_1	0.01470	0.00055	0.97886	0.02129
inp_case001_2	0.01194	0.00002	0.98301	0.01714
inp_case002_1	0.01470	0.00055	0.97886	0.02138
inp_case002_2	0.01190	0.00002	0.98304	0.01720
inp_case003_1	0.01471	0.00052	0.97893	0.02129
inp_case003_2	0.01194	0.00002	0.98301	0.01721
inp_case004_1	0.01469	0.00055	0.97887	0.02114
inp_case004_2	0.01194	0.00002	0.98301	0.01699
inp_case005_1	0.01470	0.00054	0.97890	0.02117
inp_case005_2	0.01185	0.00001	0.98311	0.01696

Calculating application nuclear data uncertainties ...

application	adjusted	prior
inp_case001	0.00056	0.01187
inp_case002	0.00056	0.01182
inp_case003	0.00052	0.01187
inp_case004	0.00056	0.01193
inp_case005	0.00054	0.01197

Calculating upper subcritical limits ...

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001	0.01469	0.00056	0.97886	0.02129

Benchmark population = 45
Population weight = 25.04319
Maximum similarity = 0.99959

Bias = 0.00673
Bias uncertainty = 0.00796
Nuc Data uncert margin = 0.00056
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-011-001.i	0.9996	1.0000
pu-met-fast-042-001.i	0.9911	0.8517
pu-met-fast-044-004.i	0.9911	0.8512
pu-met-fast-027-001.i	0.9910	0.8493
pu-met-fast-042-002.i	0.9908	0.8454
pu-met-fast-031-001.i	0.9900	0.8316
pu-met-fast-044-005.i	0.9895	0.8229
pu-met-fast-042-003.i	0.9886	0.8080
pu-met-fast-042-004.i	0.9874	0.7872
pu-met-fast-036-001.i	0.9859	0.7604
pu-met-fast-044-003.i	0.9847	0.7387
pu-met-fast-024-001.i	0.9841	0.7292
pu-met-fast-042-005.i	0.9839	0.7252
pu-met-fast-042-006.i	0.9834	0.7163
pu-met-fast-042-007.i	0.9818	0.6880
pu-met-fast-021-002.i	0.9816	0.6851
pu-met-fast-044-002.i	0.9809	0.6727
pu-met-fast-042-008.i	0.9808	0.6710
pu-met-fast-042-009.i	0.9797	0.6512
pu-met-fast-042-010.i	0.9792	0.6424
pu-met-fast-042-011.i	0.9784	0.6298
pu-met-fast-042-012.i	0.9776	0.6150
pu-met-fast-042-013.i	0.9768	0.6012
pu-met-fast-042-014.i	0.9768	0.6004
pu-met-fast-042-015.i	0.9764	0.5936
pu-met-fast-023-001.i	0.9739	0.5498
pu-met-fast-009-001.i	0.9724	0.5241
pu-met-fast-022-001.i	0.9716	0.5091
pu-met-fast-001-001.i	0.9698	0.4791
pu-met-fast-044-001.i	0.9691	0.4656
mix-met-fast-009-001.i	0.9687	0.4595

pu-met-fast-035-001.i	0.9685	0.4564
pu-met-fast-021-001.i	0.9682	0.4510
pu-met-fast-030-001.i	0.9678	0.4442
pu-met-fast-025-001.i	0.9653	0.3992
pu-met-fast-029-001.i	0.9653	0.3989
pu-met-fast-018-001.i	0.9640	0.3767
mix-met-fast-007-022.i	0.9600	0.3062
mix-met-fast-007-023.i	0.9553	0.2241
pu-met-fast-019-001.i	0.9546	0.2124
pu-met-fast-045-005.i	0.9536	0.1949
pu-met-fast-038-001.i	0.9484	0.1040
mix-met-fast-001-001.i	0.9474	0.0866
mix-met-fast-005-001.i	0.9438	0.0233
mix-met-fast-007-019.i	0.9431	0.0107

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case002	0.01469	0.00056	0.97886	0.02138

Benchmark population = 46
Population weight = 25.03407
Maximum similarity = 0.99968

Bias = 0.00674
Bias uncertainty = 0.00795
Nuc Data uncert margin = 0.00056
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-011-001.i	0.9997	1.0000
pu-met-fast-042-001.i	0.9910	0.8470
pu-met-fast-027-001.i	0.9909	0.8453
pu-met-fast-044-004.i	0.9909	0.8444
pu-met-fast-042-002.i	0.9908	0.8430
pu-met-fast-031-001.i	0.9899	0.8275
pu-met-fast-044-005.i	0.9894	0.8182
pu-met-fast-042-003.i	0.9888	0.8073
pu-met-fast-042-004.i	0.9876	0.7858
pu-met-fast-036-001.i	0.9858	0.7545
pu-met-fast-044-003.i	0.9845	0.7313
pu-met-fast-042-005.i	0.9843	0.7276
pu-met-fast-024-001.i	0.9839	0.7200
pu-met-fast-042-006.i	0.9837	0.7178
pu-met-fast-042-007.i	0.9821	0.6898
pu-met-fast-021-002.i	0.9820	0.6880
pu-met-fast-042-008.i	0.9812	0.6730
pu-met-fast-044-002.i	0.9812	0.6723
pu-met-fast-042-009.i	0.9801	0.6538
pu-met-fast-042-010.i	0.9796	0.6451
pu-met-fast-042-011.i	0.9789	0.6331
pu-met-fast-042-012.i	0.9781	0.6182
pu-met-fast-042-013.i	0.9773	0.6048
pu-met-fast-042-014.i	0.9773	0.6038
pu-met-fast-042-015.i	0.9769	0.5972
pu-met-fast-023-001.i	0.9742	0.5492
pu-met-fast-009-001.i	0.9727	0.5230
pu-met-fast-022-001.i	0.9717	0.5042

pu-met-fast-001-001.i	0.9701	0.4768
mix-met-fast-009-001.i	0.9693	0.4628
pu-met-fast-044-001.i	0.9690	0.4575
pu-met-fast-035-001.i	0.9689	0.4559
pu-met-fast-021-001.i	0.9686	0.4499
pu-met-fast-030-001.i	0.9685	0.4476
pu-met-fast-025-001.i	0.9658	0.4001
pu-met-fast-029-001.i	0.9657	0.3995
pu-met-fast-018-001.i	0.9641	0.3710
mix-met-fast-007-022.i	0.9607	0.3099
mix-met-fast-007-023.i	0.9563	0.2319
pu-met-fast-019-001.i	0.9550	0.2093
pu-met-fast-045-005.i	0.9539	0.1902
mix-met-fast-001-001.i	0.9486	0.0969

application	margin	(1-sigma)	USL	> USL
inp_case003	0.01470	0.00052	0.97894	0.02128

Benchmark population = 45
Population weight = 25.04174
Maximum similarity = 0.99959

Bias = 0.00674
Bias uncertainty = 0.00796
Nuc Data uncert margin = 0.00052
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-011-001.i	0.9996	1.0000
pu-met-fast-042-001.i	0.9912	0.8527
pu-met-fast-027-001.i	0.9910	0.8494
pu-met-fast-044-004.i	0.9910	0.8487
pu-met-fast-042-002.i	0.9910	0.8487
pu-met-fast-031-001.i	0.9900	0.8309
pu-met-fast-044-005.i	0.9894	0.8205
pu-met-fast-042-003.i	0.9889	0.8118
pu-met-fast-042-004.i	0.9876	0.7897
pu-met-fast-036-001.i	0.9857	0.7556
pu-met-fast-044-003.i	0.9845	0.7347
pu-met-fast-042-005.i	0.9842	0.7305
pu-met-fast-024-001.i	0.9837	0.7211
pu-met-fast-042-006.i	0.9836	0.7195
pu-met-fast-042-007.i	0.9822	0.6937
pu-met-fast-021-002.i	0.9819	0.6888
pu-met-fast-042-008.i	0.9811	0.6758
pu-met-fast-044-002.i	0.9810	0.6729
pu-met-fast-042-009.i	0.9800	0.6562
pu-met-fast-042-010.i	0.9795	0.6474
pu-met-fast-042-011.i	0.9788	0.6348
pu-met-fast-042-012.i	0.9779	0.6197
pu-met-fast-042-013.i	0.9772	0.6066
pu-met-fast-042-014.i	0.9771	0.6051
pu-met-fast-042-015.i	0.9767	0.5982
pu-met-fast-023-001.i	0.9740	0.5505
pu-met-fast-009-001.i	0.9722	0.5194
pu-met-fast-022-001.i	0.9712	0.5016
pu-met-fast-001-001.i	0.9695	0.4712
pu-met-fast-044-001.i	0.9690	0.4621

mix-met-fast-009-001.i	0.9686	0.4565
pu-met-fast-035-001.i	0.9686	0.4555
pu-met-fast-021-001.i	0.9683	0.4499
pu-met-fast-030-001.i	0.9680	0.4447
pu-met-fast-025-001.i	0.9653	0.3976
pu-met-fast-029-001.i	0.9649	0.3908
pu-met-fast-018-001.i	0.9639	0.3733
mix-met-fast-007-022.i	0.9600	0.3039
mix-met-fast-007-023.i	0.9554	0.2229
pu-met-fast-019-001.i	0.9546	0.2101
pu-met-fast-045-005.i	0.9539	0.1979
pu-met-fast-038-001.i	0.9485	0.1021
mix-met-fast-001-001.i	0.9476	0.0869
mix-met-fast-005-001.i	0.9441	0.0249
mix-met-fast-007-019.i	0.9431	0.0070

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004	0.01468	0.00056	0.97887	0.02113

Benchmark population = 45
Population weight = 25.08416
Maximum similarity = 0.99919

Bias = 0.00672
Bias uncertainty = 0.00796
Nuc Data uncert margin = 0.00056
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-011-001.i	0.9992	1.0000
pu-met-fast-044-004.i	0.9913	0.8629
pu-met-fast-042-001.i	0.9910	0.8576
pu-met-fast-027-001.i	0.9907	0.8540
pu-met-fast-042-002.i	0.9905	0.8494
pu-met-fast-031-001.i	0.9900	0.8408
pu-met-fast-044-005.i	0.9894	0.8312
pu-met-fast-042-003.i	0.9882	0.8095
pu-met-fast-042-004.i	0.9870	0.7900
pu-met-fast-036-001.i	0.9859	0.7706
pu-met-fast-044-003.i	0.9848	0.7507
pu-met-fast-024-001.i	0.9845	0.7452
pu-met-fast-042-005.i	0.9831	0.7210
pu-met-fast-042-006.i	0.9826	0.7139
pu-met-fast-042-007.i	0.9810	0.6859
pu-met-fast-021-002.i	0.9807	0.6799
pu-met-fast-044-002.i	0.9803	0.6742
pu-met-fast-042-008.i	0.9800	0.6677
pu-met-fast-042-009.i	0.9788	0.6469
pu-met-fast-042-010.i	0.9782	0.6376
pu-met-fast-042-011.i	0.9774	0.6235
pu-met-fast-042-012.i	0.9766	0.6096
pu-met-fast-042-013.i	0.9758	0.5948
pu-met-fast-042-014.i	0.9757	0.5934
pu-met-fast-042-015.i	0.9753	0.5869

pu-met-fast-023-001.i	0.9733	0.5520
pu-met-fast-009-001.i	0.9716	0.5235
pu-met-fast-022-001.i	0.9714	0.5190
pu-met-fast-001-001.i	0.9694	0.4845
pu-met-fast-044-001.i	0.9690	0.4775
pu-met-fast-035-001.i	0.9679	0.4587
mix-met-fast-009-001.i	0.9679	0.4583
pu-met-fast-021-001.i	0.9674	0.4503
pu-met-fast-030-001.i	0.9668	0.4397
pu-met-fast-029-001.i	0.9644	0.3988
pu-met-fast-025-001.i	0.9644	0.3978
pu-met-fast-018-001.i	0.9634	0.3818
mix-met-fast-007-022.i	0.9590	0.3045
mix-met-fast-007-023.i	0.9540	0.2194
pu-met-fast-019-001.i	0.9536	0.2113
pu-met-fast-045-005.i	0.9528	0.1977
pu-met-fast-038-001.i	0.9478	0.1111
mix-met-fast-001-001.i	0.9460	0.0799
mix-met-fast-005-001.i	0.9420	0.0118
mix-met-fast-007-019.i	0.9419	0.0093

application	margin	(1-sigma)	USL	> USL
inp_case005	0.01470	0.00054	0.97890	0.02117

Benchmark population = 44
Population weight = 25.03794
Maximum similarity = 0.99962

Bias = 0.00673
Bias uncertainty = 0.00797
Nuc Data uncert margin = 0.00054
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-011-001.i	0.9996	1.0000
pu-met-fast-042-001.i	0.9913	0.8550
pu-met-fast-044-004.i	0.9913	0.8545
pu-met-fast-027-001.i	0.9912	0.8521
pu-met-fast-042-002.i	0.9911	0.8498
pu-met-fast-031-001.i	0.9902	0.8353
pu-met-fast-044-005.i	0.9897	0.8254
pu-met-fast-042-003.i	0.9889	0.8120
pu-met-fast-042-004.i	0.9877	0.7907
pu-met-fast-036-001.i	0.9860	0.7615
pu-met-fast-044-003.i	0.9849	0.7414
pu-met-fast-024-001.i	0.9842	0.7295
pu-met-fast-042-005.i	0.9841	0.7285
pu-met-fast-042-006.i	0.9836	0.7191
pu-met-fast-042-007.i	0.9821	0.6923
pu-met-fast-021-002.i	0.9818	0.6869
pu-met-fast-044-002.i	0.9811	0.6748
pu-met-fast-042-008.i	0.9810	0.6744
pu-met-fast-042-009.i	0.9799	0.6543
pu-met-fast-042-010.i	0.9794	0.6455
pu-met-fast-042-011.i	0.9787	0.6325
pu-met-fast-042-012.i	0.9778	0.6178
pu-met-fast-042-013.i	0.9770	0.6042
pu-met-fast-042-014.i	0.9770	0.6029

pu-met-fast-042-015.i	0.9766	0.5961
pu-met-fast-023-001.i	0.9741	0.5525
pu-met-fast-009-001.i	0.9724	0.5230
pu-met-fast-022-001.i	0.9715	0.5075
pu-met-fast-001-001.i	0.9697	0.4761
pu-met-fast-044-001.i	0.9693	0.4678
pu-met-fast-035-001.i	0.9687	0.4577
mix-met-fast-009-001.i	0.9685	0.4541
pu-met-fast-021-001.i	0.9683	0.4516
pu-met-fast-030-001.i	0.9680	0.4450
pu-met-fast-025-001.i	0.9653	0.3987
pu-met-fast-029-001.i	0.9651	0.3944
pu-met-fast-018-001.i	0.9641	0.3777
mix-met-fast-007-022.i	0.9594	0.2942
pu-met-fast-019-001.i	0.9547	0.2124
mix-met-fast-007-023.i	0.9544	0.2080
pu-met-fast-045-005.i	0.9539	0.1989
pu-met-fast-038-001.i	0.9486	0.1056
mix-met-fast-001-001.i	0.9466	0.0708
mix-met-fast-005-001.i	0.9429	0.0053

