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# An Expanded Criticality Validation Suite for MCNP

## 1. Introduction and Overview

### 1.1 Previous MCNP Criticality Validation Suites

Two criticality validation suites for the MCNP Monte Carlo code<sup>1</sup> have been used at Los Alamos National Laboratory (LANL) for nearly a decade. Those criticality validation suites were created by the nuclear data team and the Monte Carlo team. However, there is some overlap between them as well as some inconsistencies. In addition, neither of them adequately addresses certain areas of nuclear data. Consequently, an expanded criticality validation suite has been created that incorporates many of the benchmarks in those two suites, eliminates overlaps, resolves inconsistencies, and fills some of the gaps that neither of them addresses.

The nuclear data team's suite<sup>2,3</sup> initially included 86 separate benchmarks but eventually expanded to 93 benchmarks. The suite is used primarily for nuclear data testing. Nearly all of the benchmarks in that suite are taken from the *International Handbook of Evaluated Criticality Safety Benchmark Experiments*<sup>4</sup> or from the Cross Section Evaluation Working Group (CSEWG) benchmark book.<sup>5</sup> They include several sets of related benchmarks so that the effects of parameter variations such as enrichment, reflector thickness, or solution content can be evaluated. However, the suite contains only fast metal systems and thermal solution systems. It doesn't include any lattice benchmarks, any benchmarks with intermediate spectra, or any benchmarks with low enriched uranium (LEU) fuel.

The Monte Carlo team subsequently created a suite<sup>6</sup> of 27 criticality benchmarks to test changes to the MCNP Monte Carlo code and to its distributed nuclear data libraries. That suite eventually expanded to 31 benchmarks,<sup>7</sup> although not all of the benchmarks in the initial version of the suite are retained in the later version. The objective was to have a wide representation of fissile materials, reflector materials, and spectra. The suite includes at least three fast, one intermediate, and two thermal benchmarks for <sup>233</sup>U systems, highly enriched uranium (HEU) systems, intermediate enriched uranium (IEU) systems, and plutonium systems. For LEU systems, it only includes thermal benchmarks, because they cannot reach criticality with intermediate or fast spectra. The three subcategories for fast systems are benchmarks that are unreflected, reflected by a heavy material, and reflected by a light material. The subcategories for thermal systems are lattice benchmarks and solution benchmarks. However, the suite does not include subsets of related benchmarks that would permit parameter variations to be studied. All of the benchmarks in the Monte Carlo team's suite are taken from the *Handbook*.

### 1.2 Expanded Validation Suite

All of the benchmarks in the expanded validation suite are taken from the *Handbook*, with the exception of one benchmark (ieu-met-fast-007-case-4) that has been submitted for inclusion in it but has not yet been approved. The name of each benchmark is the same as the

identifier for the evaluation in the Handbook from which it is taken. In those cases where the evaluation includes more than one case, the benchmark name appends the case number to the identifier.

The benchmarks in the expanded validation suite are divided according to the isotope that produces the majority of fissions:  $^{233}\text{U}$ ,  $^{235}\text{U}$ , or  $^{239}\text{Pu}$ . The  $^{235}\text{U}$  benchmarks are further subdivided by the fractional  $^{235}\text{U}$  content in the uranium as HEU, IEU, or LEU. HEU contains 60 wt.% or more  $^{235}\text{U}$ , and LEU contains 5 wt.% or less. IEU therefore contains between 5 wt.% and 60 wt.%  $^{235}\text{U}$ . The  $^{239}\text{Pu}$  category is generalized to include all plutonium isotopes and hereafter is referred to simply as plutonium. The number of cases in the expanded validation suite in each of these categories is shown in Table 1, which also indicates the degree of overlap with the benchmarks in the two previous criticality validation suites.

Table 1. Benchmarks in the Expanded Criticality Validation Suite

Principal Fuel	Number of Benchmarks			
	Data Team Suite	Monte Carlo Team Suite	Other	Expanded Suite
$^{233}\text{U}$	12	6		18
HEU	30	7	3	40
IEU	7	5	5	17
LEU		2	6	8
Plutonium	19	9	8	36
Total	68	29	22	119

It should be noted that the expanded validation suite uses 5 wt.% as the dividing line between LEU and IEU, whereas the *Handbook* uses 10 wt.%. The reason that 5 wt.% was chosen is that it is the current enrichment limit for fuel used in commercial nuclear reactors in the United States.

The expanded validation suite follows the guidelines from the ICSBEP Handbook in classifying spectra as fast, intermediate, or thermal. Fast benchmarks are those in which the majority of fissions is caused by neutrons with energy greater than 100 keV, and thermal benchmarks are those in which the majority of fissions is caused by neutrons with energies less than 0.625 eV. Benchmarks with intermediate spectra therefore are those in which the majority of fissions is caused by neutrons with energies between 0.625 eV and 100 keV. The spectral distribution of the benchmarks in the expanded validation suite is summarized in Table 2.

Table 2. Spectral Distribution of Benchmarks in the Expanded Criticality Validation Suite

Principal Fuel	Number of Benchmarks			
	Fast	Intermediate	Thermal	Total
<sup>233</sup> U	10	1	7	18
HEU	29	5	6	40
IEU	10	1	6	17
LEU			8	8
Plutonium	21	1	14	36
Total	70	8	41	119

Sections 2 through 6 describe the benchmarks in the expanded criticality validation suite. Results obtained from MCNP5 for each of those benchmarks using nuclear data derived from ENDF/B-VII.0 and from ENDF/B-VI are presented in section 7. Listings of the input files for each benchmark are given in the appendix.

## 2. <sup>233</sup>U Benchmarks

The uranium in all of the <sup>233</sup>U benchmarks is highly enriched in <sup>233</sup>U. Although that uranium does contain small amounts of other uranium isotopes, it frequently will be referred to herein as <sup>233</sup>U for convenience. The <sup>233</sup>U benchmarks in the expanded criticality validation suite are characterized in Table 3, and succinct descriptions of each of them are provided below.

Table 3. Characteristics of <sup>233</sup>U Benchmarks

Spectrum	Form	Shape	Moderator and /or Reflector	Benchmark(s)
Fast	Metal	Sphere	Unreflected	u233-met-fast-001
			HEU	u233-met-fast-002-case-1 u233-met-fast-002-case-2
			Normal uranium	u233-met-fast-003-case-1 u233-met-fast-003-case-2 u233-met-fast-006
			Tungsten	u233-met-fast-004-case-1 u233-met-fast-004-case-2
			Beryllium	u233-met-fast-005-case-1 u233-met-fast-005-case-2
Intermediate	Solution	Sphere	Beryllium	u233-sol-inter-001-case-1
Thermal	UO <sub>2</sub> + ZrO <sub>2</sub>	Lattice	Water	u233-comp-therm-001-case-3
	Solution	Sphere	Unreflected	u233-sol-therm-001-case-1 u233-sol-therm-001-case-2 u233-sol-therm-001-case-3 u233-sol-therm-001-case-4 u233-sol-therm-001-case-5 u233-sol-therm-008

### 2.1 Fast <sup>233</sup>U Benchmarks

u233-met-fast-001 consists of a bare, homogeneous sphere of <sup>233</sup>U with a radius of 5.9838 cm. The uranium is 98.13 at.% <sup>233</sup>U. It is based on the Jezebel-233 experiment that was

performed in 1961 at Los Alamos Scientific Laboratory (LASL), now known as Los Alamos National Laboratory. That experiment also is the basis for the CSEWG fast benchmark F-19.

u233-met-fast-002-case-1 and u233-met-fast-002-case-2 both contain an inner sphere of  $^{233}\text{U}$  enclosed in an annulus of HEU. The  $^{233}\text{U}$  sphere in -case-1 has a radius of 5.0444 cm, and the HEU annulus is 1.2217 cm thick. The  $^{233}\text{U}$  sphere in -case-2 has a radius of 4.5999 cm, and the HEU annulus is 1.9888 cm thick. For both benchmarks, the uranium in the inner sphere contains 98.2 wt.%  $^{233}\text{U}$ , and the uranium in the annulus contains 93.2 wt.%  $^{235}\text{U}$ . Both benchmarks are based on experiments that were performed at LASL in the 1950s.

u233-met-fast-003-case-1 and u233-met-fast-003-case-2 both contain an inner sphere of  $^{233}\text{U}$  enclosed in an annulus of normal uranium. The  $^{233}\text{U}$  sphere in -case-1 has a radius of 5.0444 cm, and the annulus of normal uranium is 2.3012 cm thick. The  $^{233}\text{U}$  sphere in -case-2 has a radius of 4.5999 cm, and the annulus of normal uranium is 5.3086 cm thick. The inner uranium spheres in both benchmarks contain 98.2 wt.%  $^{233}\text{U}$ . Both benchmarks are based on experiments that were performed at LASL in the 1950s.

u233-met-fast-004-case-1 and u233-met-fast-004-case-2 both contain an inner sphere of  $^{233}\text{U}$  enclosed in an annulus of tungsten. The  $^{233}\text{U}$  sphere in -case-1 has a radius of 5.0444 cm, and the tungsten annulus is 2.4384 cm thick. The  $^{233}\text{U}$  sphere in -case-2 has a radius of 4.5999 cm, and the tungsten annulus is 5.7912 cm thick. The uranium in both benchmarks contains 98.2 wt.%  $^{233}\text{U}$ . Both benchmarks are based on experiments that were performed at LASL in the 1950s.

u233-met-fast-005-case-1 and u233-met-fast-005-case-2 both contain an inner sphere of  $^{233}\text{U}$  enclosed in an annulus of beryllium. The  $^{233}\text{U}$  sphere in -case-1 has a radius of 5.0444 cm, and the beryllium annulus is 2.0447 cm thick. The  $^{233}\text{U}$  sphere in -case-2 has a radius of 4.5999 cm, and the beryllium annulus is 4.1961 cm thick. The uranium in both benchmarks contains 98.2 wt.%  $^{233}\text{U}$ . Both benchmarks are based on experiments that were performed at LASL in the 1950s.

u233-met-fast-006, like u233-met-fast-003-case-1 and u233-met-fast-003-case-2, contains an inner sphere of  $^{233}\text{U}$  enclosed in an annulus of normal uranium. In this benchmark, however, both the  $^{233}\text{U}$  and the normal uranium are slightly more dense and the  $^{233}\text{U}$  content (98.13 wt.%) is slightly lower than in those two benchmarks. In addition, the radius of the  $^{233}\text{U}$  sphere is smaller (4.2058 cm), and the annulus of normal uranium is much thicker (19.9136 cm). This benchmark is based on the Flatop-23 experiment that was performed in 1964 at LASL. That experiment also is the basis for the CSEWG fast benchmark F-24.

## 2.2 Intermediate $^{233}\text{U}$ Benchmark

u233-sol-inter-001-case-1 is the sole  $^{233}\text{U}$  benchmark in the expanded criticality validation suite with an intermediate spectrum. The benchmark is based on the first in the Falstaff series of experiments that were performed at Lawrence Livermore National Laboratory

in the late 1950s. All of those experiments were significantly subcritical, and this benchmark was obtained by extrapolation to a critical condition. The benchmark model contains a spherical solution of  $^{233}\text{U}$  uranyl fluoride inside a stainless steel shell surrounded by a beryllium reflector. The uranium contains 98.562 wt.%  $^{233}\text{U}$ . The radius of the solution is 7.8726 cm, and the thicknesses of the shell and reflector are 0.0483 cm and 8 cm, respectively.

### 2.3 Thermal $^{233}\text{U}$ Benchmarks

u233-comp-therm-001-case-3 is the only thermal-reactor lattice among the  $^{233}\text{U}$  benchmarks in the expanded criticality validation suite. The benchmark is based on the SB-2½ experiment that was performed at Bettis Atomic Power Laboratory in the mid 1960s. It consists of a rectangular 16 x 18 lattice of fuel pins containing uranium dioxide in a zirconium-dioxide matrix. The uranium contains 97.29 wt.%  $^{233}\text{U}$ . The pins are clad in Zircaloy-2 and are fully immersed in water. The lattice pitch is 0.91948 cm, and the radius of each fuel pin is 0.26797 cm. There is a gap of 0.01143 cm between the fuel and the cladding, and the cladding is 0.04445 cm thick. The lattice is surrounded by a water reflector, which has an outer radius of 42.18 cm.

u233-sol-therm-001-case-1 through u233-sol-therm-001-case-5 are based on the ORNL-5(-case-1) through ORNL-9 (-case-5) experiments that were performed at Oak Ridge National Laboratory (ORNL) in the 1950s. All five benchmarks are unreflected and contain  $^{233}\text{U}$  uranyl-nitrate solutions inside an annular shell of aluminum 1100. The uranium contains 97.70 wt.%  $^{233}\text{U}$ . The shell has an inner radius of 34.595 cm and is 0.32 cm thick. The solution contains different amounts of uranyl nitrate for each benchmark, from 17.14 g/l (-case-1) to 19.82 g/l (-case-5) of uranium. The resulting solution densities range from 1.0226 g/cm<sup>3</sup> to 1.0286 g/cm<sup>3</sup>.

u233-sol-therm-008 is based on the ORNL-11 experiment that was performed at ORNL in the 1950s. The benchmark is unreflected and contains a  $^{233}\text{U}$  uranyl-nitrate solution inside an annular shell of aluminum 1100. The uranium contains 97.67 wt.%  $^{233}\text{U}$ . The shell is much larger than for ORNL-5 through ORNL-9. Specifically, it has an inner radius of 61.011 cm and is 0.775 cm thick. The uranium concentration is 13.25 g/l, which produces a solution density of 1.0153 g/cm<sup>3</sup>.

### 3. HEU Benchmarks

The uranium in all of the HEU benchmarks in the expanded criticality validation suite contains more than 88 wt.%  $^{235}\text{U}$ . Those benchmarks are characterized in Tables 4-a and 4-b, and succinct descriptions of each of them are provided below.

#### 3.1 Fast HEU Benchmarks

heu-met-fast-001 contains a bare, homogeneous sphere of HEU with a radius of 8.7407 cm and an enrichment of 93.71 wt.%. This benchmark is based on the Godiva experiment that was operated during the 1950s at Los Alamos Scientific Laboratory (LASL), now known as Los Alamos National Laboratory (LANL). The same configuration also is the basis for the CSEWG fast benchmark F-5.

heu-met-fast-003-case-1 through -case-12 all are part of the TOPSY series of experiments that were performed at LASL in the 1950s. All 12 cases contain an inner sphere of HEU reflected by an annulus of another material. The enrichment for the inner sphere is 93.5 wt.% for all 12 cases. Normal uranium is the reflector for benchmarks heu-met-fast-003-case-1 through -case-7, tungsten carbide is the reflector for -case-8 through -case-11, and nickel is the reflector for -case-12. The radii of the spheres and the thicknesses of the reflector for these benchmarks are summarized in Table 5.

heu-met-fast-004-case-1 contains a homogeneous HEU sphere supported by a Lucite plate inside a cylinder of water. The radius of the sphere is 6.5537 cm, and its enrichment is 96.675 wt.%. The Lucite plate is a cylinder with a height of 2.54 cm and inner and outer radii of 3.974 and 12.7 cm, respectively. The cylinder of water is 55.554 cm high and has a radius of 30 cm. The benchmark is based on an experiment that was performed at LANL in 1976.

heu-met-fast-008 contains an unreflected, incomplete sphere of HEU with a central cavity and horizontal and vertical gaps. The upper portion of the sphere is supported by an iron diaphragm, and the lower portion is supported by a copper cup mounted on an iron cylinder. The outermost radius of the sphere is 9.15 cm, and its enrichment is 89.6 wt.%. A schematic of this benchmark is presented in Figure 1. This benchmark is based on an experiment that was performed in 1982 and then repeated with some modifications in 1995 at the Institute of Technical Physics of the Russian Federal Nuclear Center (VNIITF) at Chelyabinsk-70.

heu-met-fast-009-case-1 and heu-met-fast-009-case-2 contain an incomplete sphere of HEU reflected by beryllium and beryllium oxide, respectively. The enrichment of the sphere is 89.6 wt.% in both cases. Also, in both cases the HEU sphere has a horizontal gap, and its topmost hemispherical shell is not quite in contact with the rest of the sphere. The reflector surrounds the bottom half of the sphere and the topmost hemispherical shell of HEU. That topmost hemispherical shell is supported by an iron diaphragm, and the lower portion of the sphere is supported by a copper cup mounted on an iron cylinder. For both cases, the outer radius of the bottom half of the sphere is 8.35 cm, and the thickness of the reflector is 2.65 cm.



Table 4-a. Characteristics of HEU Benchmarks, Part I

Spectrum	Form	Shape	Reflector	Benchmark(s)
Fast	Metal	Sphere	Unreflected	heu-met-fast-001 heu-met-fast-008 heu-met-fast-018-case-2
			Normal uranium	heu-met-fast-003-case-1 heu-met-fast-003-case-2 heu-met-fast-003-case-3 heu-met-fast-003-case-4 heu-met-fast-003-case-5 heu-met-fast-003-case-6 heu-met-fast-003-case-7 heu-met-fast-028
			Depleted uranium	heu-met-fast-014
			Tungsten carbide	heu-met-fast-003-case-8 heu-met-fast-003-case-9 heu-met-fast-003-case-10 heu-met-fast-003-case-11
			Nickel	heu-met-fast-003-case-12
			Steel	heu-met-fast-013 heu-met-fast-021-case-2
			Duralumin	heu-met-fast-022-case-2
			Aluminum	heu-met-fast-012
			Graphite	heu-met-fast-019-case-2
			Beryllium oxide	heu-met-fast-009-case-2
			Beryllium	heu-met-fast-009-case-1
			Polyethylene	heu-met-fast-011 heu-met-fast-020-case-2
		Water	heu-met-fast-004-case-1	
		Cylinder	Unreflected	heu-met-fast-015
		Lattice	Paraffin	heu-met-fast-026-case-c-11

Table 4-b. Characteristics of HEU Benchmarks, Part II

Spectrum	Form	Shape	Reflector, Moderator and/or Buffer	Benchmark(s)
Intermediate	UH <sub>3</sub>	Cylinders	Natural uranium	heu-comp-inter-003, case-6
	Metal	Cylinders	Graphite, copper	heu-met-inter-006-case-1 heu-met-inter-006-case-2 heu-met-inter-006-case-3 heu-met-inter-006-case-4
Thermal	UO <sub>2</sub> + ZrO <sub>2</sub>	Lattice	Water, ThO <sub>2</sub>	u233-comp-inter-001-case-6
	Solution	Sphere	Unreflected	heu-sol-therm-013-case-1 heu-sol-therm-013-case-2 heu-sol-therm-013-case-3 heu-sol-therm-013-case-4 heu-sol-therm-032

However, in -case-2 the sphere has an inner cavity with a radius of 1.4 cm. Schematics of these benchmarks are presented in Figures 2 and 3. These benchmarks are based on experiments that were conducted at VNIITF in 1977.

heu-met-fast-011 contains a homogeneous sphere of HEU reflected by two hemispherical shells of polyethylene. However, the upper shell of polyethylene is not in direct contact with the HEU sphere, and it is supported by a steel diaphragm. The HEU sphere contains a central void. The enrichment of the HEU sphere is 89.6 wt.%, and its inner and outer radii are 2 cm and 7.55 cm, respectively. The polyethylene shells each are 10.45 cm thick, and there is a gap of 1.96 cm between the top edge of the bottom shell and the bottom edge of the top shell. A schematic of this benchmark is presented in Figure 4. This benchmark is based on an experiment that was performed in 1986 and then repeated with some modifications in 1995 at VNIITF.

heu-met-fast-012 contains an incomplete sphere of HEU reflected by asymmetric hemispherical shells of aluminum. The enrichment of the sphere is 89.6 wt.%. The sphere may be visualized as having three parts: a true sphere with a radius of 7.55 cm and a small central cavity in the form of a parallelepiped, a hemispherical shell that fits directly over the bottom portion of the sphere and extends its radius to 9.15 cm, and an upper hemispherical shell of the same size that is separated from the lower shell by 1.17 cm. A hemispherical aluminum shell with a thickness of 0.85 cm fits directly onto the lower hemispherical HEU shell, and another aluminum shell with a thickness of 2.85 cm fits directly onto the upper hemispherical HEU shell. The upper HEU and aluminum hemispherical shells are supported by an iron diaphragm, and the rest of the configuration is supported by a copper cup mounted on an iron cylinder. A



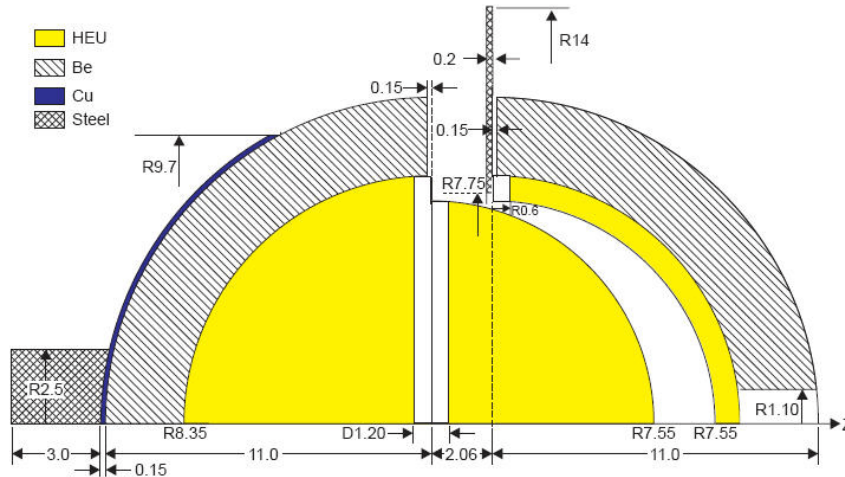


Figure 2. Incomplete HEU Sphere Reflected by Beryllium, heu-met-fast-009-case-1

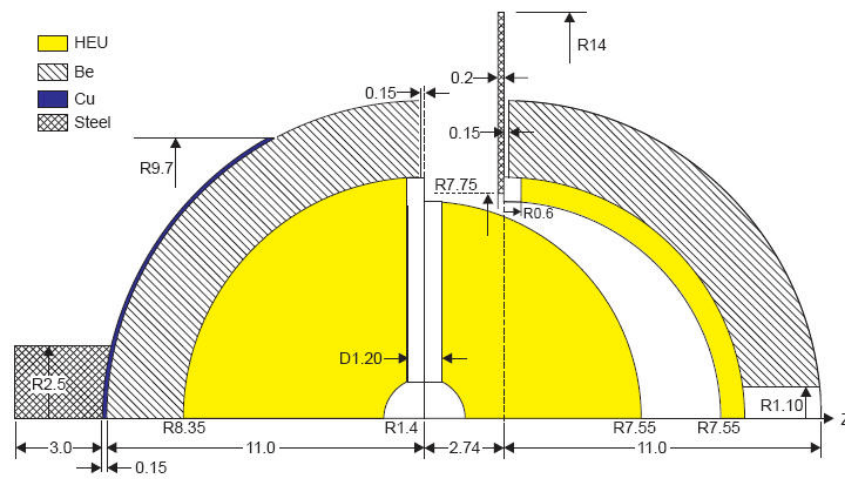


Figure 3. Incomplete HEU Sphere Reflected by Beryllium Oxide, heu-met-fast-009-case-2

schematic of this benchmark is presented in Figure 5. This benchmark is based on an experiment that was performed in 1978 at VNIITF.

heu-met-fast-013 contains an asymmetric sphere of HEU reflected by asymmetric hemispherical steel shells. The sphere may be visualized as having four parts: true upper and lower hemispheres with inner and outer radii of 1.4 cm and 7.55 cm, respectively, and upper and lower hemispherical shells with inner and outer radii of 7.55 cm 8.35 cm, respectively. The upper and lower hemispheres fit together but have a cylindrical cavity with a radius of 0.6 cm that runs through the surfaces where they join. The bottom hemispherical HEU shell fits directly under the bottom HEU hemisphere, but there is a gap of 0.2 cm between it and the top

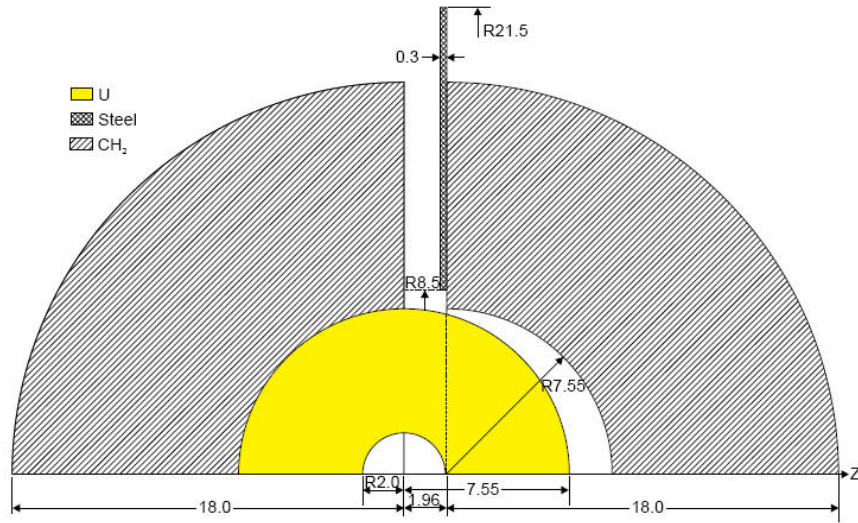


Figure 4. HEU Sphere Reflected by Polyethylene, heu-met-fast-011

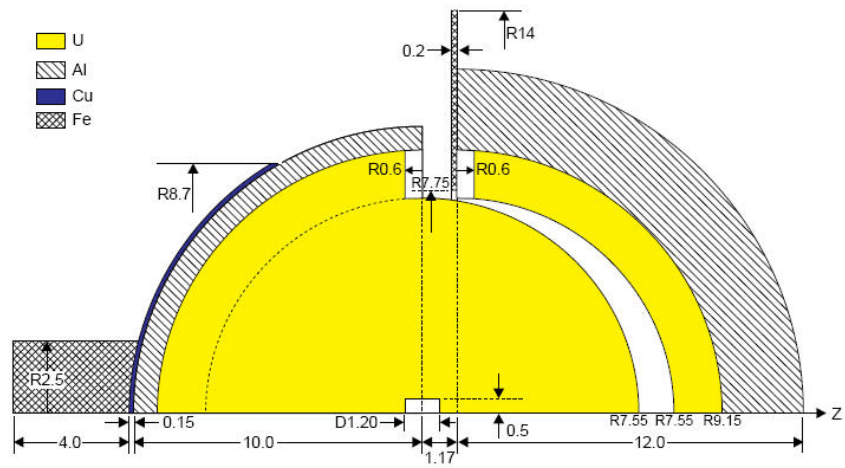


Figure 5. Incomplete HEU Sphere Reflected by Aluminum, heu-met-fast-012

hemispherical shell. The steel reflector shells have an inner radius of 8.35 cm and are 3.65 cm thick. The upper HEU and steel hemispherical shells are supported by an iron diaphragm, and the rest of the configuration is supported by a copper cup mounted on an iron cylinder. A schematic of this benchmark is presented in Figure 6. This benchmark is based on an experiment that was performed in 1976 at VNIITF.

heu-met-fast-014 contains two slightly separated hemispheres of HEU reflected by hemispherical shells of depleted uranium. The enrichment of the hemispheres is 89.6 wt.%. The hemispheres have inner radii of 3.15 cm and outer radii of 8.35 cm. The inner hemispherical

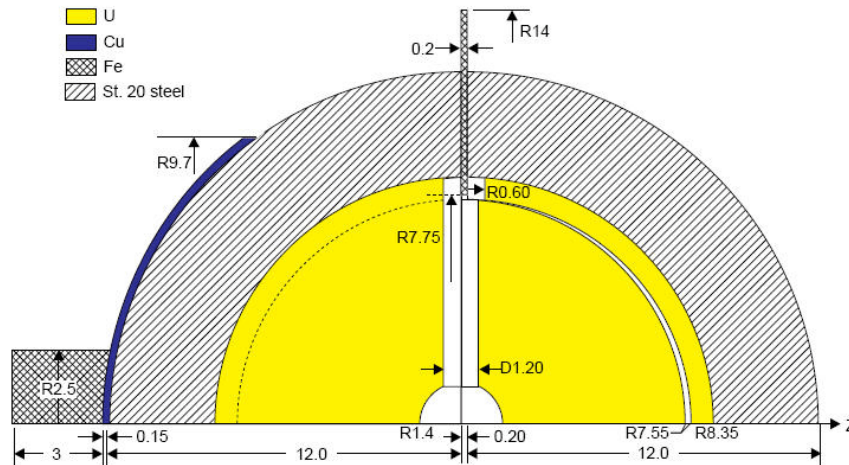


Figure 6. Asymmetric HEU Sphere Reflected by Steel, heu-met-fast-013

shell of depleted uranium has a thickness of 0.8 cm, and the outer shell has a thickness of 3.85 cm. The inner hemispherical shells are in direct contact with the HEU hemispheres, and the outer hemispherical shells are in direct contact with the inner shells. However, there is a gap of 0.64 cm between the upper and lower hemisphere and upper and lower hemispherical shells. Part of that gap contains an iron diaphragm that supports the upper hemisphere and the upper hemispherical shells. The hemispheres have a cylindrical cavity with a radius of 0.6 cm on their flat surfaces. The inner shells of depleted uranium both have a cylindrical central cavity with a radius of 1.75 cm, and the upper outer shell has a cylindrical central cavity with a radius of 0.5 cm. The bottom HEU hemisphere and depleted-uranium hemispherical shells are supported by a duralumin cup mounted on a duralumin cylinder. A schematic of this benchmark is shown in Figure 7. This benchmark is based on an experiment that was performed at VNIITF in 1980.

heu-met-fast-015 contains two circular cylinders of HEU separated by a gap of 0.5 cm. The enrichment of the cylinders is 96.0 wt.%. The bottom HEU cylinder has a radius of 9.995 cm and is 5.96 cm high. It has a central cavity that is 1 cm high and has a radius of 0.6 cm. The top cylinder has an inner radius of 1.75 cm and an outer radius of 9.995 cm. Both cylinders are supported by steel plates. A schematic of this benchmark is presented in Figure 8. The benchmark is based on an experiment that was performed at VNIITF in 1984.

heu-met-fast-018-case-2 contains a bare, homogeneous sphere of HEU with an inner radius of 1 cm and an outer radius of 9.154 cm. Its enrichment is 89.5 wt.%. This benchmark is based on an experiment that was performed in 1962 at the Institute of Experimental Physics of the Russian Federal Nuclear Center (VNIIEF) at Arzamas-16.

heu-met-fast-019-case-2 contains a sphere of HEU reflected by an annulus of graphite. The sphere has a central cavity. Its inner and outer radii are 4.029 cm and 9.150, and the

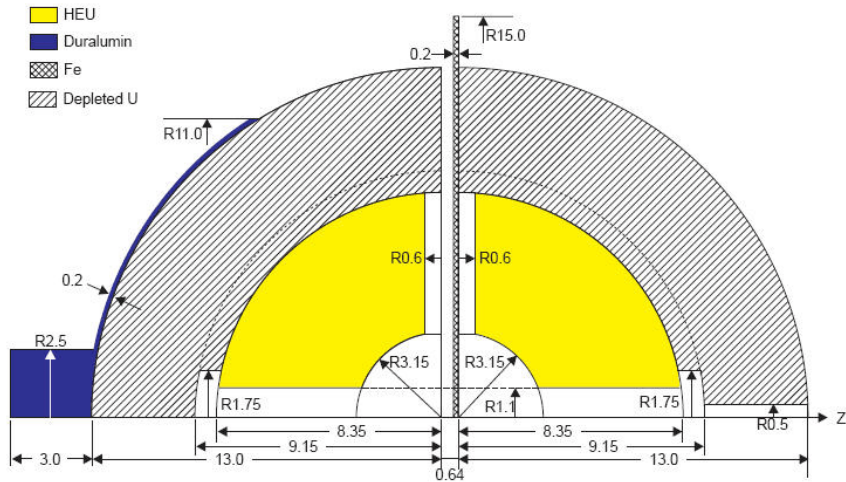


Figure 7. HEU Sphere Reflected by Depleted Uranium, heu-met-fast-014

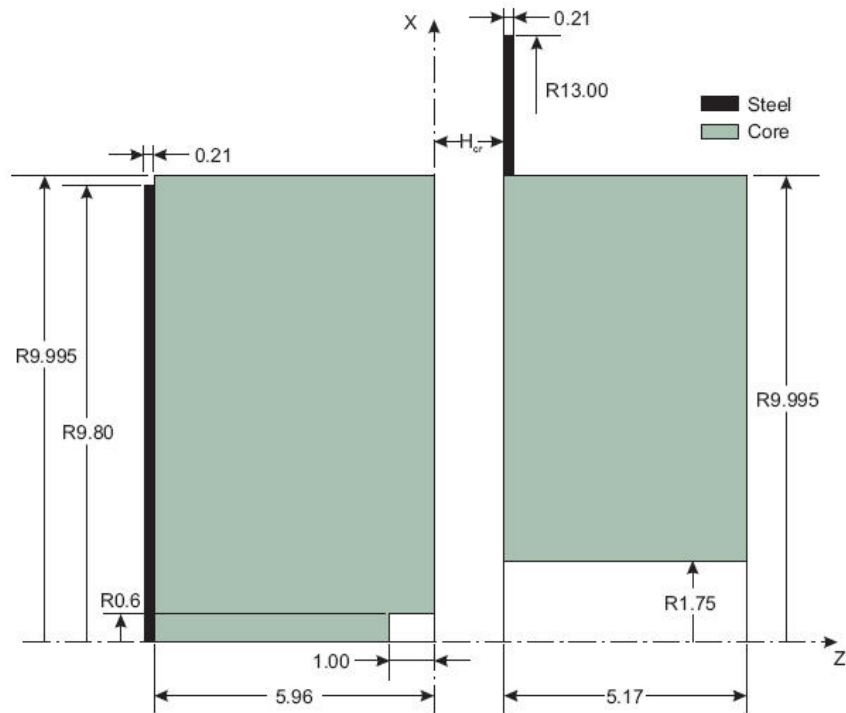


Figure 8. Unreflected Asymmetric Cylinder of HEU, heu-met-fast-015

graphite annulus is 3.45 cm thick. The enrichment of the sphere is 89.5 wt.%. This benchmark is based on an experiment that was performed at VNIIEF in 1962.