USL Summary Table

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001	0.01469	0.00056	0.97886	0.02129
inp_case002	0.01469	0.00056	0.97886	0.02138
inp_case003	0.01470	0.00052	0.97894	0.02128
inp_case004	0.01468	0.00056	0.97887	0.02113
inp_case005	0.01470	0.00054	0.97890	0.02117

Appendix E– Thermal Solutions Model

```
c @@@ X= 80 100 120 140 160
c HEU Sol
1    110   9.82964005e-2  -1          imp:n=1 $ HEU solution
2    210   6.03421952e-2  -2 +1       imp:n=1 $ HEU Al alloy container
3    310   9.99879650e-2  -3 +2         imp:n=1 $ HEU water reflector
c Pu Sol
10   410   1.0087e-1      -100         imp:n=1 $ Pu solution
20   510   8.6240e-2      100 -200      imp:n=1 $ PU container
30   610   9.9982e-2      200 -300      imp:n=1 $ PU water reflector
c
40   0              3 300 -400      imp:n=1 $ Void around sol
50   0              400             imp:n=0 $ Outer void

c   Surface cards
c    HEU surfaces
1   so 11.5177
2   so 11.6764
3   so 35.0000
c    PU surfaces
100 s X 0 0  14.5151
200 s X 0 0  14.6396
300 s X 0 0  44.6396
c Inner void surface
400   so 1000

c    Material cards
c     m1   = fuel solution
c     m2   = aluminum alloy container
c     m3   = water reflector
c
c    For m1 (9.82964005e-2):
c     - natO may be converted to 16,17O (where 16 = 16+18) (3.3360e-2)
c     - lwtr.20t is ENDF71SaB kernel
c     - hh2o.20t is rem continuous kernel
m110    92234.80c 1.7561e-5   92235.80c 1.6626e-3   92236.80c 8.8837e-6  $
        92238.80c 9.4079e-5                                    $U
        1001.80c 5.9587e-2                                    $H
        8016.80c 3.33473e-2   8017.80c 1.26768e-5                    $O
        9019.80c 3.5663e-3                                    $F
mt110   lwtr.20t
c
c    For m2 (6.03421952e-2, w/Zn; 6.03172372e-2 w/o Zn):
c     - natSi may be converted to isoSi (5.5202e-4)
c     - natCu may be converted to isoCu (5.1364e-5)
c     - natZn may be converted to isoZn (2.4958e-5)
m210   13027.80c 5.9699e-2                                      $Al
       14028.80c 5.09126e-4  14029.80c 2.58522e-5  14030.80c 1.70420e-5 $isoSi
       25055.80c 1.4853e-5                                     $Mn
       29063.80c 3.55285e-5  29065.80c 1.58355e-5                    $isoCu
       30064.80c 1.21371e-5  30066.80c 6.96328e-6  30067.80c 1.02328e-6
       30068.80c 4.67963e-6  30070.80c 1.54740e-7                    $isoZn
c
c    For m3 (9.99879650e-2):
c     - natO converted to 16,17O (where 16 = 16+18) (3.3329e-2)
c     - lwtr.20t is ENDF71SaB kernel
c     - hh2o.20t is rem continuous kernel
```

```
m310   1001.80c 6.6659e-2                              $H
       8016.80c 3.33163e-2   8017.80c 1.26650e-5                $O
mt310  lwtr.20t
c PU materials
m410   94238.80c 1.108e-08
       94239.80c 0.00017472
       94240.80c 8.5486e-06
       94241.80c 5.5623e-07
       94242.80c 1.6345e-08
       7015.80c  3.165905e-06
       7014.80c  0.000852484095
       1001.80c  0.064883
       8016.80c  0.034948
mt410  lwtr.20t
m510   26058.80c 0.0001673811
       26057.80c 0.00125773245
       26054.80c 0.00346929975
       26056.80c 0.0544605867
       24053.80c 0.00165583428
       24052.80c 0.01460274692
       24050.80c 0.0007572466
       24054.80c 0.0004121722
       28058.80c 0.0052557409107
       28064.80c 7.14590968e-05
       28060.80c 0.0020245019893
       28062.80c 0.0002805943035
       28061.80c 8.80036997e-05
       25055.80c 0.0017363
m610   1001.80c  0.066655
       8016.80c  0.033327
mt610  lwtr.20t
kcode 100000 1.0 500 1000
ksrc 0 0 0  X 0 0
c  kopts blocksize=5 ksental=mctal
c
c ---------------------------------------------------------------------------
 ksen1 xs cell=1
c       rxn = +2 +4 -6 +16 102 103 104 105 106 107 -7 -1018
c       erg =
c          1.0000e-11 3.0000e-09 7.5000e-09 1.0000e-08 2.5300e-08 3.0000e-08
c          4.0000e-08 5.0000e-08 7.0000e-08 1.0000e-07 1.5000e-07 2.0000e-07
c          2.2500e-07 2.5000e-07 2.7500e-07 3.2500e-07 3.5000e-07 3.7500e-07
c          4.0000e-07 6.2500e-07 1.0000e-06 1.7700e-06 3.0000e-06 4.7500e-06
c          6.0000e-06 8.1000e-06 1.0000e-05 3.0000e-05 1.0000e-04 5.5000e-04
c          3.0000e-03 1.7000e-02 2.5000e-02 1.0000e-01 4.0000e-01 9.0000e-01
c          1.4000e+00 1.8500e+00 2.3540e+00 2.4790e+00 3.0000e+00 4.8000e+00
c          6.4340e+00 8.1873e+00 2.0000e+01
c ---------------------------------------------------------------------------
c
c
c ---------------------------------------------------------------------------
 ksen2 xs cell=10
c       rxn = +2 +4 -6 +16 102 103 104 105 106 107 -7 -1018
c       erg =
c          1.0000e-11 3.0000e-09 7.5000e-09 1.0000e-08 2.5300e-08 3.0000e-08
c          4.0000e-08 5.0000e-08 7.0000e-08 1.0000e-07 1.5000e-07 2.0000e-07
c          2.2500e-07 2.5000e-07 2.7500e-07 3.2500e-07 3.5000e-07 3.7500e-07
c          4.0000e-07 6.2500e-07 1.0000e-06 1.7700e-06 3.0000e-06 4.7500e-06
c          6.0000e-06 8.1000e-06 1.0000e-05 3.0000e-05 1.0000e-04 5.5000e-04
```

```
c          3.0000e-03 1.7000e-02 2.5000e-02 1.0000e-01 4.0000e-01 9.0000e-01
c          1.4000e+00 1.8500e+00 2.3540e+00 2.4790e+00 3.0000e+00 4.8000e+00
c          6.4340e+00 8.1873e+00 2.0000e+01
c -------------------------------------------------------------------------
print
```

Appendix F –Thermal Solution Model Benchmark Profile and USL Calculation Studies

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_1	0.03713	0.00005	0.95775	0.04818

Benchmark population = 49
Population weight = 25.62679
Maximum similarity = 0.99380

Bias = 0.01843
Bias uncertainty = 0.01870
Nuc Data uncert margin = 0.00005
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-sol-therm-050-010.i	0.9938	1.0000
heu-sol-therm-050-001.i	0.9924	0.9534
heu-sol-therm-050-008.i	0.9922	0.9464
heu-sol-therm-050-002.i	0.9922	0.9448
heu-sol-therm-050-004.i	0.9920	0.9384
heu-sol-therm-050-006.i	0.9917	0.9298
heu-sol-therm-009-001.i	0.9902	0.8776
heu-sol-therm-009-002.i	0.9873	0.7825
heu-sol-therm-050-011.i	0.9862	0.7449
heu-sol-therm-050-003.i	0.9843	0.6822
heu-sol-therm-050-009.i	0.9843	0.6814
heu-sol-therm-050-005.i	0.9843	0.6798
heu-sol-therm-050-007.i	0.9843	0.6797
heu-sol-therm-001-004.i	0.9828	0.6314
heu-sol-therm-038-011.i	0.9824	0.6162
heu-sol-therm-001-002.i	0.9820	0.6032
heu-sol-therm-038-012.i	0.9818	0.5965
heu-sol-therm-019-001.i	0.9816	0.5895
heu-sol-therm-038-001.i	0.9814	0.5841
heu-sol-therm-038-025.i	0.9811	0.5753
heu-sol-therm-038-026.i	0.9809	0.5688
heu-sol-therm-038-013.i	0.9806	0.5580
heu-sol-therm-019-002.i	0.9800	0.5376
heu-sol-therm-038-018.i	0.9800	0.5369
heu-sol-therm-038-005.i	0.9799	0.5346
heu-sol-therm-038-027.i	0.9799	0.5334
heu-sol-therm-038-004.i	0.9792	0.5099
heu-sol-therm-019-003.i	0.9791	0.5068
heu-sol-therm-038-020.i	0.9790	0.5030
heu-sol-therm-038-019.i	0.9788	0.4979
heu-sol-therm-038-024.i	0.9788	0.4960
heu-sol-therm-009-003.i	0.9776	0.4568
heu-sol-therm-038-014.i	0.9773	0.4455
heu-sol-therm-038-028.i	0.9770	0.4349
heu-sol-therm-038-017.i	0.9768	0.4304
heu-sol-therm-038-003.i	0.9765	0.4204

heu-sol-therm-038-015.i	0.9761	0.4061
heu-sol-therm-038-016.i	0.9758	0.3955
heu-sol-therm-038-007.i	0.9753	0.3801
heu-sol-therm-038-010.i	0.9750	0.3681
heu-sol-therm-038-008.i	0.9726	0.2902
heu-comp-therm-002-018.i	0.9706	0.2227
heu-sol-therm-038-009.i	0.9680	0.1355
heu-sol-therm-001-001.i	0.9668	0.0932
heu-sol-therm-001-008.i	0.9666	0.0892
heu-sol-therm-001-003.i	0.9663	0.0783
heu-comp-therm-002-001.i	0.9662	0.0727
heu-sol-therm-001-007.i	0.9657	0.0564
heu-sol-therm-043-001.i	0.9649	0.0305

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_2	0.01401	0.00052	0.97964	0.02629

Benchmark population = 39
Population weight = 25.24366
Maximum similarity = 0.99772

Bias = 0.00562
Bias uncertainty = 0.00839
Nuc Data uncert margin = 0.00052
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9977	1.0000
pu-sol-therm-002-005.i	0.9975	0.9208
pu-sol-therm-010-009.i	0.9975	0.9147
pu-sol-therm-011-165.i	0.9975	0.9135
pu-sol-therm-010-002.i	0.9974	0.9083
pu-sol-therm-002-006.i	0.9974	0.9030
pu-sol-therm-002-007.i	0.9974	0.8925
pu-sol-therm-002-004.i	0.9974	0.8922
pu-sol-therm-002-003.i	0.9973	0.8771
pu-sol-therm-001-002.i	0.9973	0.8499
pu-sol-therm-007-010.i	0.9972	0.8398
pu-sol-therm-007-005.i	0.9972	0.8365
pu-sol-therm-007-007.i	0.9972	0.8250
pu-sol-therm-002-002.i	0.9971	0.8035
pu-sol-therm-011-163.i	0.9971	0.7865
pu-sol-therm-010-003.i	0.9971	0.7833
pu-sol-therm-002-001.i	0.9970	0.7790
pu-sol-therm-007-009.i	0.9970	0.7583
pu-sol-therm-011-164.i	0.9970	0.7559
pu-sol-therm-007-006.i	0.9970	0.7554
pu-sol-therm-007-008.i	0.9969	0.7249
pu-sol-therm-011-162.i	0.9967	0.6748
pu-sol-therm-010-006.i	0.9966	0.6361
pu-sol-therm-010-010.i	0.9965	0.6161
pu-sol-therm-010-011.i	0.9965	0.6150
pu-sol-therm-011-161.i	0.9965	0.6140
pu-sol-therm-010-004.i	0.9964	0.5851
pu-sol-therm-003-006.i	0.9962	0.5159
pu-sol-therm-001-003.i	0.9962	0.5107

pu-sol-therm-010-005.i	0.9961	0.4804
pu-sol-therm-010-012.i	0.9959	0.4028
pu-sol-therm-001-004.i	0.9956	0.3196
pu-sol-therm-003-008.i	0.9956	0.3023
pu-sol-therm-010-007.i	0.9955	0.2772
pu-sol-therm-003-005.i	0.9955	0.2750
pu-sol-therm-003-004.i	0.9954	0.2478
pu-sol-therm-001-005.i	0.9954	0.2291
pu-sol-therm-003-003.i	0.9950	0.1204
pu-sol-therm-003-007.i	0.9950	0.1010

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case002_1	0.03713	0.00005	0.95775	0.04821

Benchmark population = 49
Population weight = 25.81949
Maximum similarity = 0.99186

Bias = 0.01842
Bias uncertainty = 0.01871
Nuc Data uncert margin = 0.00005
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-sol-therm-050-010.i	0.9919	1.0000
heu-sol-therm-050-001.i	0.9900	0.9381
heu-sol-therm-050-008.i	0.9899	0.9363
heu-sol-therm-050-002.i	0.9897	0.9284
heu-sol-therm-050-004.i	0.9894	0.9201
heu-sol-therm-050-006.i	0.9892	0.9135
heu-sol-therm-009-001.i	0.9868	0.8355
heu-sol-therm-050-011.i	0.9842	0.7503
heu-sol-therm-009-002.i	0.9841	0.7454
heu-sol-therm-050-005.i	0.9820	0.6757
heu-sol-therm-050-009.i	0.9820	0.6752
heu-sol-therm-050-003.i	0.9817	0.6660
heu-sol-therm-050-007.i	0.9816	0.6643
heu-sol-therm-038-011.i	0.9811	0.6469
heu-sol-therm-038-012.i	0.9804	0.6249
heu-sol-therm-038-001.i	0.9799	0.6074
heu-sol-therm-001-004.i	0.9799	0.6061
heu-sol-therm-038-026.i	0.9794	0.5917
heu-sol-therm-038-025.i	0.9794	0.5903
heu-sol-therm-001-002.i	0.9790	0.5791
heu-sol-therm-038-013.i	0.9790	0.5788
heu-sol-therm-038-005.i	0.9784	0.5582
heu-sol-therm-019-001.i	0.9782	0.5505
heu-sol-therm-038-018.i	0.9781	0.5491
heu-sol-therm-038-027.i	0.9779	0.5421
heu-sol-therm-038-004.i	0.9777	0.5338
heu-sol-therm-038-020.i	0.9776	0.5310
heu-sol-therm-038-019.i	0.9773	0.5211
heu-sol-therm-019-002.i	0.9767	0.5020
heu-sol-therm-038-024.i	0.9764	0.4917
heu-sol-therm-019-003.i	0.9759	0.4780

heu-sol-therm-038-003.i	0.9757	0.4695
heu-sol-therm-038-028.i	0.9754	0.4592
heu-sol-therm-038-017.i	0.9754	0.4591
heu-sol-therm-038-014.i	0.9752	0.4534
heu-sol-therm-009-003.i	0.9745	0.4312
heu-sol-therm-038-007.i	0.9743	0.4234
heu-sol-therm-038-015.i	0.9742	0.4217
heu-sol-therm-038-010.i	0.9738	0.4072
heu-sol-therm-038-016.i	0.9736	0.4003
heu-sol-therm-038-008.i	0.9714	0.3291
heu-comp-therm-002-018.i	0.9679	0.2125
heu-sol-therm-038-009.i	0.9667	0.1758
heu-sol-therm-001-001.i	0.9646	0.1060
heu-sol-therm-001-008.i	0.9643	0.0943
heu-sol-therm-001-003.i	0.9640	0.0850
heu-sol-therm-001-007.i	0.9632	0.0606
heu-comp-therm-002-001.i	0.9632	0.0599
heu-sol-therm-043-001.i	0.9626	0.0396

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case002_2	0.01398	0.00051	0.97969	0.02627

Benchmark population = 39
Population weight = 25.26627
Maximum similarity = 0.99765

Bias = 0.00559
Bias uncertainty = 0.00839
Nuc Data uncert margin = 0.00051
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9976	1.0000
pu-sol-therm-011-165.i	0.9974	0.9202
pu-sol-therm-010-009.i	0.9974	0.9189
pu-sol-therm-002-005.i	0.9974	0.9113
pu-sol-therm-010-002.i	0.9974	0.9106
pu-sol-therm-002-006.i	0.9973	0.8879
pu-sol-therm-002-004.i	0.9973	0.8878
pu-sol-therm-002-007.i	0.9973	0.8756
pu-sol-therm-002-003.i	0.9973	0.8711
pu-sol-therm-001-002.i	0.9972	0.8415
pu-sol-therm-007-005.i	0.9971	0.8316
pu-sol-therm-007-010.i	0.9971	0.8297
pu-sol-therm-007-007.i	0.9971	0.8147
pu-sol-therm-011-163.i	0.9971	0.8128
pu-sol-therm-002-002.i	0.9971	0.8042
pu-sol-therm-010-003.i	0.9970	0.7930
pu-sol-therm-002-001.i	0.9970	0.7848
pu-sol-therm-011-164.i	0.9970	0.7776
pu-sol-therm-007-006.i	0.9969	0.7451
pu-sol-therm-007-009.i	0.9969	0.7448
pu-sol-therm-007-008.i	0.9968	0.7166
pu-sol-therm-011-162.i	0.9967	0.6981
pu-sol-therm-010-006.i	0.9966	0.6456
pu-sol-therm-011-161.i	0.9966	0.6383
pu-sol-therm-010-010.i	0.9965	0.6195

pu-sol-therm-010-011.i	0.9965	0.6169
pu-sol-therm-010-004.i	0.9964	0.5863
pu-sol-therm-003-006.i	0.9962	0.5174
pu-sol-therm-001-003.i	0.9961	0.4943
pu-sol-therm-010-005.i	0.9961	0.4877
pu-sol-therm-010-012.i	0.9959	0.4127
pu-sol-therm-003-008.i	0.9956	0.3125
pu-sol-therm-001-004.i	0.9955	0.2964
pu-sol-therm-010-007.i	0.9955	0.2816
pu-sol-therm-003-005.i	0.9955	0.2788
pu-sol-therm-003-004.i	0.9954	0.2578
pu-sol-therm-001-005.i	0.9952	0.1990
pu-sol-therm-003-003.i	0.9950	0.1332
pu-sol-therm-003-007.i	0.9950	0.1103

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case003_1	0.03713	0.00004	0.95778	0.04827

Benchmark population = 49
Population weight = 25.64437
Maximum similarity = 0.99359

Bias = 0.01842
Bias uncertainty = 0.01871
Nuc Data uncert margin = 0.00004
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-sol-therm-050-010.i	0.9936	1.0000
heu-sol-therm-050-001.i	0.9921	0.9492
heu-sol-therm-050-008.i	0.9919	0.9439
heu-sol-therm-050-002.i	0.9917	0.9351
heu-sol-therm-050-004.i	0.9915	0.9290
heu-sol-therm-050-006.i	0.9913	0.9229
heu-sol-therm-009-001.i	0.9893	0.8562
heu-sol-therm-009-002.i	0.9865	0.7603
heu-sol-therm-050-011.i	0.9859	0.7423
heu-sol-therm-050-009.i	0.9842	0.6841
heu-sol-therm-050-007.i	0.9839	0.6736
heu-sol-therm-050-003.i	0.9839	0.6734
heu-sol-therm-050-005.i	0.9836	0.6658
heu-sol-therm-038-011.i	0.9826	0.6294
heu-sol-therm-038-012.i	0.9822	0.6157
heu-sol-therm-001-004.i	0.9818	0.6046
heu-sol-therm-038-001.i	0.9816	0.5967
heu-sol-therm-038-025.i	0.9814	0.5894
heu-sol-therm-038-026.i	0.9814	0.5889
heu-sol-therm-001-002.i	0.9810	0.5757
heu-sol-therm-038-013.i	0.9808	0.5715
heu-sol-therm-019-001.i	0.9805	0.5584
heu-sol-therm-038-018.i	0.9803	0.5518
heu-sol-therm-038-005.i	0.9801	0.5453
heu-sol-therm-038-027.i	0.9800	0.5447

heu-sol-therm-038-020.i	0.9794	0.5243
heu-sol-therm-038-004.i	0.9794	0.5225
heu-sol-therm-038-019.i	0.9791	0.5144
heu-sol-therm-019-002.i	0.9790	0.5096
heu-sol-therm-038-024.i	0.9787	0.4991
heu-sol-therm-019-003.i	0.9783	0.4858
heu-sol-therm-038-014.i	0.9775	0.4599
heu-sol-therm-038-017.i	0.9774	0.4563
heu-sol-therm-038-028.i	0.9773	0.4525
heu-sol-therm-038-003.i	0.9771	0.4449
heu-sol-therm-009-003.i	0.9767	0.4337
heu-sol-therm-038-015.i	0.9764	0.4231
heu-sol-therm-038-007.i	0.9760	0.4091
heu-sol-therm-038-016.i	0.9760	0.4081
heu-sol-therm-038-010.i	0.9757	0.3973
heu-sol-therm-038-008.i	0.9733	0.3187
heu-comp-therm-002-018.i	0.9699	0.2020
heu-sol-therm-038-009.i	0.9688	0.1658
heu-sol-therm-001-001.i	0.9661	0.0769
heu-sol-therm-001-008.i	0.9659	0.0695
heu-sol-therm-001-003.i	0.9656	0.0601
heu-comp-therm-002-001.i	0.9654	0.0523
heu-sol-therm-001-007.i	0.9649	0.0361
heu-sol-therm-043-001.i	0.9643	0.0143

application	margin	(1-sigma)	USL	> USL
inp_case003_2	0.01397	0.00051	0.97970	0.02634

Benchmark population = 39
Population weight = 25.23635
Maximum similarity = 0.99767

Bias = 0.00557
Bias uncertainty = 0.00840
Nuc Data uncert margin = 0.00051
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9977	1.0000
pu-sol-therm-011-165.i	0.9974	0.9217
pu-sol-therm-010-009.i	0.9974	0.9205
pu-sol-therm-002-005.i	0.9974	0.9187
pu-sol-therm-010-002.i	0.9974	0.9165
pu-sol-therm-002-004.i	0.9974	0.8935
pu-sol-therm-002-006.i	0.9973	0.8884
pu-sol-therm-002-007.i	0.9973	0.8804
pu-sol-therm-002-003.i	0.9973	0.8722
pu-sol-therm-001-002.i	0.9972	0.8415
pu-sol-therm-007-005.i	0.9972	0.8296
pu-sol-therm-007-010.i	0.9972	0.8237
pu-sol-therm-011-163.i	0.9971	0.8110
pu-sol-therm-007-007.i	0.9971	0.8090
pu-sol-therm-002-002.i	0.9971	0.8063
pu-sol-therm-010-003.i	0.9971	0.8003
pu-sol-therm-002-001.i	0.9970	0.7859
pu-sol-therm-011-164.i	0.9970	0.7730
pu-sol-therm-007-006.i	0.9969	0.7395
pu-sol-therm-007-009.i	0.9969	0.7368

pu-sol-therm-007-008.i	0.9968	0.7083
pu-sol-therm-011-162.i	0.9968	0.6917
pu-sol-therm-010-006.i	0.9966	0.6480
pu-sol-therm-011-161.i	0.9966	0.6297
pu-sol-therm-010-011.i	0.9966	0.6202
pu-sol-therm-010-010.i	0.9966	0.6198
pu-sol-therm-010-004.i	0.9965	0.5860
pu-sol-therm-003-006.i	0.9963	0.5222
pu-sol-therm-001-003.i	0.9962	0.4927
pu-sol-therm-010-005.i	0.9962	0.4885
pu-sol-therm-010-012.i	0.9960	0.4132
pu-sol-therm-003-008.i	0.9956	0.3086
pu-sol-therm-001-004.i	0.9956	0.2889
pu-sol-therm-010-007.i	0.9956	0.2830
pu-sol-therm-003-005.i	0.9956	0.2807
pu-sol-therm-003-004.i	0.9955	0.2583
pu-sol-therm-001-005.i	0.9953	0.1904
pu-sol-therm-003-003.i	0.9951	0.1312
pu-sol-therm-003-007.i	0.9951	0.1061

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004_1	0.03713	0.00002	0.95782	0.04830

Benchmark population = 49
Population weight = 25.99470
Maximum similarity = 0.99010

Bias = 0.01842
Bias uncertainty = 0.01871
Nuc Data uncert margin = 0.00002
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-sol-therm-050-010.i	0.9901	1.0000
heu-sol-therm-050-001.i	0.9879	0.9297
heu-sol-therm-050-008.i	0.9879	0.9295
heu-sol-therm-050-002.i	0.9876	0.9206
heu-sol-therm-050-004.i	0.9873	0.9112
heu-sol-therm-050-006.i	0.9871	0.9028
heu-sol-therm-009-001.i	0.9843	0.8123
heu-sol-therm-050-011.i	0.9828	0.7656
heu-sol-therm-009-002.i	0.9818	0.7317
heu-sol-therm-050-005.i	0.9804	0.6876
heu-sol-therm-038-011.i	0.9795	0.6599
heu-sol-therm-050-009.i	0.9794	0.6558
heu-sol-therm-050-007.i	0.9790	0.6430
heu-sol-therm-050-003.i	0.9790	0.6416
heu-sol-therm-038-012.i	0.9789	0.6399
heu-sol-therm-038-001.i	0.9782	0.6176
heu-sol-therm-001-004.i	0.9777	0.6005
heu-sol-therm-038-026.i	0.9776	0.5995
heu-sol-therm-038-025.i	0.9775	0.5935
heu-sol-therm-038-013.i	0.9772	0.5837
heu-sol-therm-001-002.i	0.9769	0.5747
heu-sol-therm-038-005.i	0.9767	0.5693
heu-sol-therm-038-018.i	0.9761	0.5498
heu-sol-therm-038-004.i	0.9760	0.5461

heu-sol-therm-038-027.i	0.9760	0.5456
heu-sol-therm-038-020.i	0.9758	0.5405
heu-sol-therm-019-001.i	0.9756	0.5347
heu-sol-therm-038-019.i	0.9755	0.5294
heu-sol-therm-038-003.i	0.9745	0.4985
heu-sol-therm-038-024.i	0.9741	0.4845
heu-sol-therm-019-002.i	0.9741	0.4842
heu-sol-therm-038-028.i	0.9736	0.4680
heu-sol-therm-038-017.i	0.9734	0.4642
heu-sol-therm-019-003.i	0.9732	0.4566
heu-sol-therm-038-014.i	0.9730	0.4499
heu-sol-therm-038-007.i	0.9729	0.4454
heu-sol-therm-009-003.i	0.9725	0.4348
heu-sol-therm-038-010.i	0.9721	0.4225
heu-sol-therm-038-015.i	0.9721	0.4223
heu-sol-therm-038-016.i	0.9713	0.3941
heu-sol-therm-038-008.i	0.9698	0.3469
heu-comp-therm-002-018.i	0.9660	0.2246
heu-sol-therm-038-009.i	0.9649	0.1899
heu-sol-therm-001-001.i	0.9632	0.1358
heu-sol-therm-001-008.i	0.9627	0.1203
heu-sol-therm-001-003.i	0.9624	0.1105
heu-sol-therm-001-007.i	0.9617	0.0862
heu-sol-therm-043-001.i	0.9612	0.0708
heu-comp-therm-002-001.i	0.9611	0.0684