heu-met-fast-020-case-2 contains a solid, homogeneous sphere of HEU reflected by an annulus of polyethylene. The radius of the sphere is 8.35 cm, and the annulus is 1.45 cm thick. The enrichment of the sphere is 89.5 wt.%. This benchmark is based on an experiments that was performed at VNIIEF in 1962.

heu-met-fast-021-case-2 contains a homogeneous HEU sphere with a central cavity, reflected by two annuli of steel. The enrichment of the sphere is 89.5 wt.%, and its inner and outer radii are 0.89 and 7.55 cm, respectively. The thickness of the inner steel annulus is 3.45 cm, and the thickness of the outer steel annulus is 6.25 cm. This benchmark is based on an experiment that was conducted at VNIIEF in 1962.

heu-met-fast-022-case-2 contains an HEU sphere with a central cavity, reflected by an annulus of duralumin. The enrichment of the sphere is 89.5 wt.%. The inner and outer radii of the sphere are 1.018 cm and 8.350 cm, respectively, and the thickness of the duralumin is 3.900 cm. This benchmark is based on an experiment that was performed at VNIIEF in 1962.

heu-met-fast-026-case-11 is based on one of the Tinkertoy experiments that were conducted at Oak Ridge National Laboraotry (ORNL) in 1962 and 1963. It consists of a 3 x 3 x 3 array of HEU cylinders inside a hollow box of paraffin that acts as a reflector. The sides of the box are held apart by thin stainless-steel rods. The enrichment of the HEU cylinders is 93.2 wt.%, and they are 10.765 cm high with a radius of 5.742 cm. The center-to-center distance between adjacent cylinders is 30.204 cm. The sides of the paraffin box are 7.6 cm thick and are separated by a distance of 90.612 cm. The top and bottom of the paraffin box also are 7.6 cm thick but are separated by a distance of 88.455 cm.

heu-met-fast-028 contains a solid, homogeneous sphere of HEU reflected by an annulus of normal uranium. The enrichment of the sphere is 93.24 wt.%. The radius of the sphere is 6.1156 cm, and the thickness of the annulus is 18.0086 cm. This benchmark is based on the Flatop-25 experiment that was operated at LASL in the mid 1960s. That same experiment also is the basis for the CSEWG fast benchmark F-22.

### 3.2 Intermediate HEU Benchmarks

heu-comp-inter-003-case-6 is based on one of seven experiments conducted with sealed canisters containing HEU uranium hydride (UH<sub>3</sub>) at LANL in 1987 and 1988. Four cylindrical canisters are stacked on top of each other, with a separation of 0.5519 cm between the two middle canisters. The canisters are surrounded with top, bottom, and side reflectors of normal uranium. The canisters are made of stainless steel. They are approximately 3.5 cm high, with lids and bottoms that are 0.254 cm thick. They have an inner radius of 7.5050 cm and an outer radius of 7.5438 cm. The enrichment of the uranium in the uranium hydride varies from 90.44 wt.% to 90.74 wt.%. The reflector is comprised of three pieces: a solid cylindrical bottom, a solid cylindrical top, and an annular side reflector. The side reflector is 19.9085 high, with an inner radius of 7.7013 cm and a thickness of 2.3419 cm. The top and bottom reflectors both



have a radius of 7.5438 cm and are 2.34 cm high. The bottom and side reflectors are supported by a solid aluminum plate that has a radius of 15.1409 cm and is 1.27 cm thick.

heu-met-inter-006-case-1 through heu-met-inter-006-case-4 are based on the graphite-moderated Zeus experiments that were conducted at LANL from 1999 through 2003. In these benchmarks cylindrical HEU platters are separated by graphite platters and enclosed in a copper reflector. A single platter with 1 to 4 graphite platters above and below it is called a “unit.” Each HEU platter has a radius of 26.67 cm and is 0.29972 cm thick. Each graphite platter has a radius of 26.67 cm and is 1.00736 cm thick. The HEU and graphite platters in the lower units have an inner radius of 3.1750 cm to accommodate an aluminum alignment tube with an inner radius of 2.5400 cm and an outer radius of 3.1496 cm. The top and bottom copper reflectors are 14.4272 cm thick and sit directly above and below the top and bottom units, respectively. The side reflectors are configured such that they produce a rectangular exterior with a distance of 88.2904 cm from side to side. The bottom reflector sits on a aluminum platen that is 6.35 cm thick and has inner and outer radii of 4.7625 cm and 26.67 cm, respectively. The differences among the four benchmarks are summarized in Table 6, and a slice through the center of heu-met-inter-006-case-2 is shown in Figure 9.

Table 6. Graphite-Moderated Zeus Benchmarks

Benchmark	Units	Graphite Platters per unit	HEU Enrichment (wt.%)
heu-met-inter-006-case-1	10	8	93.234
heu-met-inter-006-case-2	9	6	93.224
heu-met-inter-006-case-3	9	4	93.237
heu-met-inter-006-case-4	9	2	93.234

### 3.3 Thermal HEU Benchmarks

u233-comp-therm-001-case-6 is the only thermal-reactor lattice among the HEU benchmarks in the expanded criticality validation suite. Although it is included in a <sup>233</sup>U evaluation in the *Handbook* and therefore has a u233 name, it is in fact an HEU benchmark. The benchmark is based on the SB-5 experiment that was performed at Bettis Atomic Power Laboratory in the mid 1960s. The benchmark consists of a hexagonal lattice of 1261 fuel rods surrounded by a hexagonal lattice of 1044 buffer rods. The fuel rods contain uranium dioxide in a zirconium-dioxide matrix, and the enrichment of the uranium is 92.73 wt.%. The buffer rods contain thorium dioxide. Both types of rods are clad in Zircaloy-2 and are fully immersed in water. The lattice pitch is 1.45034. The radius of the fuel rods is 0.26797 cm, and there is a gap of 0.01143 cm between each fuel rod and its cladding, which is 0.04445 cm thick. The radius

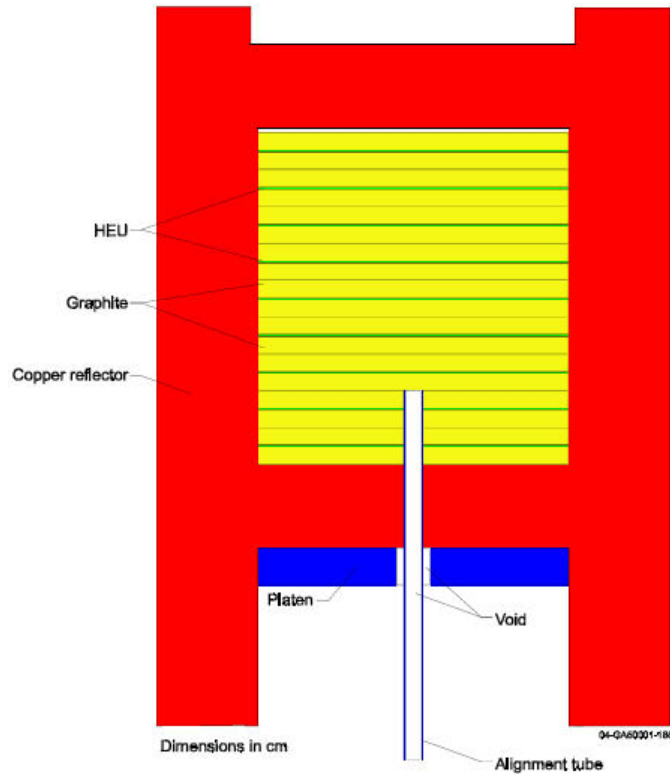


Figure 9. Vertical Slice through the Center of the Zeus-2 Benchmark, heu-met-inter-006-case-2

of the buffer rods is 0.62103, and there is a gap of 0.01270 cm between each buffer rod and its cladding, which is 0.09017 cm thick. The entire lattice is surrounded by a water reflector that has an outer radius of 60.28 cm.

heu-sol-therm-013-case-1 through heu-sol-therm-013-case-4 are based on the ORNL-1 (-case-1) through ORNL-4 (-case-4) unreflected solution experiments that were performed at ORNL in the 1950s. The same experiments also are the basis for the CSEWG thermal benchmarks T-1 through T-4. All four benchmarks contain uranyl-nitrate solutions inside a shell of aluminum 1100. The enrichment of the uranium is 93.18 wt.%  $^{235}\text{U}$ . The shell has an inner radius of 34.5948 cm and is 0.32 cm thick. The solution contains different amounts of uranyl nitrate for each benchmark, from 20.12 g/l (-case-1) to 28.45 g/l (-case-4). The resulting solution densities range from 1.0288 g/cm<sup>3</sup> to 1.0445 g/cm<sup>3</sup>.

heu-sol-therm-032 is based on the ORNL-10 unreflected solution experiment that was performed at ORNL in the 1950s. That experiment also is the basis for the CSEWG thermal benchmark T-5. This benchmark contains a uranyl-nitrate solution inside a shell of aluminum 1100. The enrichment of the uranium is 93.21 wt.%. The aluminum 1100 shell is much larger than the shell for ORNL-1 through ORNL-4. Specifically, it has an inner radius of 61.011 cm

and is 0.775 cm thick. The uranium concentration is 15.14 g/l, which produces a solution density of 1.0216 g/cm<sup>3</sup>.

#### 4. IEU Benchmarks

The uranium in all of the IEU benchmarks contains between 9 and 38 wt.% <sup>235</sup>U, at least on average. The IEU benchmarks in the expanded criticality validation suite are characterized in Table 7, and succinct descriptions of each of them are provided below.

Table 7. Characteristics of IEU Benchmarks

Spectrum	Form	Shape	Reflector and/or Buffer	Benchmark(s)
Fast	Metal	Sphere	Unreflected	ieu-met-fast-003-case-2
			Steel	ieu-met-fast-005-case-2
			Duralumin	ieu-met-fast-006-case-2
			Graphite	ieu-met-fast-004-case-2
		Cylinders	Unreflected	ieu-met-fast-001-case-1 ieu-met-fast-001-case-2 ieu-met-fast-001-case-3 ieu-met-fast-001-case-4
			Normal uranium	ieu-met-fast-002
		Depleted uranium	ieu-met-fast-007-case-4	
Intermediate	Plate	Lattice	Normal uranium, steel	mix-met-fast-008-case-7
Thermal	UO <sub>2</sub>	Lattice	Water	ieu-comp-therm-002-case-3
	Solution	Cylinder	Unreflected	ieu-sol-therm-007-case-14 ieu-sol-therm-007-case-30 ieu-sol-therm-007-case-32 ieu-sol-therm-007-case-36 ieu-sol-therm-007-case-49

##### 4.1 Fast IEU Benchmarks

ieu-met-fast-001-case-1 through -case-4 are known are based on the early Jemima experiments that were conducted between 1952 and 1954 at Los Alamos Scientific Laboratory (LASL), now Los Alamos National Laboratory. All four benchmarks contain unreflected stacks of HEU and normal uranium platters supported by an aluminum platform that sits on top of a

steel plate. The outer radius of the platters is 13.335 cm. Some of them are solid and others have an inner radius of 1.11125 cm. The HEU platters are 0.804 cm thick, and the normal-uranium platters are 0.604 cm thick. Although the stacking order varies from one benchmark to another, the basic arrangement for -case-1 and -case-2 has alternating platters of HEU and normal uranium, while that for -case-3 and -case-4 has two platters of normal uranium between successive HEU platters. More details are provided in Table 8.

Table 8. Early Jemima Benchmarks

Benchmark	HEU Enrichment (wt.%)	Platters	
		HEU	Normal U
ieu-met-fast-001-case-1	93.41	10	11
ieu-met-fast-001-case-2	93.41	11	11
ieu-met-fast-001-case-3	93.43	12	26
ieu-met-fast-001-case-4	93.43	13	26

ieu-met-fast-002 is based on an experiment that was performed at LASL with the Jemima platters in the early 1950s. An homogenized representation of alternating HEU and normal-uranium plates is completely enclosed inside a normal-uranium reflector. The homogenized cylindrical core has an enrichment of 16.19 wt.%. The core has a radius of 19.05 cm and is 38.809 cm high. The reflector is 7.62 cm thick at the bottom, 7.5946 cm thick at the top, and 7.5184 cm thick on the sides.

ieu-met-fast-003-case-2 contains a bare IEU sphere with a radius of 15.324 cm and an enrichment of 36.53 wt.%. It is based on an experiment that was performed in 1994 at the Institute of Experimental Physics of the Russian Federal Nuclear Center (VNIIEF) at Arzamas-16.

ieu-met-fast-004-case-2 contains a sphere of IEU with a central cavity, reflected by graphite. The sphere has an inner radius of 2.788 cm and an outer radius of 14 cm. Its enrichment is 36.54 wt.%. The graphite reflector is 3.2 cm thick. The benchmark is based on an experiment that was performed at VNIIEF in 1977.

ieu-met-fast-005-case-2 contains a sphere of IEU with a central cavity, reflected by two layers of steel. The sphere has an inner radius of 2.686 cm and an outer radius of 13.25 cm. Its enrichment is 36.51 wt.%. The inner steel reflector is 1.75 cm thick, and the outer steel reflector is 6 cm thick. The benchmark is based on an experiment that was performed at VNIIEF in 1994.

ieu-met-fast-006-case-2 contains a sphere of IEU with a central cavity, reflected by two layers of duralumin. The sphere has an inner radius of 2.1 cm and an outer radius of 13.25 cm. Its enrichment is 36.51 wt.%. The inner duralumin reflector is 1.75 cm thick, and the outer duralumin reflector is 10 cm thick. The benchmark is based on an experiment that was performed at VNIIEF in 1994.

ieu-met-fast-007-case-4 is based on the BIG TEN experiment that was operated at LASL in the 1970s. Four IEU cylinders are stacked on top of each other and surrounded by annuli of normal uranium or a homogeneous mixture of HEU and normal uranium. A depleted-uranium reflector encloses those regions. Dimensions and enrichments for the various regions are given in Table 9, and a slice through the center of the benchmark configuration is shown in Figure 10.

Table 9. Enrichments and Dimensions for the BIG TEN Benchmark, ieu-met-fast-007-case-4

Region	<sup>235</sup> U (wt.%)	Outer Radius (cm)	Height (cm)
Central IEU	10.06	2.25014	15.24
		3.10996	19.46148
		7.62	26.74112
		12.54604	19.34351
Normal Uranium	0.711	26.67	3.48717
Homogenized HEU and Normal Uranium	10.23	26.67	55.41309
Normal Uranium	0.711	26.67	6.64585
Depleted Uranium	0.21	26.67	15.24
		41.91	96.52
		26.67	15.73389

#### 4.2 Intermediate IEU Benchmark

mix-met-inter-008-case-7 is the only IEU benchmark in the expanded criticality suite with an intermediate spectrum. Although it is included in a mixed uranium/plutonium evaluation and therefore has a mix name, it is in fact an IEU benchmark. It is based on a  $k_{\infty}$  measurement that was performed at the Atomic Energy Establishment at Winfrith in the 1960s. Because it is based on a  $k_{\infty}$  measurement, reflecting boundary conditions are imposed on all exterior surfaces.

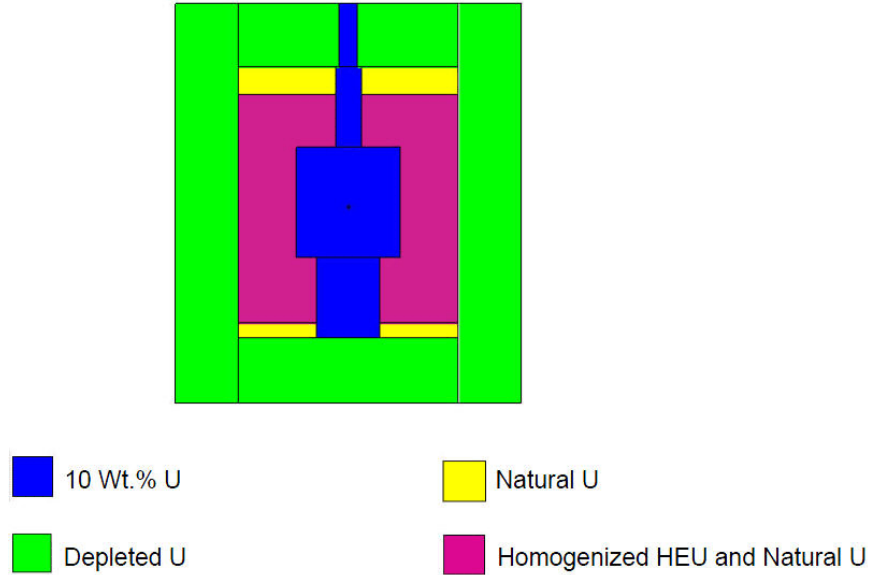


Figure 10. Slice through the Center of the BIG TEN benchmark, heu-met-inter-007-case-4

The configuration consists of a rectangular plate of IEU with an enrichment of 37.68 wt.% , with three rectangular normal-uranium plates above it and another three below it. Each of the plates is 5.067 cm wide and high and 0.3175 cm thick. The plates are enclosed on all sides in a rectangular steel sheath. The distance from one outer edge of the sheath to the opposing outer edge is 5.2544 cm, and the walls of the sheath are 0.0762 cm thick.

#### 4.3 Thermal IEU Benchmarks

ieu-comp-therm-002-case-3 contains an hexagonal lattice of IEU uranium-dioxide fuel rods in a tank filled with water. The benchmark is based on an experiment performed between 1970 and 1973 at the Institute of Physics and Power Engineering in Obninsk. The enrichment of the rods is 17 wt.%, and they are clad with stainless steel. The lattice pitch is 6.8 cm. The fuel rods are complex, with inner and outer uranium dioxide regions contained inside two concentric stainless steel tubes. The outer radii of the tubes are 1.20 cm and 1.46 cm, and the tube walls are 0.03 cm thick. This particular lattice also includes a fuel rod with a gadolinium absorber inside a portion of it. A diagram of the lattice is shown in Figure 11.

leu-sol-therm-007-case-14, leu-sol-therm-007-case-30, leu-sol-therm-case-32, leu-sol-therm-007-case-36, and leu-sol-therm-007-case-40 are included here as IEU benchmarks because they have an enrichment of 9.97 wt.%. They are based on experiments in the STACY series that were performed at the Japan Atomic Energy Research Institute in 1995. The benchmarks contain an unreflected uranium nitrate solution inside a cylindrical tank made of stainless steel 304. The inner radius of the tank is 29.5 cm, and it is 0.3 cm thick. The critical

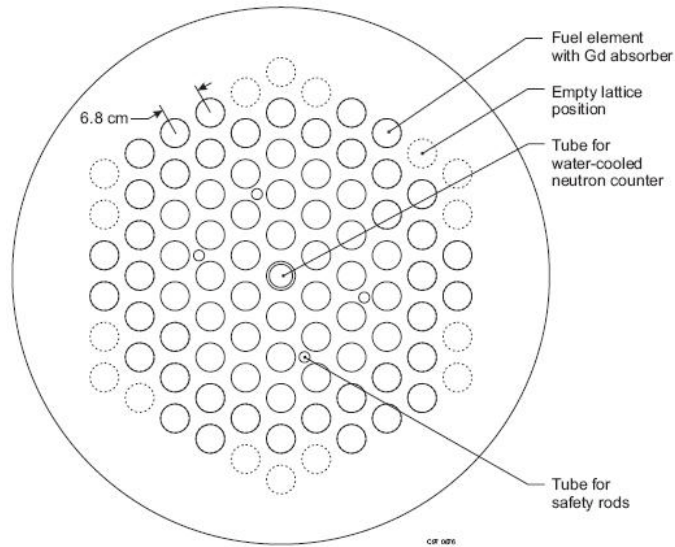


Figure 11. Hexagonal Lattice of IEU Fuel rods, ieu-comp-therm-002-case-3

heights, solution densities, and uranium concentrations for the five benchmarks are given in Table 10.

Table 10. Characteristics of the STACY benchmarks

Benchmark	Critical Height (cm)	Uranium Content (g/l)	Solution Density (g/cm <sup>3</sup> )
leu-sol-therm-007-case-14	46.83	313.0	1.4881
leu-sol-therm-007-case-30	54.20	290.7	1.4571
leu-sol-therm-007-case-32	63.55	270.0	1.4348
leu-sol-therm-007-case-36	83.55	253.9	1.4102
leu-sol-therm-007-case-49	112.27	241.9	1.3941



## 5. LEU Benchmarks

The uranium in all of the LEU benchmarks in the expanded criticality validation suite contains between 2.4 and 5 wt.% <sup>235</sup>U. Those benchmarks are characterized in Table 11. All of them are thermal benchmarks, because LEU can only reach a critical condition with a thermal spectrum. Succinct descriptions of each of those benchmarks are provided below.

Table 11. Characteristics of LEU Benchmarks

Spectrum	Form	Shape	Buffer and/or Reflector	Benchmark(s)
Thermal	UO <sub>2</sub>	Lattice	UO <sub>2</sub> Rods, Water	leu-comp-therm-008-case-1
				leu-comp-therm-008-case-2
				leu-comp-therm-008-case-5
				leu-comp-therm-008-case-7
				leu-comp-therm-008-case-8
				leu-comp-therm-008-case-11
	Solution	Sphere	Water	leu-sol-therm-002-case-1
			Unreflected	leu-sol-therm-002-case-2

### 5.1 Thermal LEU Benchmarks

leu-comp-therm-008-case-1, leu-comp-therm-008-case-2, leu-comp-therm-008-case-5, leu-comp-therm-008-case-7, leu-comp-therm-008-case-8, and leu-comp-therm-008-case-11 all are based on experiments that were part of the Core XI series performed by Babcock and Wilcox in Lynchburg, Virginia, in 1970. The central region of these benchmarks is configured to resemble nine 15 x 15 assemblies for pressurized water reactors, surrounded by a driver region of 2,936 fuel rods identical to those in the “assemblies.” The assemblies and the buffer pins are immersed in borated water. The water extends beyond the buffer to a radius of 76.2 cm, and the entire configuration is axially uniform with a height of 163.324 cm. A diagram of the configuration is shown in Figure 12. The “assemblies” have a pin-cell pitch of 1.63576 cm. The uranium-dioxide fuel rods are clad with aluminum 6061 and have an enrichment of 2.459 wt.%. Figure 13 shows an “assembly” with a central water hole and 16 pyrex absorber pins (the vacant cells contain fuel rods). Depending on the benchmark, the 16 locations may contain fuel rods, water holes, Pyrex absorber pins, Al<sub>2</sub>O<sub>3</sub> rods, or some combination of water holes and Pyrex pins. The contents of the “assemblies” is summarized in Table 12.

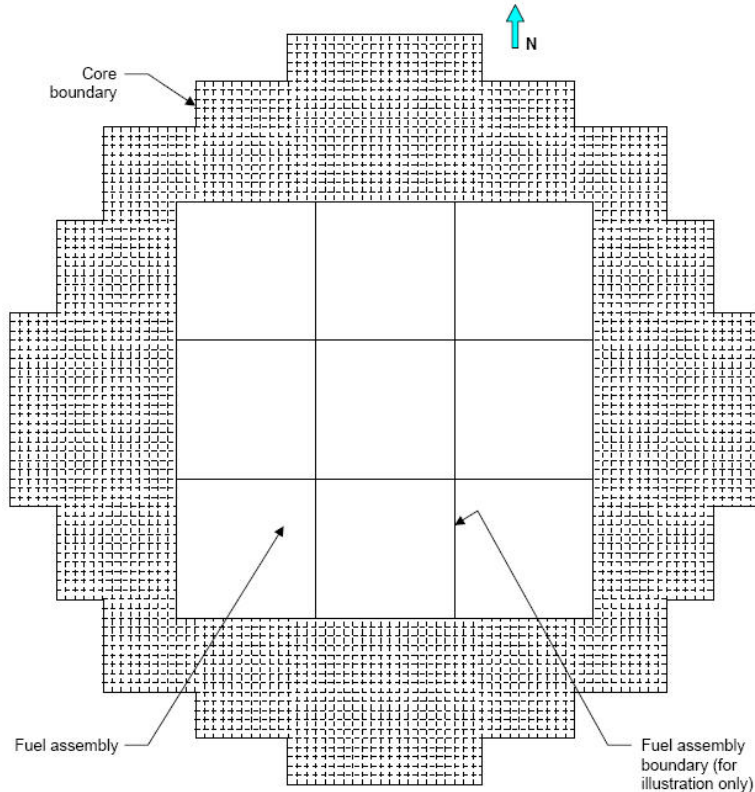
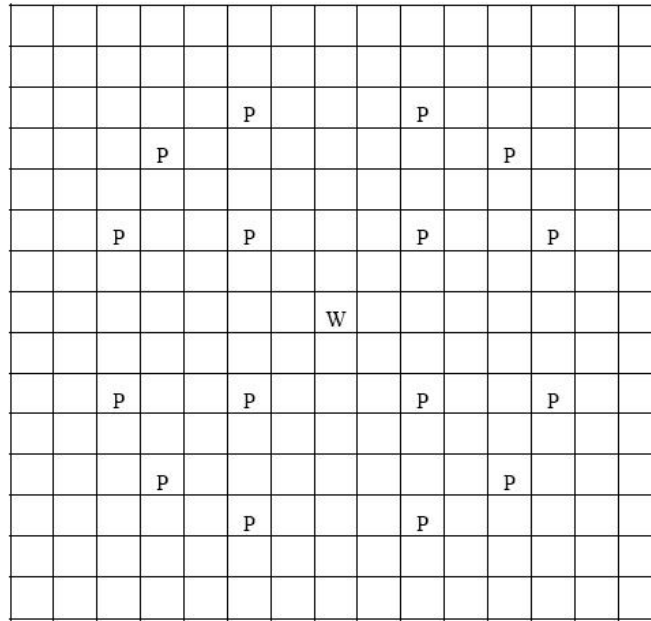


Figure 12. Arrangement for the Babcock and Wilcox Core XI Benchmarks.

leu-sol-therm-002-case-1 and leu-sol-therm-002-case-2 both contain a uranium-fluoride solution inside an annular shell made from aluminum 1100. The enrichment of the uranium is 4.89 wt.% in both benchmarks. However, -case-1 is reflected by water and -case-2 is unreflected. In addition, the inner and outer radii of the shell are slightly different in the two benchmarks, and so is the uranium concentration. The uranium concentration in -case-1 is 452.2 g/l, which produces a solution density of 1.516 g/cm<sup>3</sup>. The uranium concentration in -case-2 is 491.7 g/l, which produces a solution density of 1.559 g/cm<sup>3</sup>. The inner radii of the shell are 34.3990 in -case-1 and 34.4995 cm in -case-2, and the thickness of the shell is 0.1588 cm in both benchmarks. The thickness of the water reflector in -case-1 is 15 cm. These two benchmarks are based on experiments that were performed at Oak Ridge National Laboratory in the 1950s.



P = Pyrex Rod      W = Water Hole

Figure 13. Layout for an “Assembly” in leu-comp-therm-008-case-8.

Table 12. Characteristics of Babcock and Wilcox Core XI Benchmarks.

Benchmark	Soluble Boron (ppm)	Contents of Each “Assembly”			
		Fuel Pins	Water Holes	Pyrex Rods	Al <sub>2</sub> O <sub>3</sub> Rods
leu-comp-therm-008-case-1	1511	225	0	0	0
leu-comp-therm-008-case-2	1335.5	208	17	0	0
leu-comp-therm-008-case-5	1182	208	13	4	0
leu-comp-therm-008-case-7	1032.5	208	9	8	0
leu-comp-therm-008-case-8	794	208	1	16	0
leu-comp-therm-008-case-11	1384	208	1	0	16

## 6. Plutonium Benchmarks

The plutonium benchmarks include benchmarks with both pu and mix identifiers. The pu benchmarks include metal plutonium systems, a homogeneous  $k_{\infty}$  measurement, and plutonium solution systems. The mix benchmarks include two plutonium spheres reflected by HEU and six mixed-oxide (MOX) lattices. More than 60% of the fissions in the HEU-reflected benchmarks and more than 75% of the fissions in the MOX benchmarks occur in plutonium.

The plutonium benchmarks in the expanded criticality validation suite are characterized in Tables 13-a and 13-b, and succinct descriptions of each of them are provided below.

### 6.1 Fast Plutonium Benchmarks

pu-met-fast-001 contains a bare, homogeneous sphere of plutonium with a radius of 6.3849 cm and a  $^{240}\text{Pu}$  content of 4.5 at.%. This benchmark is based on the Jezebel experiment that was operated at Los Alamos Scientific Laboratory (LASL), now known as Los Alamos National Laboratory, during the 1950s. The same configuration also is the basis for the CSEWG fast benchmark F-1.

pu-met-fast-002 contains a bare, homogeneous sphere of plutonium with a radius of 6.6595 cm and a  $^{240}\text{Pu}$  content of 20.1 at.%. This benchmark is based on the Jezebel-240 experiment that was performed at LASL in 1964. That same experiment also is the basis for the CSEWG fast benchmark F-21.

pu-met-fast-003-case-103 is based on one in a series of experiments with plutonium “buttons” that were conducted at Lawrence Livermore National Laboratory between 1965 and 1969. In this benchmark, a 3 x 3 x 3 array of solid buttons is held in place by a set of aluminum tubes but is not otherwise reflected. Each button has a radius of 3.2625 cm, is 4.633 cm high, and weighs approximately 3 kg. The horizontal center-to-center separation between the buttons is 9.60 cm, and the vertical center-to-center separation is 7.71 cm. The plutonium contains 5.95 at.%  $^{240}\text{Pu}$ .

pu-met-fast-005 contains a sphere of delta-phase plutonium reflected by an annulus of tungsten. The sphere has a radius of 5.0419 cm and contains 4.90 at.%  $^{240}\text{Pu}$ . The tungsten annulus is 4.699 cm thick. The benchmark is based on an experiment that was performed at LASL in 1958.

pu-met-fast-006 contains a sphere of delta-phase plutonium reflected by an annulus of normal uranium. The sphere has a radius of 4.5332 cm and contains 4.83 at.%  $^{240}\text{Pu}$ . The annulus of normal uranium is 19.6088 cm thick. The benchmark is based on the Flattop-Pu experiment that was operated at LASL during the mid 1960s. That experiment also is the basis for the CSEWG fast benchmark F-23.

Table 13-a. Characteristics of Plutonium Benchmarks, Part I

Spectrum	Form	Shape	Reflector and/or Buffer	Benchmark(s)
Fast	Metal	Sphere	Unreflected	pu-met-fast-001 pu-met-fast-002 pu-met-fast-022-case-2
			HEU	mix-met-fast-001 mix-met-fast-003
			Normal uranium	pu-met-fast-006 pu-met-fast-010
			Depleted uranium	pu-met-fast-020
			Thorium	pu-met-fast-008-case-2
			Tungsten	pu-met-fast-005
			Steel	pu-met-fast-025-case-2 pu-met-fast-026-case-2
			Aluminum	pu-met-fast-009
			Graphite	pu-met-fast-023-case-2
			Beryllium	pu-met-fast-018 pu-met-fast-019
			Polyethylene	pu-met-fast-024-case-2
		Water	pu-met-fast-011	
		Cylinders	Beryllium oxide	pu-met-fast-021-case-2
			Beryllium	pu-met-fast-021-case-1
Lattice	Unreflected	pu-met-fast-003-case-103		

pu-met-fast-008-case-2 contains a sphere of plutonium enclosed in the center of a right circular cylinder of thorium. The sphere has a radius of 5.31 cm, while the cylinder has a radius of 26.67 cm and is 53.34 cm high. The plutonium contains 5.13 at.% <sup>240</sup>Pu. This benchmark is based on the Thor experiment that was operated at LASL in 1961 and 1962. That experiment also is the basis for the CSEWG fast benchmark F-25.