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004_2	0.01403	0.00053	0.97958	0.02653

Benchmark population = 39
Population weight = 25.24617
Maximum similarity = 0.99774

Bias = 0.00565
Bias uncertainty = 0.00838
Nuc Data uncert margin = 0.00053
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9977	1.0000
pu-sol-therm-002-005.i	0.9975	0.9173
pu-sol-therm-010-009.i	0.9975	0.9138
pu-sol-therm-010-002.i	0.9975	0.9120
pu-sol-therm-011-165.i	0.9974	0.9052
pu-sol-therm-002-006.i	0.9974	0.8988
pu-sol-therm-002-007.i	0.9974	0.8926
pu-sol-therm-002-004.i	0.9974	0.8888
pu-sol-therm-002-003.i	0.9973	0.8701
pu-sol-therm-001-002.i	0.9973	0.8581
pu-sol-therm-007-005.i	0.9973	0.8465
pu-sol-therm-007-010.i	0.9973	0.8447
pu-sol-therm-007-007.i	0.9972	0.8321
pu-sol-therm-002-002.i	0.9971	0.7964
pu-sol-therm-010-003.i	0.9971	0.7813
pu-sol-therm-011-163.i	0.9971	0.7800

pu-sol-therm-002-001.i	0.9970	0.7742
pu-sol-therm-007-009.i	0.9970	0.7664
pu-sol-therm-007-006.i	0.9970	0.7647
pu-sol-therm-011-164.i	0.9970	0.7487
pu-sol-therm-007-008.i	0.9969	0.7373
pu-sol-therm-011-162.i	0.9967	0.6658
pu-sol-therm-010-006.i	0.9966	0.6320
pu-sol-therm-010-010.i	0.9965	0.6122
pu-sol-therm-010-011.i	0.9965	0.6096
pu-sol-therm-011-161.i	0.9965	0.6052
pu-sol-therm-010-004.i	0.9965	0.5843
pu-sol-therm-001-003.i	0.9963	0.5299
pu-sol-therm-003-006.i	0.9962	0.5096
pu-sol-therm-010-005.i	0.9961	0.4780
pu-sol-therm-010-012.i	0.9959	0.3988
pu-sol-therm-001-004.i	0.9957	0.3409
pu-sol-therm-003-008.i	0.9956	0.2955
pu-sol-therm-010-007.i	0.9955	0.2737
pu-sol-therm-003-005.i	0.9955	0.2713
pu-sol-therm-001-005.i	0.9954	0.2496
pu-sol-therm-003-004.i	0.9954	0.2436
pu-sol-therm-003-003.i	0.9950	0.1197
pu-sol-therm-003-007.i	0.9949	0.0973

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case005_1	0.03713	0.00004	0.95776	0.04828

Benchmark population = 49
Population weight = 25.71889
Maximum similarity = 0.99286

Bias = 0.01841
Bias uncertainty = 0.01872
Nuc Data uncert margin = 0.00004
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
heu-sol-therm-050-010.i	0.9929	1.0000
heu-sol-therm-050-001.i	0.9910	0.9364
heu-sol-therm-050-008.i	0.9908	0.9295
heu-sol-therm-050-002.i	0.9905	0.9189
heu-sol-therm-050-004.i	0.9903	0.9111
heu-sol-therm-050-006.i	0.9900	0.9003
heu-sol-therm-009-001.i	0.9881	0.8333
heu-sol-therm-050-011.i	0.9857	0.7509
heu-sol-therm-009-002.i	0.9854	0.7424
heu-sol-therm-050-005.i	0.9832	0.6654
heu-sol-therm-038-011.i	0.9829	0.6539
heu-sol-therm-038-012.i	0.9825	0.6390
heu-sol-therm-050-009.i	0.9824	0.6386
heu-sol-therm-050-007.i	0.9819	0.6209
heu-sol-therm-050-003.i	0.9819	0.6197
heu-sol-therm-038-001.i	0.9818	0.6164
heu-sol-therm-038-026.i	0.9816	0.6083
heu-sol-therm-038-025.i	0.9815	0.6046
heu-sol-therm-001-004.i	0.9814	0.6029

heu-sol-therm-038-013.i	0.9810	0.5887
heu-sol-therm-001-002.i	0.9806	0.5751
heu-sol-therm-038-018.i	0.9803	0.5641
heu-sol-therm-038-005.i	0.9803	0.5626
heu-sol-therm-038-027.i	0.9802	0.5604
heu-sol-therm-019-001.i	0.9798	0.5472
heu-sol-therm-038-020.i	0.9797	0.5437
heu-sol-therm-038-004.i	0.9796	0.5397
heu-sol-therm-038-019.i	0.9793	0.5299
heu-sol-therm-019-002.i	0.9786	0.5065
heu-sol-therm-038-024.i	0.9784	0.4994
heu-sol-therm-019-003.i	0.9781	0.4869
heu-sol-therm-038-003.i	0.9776	0.4716
heu-sol-therm-038-017.i	0.9776	0.4711
heu-sol-therm-038-028.i	0.9775	0.4680
heu-sol-therm-038-014.i	0.9775	0.4654
heu-sol-therm-038-007.i	0.9765	0.4333
heu-sol-therm-038-015.i	0.9765	0.4313
heu-sol-therm-009-003.i	0.9763	0.4239
heu-sol-therm-038-010.i	0.9761	0.4176
heu-sol-therm-038-016.i	0.9759	0.4104
heu-sol-therm-038-008.i	0.9737	0.3343
heu-comp-therm-002-018.i	0.9698	0.1992
heu-sol-therm-038-009.i	0.9691	0.1766
heu-sol-therm-001-001.i	0.9665	0.0865
heu-sol-therm-001-008.i	0.9662	0.0741
heu-sol-therm-001-003.i	0.9659	0.0652
heu-sol-therm-001-007.i	0.9652	0.0398
heu-comp-therm-002-001.i	0.9652	0.0394
heu-sol-therm-043-001.i	0.9645	0.0145

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case005_2	0.01399	0.00050	0.97972	0.02632

Benchmark population = 39
Population weight = 25.25446
Maximum similarity = 0.99783

Bias = 0.00560
Bias uncertainty = 0.00839
Nuc Data uncert margin = 0.00050
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9978	1.0000
pu-sol-therm-010-009.i	0.9976	0.9165
pu-sol-therm-002-005.i	0.9976	0.9159
pu-sol-therm-011-165.i	0.9976	0.9141
pu-sol-therm-010-002.i	0.9976	0.9133
pu-sol-therm-002-004.i	0.9975	0.8914
pu-sol-therm-002-006.i	0.9975	0.8867
pu-sol-therm-002-007.i	0.9975	0.8776
pu-sol-therm-002-003.i	0.9974	0.8705
pu-sol-therm-001-002.i	0.9974	0.8450
pu-sol-therm-007-005.i	0.9973	0.8353
pu-sol-therm-007-010.i	0.9973	0.8290
pu-sol-therm-007-007.i	0.9973	0.8146

pu-sol-therm-002-002.i	0.9972	0.8033
pu-sol-therm-011-163.i	0.9972	0.7991
pu-sol-therm-010-003.i	0.9972	0.7905
pu-sol-therm-002-001.i	0.9972	0.7847
pu-sol-therm-011-164.i	0.9971	0.7657
pu-sol-therm-007-006.i	0.9971	0.7491
pu-sol-therm-007-009.i	0.9971	0.7479
pu-sol-therm-007-008.i	0.9970	0.7213
pu-sol-therm-011-162.i	0.9969	0.6819
pu-sol-therm-010-006.i	0.9968	0.6415
pu-sol-therm-011-161.i	0.9967	0.6205
pu-sol-therm-010-010.i	0.9967	0.6203
pu-sol-therm-010-011.i	0.9967	0.6171
pu-sol-therm-010-004.i	0.9966	0.5883
pu-sol-therm-003-006.i	0.9964	0.5194
pu-sol-therm-001-003.i	0.9964	0.5078
pu-sol-therm-010-005.i	0.9963	0.4832
pu-sol-therm-010-012.i	0.9961	0.4089
pu-sol-therm-001-004.i	0.9958	0.3094
pu-sol-therm-003-008.i	0.9958	0.3068
pu-sol-therm-003-005.i	0.9957	0.2843
pu-sol-therm-010-007.i	0.9957	0.2827
pu-sol-therm-003-004.i	0.9956	0.2545
pu-sol-therm-001-005.i	0.9955	0.2112
pu-sol-therm-003-003.i	0.9952	0.1350
pu-sol-therm-003-007.i	0.9952	0.1102

USL Summary Table

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_1	0.03713	0.00005	0.95775	0.04818
inp_case001_2	0.01401	0.00052	0.97964	0.02629
inp_case002_1	0.03713	0.00005	0.95775	0.04821
inp_case002_2	0.01398	0.00051	0.97969	0.02627
inp_case003_1	0.03713	0.00004	0.95778	0.04827
inp_case003_2	0.01397	0.00051	0.97970	0.02634
inp_case004_1	0.03713	0.00002	0.95782	0.04830
inp_case004_2	0.01403	0.00053	0.97958	0.02653
inp_case005_1	0.03713	0.00004	0.95776	0.04828
inp_case005_2	0.01399	0.00050	0.97972	0.02632

application	margin	(1-sigma)	USL	> USL
inp_case001	0.01429	0.00033	0.97986	0.02607

Benchmark population = 42
Population weight = 25.08752
Maximum similarity = 0.99926

Bias = 0.00604
Bias uncertainty = 0.00825
Nuc Data uncert margin = 0.00033
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9993	1.0000
pu-sol-therm-007-010.i	0.9989	0.9366

pu-sol-therm-010-002.i	0.9989	0.9293
pu-sol-therm-002-006.i	0.9988	0.9150
pu-sol-therm-010-009.i	0.9988	0.9078
pu-sol-therm-002-005.i	0.9988	0.9021
pu-sol-therm-007-005.i	0.9988	0.9006
pu-sol-therm-007-009.i	0.9988	0.9003
pu-sol-therm-001-002.i	0.9988	0.8996
pu-sol-therm-007-007.i	0.9988	0.8979
pu-sol-therm-002-004.i	0.9988	0.8964
pu-sol-therm-007-006.i	0.9987	0.8937
pu-sol-therm-007-008.i	0.9987	0.8931
pu-sol-therm-002-003.i	0.9987	0.8828
pu-sol-therm-002-007.i	0.9986	0.8710
pu-sol-therm-002-002.i	0.9983	0.7981
pu-sol-therm-002-001.i	0.9981	0.7626
pu-sol-therm-010-004.i	0.9980	0.7512
pu-sol-therm-010-003.i	0.9979	0.7230
pu-sol-therm-001-003.i	0.9978	0.7096
pu-sol-therm-010-010.i	0.9977	0.6914
pu-sol-therm-010-011.i	0.9975	0.6425
pu-sol-therm-010-006.i	0.9973	0.5993
pu-sol-therm-011-165.i	0.9973	0.5981
pu-sol-therm-001-004.i	0.9972	0.5869
pu-sol-therm-010-005.i	0.9970	0.5439
pu-sol-therm-001-005.i	0.9968	0.4980
pu-sol-therm-003-006.i	0.9967	0.4794
pu-sol-therm-011-164.i	0.9964	0.4194
pu-sol-therm-010-012.i	0.9964	0.4054
pu-sol-therm-011-163.i	0.9962	0.3773
pu-sol-therm-003-005.i	0.9961	0.3442
pu-sol-therm-010-007.i	0.9960	0.3418
pu-sol-therm-011-162.i	0.9959	0.3179
pu-sol-therm-011-161.i	0.9956	0.2605
pu-sol-therm-003-004.i	0.9954	0.2096
pu-sol-therm-003-003.i	0.9953	0.1809
pu-sol-therm-003-008.i	0.9949	0.1120
pu-sol-therm-003-002.i	0.9946	0.0492
pu-sol-therm-005-007.i	0.9946	0.0382
pu-sol-therm-004-011.i	0.9945	0.0168
pu-sol-therm-003-007.i	0.9944	0.0040

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case002	0.01427	0.00032	0.97989	0.02607

Benchmark population = 42
Population weight = 25.07923
Maximum similarity = 0.99934