Table 13-b. Characteristics of Plutonium Benchmarks, Part II

Spectrum	Form	Shape	Reflector and/or Moderator	Benchmark(s)
Intermediate	Mixture	Homogeneous	Hydrogen, graphite	pu-comp-inter-001
Thermal	MOX	Lattice	Water	mix-comp-therm-002-case-pnl-30 mix-comp-therm-002-case-pnl-31 mix-comp-therm-002-case-pnl-32 mix-comp-therm-002-case-pnl-33 mix-comp-therm-002-case-pnl-34 mix-comp-therm-002-case-pnl-35
	Solution	Sphere	Unreflected	pu-sol-therm-009-case-3a pu-sol-therm-011-case-16-5 pu-sol-therm-011-case-18-1 pu-sol-therm-011-case-18-6 pu-sol-therm-021-case-1 pu-sol-therm-021-case-3
		Cylinder	Water	pu-sol-therm-018-case-9 pu-sol-therm-034-case-1

pu-met-fast-009 contains a sphere of delta-phase plutonium reflected by an annulus of aluminum. The sphere has a radius of 5.5118 cm and contains 4.88 at.% <sup>240</sup>Pu. The aluminum annulus is 7.9248 cm thick. This benchmark is based on an experiment that was performed at LASL in 1960.

pu-met-fast-010 contains a sphere of delta-phase plutonium reflected by an annulus of normal uranium. The sphere has a radius of 5.0419 cm and contains 4.90 at.% <sup>240</sup>Pu. The annulus of normal uranium is 4.1275 cm thick. This benchmark is based on an experiment that was performed at LASL in 1958.

pu-met-fast-011-case-1 contains a sphere of alpha-phase plutonium reflected by an annulus of water. The sphere has a radius of 4.1217 cm and contains 5.18 at.% <sup>240</sup>Pu. The annulus of water is 25.4 cm thick. The benchmark is based on an experiment that was performed at LASL in 1968.

pu-met-fast-018 contains a sphere of delta-phase plutonium reflected by an annulus of beryllium. The sphere has a radius of 5.0419 cm and contains 4.90 at.% <sup>240</sup>Pu. The beryllium

annulus is 3.6881 cm thick. This benchmark is based on an experiment that was performed at LASL in 1958.

pu-met-fast-019 contains a sphere of plutonium reflected by two hemispherical shells of beryllium. However, the upper shell of beryllium is not in direct contact with the plutonium sphere, and the plutonium sphere contains a central void. The sphere contains 8.15 at.%  $^{240}\text{Pu}$ , and its inner and outer radii are 1.4 cm and 5.35 cm, respectively. The beryllium shells are 5.65 cm thick, and there is a gap of 1.20 cm between the top edge of the bottom shell and the bottom edge of the top shell. There also is a cylindrical void with a radius of 1.1 cm at the center of the upper reflector. The upper reflector is supported by a steel diaphragm, while the sphere and the lower reflector are supported by a copper cup mounted to a steel cylinder. A schematic of this benchmark is presented in Figure 14. This benchmark is based on an experiment that was performed in 1983 and then repeated with some modifications in 1995 the Institute of Technical Physics of the Russian Federal Nuclear Center (VNIITF) at Chelyabinsk-70.

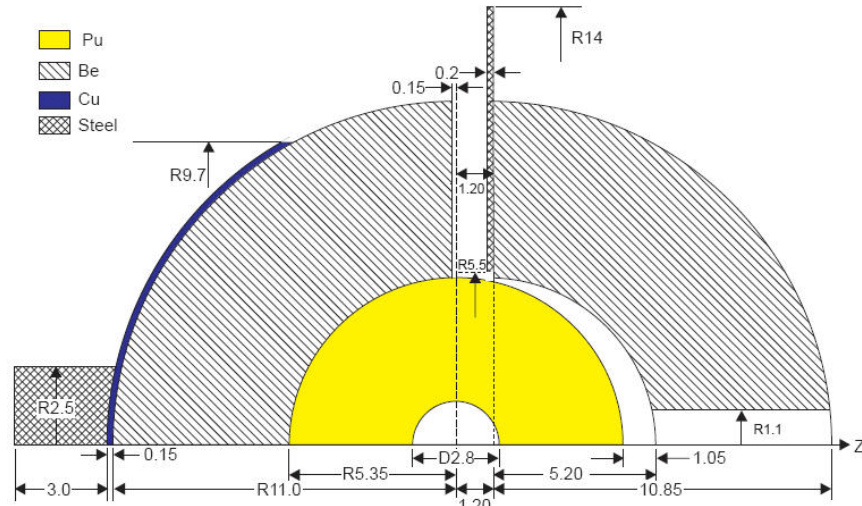


Figure 14. Plutonium Sphere Reflected by Beryllium, pu-met-fast-019

pu-met-fast-020 contains a two hemispheres of plutonium reflected by four hemispherical shells of depleted uranium. However, there is a separation of 0.61 cm between the top of the lower hemisphere and shells and the bottom of the upper hemisphere and shells. The inner and outer radii of the plutonium hemispheres are 1.4 cm and 5.35 cm, respectively, and they contain 8.15 at.%  $^{240}\text{Pu}$ . The inner shells of depleted uranium are 3.8 cm thick, and the outer shells are 3.85 cm thick. The inner hemispherical shells have a central cylindrical void with a radius of 1.75 cm, and the upper outer shell has a central cylindrical void with a radius of 0.5 cm. The upper hemisphere and shells are supported by an iron diaphragm, while the lower hemisphere and shells are supported by a duralumin cup mounted to a duralumin cylinder. A schematic of this benchmark is presented in Figure 15. This benchmark is based on an experiment that was performed at VNIITF in 1980.

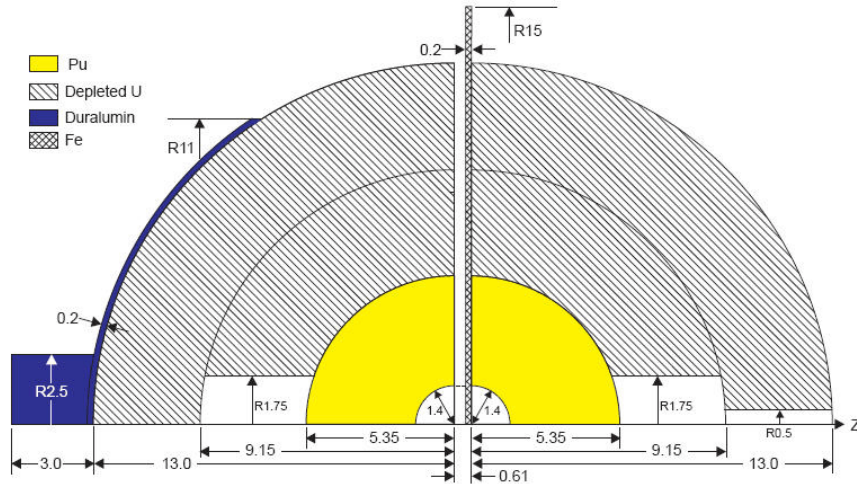


Figure 15. Plutonium Sphere Reflected by Depleted Uranium, pu-met-fast-020

pu-met-fast-021-case-1 and pu-met-fast-021-case-2 contain stacked cylinders of plutonium reflected on the top and bottom by beryllium and beryllium oxide, respectively. The plutonium stack consists of 10 identical steel canisters, each containing a plutonium disk. There is a gap between the fifth and sixth canisters, and the thickness of that gap is different for the two benchmarks. The gap is 0.01 cm thick for -case-1 and 0.24 cm thick for -case-2. Each plutonium disk has a radius of 5.995 cm and is 0.45 cm thick, and it contains 4.57 at.%  $^{240}\text{Pu}$ . The outer radius of the steel canisters is 6.063 cm, and the top and bottom of each canister is 0.02 cm thick. The cylindrical reflectors at the top and bottom of the stack all have a radius of 9.995 cm but slightly different thicknesses. The bottom beryllium reflector is 14.895 cm thick, and the top beryllium reflector is 14.865 cm thick. The bottom beryllium-oxide reflector is 14.94 cm thick, and the top beryllium-oxide reflector is 14.92 cm thick. The entire stack is supported by a duralumin basket, as shown in Figure 16. These two benchmarks are based on experiments that were performed at VNIITF in 1987.

pu-met-fast-022-case-2 contains a bare, homogeneous sphere of plutonium with a central cavity. The inner and outer radii of the sphere are 1.4 cm and 6.67 cm, respectively. The plutonium has 1.80 at.%  $^{240}\text{Pu}$ . This benchmark is based on an experiment that was operated from 1956 through 1965 at the Institute of Experimental Physics of the Russian Federal Nuclear Center (VNIIEF) at Arzamas-16.

pu-met-fast-023-case-2 contains a plutonium sphere reflected by an annulus of graphite. The sphere has a central cavity and is 1.80 at.%  $^{240}\text{Pu}$ . Its inner and outer radii are 1.715 cm and 6 cm, respectively. The thickness of the graphite annulus is 2.35 cm. The benchmark is based on an experiment that was performed at VNIIEF in 1962.



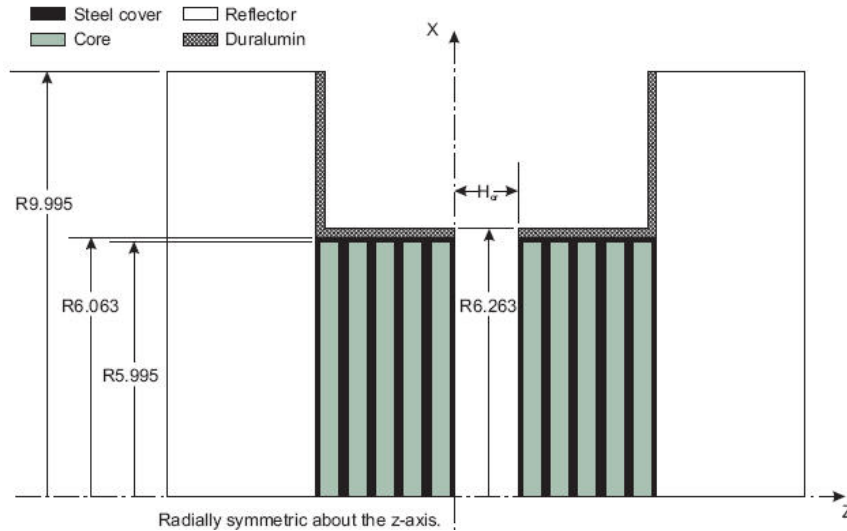


Figure 16. Stacked Plutonium Cylinder Reflected by Beryllium or Beryllium Oxide, pu-met-fast-021-case-1 or pu-met-fast-021-case-2

pu-met-fast-024-case-2 contains a solid, homogeneous sphere of plutonium reflected by an annulus of polyethylene. The radius of the sphere is 6 cm, and it is 1.80 at.%  $^{240}\text{Pu}$ . The thickness of the graphite annulus is 1.55 cm. The benchmark is based on an experiment that was performed at VNIIEF in 1964.

pu-met-fast-025-case-2 and pu-met-fast-026-case-2 both contain a plutonium sphere reflected by steel. In both cases, the sphere is 1.80 at.%  $^{240}\text{Pu}$ . However, the geometries of the two benchmarks are different. pu-met-fast-025-case-2 contains a solid, homogeneous sphere with a radius of 6 cm and a single steel annulus that is 1.55 cm thick. In contrast, the sphere in pu-met-fast-026-case-2 contains a central cavity, and there are two separate steel annuli. The inner and outer radii of that sphere are 0.77 and 5.35 cm, respectively. The inner steel annulus is 5.65 cm thick, and the outer steel annulus is 6.25 cm thick. These benchmarks are based on experiments that were performed at VNIIEF, in 1962 and 1964.

mix-met-fast-001 contains a solid, homogeneous sphere of plutonium reflected by an annulus of HEU. The plutonium sphere has a radius of 5.0419 cm and contains 4.90 at.%  $^{240}\text{Pu}$ . The thickness of the HEU annulus is 1.6637cm, and its enrichment is 93.2 wt.%. This benchmark is based on an experiment that was performed at LASL in 1958.

mix-met-fast-003 contains a sphere of plutonium reflected by two hemispherical shells of HEU. The sphere has a central cavity and contains 9.26 at.%  $^{240}\text{Pu}$ . Its inner and outer radii are 1 cm and 5.35 cm, respectively. The HEU shells have an enrichment of 89.61 wt.% and inner and outer radii of 5.35 cm and 7.55 cm, respectively. However, they both have a cylindrical cavity with a radius of 0.6 cm across their flat surfaces. In addition, the upper shell has a central cavity with a radius of 1.1 cm that runs from the center of its rounded surface to the center of its

flat surface. The bottom HEU shell is in direct contact with the plutonium sphere, but there is a gap of 1.225 cm between the flat surfaces of the upper and lower shells. The upper HEU shell is supported by a duralumin diaphragm, while the sphere and the lower shell are supported by a copper cup mounted to an iron cylinder. A schematic of this benchmark is presented in Figure 17. This benchmark is based on an experiment that was performed at VNIITF in 1992.

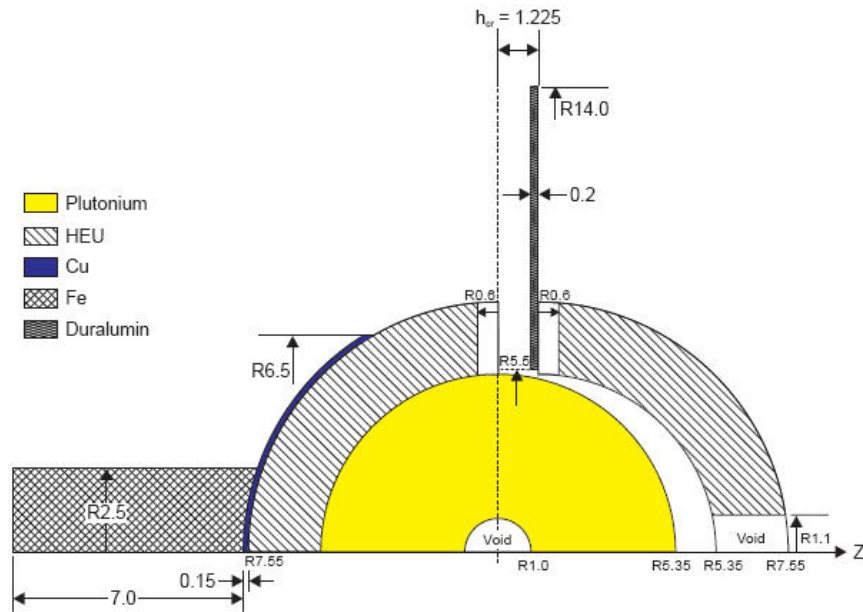


Figure 17. Plutonium sphere reflected by HEU, mix-met-fast-003

## 6.2 Intermediate Plutonium Benchmark

pu-comp-inter-001 is the only plutonium benchmark in the expanded criticality validation suite with an intermediate spectrum. It is based on a  $k_{\infty}$  measurement that was performed at the Atomic Energy Establishment at Winfrith in the late 1960s. Because it is based on a  $k_{\infty}$  measurement, reflecting boundary conditions are imposed on all exterior surfaces. The benchmark is a completely homogeneous mixture of various amounts of plutonium, hydrogen, boron, carbon, oxygen, and calcium.

## 6.3 Thermal Plutonium Benchmarks

mix-comp-therm-002-case-pnl30 through -case-pnl35 are based on a series of MOX lattice experiments that were performed at Pacific Northwest Laboratory (PNL) in 1975 and 1976. Those experiments are known as PNL-30 through PNL-35 and also are the basis for the CSEWG thermal benchmarks T-31 through T-36. The MOX fuel is 2 wt.%  $\text{PuO}_2$  and 98 wt.% normal-uranium  $\text{UO}_2$ . The plutonium contains 7.7 at.%  $^{240}\text{Pu}$ . The radius of the fuel rods is 0.64135 cm, and they are clad in Zircaloy-2. The fuel rods are completely immersed in water,

and the radius of the water is 50 cm. The rectangular lattices have three different lattice pitches, and there is one case with lightly borated water and another with heavily borated water for each pitch. The characteristics of the PNL MOX benchmarks are summarized in Table 14, and diagrams of the cores are shown in Figs. 18 through 22.

Table 14. Characteristics of PNL MOX Benchmarks

Benchmark	Fuel Rods	Pitch (cm)	Soluble Boron (ppm)
mix-comp-therm-002-case-pnl30	469	1.77800	1.7
mix-comp-therm-002-case-pnl31	761	1.77800	687.9
mix-comp-therm-002-case-pnl32	195	2.20914	0.9
mix-comp-therm-002-case-pnl33	761	2.20914	1090.4
mix-comp-therm-002-case-pnl34	161	2.51447	1.6
mix-comp-therm-002-case-pnl35	689	2.51447	767.2

pu-sol-therm-009-case-3a contains an unreflected sphere of plutonium nitrate inside a spherical shell of aluminum 1100. The inner radius of the shell is 60.964 cm, and the shell is 0.77 cm thick. The solution contains 9.457 g/l of plutonium, which produces a solution density of 1.053 g/cm<sup>3</sup>. The plutonium contains 2.51 at.% <sup>240</sup>Pu. This benchmark is based on an experiment performed at PNL in 1978. It is reported that the aluminum 1100 shell is the same one used for ORNL-10 (heu-sol-therm-032) and ORNL-11 (u233-sol-therm-008).

pu-sol-therm-011-case-16-5 contains an unreflected sphere of plutonium nitrate inside a spherical shell of stainless steel 347. The inner radius of the shell is 20.1206 cm, and the shell is 0.127 cm thick. The solution contains 43.43 g/l of plutonium, which produces a solution density of 1.1958 g/cm<sup>3</sup>. The plutonium contains 4.15 at.% <sup>240</sup>Pu. This benchmark is based on the PNL-5 experiment performed at PNL in the early 1950s. That experiment also is the basis for the CSEWG thermal benchmark T-17.

pu-sol-therm-011-case-18-1 and pu-sol-therm-011-case-18-6 both contain an unreflected sphere of plutonium nitrate inside a spherical shell of stainless steel 347 that in turn is covered by a layer of cadmium. In both cases, the inner radius of the shell is 22.6974 cm, the shell is 0.127 cm thick, and the cadmium is 0.0508 cm thick. The plutonium in both cases contains 4.18 at.% <sup>240</sup>Pu. The solution in -case-18-1 contains 22.35 g/l of plutonium, which produces a solution density of 1.0662 g/cm<sup>3</sup>. The solution in -case-18-6 contains 27.49 g/l of plutonium, which produces a solution density of 1.1816 g/cm<sup>3</sup>. These two benchmarks are based on the

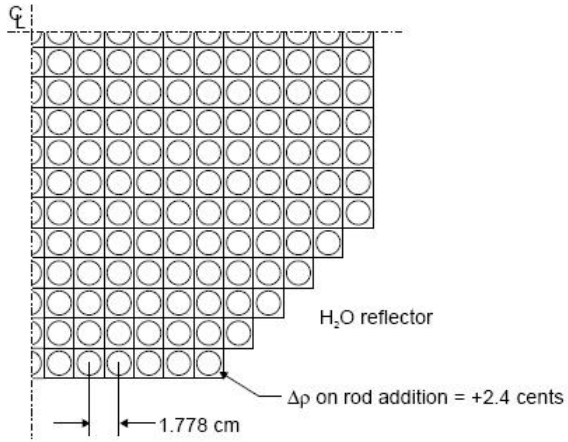


Figure 18. Core Layout for PNL-30

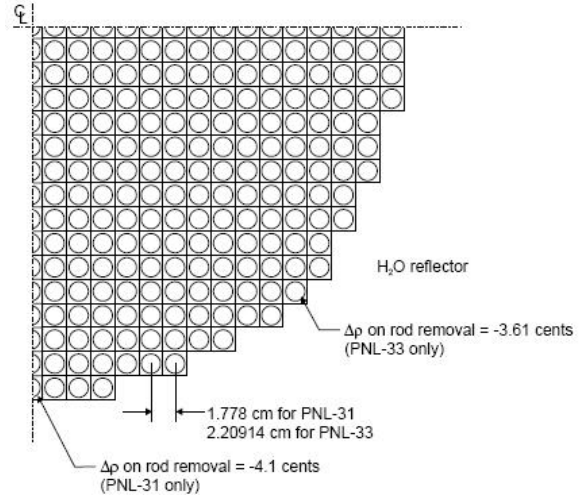


Figure 19. Core Layout for PNL-31 and PNL-33

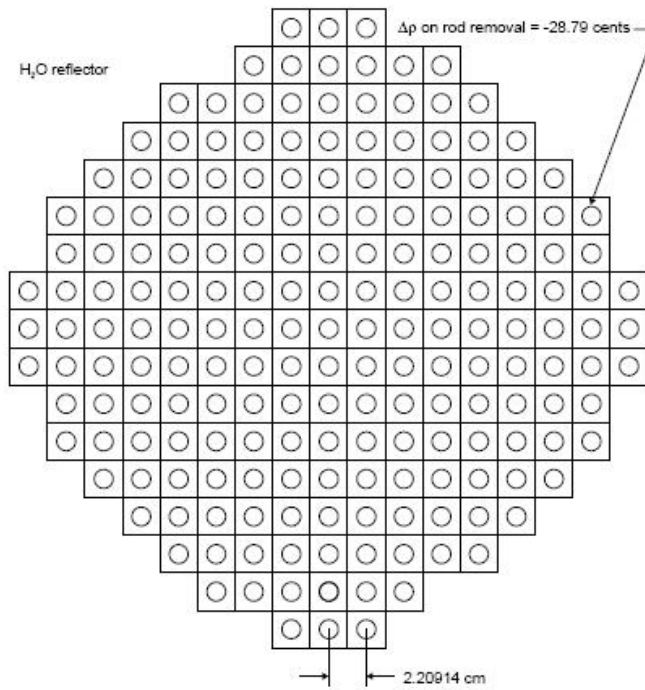


Figure 20. Core Layout for PNL-32

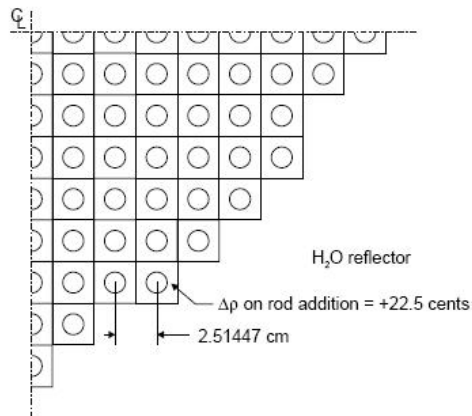


Figure 21. Core Layout for PNL-34

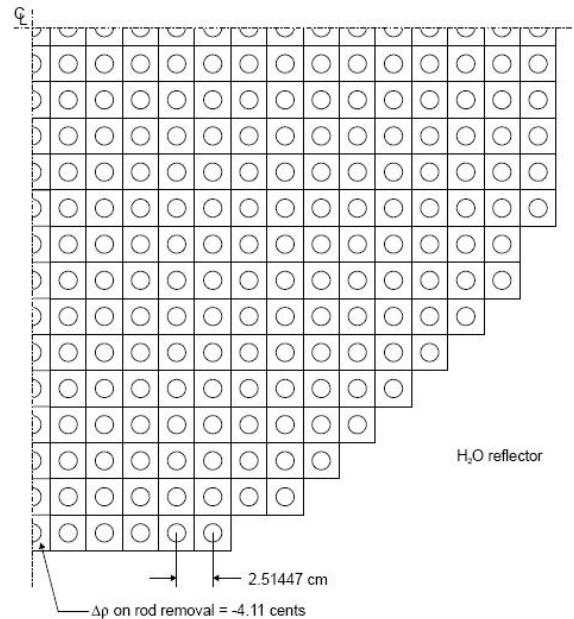


Figure 22. Core Layout for PNL-35

PNL-3 and PNL-4 experiments that were performed at PNL in the early 1950s. Those experiments also are the basis for the CSEWG thermal benchmarks T-15 and T-16, respectively.

pu-sol-therm-018-case-9 contains a water-reflected cylinder of plutonium nitrate in water. The solution is contained in a tank made of stainless steel 304, which has an inner radius of 30.514 cm and is 0.079 cm thick. The water reflector is contained in a second cylindrical tank, also made of stainless steel 304, which has an inner radius of 50.523 cm and a thickness of 0.277 cm. The height of the reflector is 127.630 cm, and the height of the solution is 80.920 cm. The solution contains 40.58 g/l of plutonium, which produces a solution density of 1.1124 g/cm<sup>3</sup>. The distinguishing feature of this benchmark is that the plutonium contains 42.83 at.% <sup>240</sup>Pu. This benchmark is based on the PNL-11 experiment that was performed at PNL in 1971. That experiment also is the basis for the CSEWG thermal benchmark T-29.

pu-sol-therm-021-case-1 contains an unreflected sphere of plutonium nitrate inside a spherical shell of stainless steel. The inner radius of the shell is 19.3304 cm, and the shell is 0.1219 cm thick. The solution contains 39.0 g/l of plutonium, which produces a solution density of 1.081 g/cm<sup>3</sup>. The plutonium contains 4.65 at.% <sup>240</sup>Pu. This benchmark is based on the PNL-1 experiment performed at PNL in 1964. That experiment also is the basis for the CSEWG thermal benchmark T-13.

pu-sol-therm-021-case-3 contains an unreflected sphere of plutonium nitrate inside a spherical shell of stainless steel. The inner radius of the shell is 19.3163 cm, and the shell is 0.1219 cm thick. The solution contains 172.3 g/l of plutonium, which produces a solution

density of 1.4290 g/cm<sup>3</sup>. The plutonium contains 4.65 at.% <sup>240</sup>Pu. This benchmark is based on the PNL-6 experiment performed at PNL in 1964. That experiment also is the basis for the CSEWG thermal benchmark T-24.

pu-sol-therm-034-case-1 contains a water-reflected cylinder of plutonium nitrate in water. The solution is contained in a stainless steel tank that has an inner radius of 30.514 cm and is 0.079 cm thick. The water reflector is contained in a second cylindrical tank, also made of stainless steel, which has an inner radius of 50.523 cm and a thickness of 0.277 cm. The height of the reflector is 127.630 cm, and the height of the solution is 15.44 cm. The solution contains 116 g/l of plutonium, which produces a solution density of 1.2503 g/cm<sup>3</sup>. The plutonium contains 8.35 at.% <sup>240</sup>Pu. This benchmark is based on the PNL-10 experiment that was performed at PNL in 1970 and 1971. That experiment also is the basis for the CSEWG thermal benchmark T-28.

## 7 Calculated Results for Benchmarks

MCNP results for  $k_{\text{eff}}$  for each of the benchmarks are presented in Tables 15 through 19. The results were obtained using ENDF/B-VII.0 and ENDF/B-VI nuclear data. The ENDF/B-VII.0 data are taken from the ENDF70 nuclear data library distributed with MCNP5 1.51. The ENDF/B-VI data are taken from the ACTI<sup>8</sup> and ENDF66<sup>9</sup> nuclear data libraries included in the same distribution. Each of the calculations used a total of 600 generations with 10,000 histories per generation. The results from the first 100 generations were excluded from the statistics. Consequently, the reported result for each case is based on 5,000,000 active neutron histories.

Table 15. MCNP Results for  $^{233}\text{U}$  Benchmarks

Case Name	Benchmark $k_{\text{eff}}$	Calculated $k_{\text{eff}}$	
		ENDF/B-VII.0	ENDF/B-VI
u233-met-fast-001	$1.0000 \pm 0.0010$	$0.9993 \pm 0.0003$	$0.9932 \pm 0.0003$
u233-met-fast-002-case-1	$1.0000 \pm 0.0010$	$0.9987 \pm 0.0003$	$0.9950 \pm 0.0003$
u233-met-fast-002-case-2	$1.0000 \pm 0.0011$	$1.0005 \pm 0.0003$	$0.9975 \pm 0.0003$
u233-met-fast-003-case-1	$1.0000 \pm 0.0010$	$0.9997 \pm 0.0003$	$0.9958 \pm 0.0003$
u233-met-fast-003-case-2	$1.0000 \pm 0.0010$	$1.0001 \pm 0.0003$	$0.9977 \pm 0.0003$
u233-met-fast-004-case-1	$1.0000 \pm 0.0007$	$1.0051 \pm 0.0003$	$1.0017 \pm 0.0003$
u233-met-fast-004-case-2	$1.0000 \pm 0.0008$	$1.0051 \pm 0.0003$	$1.0040 \pm 0.0003$
u233-met-fast-005-case-1	$1.0000 \pm 0.0030$	$0.9944 \pm 0.0003$	$0.9950 \pm 0.0003$
u233-met-fast-005-case-2	$1.0000 \pm 0.0030$	$0.9925 \pm 0.0003$	$0.9967 \pm 0.0003$
u233-met-fast-006	$1.0000 \pm 0.0014$	$0.9994 \pm 0.0003$	$1.0002 \pm 0.0003$
u233-sol-inter-001-case-1	$1.0000 \pm 0.0083$	$0.9848 \pm 0.0005$	$0.9903 \pm 0.0005$
u233-comp-therm-001-case-3	$1.0000 \pm 0.0024$	$1.0045 \pm 0.0005$	$0.9968 \pm 0.0005$
u233-sol-therm-001-case-1	$1.0000 \pm 0.0031$	$1.0015 \pm 0.0003$	$0.9991 \pm 0.0003$
u233-sol-therm-001-case-2	$1.0000 \pm 0.0033$	$1.0011 \pm 0.0003$	$0.9988 \pm 0.0003$
u233-sol-therm-001-case-3	$1.0000 \pm 0.0033$	$1.0009 \pm 0.0003$	$0.9982 \pm 0.0003$
u233-sol-therm-001-case-4	$1.0000 \pm 0.0033$	$1.0019 \pm 0.0003$	$0.9976 \pm 0.0003$
u233-sol-therm-001-case-5	$1.0000 \pm 0.0033$	$0.9996 \pm 0.0003$	$0.9972 \pm 0.0003$
u233-sol-therm-008	$1.0000 \pm 0.0029$	$1.0014 \pm 0.0002$	$0.9975 \pm 0.0002$



Table 16-a. MCNP Results for HEU Benchmarks, Part I

Case Name	Benchmark $k_{\text{eff}}$	Calculated $k_{\text{eff}}$	
		ENDF/B-VII.0	ENDF/B-VI
heu-met-fast-001	$1.0000 \pm 0.0010$	$0.9993 \pm 0.0003$	$0.9962 \pm 0.0003$
heu-met-fast-003-case-1	$1.0000 \pm 0.0050$	$0.9954 \pm 0.0003$	$0.9921 \pm 0.0003$
heu-met-fast-003-case-2	$1.0000 \pm 0.0050$	$0.9942 \pm 0.0003$	$0.9912 \pm 0.0003$
heu-met-fast-003-case-3	$1.0000 \pm 0.0050$	$0.9994 \pm 0.0003$	$0.9972 \pm 0.0003$
heu-met-fast-003-case-4	$1.0000 \pm 0.0030$	$0.9971 \pm 0.0003$	$0.9952 \pm 0.0003$
heu-met-fast-003-case-5	$1.0000 \pm 0.0030$	$1.0008 \pm 0.0003$	$1.0004 \pm 0.0003$
heu-met-fast-003-case-6	$1.0000 \pm 0.0030$	$1.0017 \pm 0.0003$	$1.0004 \pm 0.0003$
heu-met-fast-003-case-6	$1.0000 \pm 0.0030$	$1.0027 \pm 0.0003$	$1.0018 \pm 0.0003$
heu-met-fast-003-case-8	$1.0000 \pm 0.0050$	$1.0081 \pm 0.0003$	$1.0048 \pm 0.0003$
heu-met-fast-003-case-9	$1.0000 \pm 0.0050$	$1.0095 \pm 0.0003$	$1.0063 \pm 0.0003$
heu-met-fast-003-case-10	$1.0000 \pm 0.0050$	$1.0129 \pm 0.0003$	$1.0093 \pm 0.0003$
heu-met-fast-003-case-11	$1.0000 \pm 0.0050$	$1.0166 \pm 0.0003$	$1.0136 \pm 0.0003$
heu-met-fast-003-case-12	$1.0000 \pm 0.0030$	$1.0083 \pm 0.0003$	$1.0043 \pm 0.0003$
heu-met-fast-004-case-1	$1.0020 \pm 0.0010$	$1.0028 \pm 0.0003$	$0.9976 \pm 0.0003$
heu-met-fast-008	$0.9989 \pm 0.0016$	$0.9957 \pm 0.0003$	$0.9924 \pm 0.0003$
heu-met-fast-009-case-1	$0.9992 \pm 0.0015$	$0.9957 \pm 0.0003$	$0.9952 \pm 0.0003$
heu-met-fast-009-case- 2	$0.9992 \pm 0.0015$	$0.9955 \pm 0.0003$	$0.9928 \pm 0.0003$
heu-met-fast-011	$0.9989 \pm 0.0015$	$0.9989 \pm 0.0003$	$0.9946 \pm 0.0003$
heu-met-fast-012	$0.9992 \pm 0.0018$	$0.9982 \pm 0.0003$	$0.9933 \pm 0.0003$
heu-met-fast-013	$0.9990 \pm 0.0015$	$0.9975 \pm 0.0003$	$0.9938 \pm 0.0003$
heu-met-fast-014	$0.9989 \pm 0.0017$	$0.9978 \pm 0.0002$	$0.9939 \pm 0.0002$
heu-met-fast-015	$0.9996 \pm 0.0017$	$0.9943 \pm 0.0003$	$0.9918 \pm 0.0003$