Bias = 0.00602
Bias uncertainty = 0.00825
Nuc Data uncert margin = 0.00032
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9993	1.0000

pu-sol-therm-010-002.i	0.9990	0.9333
pu-sol-therm-007-010.i	0.9990	0.9300
pu-sol-therm-010-009.i	0.9989	0.9129
pu-sol-therm-002-006.i	0.9989	0.9060
pu-sol-therm-002-005.i	0.9989	0.8975
pu-sol-therm-007-005.i	0.9989	0.8961
pu-sol-therm-002-004.i	0.9988	0.8953
pu-sol-therm-001-002.i	0.9988	0.8938
pu-sol-therm-007-009.i	0.9988	0.8905
pu-sol-therm-007-007.i	0.9988	0.8902
pu-sol-therm-007-008.i	0.9988	0.8867
pu-sol-therm-007-006.i	0.9988	0.8859
pu-sol-therm-002-003.i	0.9988	0.8805
pu-sol-therm-002-007.i	0.9987	0.8612
pu-sol-therm-002-002.i	0.9984	0.8002
pu-sol-therm-002-001.i	0.9982	0.7666
pu-sol-therm-010-004.i	0.9982	0.7561
pu-sol-therm-010-003.i	0.9981	0.7325
pu-sol-therm-001-003.i	0.9979	0.6975
pu-sol-therm-010-010.i	0.9979	0.6959
pu-sol-therm-010-011.i	0.9977	0.6467
pu-sol-therm-010-006.i	0.9975	0.6083
pu-sol-therm-011-165.i	0.9974	0.5975
pu-sol-therm-001-004.i	0.9973	0.5693
pu-sol-therm-010-005.i	0.9972	0.5537
pu-sol-therm-003-006.i	0.9969	0.4807
pu-sol-therm-001-005.i	0.9969	0.4756
pu-sol-therm-011-164.i	0.9966	0.4266
pu-sol-therm-010-012.i	0.9966	0.4137
pu-sol-therm-011-163.i	0.9964	0.3873
pu-sol-therm-003-005.i	0.9962	0.3465
pu-sol-therm-010-007.i	0.9962	0.3463
pu-sol-therm-011-162.i	0.9961	0.3266
pu-sol-therm-011-161.i	0.9959	0.2697
pu-sol-therm-003-004.i	0.9956	0.2161
pu-sol-therm-003-003.i	0.9955	0.1882
pu-sol-therm-003-008.i	0.9951	0.1129
pu-sol-therm-003-002.i	0.9948	0.0541
pu-sol-therm-005-007.i	0.9948	0.0359
pu-sol-therm-004-011.i	0.9946	0.0108
pu-sol-therm-003-007.i	0.9946	0.0039

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case003	0.01426	0.00033	0.97989	0.02616

Benchmark population = 41
Population weight = 25.04880
Maximum similarity = 0.99957

Bias = 0.00600
Bias uncertainty = 0.00826
Nuc Data uncert margin = 0.00033
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight

pu-sol-therm-001-001.i	0.9996	1.0000
pu-sol-therm-010-002.i	0.9993	0.9397
pu-sol-therm-007-010.i	0.9992	0.9250
pu-sol-therm-010-009.i	0.9992	0.9170
pu-sol-therm-002-006.i	0.9991	0.9070
pu-sol-therm-002-005.i	0.9991	0.9034
pu-sol-therm-002-004.i	0.9991	0.9001
pu-sol-therm-007-005.i	0.9991	0.8936
pu-sol-therm-001-002.i	0.9991	0.8928
pu-sol-therm-007-007.i	0.9990	0.8847
pu-sol-therm-007-009.i	0.9990	0.8828
pu-sol-therm-002-003.i	0.9990	0.8825
pu-sol-therm-007-006.i	0.9990	0.8800
pu-sol-therm-007-008.i	0.9990	0.8785
pu-sol-therm-002-007.i	0.9989	0.8650
pu-sol-therm-002-002.i	0.9987	0.8029
pu-sol-therm-002-001.i	0.9985	0.7684
pu-sol-therm-010-004.i	0.9985	0.7604
pu-sol-therm-010-003.i	0.9984	0.7418
pu-sol-therm-010-010.i	0.9982	0.6991
pu-sol-therm-001-003.i	0.9982	0.6931
pu-sol-therm-010-011.i	0.9980	0.6526
pu-sol-therm-010-006.i	0.9978	0.6135
pu-sol-therm-011-165.i	0.9977	0.5932
pu-sol-therm-001-004.i	0.9975	0.5603
pu-sol-therm-010-005.i	0.9975	0.5600
pu-sol-therm-003-006.i	0.9972	0.4853
pu-sol-therm-001-005.i	0.9971	0.4655
pu-sol-therm-011-164.i	0.9969	0.4180
pu-sol-therm-010-012.i	0.9969	0.4173
pu-sol-therm-011-163.i	0.9967	0.3812
pu-sol-therm-010-007.i	0.9966	0.3504
pu-sol-therm-003-005.i	0.9966	0.3482
pu-sol-therm-011-162.i	0.9964	0.3173
pu-sol-therm-011-161.i	0.9962	0.2589
pu-sol-therm-003-004.i	0.9960	0.2179
pu-sol-therm-003-003.i	0.9958	0.1874
pu-sol-therm-003-008.i	0.9955	0.1055
pu-sol-therm-003-002.i	0.9952	0.0466
pu-sol-therm-005-007.i	0.9952	0.0409
pu-sol-therm-004-011.i	0.9950	0.0113

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004	0.01425	0.00036	0.97980	0.02632

Benchmark population = 41
Population weight = 25.03635
Maximum similarity = 0.99989

Bias = 0.00599
Bias uncertainty = 0.00826
Nuc Data uncert margin = 0.00036
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9999	1.0000

pu-sol-therm-010-002.i	0.9997	0.9473
pu-sol-therm-007-010.i	0.9996	0.9252
pu-sol-therm-010-009.i	0.9996	0.9248
pu-sol-therm-002-006.i	0.9995	0.9189
pu-sol-therm-002-005.i	0.9995	0.9122
pu-sol-therm-002-004.i	0.9995	0.9034
pu-sol-therm-001-002.i	0.9994	0.8962
pu-sol-therm-007-005.i	0.9994	0.8934
pu-sol-therm-007-007.i	0.9994	0.8877
pu-sol-therm-002-003.i	0.9994	0.8863
pu-sol-therm-002-007.i	0.9994	0.8824
pu-sol-therm-007-009.i	0.9994	0.8816
pu-sol-therm-007-006.i	0.9993	0.8774
pu-sol-therm-007-008.i	0.9993	0.8714
pu-sol-therm-002-002.i	0.9990	0.8028
pu-sol-therm-002-001.i	0.9988	0.7664
pu-sol-therm-010-004.i	0.9988	0.7638
pu-sol-therm-010-003.i	0.9988	0.7530
pu-sol-therm-010-010.i	0.9985	0.6993
pu-sol-therm-001-003.i	0.9985	0.6910
pu-sol-therm-010-011.i	0.9984	0.6582
pu-sol-therm-010-006.i	0.9982	0.6192
pu-sol-therm-011-165.i	0.9980	0.5893
pu-sol-therm-010-005.i	0.9979	0.5687
pu-sol-therm-001-004.i	0.9979	0.5583
pu-sol-therm-003-006.i	0.9976	0.4882
pu-sol-therm-001-005.i	0.9975	0.4691
pu-sol-therm-010-012.i	0.9973	0.4198
pu-sol-therm-011-164.i	0.9972	0.4063
pu-sol-therm-011-163.i	0.9971	0.3736
pu-sol-therm-010-007.i	0.9970	0.3509
pu-sol-therm-003-005.i	0.9969	0.3394
pu-sol-therm-011-162.i	0.9968	0.3069
pu-sol-therm-011-161.i	0.9965	0.2478
pu-sol-therm-003-004.i	0.9964	0.2158
pu-sol-therm-003-003.i	0.9962	0.1746
pu-sol-therm-003-008.i	0.9958	0.0921
pu-sol-therm-005-007.i	0.9955	0.0356
pu-sol-therm-003-002.i	0.9955	0.0254
pu-sol-therm-004-011.i	0.9954	0.0125

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case005	0.01428	0.00032	0.97989	0.02615

Benchmark population = 42
Population weight = 25.08590
Maximum similarity = 0.99933

Bias = 0.00603
Bias uncertainty = 0.00825
Nuc Data uncert margin = 0.00032
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9993	1.0000

pu-sol-therm-010-002.i	0.9990	0.9350
pu-sol-therm-007-010.i	0.9990	0.9299
pu-sol-therm-010-009.i	0.9989	0.9112
pu-sol-therm-002-006.i	0.9989	0.9052
pu-sol-therm-002-005.i	0.9989	0.8996
pu-sol-therm-007-005.i	0.9989	0.8993
pu-sol-therm-002-004.i	0.9988	0.8970
pu-sol-therm-001-002.i	0.9988	0.8962
pu-sol-therm-007-009.i	0.9988	0.8930
pu-sol-therm-007-007.i	0.9988	0.8904
pu-sol-therm-007-008.i	0.9988	0.8904
pu-sol-therm-007-006.i	0.9988	0.8889
pu-sol-therm-002-003.i	0.9988	0.8801
pu-sol-therm-002-007.i	0.9987	0.8619
pu-sol-therm-002-002.i	0.9984	0.7994
pu-sol-therm-002-001.i	0.9982	0.7665
pu-sol-therm-010-004.i	0.9982	0.7580
pu-sol-therm-010-003.i	0.9981	0.7304
pu-sol-therm-001-003.i	0.9979	0.7065
pu-sol-therm-010-010.i	0.9979	0.6969
pu-sol-therm-010-011.i	0.9977	0.6469
pu-sol-therm-010-006.i	0.9975	0.6055
pu-sol-therm-011-165.i	0.9974	0.5918
pu-sol-therm-001-004.i	0.9973	0.5785
pu-sol-therm-010-005.i	0.9972	0.5512
pu-sol-therm-001-005.i	0.9969	0.4844
pu-sol-therm-003-006.i	0.9969	0.4819
pu-sol-therm-011-164.i	0.9966	0.4181
pu-sol-therm-010-012.i	0.9965	0.4116
pu-sol-therm-011-163.i	0.9964	0.3774
pu-sol-therm-003-005.i	0.9962	0.3504
pu-sol-therm-010-007.i	0.9962	0.3476
pu-sol-therm-011-162.i	0.9961	0.3152
pu-sol-therm-011-161.i	0.9958	0.2575
pu-sol-therm-003-004.i	0.9956	0.2141
pu-sol-therm-003-003.i	0.9955	0.1903
pu-sol-therm-003-008.i	0.9951	0.1090
pu-sol-therm-003-002.i	0.9948	0.0557
pu-sol-therm-005-007.i	0.9948	0.0448
pu-sol-therm-004-011.i	0.9946	0.0143
pu-sol-therm-003-007.i	0.9946	0.0039

USL Summary Table

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001	0.01429	0.00033	0.97986	0.02607
inp_case002	0.01427	0.00032	0.97989	0.02607
inp_case003	0.01426	0.00033	0.97989	0.02616
inp_case004	0.01425	0.00036	0.97980	0.02632
inp_case005	0.01428	0.00032	0.97989	0.02615

Appendix G – Mixed Plutonium Model

```
c PU-MET-FAST-011-001
c  PU-SOL-THERM-001-001
c Reflected Pu sphere
c @@@ X= 80 100 120 140 160
1    110    -19.74       -1              imp:n=1
2    210    0.100149      1 -2           imp:n=1
c PU sol
10    310    1.0087e-1   -3              imp:n=1
20    410    8.6240e-2    3 -4           imp:n=1
30    510    9.9982e-2    4 -5           imp:n=1
c Inner void
40    0              5 2 -6          imp:n=1
c Outer Void
50    0              6              imp:n=0

1    so   4.1217
2    so   29.5217
c      75
3    s  X 0 0 14.5151
4    s  X 0 0 14.6396
5    s  X 0 0 44.6396
6    so  1000

m110   94239.80c 0.046982
       94240.80c 0.0025852
       94241.80c 0.00014915
       94242.80c 9.9432e-06
m210   1001.80c  0.066766
       8016.80c  0.033383
mt210  lwtr.20t
m310   94238.80c 1.108e-08
       94239.80c 0.00017472
       94240.80c 8.5486e-06
       94241.80c 5.5623e-07
       94242.80c 1.6345e-08
       7015.80c  3.165905e-06
       7014.80c  0.000852484095
       1001.80c  0.064883
       8016.80c  0.034948
mt310  lwtr.20t
m410   26058.80c 0.0001673811
       26057.80c 0.00125773245
       26054.80c 0.00346929975
       26056.80c 0.0544605867
       24053.80c 0.00165583428
       24052.80c 0.01460274692
       24050.80c 0.0007572466
       24054.80c 0.0004121722
       28058.80c 0.0052557409107
       28064.80c 7.14590968e-05
       28060.80c 0.0020245019893
       28062.80c 0.0002805943035
       28061.80c 8.80036997e-05
       25055.80c 0.0017363
m510   1001.80c  0.066655
       8016.80c  0.033327
```

```
mt510  lwtr.20t
kcode 100000 1.0 500 1000
ksrc 0 0 0  X 0 0
c kopts blocksize=5 ksental=mctal
c
c -------------------------------------------------------------------------
 ksen1 xs cell=1
c       rxn = +2 +4 -6 +16 102 103 104 105 106 107 -7 -1018
c       erg =
c          1.0000e-11 3.0000e-09 7.5000e-09 1.0000e-08 2.5300e-08 3.0000e-08
c          4.0000e-08 5.0000e-08 7.0000e-08 1.0000e-07 1.5000e-07 2.0000e-07
c          2.2500e-07 2.5000e-07 2.7500e-07 3.2500e-07 3.5000e-07 3.7500e-07
c          4.0000e-07 6.2500e-07 1.0000e-06 1.7700e-06 3.0000e-06 4.7500e-06
c          6.0000e-06 8.1000e-06 1.0000e-05 3.0000e-05 1.0000e-04 5.5000e-04
c          3.0000e-03 1.7000e-02 2.5000e-02 1.0000e-01 4.0000e-01 9.0000e-01
c          1.4000e+00 1.8500e+00 2.3540e+00 2.4790e+00 3.0000e+00 4.8000e+00
c          6.4340e+00 8.1873e+00 2.0000e+01
c -------------------------------------------------------------------------
c
c
c -------------------------------------------------------------------------
 ksen2 xs cell=10
c       rxn = +2 +4 -6 +16 102 103 104 105 106 107 -7 -1018
c       erg =
c          1.0000e-11 3.0000e-09 7.5000e-09 1.0000e-08 2.5300e-08 3.0000e-08
c          4.0000e-08 5.0000e-08 7.0000e-08 1.0000e-07 1.5000e-07 2.0000e-07
c          2.2500e-07 2.5000e-07 2.7500e-07 3.2500e-07 3.5000e-07 3.7500e-07
c          4.0000e-07 6.2500e-07 1.0000e-06 1.7700e-06 3.0000e-06 4.7500e-06
c          6.0000e-06 8.1000e-06 1.0000e-05 3.0000e-05 1.0000e-04 5.5000e-04
c          3.0000e-03 1.7000e-02 2.5000e-02 1.0000e-01 4.0000e-01 9.0000e-01
c          1.4000e+00 1.8500e+00 2.3540e+00 2.4790e+00 3.0000e+00 4.8000e+00
c          6.4340e+00 8.1873e+00 2.0000e+01
c -------------------------------------------------------------------------
print
```

Appendix H – Mixed Plutonium Model Benchmark Profile and USL Calculation Studies

Calculating upper subcritical limits ...

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_1	0.01462	0.00001	0.98034	0.02533

Benchmark population = 41
Population weight = 25.52889
Maximum similarity = 0.99474

Bias = 0.00640
Bias uncertainty = 0.00822
Nuc Data uncert margin = 0.00001
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-044-004.i	0.9947	1.0000
pu-met-fast-044-005.i	0.9936	0.9703
pu-met-fast-024-001.i	0.9932	0.9611
pu-met-fast-036-001.i	0.9929	0.9526
pu-met-fast-031-001.i	0.9920	0.9309
pu-met-fast-044-003.i	0.9912	0.9094
pu-met-fast-042-002.i	0.9896	0.8695
pu-met-fast-042-001.i	0.9886	0.8428
pu-met-fast-027-001.i	0.9881	0.8305
pu-met-fast-042-004.i	0.9881	0.8301
pu-met-fast-042-003.i	0.9879	0.8266
pu-met-fast-011-001.i	0.9869	0.8011
pu-met-fast-044-002.i	0.9845	0.7387
pu-met-fast-042-006.i	0.9835	0.7150
pu-met-fast-022-001.i	0.9835	0.7133
pu-met-fast-042-005.i	0.9828	0.6952
pu-met-fast-042-007.i	0.9820	0.6769
pu-met-fast-023-001.i	0.9814	0.6606
pu-met-fast-001-001.i	0.9811	0.6535
pu-met-fast-042-008.i	0.9809	0.6477
pu-met-fast-042-009.i	0.9799	0.6232
pu-met-fast-009-001.i	0.9794	0.6105
pu-met-fast-042-010.i	0.9792	0.6051
pu-met-fast-042-011.i	0.9782	0.5791
pu-met-fast-042-012.i	0.9779	0.5710
pu-met-fast-035-001.i	0.9770	0.5480
pu-met-fast-042-013.i	0.9767	0.5407
pu-met-fast-042-014.i	0.9766	0.5380
pu-met-fast-042-015.i	0.9764	0.5336
mix-met-fast-009-001.i	0.9762	0.5275
pu-met-fast-029-001.i	0.9753	0.5051
pu-met-fast-021-002.i	0.9751	0.5009
pu-met-fast-044-001.i	0.9745	0.4841
pu-met-fast-021-001.i	0.9744	0.4831
pu-met-fast-030-001.i	0.9743	0.4785
pu-met-fast-025-001.i	0.9730	0.4457

pu-met-fast-018-001.i	0.9701	0.3724
mix-met-fast-007-022.i	0.9634	0.2033
pu-met-fast-019-001.i	0.9588	0.0850
mix-met-fast-007-023.i	0.9575	0.0533
pu-met-fast-045-005.i	0.9561	0.0154

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_2	0.01398	0.00054	0.97962	0.02606

Benchmark population = 39
Population weight = 25.27474
Maximum similarity = 0.99760

Bias = 0.00559
Bias uncertainty = 0.00839
Nuc Data uncert margin = 0.00054
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9976	1.0000
pu-sol-therm-010-009.i	0.9974	0.9219
pu-sol-therm-011-165.i	0.9974	0.9177
pu-sol-therm-010-002.i	0.9973	0.9142
pu-sol-therm-002-005.i	0.9973	0.9120
pu-sol-therm-002-004.i	0.9973	0.8866
pu-sol-therm-002-006.i	0.9973	0.8852
pu-sol-therm-002-007.i	0.9972	0.8755
pu-sol-therm-002-003.i	0.9972	0.8693
pu-sol-therm-001-002.i	0.9971	0.8402
pu-sol-therm-007-005.i	0.9971	0.8318
pu-sol-therm-007-010.i	0.9971	0.8253
pu-sol-therm-011-163.i	0.9970	0.8145
pu-sol-therm-007-007.i	0.9970	0.8133
pu-sol-therm-002-002.i	0.9970	0.8027
pu-sol-therm-010-003.i	0.9970	0.7971
pu-sol-therm-002-001.i	0.9970	0.7854
pu-sol-therm-011-164.i	0.9969	0.7768
pu-sol-therm-007-009.i	0.9968	0.7435
pu-sol-therm-007-006.i	0.9968	0.7421
pu-sol-therm-007-008.i	0.9967	0.7146
pu-sol-therm-011-162.i	0.9967	0.6959
pu-sol-therm-010-006.i	0.9965	0.6487
pu-sol-therm-011-161.i	0.9965	0.6368
pu-sol-therm-010-010.i	0.9965	0.6201
pu-sol-therm-010-011.i	0.9965	0.6194
pu-sol-therm-010-004.i	0.9964	0.5874
pu-sol-therm-003-006.i	0.9962	0.5193
pu-sol-therm-001-003.i	0.9961	0.4944
pu-sol-therm-010-005.i	0.9961	0.4902
pu-sol-therm-010-012.i	0.9959	0.4157
pu-sol-therm-003-008.i	0.9955	0.3134
pu-sol-therm-001-004.i	0.9955	0.2957
pu-sol-therm-010-007.i	0.9955	0.2829
pu-sol-therm-003-005.i	0.9954	0.2800
pu-sol-therm-003-004.i	0.9954	0.2610
pu-sol-therm-001-005.i	0.9952	0.1992
pu-sol-therm-003-003.i	0.9950	0.1351

pu-sol-therm-003-007.i 0.9949 0.1104

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case002_1	0.01511	0.00001	0.97985	0.02642

Benchmark population = 39
Population weight = 26.03231
Maximum similarity = 0.98971

Bias = 0.00667
Bias uncertainty = 0.00844
Nuc Data uncert margin = 0.00001
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-042-002.i	0.9897	1.0000
pu-met-fast-042-003.i	0.9892	0.9790
pu-met-fast-044-005.i	0.9886	0.9578
pu-met-fast-027-001.i	0.9881	0.9373
pu-met-fast-044-004.i	0.9880	0.9338
pu-met-fast-042-001.i	0.9880	0.9330
pu-met-fast-042-004.i	0.9879	0.9324
pu-met-fast-011-001.i	0.9879	0.9308
pu-met-fast-042-005.i	0.9879	0.9290
pu-met-fast-031-001.i	0.9870	0.8950
pu-met-fast-042-006.i	0.9867	0.8851
pu-met-fast-042-007.i	0.9858	0.8510
pu-met-fast-042-008.i	0.9852	0.8289
pu-met-fast-042-009.i	0.9847	0.8080
pu-met-fast-042-011.i	0.9846	0.8031
pu-met-fast-042-010.i	0.9846	0.8025
pu-met-fast-036-001.i	0.9844	0.7980
pu-met-fast-044-003.i	0.9838	0.7739
pu-met-fast-044-002.i	0.9838	0.7734
pu-met-fast-042-014.i	0.9835	0.7629
pu-met-fast-042-012.i	0.9834	0.7603
pu-met-fast-042-013.i	0.9834	0.7573
pu-met-fast-042-015.i	0.9830	0.7441
pu-met-fast-021-002.i	0.9805	0.6460
pu-met-fast-023-001.i	0.9804	0.6419
pu-met-fast-024-001.i	0.9802	0.6364
pu-met-fast-009-001.i	0.9791	0.5955
pu-met-fast-030-001.i	0.9770	0.5146
pu-met-fast-021-001.i	0.9757	0.4648
mix-met-fast-009-001.i	0.9747	0.4253
pu-met-fast-035-001.i	0.9746	0.4228
pu-met-fast-022-001.i	0.9727	0.3510
pu-met-fast-025-001.i	0.9726	0.3439
pu-met-fast-001-001.i	0.9726	0.3437
pu-met-fast-029-001.i	0.9703	0.2562
pu-met-fast-018-001.i	0.9698	0.2392
pu-met-fast-044-001.i	0.9692	0.2151
mix-met-fast-007-022.i	0.9671	0.1344
pu-met-fast-019-001.i	0.9642	0.0248

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case002_2	0.01397	0.00051	0.97970	0.02658

Benchmark population = 39
Population weight = 25.24782
Maximum similarity = 0.99781

Bias = 0.00558
Bias uncertainty = 0.00839
Nuc Data uncert margin = 0.00051
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9978	1.0000
pu-sol-therm-011-165.i	0.9976	0.9182
pu-sol-therm-010-009.i	0.9976	0.9181
pu-sol-therm-002-005.i	0.9976	0.9158
pu-sol-therm-010-002.i	0.9976	0.9158
pu-sol-therm-002-004.i	0.9975	0.8928
pu-sol-therm-002-006.i	0.9975	0.8822
pu-sol-therm-002-007.i	0.9974	0.8723
pu-sol-therm-002-003.i	0.9974	0.8692
pu-sol-therm-001-002.i	0.9973	0.8406
pu-sol-therm-007-005.i	0.9973	0.8314
pu-sol-therm-007-010.i	0.9973	0.8222
pu-sol-therm-011-163.i	0.9973	0.8096
pu-sol-therm-007-007.i	0.9972	0.8066
pu-sol-therm-002-002.i	0.9972	0.8062
pu-sol-therm-010-003.i	0.9972	0.7980
pu-sol-therm-002-001.i	0.9972	0.7879
pu-sol-therm-011-164.i	0.9971	0.7731
pu-sol-therm-007-006.i	0.9971	0.7414
pu-sol-therm-007-009.i	0.9970	0.7371
pu-sol-therm-007-008.i	0.9970	0.7116
pu-sol-therm-011-162.i	0.9969	0.6898
pu-sol-therm-010-006.i	0.9968	0.6462
pu-sol-therm-011-161.i	0.9967	0.6273
pu-sol-therm-010-010.i	0.9967	0.6219
pu-sol-therm-010-011.i	0.9967	0.6197
pu-sol-therm-010-004.i	0.9966	0.5885
pu-sol-therm-003-006.i	0.9964	0.5235
pu-sol-therm-001-003.i	0.9963	0.4975
pu-sol-therm-010-005.i	0.9963	0.4863
pu-sol-therm-010-012.i	0.9961	0.4137
pu-sol-therm-003-008.i	0.9958	0.3101
pu-sol-therm-001-004.i	0.9957	0.2936
pu-sol-therm-003-005.i	0.9957	0.2882
pu-sol-therm-010-007.i	0.9957	0.2864
pu-sol-therm-003-004.i	0.9956	0.2600
pu-sol-therm-001-005.i	0.9954	0.1920
pu-sol-therm-003-003.i	0.9953	0.1400
pu-sol-therm-003-007.i	0.9952	0.1131

application	margin	(1-sigma) USL	> USL
inp_case003_1	0.01491	0.00002	0.98005	0.02572

Benchmark population = 39
Population weight = 25.67279
Maximum similarity = 0.99329

Bias = 0.00648
Bias uncertainty = 0.00843
Nuc Data uncert margin = 0.00002
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-044-004.i	0.9933	1.0000
pu-met-fast-044-005.i	0.9931	0.9950
pu-met-fast-042-002.i	0.9924	0.9712
pu-met-fast-042-001.i	0.9914	0.9361
pu-met-fast-031-001.i	0.9913	0.9325
pu-met-fast-042-003.i	0.9912	0.9303
pu-met-fast-027-001.i	0.9912	0.9284
pu-met-fast-011-001.i	0.9909	0.9195
pu-met-fast-042-004.i	0.9905	0.9055
pu-met-fast-036-001.i	0.9901	0.8911
pu-met-fast-044-003.i	0.9891	0.8552
pu-met-fast-042-005.i	0.9883	0.8304
pu-met-fast-042-006.i	0.9879	0.8147
pu-met-fast-024-001.i	0.9876	0.8072
pu-met-fast-042-007.i	0.9865	0.7690
pu-met-fast-044-002.i	0.9862	0.7581
pu-met-fast-042-008.i	0.9858	0.7450
pu-met-fast-042-009.i	0.9850	0.7185
pu-met-fast-042-010.i	0.9847	0.7062
pu-met-fast-042-011.i	0.9844	0.6959
pu-met-fast-042-012.i	0.9834	0.6627
pu-met-fast-042-014.i	0.9831	0.6504
pu-met-fast-042-013.i	0.9829	0.6453
pu-met-fast-042-015.i	0.9826	0.6354
pu-met-fast-023-001.i	0.9825	0.6330
pu-met-fast-009-001.i	0.9814	0.5939
pu-met-fast-021-002.i	0.9806	0.5675
pu-met-fast-022-001.i	0.9787	0.5007
pu-met-fast-001-001.i	0.9776	0.4631
pu-met-fast-030-001.i	0.9774	0.4585
pu-met-fast-021-001.i	0.9772	0.4489
pu-met-fast-035-001.i	0.9771	0.4473
mix-met-fast-009-001.i	0.9769	0.4386
pu-met-fast-025-001.i	0.9744	0.3550
pu-met-fast-029-001.i	0.9738	0.3349
pu-met-fast-044-001.i	0.9735	0.3235
pu-met-fast-018-001.i	0.9722	0.2794
mix-met-fast-007-022.i	0.9674	0.1150
pu-met-fast-019-001.i	0.9643	0.0099

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case003_2	0.01397	0.00054	0.97962	0.02614

Benchmark population = 39
Population weight = 25.24182
Maximum similarity = 0.99765