Table 16-b. MCNP Results for HEU Benchmarks, Part II

Case Name	Benchmark $k_{\text{eff}}$	Calculated $k_{\text{eff}}$	
		ENDF/B-VII.0	ENDF/B-VI
heu-met-fast-018-case-2	$1.0000 \pm 0.0014$	$0.9999 \pm 0.0003$	$0.9962 \pm 0.0003$
heu-met-fast-019-case-2	$1.0000 \pm 0.0028$	$1.0074 \pm 0.0003$	$1.0031 \pm 0.0003$
heu-met-fast-020-case-2	$1.0000 \pm 0.0028$	$1.0008 \pm 0.0003$	$0.9968 \pm 0.0003$
heu-met-fast-021-case-2	$1.0000 \pm 0.0024$	$0.9969 \pm 0.0003$	$0.9943 \pm 0.0003$
heu-met-fast-022-case-2	$1.0000 \pm 0.0019$	$0.9977 \pm 0.0003$	$0.9927 \pm 0.0003$
heu-met-fast-026-case-11	$1.0000 \pm 0.0038$	$1.0037 \pm 0.0003$	$1.0002 \pm 0.0004$
heu-met-fast-028	$1.0000 \pm 0.0030$	$1.0032 \pm 0.0003$	$1.0020 \pm 0.0003$
heu-comp-inter-003-case-6	$1.0000 \pm 0.0047$	$0.9951 \pm 0.0003$	$0.9916 \pm 0.0003$
heu-met-inter-006-case-1	$0.9977 \pm 0.0008$	$0.9930 \pm 0.0004$	$0.9914 \pm 0.0003$
heu-met-inter-006-case-2	$0.9997 \pm 0.0008$	$0.9960 \pm 0.0004$	$0.9958 \pm 0.0004$
heu-met-inter-006-case-3	$1.0015 \pm 0.0009$	$1.0006 \pm 0.0004$	$0.9993 \pm 0.0003$
heu-met-inter-006-case-4	$1.0016 \pm 0.0008$	$1.0075 \pm 0.0003$	$1.0050 \pm 0.0004$
u233-comp-therm-001-case-6	$1.0015 \pm 0.0028$	$0.9991 \pm 0.0004$	$0.9976 \pm 0.0004$
heu-sol-therm-013-case-1	$1.0012 \pm 0.0026$	$0.9985 \pm 0.0003$	$0.9988 \pm 0.0003$
heu-sol-therm-013-case- 2	$1.0007 \pm 0.0036$	$0.9975 \pm 0.0003$	$0.9981 \pm 0.0003$
heu-sol-therm-013-case-3	$1.0009 \pm 0.0036$	$0.9942 \pm 0.0003$	$0.9945 \pm 0.0003$
heu-sol-therm-013-case-4	$1.0003 \pm 0.0036$	$0.9957 \pm 0.0003$	$0.9965 \pm 0.0003$
heu-sol-therm-032	$1.0015 \pm 0.0026$	$0.9991 \pm 0.0002$	$0.9993 \pm 0.0002$

Table 17. MCNP Results for IEU Benchmarks

Case Name	Benchmark $k_{\text{eff}}$	Calculated $k_{\text{eff}}$	
		ENDF/B-VII.0	ENDF/B-VI
ieu-met-fast-001-case-1	$0.9989 \pm 0.0010$	$1.0009 \pm 0.0003$	$0.9964 \pm 0.0003$
ieu-met-fast-001-case-2	$0.9997 \pm 0.0010$	$1.0013 \pm 0.0003$	$0.9967 \pm 0.0003$
ieu-met-fast-001-case-3	$0.9993 \pm 0.0005$	$1.0014 \pm 0.0003$	$0.9978 \pm 0.0003$
ieu-met-fast-001-case-4	$1.0002 \pm 0.0005$	$1.0015 \pm 0.0003$	$0.9979 \pm 0.0003$
ieu-met-fast-002	$1.0000 \pm 0.0030$	$0.9991 \pm 0.0003$	$1.0033 \pm 0.0003$
ieu-met-fast-003-case-2	$1.0000 \pm 0.0017$	$1.0029 \pm 0.0003$	$0.9994 \pm 0.0003$
ieu-met-fast-004-case-2	$1.0000 \pm 0.0030$	$1.0075 \pm 0.0003$	$1.0040 \pm 0.0003$
ieu-met-fast-005-case-2	$1.0000 \pm 0.0021$	$1.0018 \pm 0.0003$	$0.9994 \pm 0.0003$
ieu-met-fast-006-case-2	$1.0000 \pm 0.0023$	$0.9957 \pm 0.0003$	$0.9912 \pm 0.0003$
ieu-met-fast-007-case-4	$1.0049 \pm 0.0008$	$1.0049 \pm 0.0002$	$1.0164 \pm 0.0002$
mix-met-fast-008-case-7	$1.0030 \pm 0.0025$	$1.0193 \pm 0.0002$	$1.0402 \pm 0.0002$
ieu-comp-therm-002-case-3	$1.0017 \pm 0.0044$	$1.0045 \pm 0.0004$	$1.0002 \pm 0.0005$
leu-sol-therm-007-case-14	$0.9961 \pm 0.0009$	$0.9950 \pm 0.0003$	$0.9955 \pm 0.0003$
leu-sol-therm-007-case-30	$0.9973 \pm 0.0009$	$0.9977 \pm 0.0003$	$0.9972 \pm 0.0003$
leu-sol-therm-007-case-32	$0.9985 \pm 0.0010$	$0.9958 \pm 0.0003$	$0.9958 \pm 0.0003$
leu-sol-therm-007-case-36	$0.9988 \pm 0.0011$	$0.9986 \pm 0.0003$	$0.9984 \pm 0.0003$
leu-sol-therm-007-case-49	$0.9983 \pm 0.0011$	$0.9975 \pm 0.0003$	$0.9975 \pm 0.0003$

Table 18. MCNP Results for LEU Benchmarks

Case Name	Benchmark $k_{\text{eff}}$	Calculated $k_{\text{eff}}$	
		ENDF/B-VII.0	ENDF/B-VI
leu-comp-therm-008-case-1	$1.0007 \pm 0.0016$	$1.0012 \pm 0.0003$	$0.9970 \pm 0.0003$
leu-comp-therm-008-case-2	$1.0007 \pm 0.0016$	$1.0013 \pm 0.0003$	$0.9967 \pm 0.0003$
leu-comp-therm-008-case-5	$1.0007 \pm 0.0016$	$1.0007 \pm 0.0003$	$0.9977 \pm 0.0003$
leu-comp-therm-008-case-7	$1.0007 \pm 0.0016$	$1.0003 \pm 0.0003$	$0.9969 \pm 0.0003$
leu-comp-therm-008-case-8	$1.0007 \pm 0.0016$	$1.0007 \pm 0.0003$	$0.9965 \pm 0.0003$
leu-comp-therm-008-case-11	$1.0007 \pm 0.0016$	$1.0020 \pm 0.0003$	$0.9973 \pm 0.0003$
leu-sol-therm-002-case-1	$1.0038 \pm 0.0040$	$1.0000 \pm 0.0003$	$0.9988 \pm 0.0003$
leu-sol-therm-002-case-2	$1.0024 \pm 0.0037$	$0.9959 \pm 0.0003$	$0.9957 \pm 0.0003$

Table 19-a. MCNP Results for Plutonium Benchmarks, Part I

Case Name	Benchmark $k_{\text{eff}}$	Calculated $k_{\text{eff}}$	
		ENDF/B-VII.0	ENDF/B-VI
pu-met-fast-001	$1.0000 \pm 0.0020$	$1.0000 \pm 0.0003$	$0.9973 \pm 0.0003$
pu-met-fast-002	$1.0000 \pm 0.0020$	$0.9999 \pm 0.0003$	$0.9979 \pm 0.0003$
pu-met-fast-003-case-103	$1.0000 \pm 0.0030$	$0.9981 \pm 0.0003$	$0.9961 \pm 0.0003$
pu-met-fast-005	$1.0000 \pm 0.0013$	$1.0092 \pm 0.0003$	$1.0078 \pm 0.0003$
pu-met-fast-006	$1.0000 \pm 0.0030$	$0.9995 \pm 0.0003$	$1.0021 \pm 0.0003$
pu-met-fast-008-case-2	$1.0000 \pm 0.0006$	$0.9977 \pm 0.0003$	$1.0039 \pm 0.0003$
pu-met-fast-009	$1.0000 \pm 0.0027$	$1.0053 \pm 0.0003$	$1.0017 \pm 0.0003$
pu-met-fast-010	$1.0000 \pm 0.0018$	$1.0001 \pm 0.0003$	$0.9986 \pm 0.0003$
pu-met-fast-011	$1.0000 \pm 0.0010$	$1.0002 \pm 0.0003$	$0.9963 \pm 0.0003$
pu-met-fast-018	$1.0000 \pm 0.0030$	$0.9965 \pm 0.0003$	$0.9990 \pm 0.0003$
pu-met-fast-019	$0.9992 \pm 0.0015$	$0.9975 \pm 0.0003$	$1.0011 \pm 0.0003$
pu-met-fast-020	$0.9993 \pm 0.0017$	$0.9981 \pm 0.0003$	$0.9978 \pm 0.0003$
pu-met-fast-021-case-1	$1.0000 \pm 0.0026$	$1.0021 \pm 0.0003$	$1.0039 \pm 0.0003$
pu-met-fast-021-case-2	$1.0000 \pm 0.0026$	$0.9932 \pm 0.0003$	$0.9927 \pm 0.0003$
pu-met-fast-022	$1.0000 \pm 0.0021$	$0.9983 \pm 0.0003$	$0.9960 \pm 0.0003$
pu-met-fast-023	$1.0000 \pm 0.0020$	$0.9993 \pm 0.0003$	$0.9976 \pm 0.0003$
pu-met-fast-024	$1.0000 \pm 0.0020$	$1.0019 \pm 0.0003$	$1.0001 \pm 0.0003$
pu-met-fast-025	$1.0000 \pm 0.0020$	$0.9988 \pm 0.0003$	$0.9966 \pm 0.0003$
pu-met-fast-026	$1.0000 \pm 0.0024$	$0.9985 \pm 0.0003$	$0.9968 \pm 0.0003$
mix-met-fast-001	$1.0000 \pm 0.0016$	$0.9993 \pm 0.0003$	$0.9969 \pm 0.0003$
mix-met-fast-003	$0.9993 \pm 0.0016$	$1.0008 \pm 0.0003$	$0.9979 \pm 0.0003$
pu-comp-inter-001	$1.0000 \pm 0.0110$	$1.0116 \pm 0.0002$	$1.0107 \pm 0.0002$

Table 19-b. MCNP Results for Plutonium Benchmarks, Part II

Case Name	Benchmark $k_{\text{eff}}$	Calculated $k_{\text{eff}}$	
		ENDF/B-VII.0	ENDF/B-VI
mix-comp-therm-002-case-pnl30	$1.0024 \pm 0.0060$	$1.0010 \pm 0.0003$	$0.9932 \pm 0.0003$
mix-comp-therm-002-case-pnl31	$1.0009 \pm 0.0047$	$1.0028 \pm 0.0003$	$0.9967 \pm 0.0003$
mix-comp-therm-002-case-pnl32	$1.0042 \pm 0.0031$	$1.0032 \pm 0.0003$	$0.9960 \pm 0.0003$
mix-comp-therm-002-case-pnl33	$1.0024 \pm 0.0021$	$1.0079 \pm 0.0003$	$1.0032 \pm 0.0003$
mix-comp-therm-002-case-pnl34	$1.0038 \pm 0.0025$	$1.0046 \pm 0.0003$	$0.9999 \pm 0.0003$
mix-comp-therm-002-case-pnl35	$1.0029 \pm 0.0027$	$1.0068 \pm 0.0003$	$1.0026 \pm 0.0003$
pu-sol-therm-009-case-3a	$1.0000 \pm 0.0033$	$1.0190 \pm 0.0002$	$1.0186 \pm 0.0002$
pu-sol-therm-011-case-16-5	$1.0000 \pm 0.0052$	$1.0060 \pm 0.0004$	$1.0054 \pm 0.0004$
pu-sol-therm-011-case-18-1	$1.0000 \pm 0.0052$	$0.9944 \pm 0.0004$	$0.9954 \pm 0.0003$
pu-sol-therm-011-case-18-6	$1.0000 \pm 0.0052$	$0.9996 \pm 0.0004$	$1.0010 \pm 0.0004$
pu-sol-therm-018-case-9	$1.0000 \pm 0.0034$	$1.0031 \pm 0.0003$	$1.0033 \pm 0.0003$
pu-sol-therm-021-case-1	$1.0000 \pm 0.0032$	$1.0043 \pm 0.0004$	$1.0051 \pm 0.0004$
pu-sol-therm-021-case-3	$1.0000 \pm 0.0065$	$1.0044 \pm 0.0005$	$1.0032 \pm 0.0004$
pu-sol-therm-034-case-1	$1.0000 \pm 0.0062$	$0.9999 \pm 0.0004$	$0.9978 \pm 0.0004$

## 8. References

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5. *Cross Section Evaluation Working Group Benchmark Specifications*, Brookhaven National Laboratory report BNL-19302, ENDF-202 (Rev., September 1986).
6. Russell D. Mosteller, "Validation Suites for MCNP," *Proceedings of the American Nuclear Society Radiation Protection and Shielding Division 12<sup>th</sup> Biennial Topical Meeting*, Santa Fe, New Mexico, USA (April 2002).
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8. Stephanie C. Frankle, Robert C. Reedy, and Phillip G. Young, "ACTI: An MCNP Data Library for Prompt Gamma-Ray Spectroscopy," *Proceedings of the American Nuclear Society Radiation Protection and Shielding Division 12<sup>th</sup> Biennial Topical Meeting*, Santa Fe, New Mexico, USA (April 2002).
9. JoAnn M. Campbell, Stephanie C. Frankle, and Robert C. Little, "ENDF66: A Continuous-Energy Neutron Data Library for MCNP4C," *Proceedings of the American Nuclear Society Radiation Protection and Shielding Division 12<sup>th</sup> Biennial Topical Meeting*, Santa Fe, New Mexico, USA (April 2002).

## Appendix

### Listings of Input Files for Benchmarks

MCNP input files for each of the 119 benchmarks in the expanded criticality validation suite are given below. The files are intended for use with the endf70 data library distributed with MCNP5. However, the lines necessary to use the files with the endf66 and acti libraries are included as comment lines. Consequently, a user who wishes to run ENDF/B-VI rather than ENDF/B-VII.0 calculations can do so by converting those commented lines to active lines and commenting the corresponding ENDF/B-VII.0 lines to make them inactive. The user also must make certain that the correct nuclear data libraries and, if required, thermal scattering laws are employed. ENDF/B-VI calculations should use the acti (.62c) library, supplemented by the endf66 (.66c) library for nuclides not in that library. The ENDF/B-VI thermal scattering laws should be taken from the SAB2002 library (.60t).

#### A.1 <sup>233</sup>U Input Files

The input files for the <sup>233</sup>U benchmarks are given in Tables A-1 through A-18.