Bias = 0.00557
Bias uncertainty = 0.00840
Nuc Data uncert margin = 0.00054
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9977	1.0000
pu-sol-therm-011-165.i	0.9974	0.9245
pu-sol-therm-010-009.i	0.9974	0.9195
pu-sol-therm-002-005.i	0.9974	0.9182
pu-sol-therm-010-002.i	0.9974	0.9096
pu-sol-therm-002-006.i	0.9973	0.8947
pu-sol-therm-002-004.i	0.9973	0.8930
pu-sol-therm-002-007.i	0.9973	0.8811
pu-sol-therm-002-003.i	0.9973	0.8774
pu-sol-therm-001-002.i	0.9972	0.8370
pu-sol-therm-007-010.i	0.9971	0.8256
pu-sol-therm-007-005.i	0.9971	0.8245
pu-sol-therm-011-163.i	0.9971	0.8117
pu-sol-therm-002-002.i	0.9971	0.8092
pu-sol-therm-007-007.i	0.9971	0.8092
pu-sol-therm-010-003.i	0.9970	0.7958
pu-sol-therm-002-001.i	0.9970	0.7882
pu-sol-therm-011-164.i	0.9970	0.7764
pu-sol-therm-007-009.i	0.9969	0.7381
pu-sol-therm-007-006.i	0.9969	0.7380
pu-sol-therm-007-008.i	0.9968	0.7056
pu-sol-therm-011-162.i	0.9968	0.6975
pu-sol-therm-010-006.i	0.9966	0.6475
pu-sol-therm-011-161.i	0.9966	0.6363
pu-sol-therm-010-010.i	0.9965	0.6220
pu-sol-therm-010-011.i	0.9965	0.6213
pu-sol-therm-010-004.i	0.9964	0.5867
pu-sol-therm-003-006.i	0.9962	0.5227
pu-sol-therm-010-005.i	0.9961	0.4881
pu-sol-therm-001-003.i	0.9961	0.4824
pu-sol-therm-010-012.i	0.9959	0.4142
pu-sol-therm-003-008.i	0.9956	0.3139
pu-sol-therm-010-007.i	0.9955	0.2838
pu-sol-therm-001-004.i	0.9955	0.2825
pu-sol-therm-003-005.i	0.9955	0.2808
pu-sol-therm-003-004.i	0.9954	0.2589
pu-sol-therm-001-005.i	0.9952	0.1862
pu-sol-therm-003-003.i	0.9951	0.1302
pu-sol-therm-003-007.i	0.9950	0.1095

application	margin	(1-sigma)	USL	> USL
inp_case004_1	0.01489	0.00001	0.98009	0.02603

Benchmark population = 40
Population weight = 25.58940
Maximum similarity = 0.99414

Bias = 0.00641
Bias uncertainty = 0.00848
Nuc Data uncert margin = 0.00001

Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-044-004.i	0.9941	1.0000
pu-met-fast-044-005.i	0.9935	0.9794
pu-met-fast-042-002.i	0.9932	0.9718
pu-met-fast-031-001.i	0.9923	0.9428
pu-met-fast-042-001.i	0.9920	0.9343
pu-met-fast-042-003.i	0.9917	0.9263
pu-met-fast-027-001.i	0.9915	0.9206
pu-met-fast-042-004.i	0.9909	0.9007
pu-met-fast-036-001.i	0.9902	0.8797
pu-met-fast-011-001.i	0.9901	0.8765
pu-met-fast-044-003.i	0.9894	0.8556
pu-met-fast-042-005.i	0.9882	0.8177
pu-met-fast-024-001.i	0.9879	0.8088
pu-met-fast-042-006.i	0.9876	0.7993
pu-met-fast-042-007.i	0.9868	0.7748
pu-met-fast-044-002.i	0.9860	0.7503
pu-met-fast-042-008.i	0.9856	0.7399
pu-met-fast-042-009.i	0.9848	0.7125
pu-met-fast-042-010.i	0.9843	0.6993
pu-met-fast-042-011.i	0.9838	0.6820
pu-met-fast-042-012.i	0.9829	0.6554
pu-met-fast-023-001.i	0.9824	0.6408
pu-met-fast-042-013.i	0.9824	0.6395
pu-met-fast-042-014.i	0.9823	0.6375
pu-met-fast-042-015.i	0.9819	0.6242
pu-met-fast-009-001.i	0.9798	0.5616
pu-met-fast-021-002.i	0.9793	0.5456
pu-met-fast-022-001.i	0.9782	0.5116
pu-met-fast-035-001.i	0.9767	0.4656
pu-met-fast-001-001.i	0.9764	0.4583
pu-met-fast-030-001.i	0.9764	0.4570
pu-met-fast-021-001.i	0.9759	0.4412
mix-met-fast-009-001.i	0.9759	0.4410
pu-met-fast-044-001.i	0.9737	0.3745
pu-met-fast-025-001.i	0.9733	0.3609
pu-met-fast-029-001.i	0.9719	0.3191
pu-met-fast-018-001.i	0.9712	0.2967
mix-met-fast-007-022.i	0.9665	0.1528
pu-met-fast-019-001.i	0.9624	0.0288
mix-met-fast-007-023.i	0.9616	0.0051

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004_2	0.01393	0.00054	0.97967	0.02645

Benchmark population = 39
Population weight = 25.25535
Maximum similarity = 0.99757

Bias = 0.00552
Bias uncertainty = 0.00841
Nuc Data uncert margin = 0.00054
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9976	1.0000
pu-sol-therm-011-165.i	0.9974	0.9362
pu-sol-therm-010-009.i	0.9974	0.9265
pu-sol-therm-002-005.i	0.9973	0.9170
pu-sol-therm-010-002.i	0.9973	0.9137
pu-sol-therm-002-004.i	0.9973	0.8940
pu-sol-therm-002-006.i	0.9972	0.8825
pu-sol-therm-002-003.i	0.9972	0.8776
pu-sol-therm-002-007.i	0.9972	0.8689
pu-sol-therm-011-163.i	0.9971	0.8380
pu-sol-therm-001-002.i	0.9971	0.8248
pu-sol-therm-002-002.i	0.9970	0.8150
pu-sol-therm-007-005.i	0.9970	0.8132
pu-sol-therm-010-003.i	0.9970	0.8105
pu-sol-therm-007-010.i	0.9970	0.8096
pu-sol-therm-011-164.i	0.9970	0.7976
pu-sol-therm-002-001.i	0.9970	0.7970
pu-sol-therm-007-007.i	0.9970	0.7926
pu-sol-therm-011-162.i	0.9968	0.7195
pu-sol-therm-007-006.i	0.9968	0.7191
pu-sol-therm-007-009.i	0.9968	0.7177
pu-sol-therm-007-008.i	0.9967	0.6881
pu-sol-therm-010-006.i	0.9966	0.6616
pu-sol-therm-011-161.i	0.9966	0.6585
pu-sol-therm-010-011.i	0.9965	0.6293
pu-sol-therm-010-010.i	0.9965	0.6279
pu-sol-therm-010-004.i	0.9964	0.5884
pu-sol-therm-003-006.i	0.9962	0.5302
pu-sol-therm-010-005.i	0.9961	0.4980
pu-sol-therm-001-003.i	0.9960	0.4564
pu-sol-therm-010-012.i	0.9959	0.4263
pu-sol-therm-003-008.i	0.9956	0.3252
pu-sol-therm-010-007.i	0.9955	0.2901
pu-sol-therm-003-005.i	0.9955	0.2870
pu-sol-therm-003-004.i	0.9955	0.2713
pu-sol-therm-001-004.i	0.9954	0.2450
pu-sol-therm-001-005.i	0.9951	0.1422

application	margin	(1-sigma)	USL	> USL
inp_case005_1	0.01464	0.00001	0.98033	0.02570

Benchmark population = 42
Population weight = 25.61382
Maximum similarity = 0.99390

Bias = 0.00639
Bias uncertainty = 0.00825
Nuc Data uncert margin = 0.00001
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-met-fast-044-004.i	0.9939	1.0000
pu-met-fast-044-005.i	0.9921	0.9599
pu-met-fast-031-001.i	0.9905	0.9255
pu-met-fast-024-001.i	0.9900	0.9145

pu-met-fast-036-001.i	0.9897	0.9086
pu-met-fast-042-001.i	0.9894	0.9024
pu-met-fast-044-003.i	0.9892	0.8987
pu-met-fast-042-002.i	0.9890	0.8936
pu-met-fast-027-001.i	0.9889	0.8908
pu-met-fast-011-001.i	0.9873	0.8560
pu-met-fast-042-003.i	0.9864	0.8373
pu-met-fast-042-004.i	0.9862	0.8337
pu-met-fast-044-002.i	0.9808	0.7164
pu-met-fast-042-006.i	0.9808	0.7158
pu-met-fast-042-005.i	0.9804	0.7059
pu-met-fast-042-007.i	0.9790	0.6772
pu-met-fast-042-008.i	0.9779	0.6524
pu-met-fast-022-001.i	0.9769	0.6313
pu-met-fast-042-009.i	0.9766	0.6232
pu-met-fast-023-001.i	0.9765	0.6223
pu-met-fast-042-010.i	0.9759	0.6097
pu-met-fast-009-001.i	0.9752	0.5941
pu-met-fast-042-011.i	0.9750	0.5883
pu-met-fast-042-012.i	0.9743	0.5736
pu-met-fast-001-001.i	0.9738	0.5642
pu-met-fast-042-014.i	0.9732	0.5503
pu-met-fast-042-013.i	0.9732	0.5502
pu-met-fast-042-015.i	0.9728	0.5420
pu-met-fast-021-002.i	0.9721	0.5258
pu-met-fast-044-001.i	0.9720	0.5244
pu-met-fast-035-001.i	0.9708	0.4975
pu-met-fast-021-001.i	0.9699	0.4792
mix-met-fast-009-001.i	0.9693	0.4661
pu-met-fast-030-001.i	0.9680	0.4379
pu-met-fast-029-001.i	0.9674	0.4246
pu-met-fast-018-001.i	0.9674	0.4240
pu-met-fast-025-001.i	0.9664	0.4032
mix-met-fast-007-022.i	0.9587	0.2354
pu-met-fast-019-001.i	0.9559	0.1749
pu-met-fast-045-005.i	0.9537	0.1270
mix-met-fast-007-023.i	0.9517	0.0826
pu-met-fast-038-001.i	0.9513	0.0735

application	margin	(1-sigma)	USL	> USL
inp_case005_2	0.01394	0.00052	0.97972	0.02630

Benchmark population = 39
Population weight = 25.26477
Maximum similarity = 0.99780

Bias = 0.00554
Bias uncertainty = 0.00840
Nuc Data uncert margin = 0.00052
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9978	1.0000
pu-sol-therm-011-165.i	0.9976	0.9290
pu-sol-therm-010-009.i	0.9976	0.9222
pu-sol-therm-002-005.i	0.9975	0.9131
pu-sol-therm-010-002.i	0.9975	0.9112

pu-sol-therm-002-004.i	0.9975	0.8918
pu-sol-therm-002-006.i	0.9974	0.8740
pu-sol-therm-002-003.i	0.9974	0.8737
pu-sol-therm-002-007.i	0.9974	0.8593
pu-sol-therm-011-163.i	0.9973	0.8308
pu-sol-therm-001-002.i	0.9973	0.8245
pu-sol-therm-007-005.i	0.9973	0.8159
pu-sol-therm-002-002.i	0.9973	0.8127
pu-sol-therm-007-010.i	0.9972	0.8086
pu-sol-therm-010-003.i	0.9972	0.8022
pu-sol-therm-002-001.i	0.9972	0.7993
pu-sol-therm-011-164.i	0.9972	0.7946
pu-sol-therm-007-007.i	0.9972	0.7928
pu-sol-therm-007-006.i	0.9970	0.7243
pu-sol-therm-007-009.i	0.9970	0.7234
pu-sol-therm-011-162.i	0.9970	0.7123
pu-sol-therm-007-008.i	0.9969	0.6974
pu-sol-therm-010-006.i	0.9968	0.6568
pu-sol-therm-011-161.i	0.9968	0.6512
pu-sol-therm-010-010.i	0.9967	0.6311
pu-sol-therm-010-011.i	0.9967	0.6277
pu-sol-therm-010-004.i	0.9966	0.5925
pu-sol-therm-003-006.i	0.9964	0.5299
pu-sol-therm-010-005.i	0.9963	0.4925
pu-sol-therm-001-003.i	0.9963	0.4677
pu-sol-therm-010-012.i	0.9961	0.4246
pu-sol-therm-003-008.i	0.9958	0.3257
pu-sol-therm-003-005.i	0.9958	0.2969
pu-sol-therm-010-007.i	0.9957	0.2928
pu-sol-therm-003-004.i	0.9957	0.2713
pu-sol-therm-001-004.i	0.9956	0.2586
pu-sol-therm-001-005.i	0.9953	0.1528
pu-sol-therm-003-003.i	0.9953	0.1522
pu-sol-therm-003-007.i	0.9953	0.1274

USL Summary Table

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001_1	0.01462	0.00001	0.98034	0.02533
inp_case001_2	0.01398	0.00054	0.97962	0.02606
inp_case002_1	0.01511	0.00001	0.97985	0.02642
inp_case002_2	0.01397	0.00051	0.97970	0.02658
inp_case003_1	0.01491	0.00002	0.98005	0.02572
inp_case003_2	0.01397	0.00054	0.97962	0.02614
inp_case004_1	0.01489	0.00001	0.98009	0.02603
inp_case004_2	0.01393	0.00054	0.97967	0.02645
inp_case005_1	0.01464	0.00001	0.98033	0.02570
inp_case005_2	0.01394	0.00052	0.97972	0.02630

Calculating upper subcritical limits ...

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001	0.01422	0.00038	0.97979	0.02589

Benchmark population = 41

Population weight = 25.03807
Maximum similarity = 0.99990

Bias = 0.00595
Bias uncertainty = 0.00827
Nuc Data uncert margin = 0.00038
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9999	1.0000
pu-sol-therm-010-002.i	0.9997	0.9628
pu-sol-therm-010-009.i	0.9996	0.9351
pu-sol-therm-002-006.i	0.9996	0.9193
pu-sol-therm-002-005.i	0.9996	0.9172
pu-sol-therm-007-010.i	0.9995	0.9145
pu-sol-therm-002-004.i	0.9995	0.9093
pu-sol-therm-001-002.i	0.9995	0.8923
pu-sol-therm-007-005.i	0.9994	0.8894
pu-sol-therm-002-003.i	0.9994	0.8851
pu-sol-therm-002-007.i	0.9994	0.8844
pu-sol-therm-007-007.i	0.9994	0.8775
pu-sol-therm-007-006.i	0.9993	0.8654
pu-sol-therm-007-009.i	0.9993	0.8639
pu-sol-therm-007-008.i	0.9993	0.8509
pu-sol-therm-002-002.i	0.9991	0.8085
pu-sol-therm-010-003.i	0.9990	0.7777
pu-sol-therm-010-004.i	0.9990	0.7737
pu-sol-therm-002-001.i	0.9990	0.7713
pu-sol-therm-010-010.i	0.9987	0.7064
pu-sol-therm-001-003.i	0.9986	0.6785
pu-sol-therm-010-011.i	0.9985	0.6706
pu-sol-therm-010-006.i	0.9984	0.6344
pu-sol-therm-010-005.i	0.9982	0.5870
pu-sol-therm-011-165.i	0.9982	0.5790
pu-sol-therm-001-004.i	0.9980	0.5400
pu-sol-therm-003-006.i	0.9978	0.4989
pu-sol-therm-001-005.i	0.9976	0.4503
pu-sol-therm-010-012.i	0.9975	0.4342
pu-sol-therm-011-164.i	0.9974	0.3974
pu-sol-therm-011-163.i	0.9973	0.3740
pu-sol-therm-010-007.i	0.9973	0.3628
pu-sol-therm-003-005.i	0.9972	0.3436
pu-sol-therm-011-162.i	0.9970	0.3007
pu-sol-therm-011-161.i	0.9967	0.2395
pu-sol-therm-003-004.i	0.9967	0.2255
pu-sol-therm-003-003.i	0.9965	0.1772
pu-sol-therm-003-008.i	0.9961	0.0798
pu-sol-therm-005-007.i	0.9959	0.0412
pu-sol-therm-003-002.i	0.9958	0.0116
pu-sol-therm-004-011.i	0.9958	0.0074

application	margin	(1-sigma)	USL	> USL
inp_case002	0.01422	0.00038	0.97980	0.02647

Benchmark population = 41
Population weight = 25.03233
Maximum similarity = 0.99993

Bias = 0.00595
Bias uncertainty = 0.00827
Nuc Data uncert margin = 0.00038
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9999	1.0000
pu-sol-therm-010-002.i	0.9998	0.9639
pu-sol-therm-010-009.i	0.9997	0.9344
pu-sol-therm-002-005.i	0.9996	0.9200
pu-sol-therm-002-006.i	0.9996	0.9163
pu-sol-therm-002-004.i	0.9996	0.9130
pu-sol-therm-007-010.i	0.9996	0.9112
pu-sol-therm-001-002.i	0.9995	0.8911
pu-sol-therm-007-005.i	0.9995	0.8881
pu-sol-therm-002-003.i	0.9995	0.8863
pu-sol-therm-002-007.i	0.9994	0.8819
pu-sol-therm-007-007.i	0.9994	0.8726
pu-sol-therm-007-006.i	0.9994	0.8643
pu-sol-therm-007-009.i	0.9994	0.8611
pu-sol-therm-007-008.i	0.9993	0.8503
pu-sol-therm-002-002.i	0.9991	0.8108
pu-sol-therm-010-003.i	0.9990	0.7786
pu-sol-therm-010-004.i	0.9990	0.7782
pu-sol-therm-002-001.i	0.9990	0.7739
pu-sol-therm-010-010.i	0.9987	0.7103
pu-sol-therm-001-003.i	0.9986	0.6799
pu-sol-therm-010-011.i	0.9986	0.6731
pu-sol-therm-010-006.i	0.9984	0.6344
pu-sol-therm-010-005.i	0.9982	0.5869
pu-sol-therm-011-165.i	0.9982	0.5754
pu-sol-therm-001-004.i	0.9980	0.5385
pu-sol-therm-003-006.i	0.9979	0.5020
pu-sol-therm-001-005.i	0.9976	0.4453
pu-sol-therm-010-012.i	0.9976	0.4344
pu-sol-therm-011-164.i	0.9974	0.3918
pu-sol-therm-010-007.i	0.9973	0.3665
pu-sol-therm-011-163.i	0.9973	0.3661
pu-sol-therm-003-005.i	0.9973	0.3504
pu-sol-therm-011-162.i	0.9970	0.2921
pu-sol-therm-011-161.i	0.9968	0.2294
pu-sol-therm-003-004.i	0.9967	0.2251
pu-sol-therm-003-003.i	0.9966	0.1819
pu-sol-therm-003-008.i	0.9961	0.0756
pu-sol-therm-005-007.i	0.9960	0.0513
pu-sol-therm-003-002.i	0.9959	0.0156
pu-sol-therm-004-011.i	0.9959	0.0104

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case003	0.01422	0.00039	0.97977	0.02599

Benchmark population = 41
Population weight = 25.02508
Maximum similarity = 0.99988

Bias = 0.00594
Bias uncertainty = 0.00828
Nuc Data uncert margin = 0.00039
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9999	1.0000
pu-sol-therm-010-002.i	0.9997	0.9598
pu-sol-therm-010-009.i	0.9996	0.9333
pu-sol-therm-002-006.i	0.9996	0.9256
pu-sol-therm-002-005.i	0.9996	0.9217
pu-sol-therm-007-010.i	0.9995	0.9157
pu-sol-therm-002-004.i	0.9995	0.9135
pu-sol-therm-001-002.i	0.9994	0.8919
pu-sol-therm-002-003.i	0.9994	0.8902
pu-sol-therm-002-007.i	0.9994	0.8893
pu-sol-therm-007-005.i	0.9994	0.8864
pu-sol-therm-007-007.i	0.9994	0.8763
pu-sol-therm-007-006.i	0.9993	0.8641
pu-sol-therm-007-009.i	0.9993	0.8628
pu-sol-therm-007-008.i	0.9992	0.8476
pu-sol-therm-002-002.i	0.9991	0.8121
pu-sol-therm-010-003.i	0.9989	0.7758
pu-sol-therm-010-004.i	0.9989	0.7725
pu-sol-therm-002-001.i	0.9989	0.7722
pu-sol-therm-010-010.i	0.9987	0.7071
pu-sol-therm-001-003.i	0.9985	0.6745
pu-sol-therm-010-011.i	0.9985	0.6714
pu-sol-therm-010-006.i	0.9984	0.6329
pu-sol-therm-010-005.i	0.9982	0.5848
pu-sol-therm-011-165.i	0.9981	0.5830
pu-sol-therm-001-004.i	0.9980	0.5364
pu-sol-therm-003-006.i	0.9978	0.5005
pu-sol-therm-001-005.i	0.9976	0.4472
pu-sol-therm-010-012.i	0.9975	0.4321
pu-sol-therm-011-164.i	0.9974	0.3959
pu-sol-therm-011-163.i	0.9973	0.3705
pu-sol-therm-010-007.i	0.9972	0.3627
pu-sol-therm-003-005.i	0.9972	0.3438
pu-sol-therm-011-162.i	0.9970	0.2998
pu-sol-therm-011-161.i	0.9967	0.2375
pu-sol-therm-003-004.i	0.9967	0.2231
pu-sol-therm-003-003.i	0.9964	0.1731
pu-sol-therm-003-008.i	0.9961	0.0788
pu-sol-therm-005-007.i	0.9959	0.0403
pu-sol-therm-003-002.i	0.9958	0.0094
pu-sol-therm-004-011.i	0.9958	0.0094

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case004	0.01420	0.00038	0.97980	0.02631

Benchmark population = 41
Population weight = 25.04493
Maximum similarity = 0.99994

Bias = 0.00592

Bias uncertainty = 0.00828
Nuc Data uncert margin = 0.00038
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9999	1.0000
pu-sol-therm-010-002.i	0.9998	0.9618
pu-sol-therm-010-009.i	0.9997	0.9398
pu-sol-therm-002-005.i	0.9996	0.9212
pu-sol-therm-002-006.i	0.9996	0.9180
pu-sol-therm-002-004.i	0.9996	0.9145
pu-sol-therm-007-010.i	0.9996	0.9054
pu-sol-therm-002-003.i	0.9995	0.8932
pu-sol-therm-001-002.i	0.9995	0.8812
pu-sol-therm-002-007.i	0.9994	0.8795
pu-sol-therm-007-005.i	0.9994	0.8760
pu-sol-therm-007-007.i	0.9994	0.8643
pu-sol-therm-007-006.i	0.9993	0.8515
pu-sol-therm-007-009.i	0.9993	0.8496
pu-sol-therm-007-008.i	0.9993	0.8364
pu-sol-therm-002-002.i	0.9992	0.8175
pu-sol-therm-010-003.i	0.9991	0.7859
pu-sol-therm-002-001.i	0.9990	0.7801
pu-sol-therm-010-004.i	0.9990	0.7801
pu-sol-therm-010-010.i	0.9988	0.7152
pu-sol-therm-010-011.i	0.9986	0.6801
pu-sol-therm-001-003.i	0.9985	0.6538
pu-sol-therm-010-006.i	0.9985	0.6445
pu-sol-therm-010-005.i	0.9983	0.5959
pu-sol-therm-011-165.i	0.9983	0.5868
pu-sol-therm-001-004.i	0.9979	0.5080
pu-sol-therm-003-006.i	0.9979	0.5069
pu-sol-therm-010-012.i	0.9977	0.4430
pu-sol-therm-001-005.i	0.9976	0.4143
pu-sol-therm-011-164.i	0.9975	0.4059
pu-sol-therm-011-163.i	0.9974	0.3817
pu-sol-therm-010-007.i	0.9974	0.3707
pu-sol-therm-003-005.i	0.9973	0.3510
pu-sol-therm-011-162.i	0.9971	0.3101
pu-sol-therm-011-161.i	0.9969	0.2483
pu-sol-therm-003-004.i	0.9968	0.2330
pu-sol-therm-003-003.i	0.9966	0.1838
pu-sol-therm-003-008.i	0.9962	0.0851
pu-sol-therm-005-007.i	0.9960	0.0423
pu-sol-therm-003-002.i	0.9959	0.0187
pu-sol-therm-004-011.i	0.9959	0.0098

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case005	0.01420	0.00038	0.97982	0.02620

Benchmark population = 41
Population weight = 25.01380
Maximum similarity = 0.99991

Bias = 0.00592

Bias uncertainty = 0.00828
Nuc Data uncert margin = 0.00038
Software/method margin = 0.00500
Non-coverage penalty = 0.00000

benchmark	ck	weight
pu-sol-therm-001-001.i	0.9999	1.0000
pu-sol-therm-010-002.i	0.9998	0.9610
pu-sol-therm-010-009.i	0.9997	0.9358
pu-sol-therm-002-005.i	0.9996	0.9180
pu-sol-therm-002-004.i	0.9996	0.9127
pu-sol-therm-002-006.i	0.9996	0.9126
pu-sol-therm-007-010.i	0.9995	0.9040
pu-sol-therm-002-003.i	0.9995	0.8883
pu-sol-therm-001-002.i	0.9994	0.8817
pu-sol-therm-007-005.i	0.9994	0.8788
pu-sol-therm-002-007.i	0.9994	0.8739
pu-sol-therm-007-007.i	0.9994	0.8646
pu-sol-therm-007-006.i	0.9993	0.8545
pu-sol-therm-007-009.i	0.9993	0.8522
pu-sol-therm-007-008.i	0.9993	0.8405
pu-sol-therm-002-002.i	0.9992	0.8148
pu-sol-therm-010-003.i	0.9990	0.7806
pu-sol-therm-002-001.i	0.9990	0.7801
pu-sol-therm-010-004.i	0.9990	0.7794
pu-sol-therm-010-010.i	0.9987	0.7145
pu-sol-therm-010-011.i	0.9986	0.6766
pu-sol-therm-001-003.i	0.9985	0.6614
pu-sol-therm-010-006.i	0.9984	0.6393
pu-sol-therm-010-005.i	0.9982	0.5892
pu-sol-therm-011-165.i	0.9982	0.5818
pu-sol-therm-001-004.i	0.9979	0.5169
pu-sol-therm-003-006.i	0.9979	0.5050
pu-sol-therm-010-012.i	0.9976	0.4397
pu-sol-therm-001-005.i	0.9976	0.4213
pu-sol-therm-011-164.i	0.9975	0.4039
pu-sol-therm-011-163.i	0.9974	0.3785
pu-sol-therm-010-007.i	0.9973	0.3695
pu-sol-therm-003-005.i	0.9973	0.3545
pu-sol-therm-011-162.i	0.9971	0.3057
pu-sol-therm-011-161.i	0.9968	0.2432
pu-sol-therm-003-004.i	0.9968	0.2306
pu-sol-therm-003-003.i	0.9966	0.1874
pu-sol-therm-003-008.i	0.9962	0.0834
pu-sol-therm-005-007.i	0.9960	0.0476
pu-sol-therm-003-002.i	0.9959	0.0213
pu-sol-therm-004-011.i	0.9959	0.0091

USL Summary Table

application	calc margin	data unc (1-sigma)	baseline USL	k(calc) > USL
inp_case001	0.01422	0.00038	0.97979	0.02589
inp_case002	0.01422	0.00038	0.97980	0.02647
inp_case003	0.01422	0.00039	0.97977	0.02599
inp_case004	0.01420	0.00038	0.97980	0.02631
inp_case005	0.01420	0.00038	0.97982	0.02620