Table A-1. Input file for u233-met-fast-001

```
Jezebel-233  U233-MET-FAST-001  solid bare U-233 sphere  CSEWG F-19
1            1            0.047602            -1            $ U-233 Sphere
2            0
1
1            so            5.9838
kcode       10000  1.0  100  600
imp:n       1.0  0.0
sdef        cel=1  erg=d1
spl         -3
totnu
ml          92233.70c      4.6712e-2
           92234.70c      5.9026e-4
           92235.70c      1.4281e-5
           92238.70c      2.8561e-4

end of input
```



Table A-2. Input file for u233-met-fast-002-case-1

```
0.481" HEU REFLECTED U-233 SPHERE, PLANET: U233-MET-FAST-002
1 1 0.0481098 -1 imp:n=1
2 2 0.048126 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 5.0444
2 so 6.2661

c      Materials specified with atom densities
m1  92233.70c 0.047253
    92234.70c 0.00052705
    92238.70c 0.00032975
m2  92238.70c 0.0032340
    92235.70c 0.044892
kcode 10000 1. 100 600
ksrc 0. 0. 0.
c print
```

Table A-3. Input file for u233-met-fast-002-case-2

```
0.783" HEU REFLECTED U-233 SPHERE, PLANET: U233-MET-FAST-002
1 1 0.04816985 -1 imp:n=1
2 2 0.048126 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 4.5999
2 so 6.5887

c      Materials specified with atom densities
m1  92233.70c 0.047312
    92234.70c 0.00052770
    92238.70c 0.00033015
m2  92238.70c 0.0032340
    92235.70c 0.044892
kcode 10000 1. 100 600
ksrc 0. 0. 0.
c print
```

Table A-4. Input file for u233-met-fast-003-case-1

```
0.906" NU REFLECTED U-233 SPHERE, 10 KG EXP, PLANET: U233-MET-FAST-003 Case 1
1 1 0.0481098 -1 imp:n=1
2 2 0.04786702 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 5.0444
2 so 7.3456

c      Materials specified with atom densities
m1     92233.70c 0.047253
       92234.70c 0.00052705
       92238.70c 0.00032975
m2     92238.70c 0.047518
       92235.70c 0.00034902
kcode 10000 1. 100 600
ksrc 0. 0. 0.
c print
```

Table A-5. Input file for u233-met-fast-003-case-2

```
2.09" NU REFLECTED U-233 SPHERE, 7.6 KG EXP, PLANET: U233-MET-FAST-003 Case 2
1 1 0.04816985 -1 imp:n=1
2 2 0.04786702 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 4.5999
2 so 9.9085

c      Materials specified with atom densities
m1     92233.70c 0.047312
       92234.70c 0.00052770
       92238.70c 0.00033015
m2     92238.70c 0.047518
       92235.70c 0.00034902
kcode 10000 1. 100 600
ksrc 0. 0. 0.
c print
```

Table A-6. Input file for u233-met-fast-004-case-1

```
W REFLECTED 10.012 kg U-233 SPHERE, PLANET: U233-FAST-MET-004, CASE 1
1 1 0.0481098 -1 imp:n=1
2 2 0.06605308 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 5.0444
2 so 7.4828

c      Materials specified with atom densities
m1  92233.70c 0.047253
    92234.70c 0.00052705
    92238.70c 0.00032975
m2  74182.70c 1.35361e-02
    74183.70c 7.34963e-03
    74184.70c 1.58007e-02
    74186.70c 1.47198e-02
    28058.70c 6.63066-3
    28060.70c 2.53494-3
    28061.70c 1.09750-4
    28062.70c 3.48675-4
    28064.70c 8.83828-5
    29063.70c 2.82034-3
    29065.70c 1.25706-3
    40090.70c 4.09172E-04
    40091.70c 8.92304E-05
    40092.70c 1.36391E-04
    40094.70c 1.38220E-04
    40096.70c 2.22678E-05
kcode 10000 1. 100 600
ksrc 0. 0. 0.
c print
totnu
```

Table A-7. Input file for u233-met-fast-004-case-2

```

W REFLECTED 7.601 kg U-233 SPHERE, PLANET: U233-FAST-MET-004, CASE 2
1 1 0.04816985 -1 imp:n=1
2 2 0.06605308 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 4.5999
2 so 10.3911

c      Materials specified with atom densities
m1  92233.70c 0.047312
    92234.70c 0.00052770
    92238.70c 0.00033015
m2  74182.70c 1.35361e-02
    74183.70c 7.34963e-03
    74184.70c 1.58007e-02
    74186.70c 1.47198e-02
    28058.70c 6.63066-3
    28060.70c 2.53494-3
    28061.70c 1.09750-4
    28062.70c 3.48675-4
    28064.70c 8.83828-5
    29063.70c 2.82034-3
    29065.70c 1.25706-3
    40090.70c 4.09172E-04
    40091.70c 8.92304E-05
    40092.70c 1.36391E-04
    40094.70c 1.38220E-04
    40096.70c 2.22678E-05
kcode 10000 1. 100 600
ksrc 0. 0. 0.
c print
totnu

```

Table A-8. Input file for u233-met-fast-005-case-1

```

BERYLLIUM REFLECTED 10.012 kg U-233 SPHERE, U233-MET-FAST-005, CASE-1
1 1 0.048110 -1 imp:n=1
2 2 0.121208 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 5.0444
2 so 7.0891

c      Materials specified with atom densities
m1  92233.70c 4.7253e-2 92234.70c 5.2705e-4
    92238.70c 3.2975e-4
m2  4009.70c 1.1984e-1
    8016.70c 1.3776e-3 8017.70c 5.5104e-7
mt2 be.10t
kcode 10000 1. 100 600
ksrc 0. 0. 0.

```

Table A-9. Input file for u233-met-fast-005-case-2

```

BERYLLIUM REFLECTED 7.601 kg U-233 SPHERE, U233-MET-FAST-005, CASE 2
1      1      0.048170      -1      $ U-233 Sphere
2      2      0.121208      1  -2  $ Be Reflector
3      0

```

```

1      so      4.5999
2      so      8.7960

```

```

kcode  10000  1.0  100  600
imp:n   1.0    1.0  0.0
sdef    cel=1  erg=d1
spl     -3
totnu
c       Uranium (98.2 wt.% U-233)
m1      92233.70c  4.7312e-2      92234.70c  5.2770e-4
        92238.70c  3.3015e-4
c       Beryllium Reflector
m2      4009.70c  1.1984e-1
        8016.70c  1.3770e-3      8017.70c  5.5104e-7
mt2     be.10t
prdmp   j      575

```

end of input

Table A-10. Input file for u233-met-fast-006

```

U-233 SPHERE Reflected by Normal Uranium, FLATTOP-23: U233-MET-FAST-006
1 1 0.047591468 -1 imp:n=1
2 2 0.0480675 1 -2 imp:n=1
3 0 2 imp:n=0

```

```

1 so 4.2058
2 so 24.1194

```

```

c       Materials specified with atom densities
m1      92233.70c 0.046710
        92234.70c 0.00058772
        92235.70c 0.000014158
        92238.70c 0.00027959
m2      92235.70c 0.00035050
        92238.70c 0.047719
kcode  10000  1. 100 600
ksrc   0. 0. 0.

```

Table A-11. Input file for u233-sol-inter-001-case-1

```

Falstaff Case 1 U233-SOL-INTER-001 IEU Fluoride Solution reflected by Be
1 1 0.094214 -1 $ IEU Fluoride
2 2 0.086952 1 -2 $ SS Shell
3 3 0.12161 2 -3 $ Be Reflector
4 0 3

1 so 7.8726 $ IR of Shell
2 so 7.9209 $ OR of Shell
3 so 15.9209 $ OR of Be

kcode 10000 1.0 100 600
imp:n 1.0 1.0 1.0 0.0
sdef cel=1 erg=d1 rad=d2 pos=0.0 0.0 0.0
sp1 -3
si2 0.0 7.8726
sp2 -21 2
vol 2043.82 37.85 14822.41 0.0
area 778.84 788.42 3185.26
c IEU Fluoride Solution
m1 1001.70c 5.5183e-02
8016.70c 3.2030e-02 8017.70c 1.2817e-05
9019.70c 4.7182e-03
92232.70c 4.5608e-08 92233.70c 2.2379e-03
92234.70c 2.4316e-05 92235.70c 8.9598e-07
92238.70c 7.1284e-06
mt1 lwtr.10t
c Stainless Steel
m2 24050.70c 7.2466e-04 24052.70c 1.3974e-02
24053.70c 1.5844e-03 24054.70c 3.9443e-04
26054.70c 3.6136e-03 26056.70c 5.6177e-02
26057.70c 1.2862e-03 26058.70c 1.7149e-04
28058.70c 6.1623e-03 28060.70c 2.3559e-03
28061.70c 1.0200e-04 28062.70c 3.2405e-04
28064.70c 8.2140e-05
c Beryllium
m3 4009.70c 1.2161e-01
mt3 be.10t
totnu

end of input

```

Table A-12. Input file for u233-comp-therm-001-case-3

```

BAPL SB Criticals Core 2 1/2 Full U-233 Core U233-COMP-THERM-001 Case 3
c Universe 1: Fuel Pin Cell
1 5 0.080898 -2 7 -9 u=1 $ Fuel Pin
2 1 0.043036 -2 -7 u=1 $ ENDF/B-VII.0 Bottom End Plug
c 2 1 0.042537 -2 -7 u=1 $ ENDF/B-VI Bottom End Plug
3 1 0.043036 -2 9 u=1 $ ENDF/B-VII.0 Top End Plug
c 3 1 0.042537 -2 9 u=1 $ ENDF/B-VI Top End Plug
4 0 2 -3 u=1 $ Void
5 1 0.043036 3 -4 u=1 $ ENDF/B-VII.0 Cladding
c 5 1 0.042537 3 -4 u=1 $ ENDF/B-VI Cladding
6 3 0.100103 4 u=1 $ Water
7 4 0.088821 8 -11 13 -16 19 -20 $ Control Blade D
8 4 0.088821 8 -11 13 -16 21 -22 $ Control Blade C
9 4 0.088821 8 -11 13 -16 25 -26 $ Control Blade B
10 4 0.088821 8 -11 13 -16 27 -28 $ Control Blade A
11 0 -15 14 -24 23 lat=1 u=2
fill=-8:7 -9:8 0:0 1 287r $ Fuel Pin Array
12 0 12 -17 18 -29 6 -10
#7 #8 #9 #10 fill=2 $ Core
13 3 0.100103 -1 10 -11
#7 #8 #9 #10 $ Top Reflector
14 3 0.100103 -1 5 -6 $ Bottom Reflector
15 3 0.100103 -1 6 -10 -12 $ Left Reflector
16 3 0.100103 -1 6 -10 17 $ Right Reflector
17 3 0.100103 -1 6 -10 12 -17 -18 $ Front Reflector
18 3 0.100103 -1 6 -10 12 -17 29 $ Back Reflector
19 0 1:-5:11

1 cz 42.18 $ Reflector Outer Radius
2 c/z 0.45974 0.45974 0.26797 $ Fuel Outer Radius
3 c/z 0.45974 0.45974 0.27940 $ Clad Inner Radius
4 c/z 0.45974 0.45974 0.32385 $ Clad Outer Radius
5 pz -56.2991 $ Bottom of Relector
6 pz -25.8191 $ Bottom of End Plug
7 pz -19.05 $ Bottom of Fuel
8 pz 16.05 $ Bottom of Control Blades
9 pz 19.05 $ Top of Fuel
10 pz 25.8191 $ Top of End Plug
11 pz 56.2991 $ Top of Reflector
12 px -7.35584 $ Left Edge of Core
13 px -3.81 $ Left Edge of Control Blades
14 px 0.0 $ Left Edge of Cell
15 px 0.91948 $ Right Edge of Cell
16 px 3.81 $ Right Edge of Control Blades
17 px 7.35584 $ Right Edge of Core
18 py -8.27532 $ Front Edge of Core
19 py -5.60578 $ Front Edge of Control Blade D
20 py -5.42798 $ Back Edge of Control Blade D
21 py -1.92786 $ Front Edge of Control Blade C
22 py -1.75006 $ Back Edge of Control Blade C
23 py 0.0 $ Front Edge of Cell
24 py 0.91948 $ Back Edge of Cell
25 py 1.75006 $ Front Edge of Control Blade B
26 py 1.92786 $ Back Edge of Control Blade B
27 py 5.42798 $ Front Edge of Control Blade A

```

Table A-12. Input file for u233-comp-therm-001-case-3 (Cont'd)

```

28 py 5.60578 $ Back Edge of Control Blade A
29 py 8.27532 $ Back Edge of Core

mode n
kcode 10000 1.0 100 600
rand hist=3147300
imp:n 1.0 17r 0.0
totnu
sdef x=d1 y=d2 z=d3
si1 -7.1 7.1
sp1 0 1
si2 -8.2 8.2
sp2 0 1
si3 -19.0 19.0
sp3 0 1
c Zircaloy-2 Cladding
m1 40090.70c 2.1885e-2 40091.70c 4.7727e-3
40092.70c 7.2951e-3 40094.70c 7.3929e-3
40096.70c 1.1910e-3
50112.70c 4.8420e-6 50114.70c 3.2447e-6 $ ENDF/B-VII.0
50115.70c 1.6972e-6 50116.70c 7.2581e-5 $ ENDF/B-VII.0
50117.70c 3.8337e-5 50118.70c 1.2090e-4 $ ENDF/B-VII.0
50119.70c 4.2880e-5 50120.70c 1.6268e-4 $ ENDF/B-VII.0
50122.70c 2.3112e-5 50124.70c 2.8902e-5 $ ENDF/B-VII.0
c Polyethylene (0.9183 g/cc) N-tot=0.11828
m2 1001.70c 7.8854e-2
6000.70c 3.9427e-2
mt2 poly.10t
c Water at 20 Degrees C (0.9982 g/cc) N-tot=0.100103
m3 1001.70c 6.6735e-2
8016.70c 3.3355e-2 8017.70c 1.3347e-5
mt3 lwtr.10t
c Borated Steel for Control Blade N-tot=0.088821
m4 5010.70c 3.7488e-3
24050.70c 7.5725e-4 24052.70c 1.4603e-2
24053.70c 1.6557e-3 24054.70c 4.1217e-4
25055.70c 8.6816e-4
26054.70c 3.4963e-3 26056.70c 5.4352e-2
26057.70c 1.2444e-3 26058.70c 1.6593e-4
28058.70c 5.1319e-3 28060.70c 1.9620e-3
28061.70c 8.4943e-5 28062.70c 2.6986e-4
28064.70c 6.8406e-5
c UO2-ZrO2 Seed Fuel (97.19 w/o U-233) N-tot=0.080898
m5 8016.70c 5.3910e-2 8017.70c 2.1573e-5
40090.70c 1.1765e-2 40091.70c 2.5657e-3
40092.70c 3.9217e-3 40094.70c 3.9743e-3
40096.70c 6.4028e-4
92233.70c 3.9891e-3 92234.70c 6.3690e-5
92238.70c 4.5759e-5

end of input

```



Table A-13. Input file for u233-sol-therm-001-case-1

```

CSEWG: ORNL-5 1.0226 g/l Unreflected 27.24" Sphere; U233-SOL-THERM-001 #1
 1  1  0.099998 -1      $ Spherical Solution U(NO3)2-H2O
 2  2  0.060275 1 -2    $ Spherical Shell of Al-1100
 3  0  2

 1 so 34.595          $ Inner Radius of Al-1100 Sphell
 2 so 34.915          $ Outer RADIUS of Al-1100 Sphell

mode n
imp:n 1 1 0
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad d1
sc1 Spherical Source
sil 34.595
c Solution
c      Materials specified with atom densities
m1    1001.70c  6.6271e-02
      7014.70c  1.1819e-04
      8016.70c  3.3551e-02      8017.70c  1.3426e-05
      90232.70c 1.9639e-07      92233.70c  4.3271e-05
      92234.70c 7.1442e-07      92235.70c  1.7565e-08
      92238.70c 2.7748e-07
c Al-1100
m2    13027.70c 5.9881e-02
      14028.70c 2.0097E-04      14029.70c  1.0176E-05
      14030.70c 6.7549E-06
      25055.70c 1.4853e-05
      26054.70c 6.4652e-06      26056.70c  1.0051e-04
      26057.70c 2.3012e-06      26058.70c  3.0682e-07
      29063.70c 3.5528e-05      29065.70c  1.5836e-05
mt1   lwtr.10t
totnu

```

Table A-14. Input file for u233-sol-therm-001-case-2

```

CSEWG: ORNL-6 1.0253 g/l Unreflected 27.24" Sphere; U233-SOL-THERM-001 #2
1 1 0.10016 -1 $ Spherical Solution U(NO3)2-H2O
2 2 0.060275 1 -2 $ Spherical Shell of Al-1100
3 0 2

1 so 34.595 $ Inner Radius of Al-1100 Sphell
2 so 34.915 $ Outer RAdius of Al-1100 Sphell

mode n
imp:n 1 1 0
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad d1
sc1 Spherical Source
sil 34.595
c Solution
c Materials specified with atom densities
m1 1001.70c 6.6362e-02
5010.70c 2.6481e-07 5011.70c 1.0659e-06
7014.70c 1.2248e-04
8016.70c 3.3615e-02 8017.70c 1.3451e-05
90232.70c 2.0489e-07
92233.70c 4.5093e-05 92234.70c 7.4451e-07
92235.70c 1.8305e-08 92238.70c 2.8917e-07
c Al-1100
m2 13027.70c 5.9881e-02
14028.70c 2.0097E-04 14029.70c 1.0176E-05
14030.70c 6.7549E-06
25055.70c 1.4853e-05
26054.70c 6.4652e-06 26056.70c 1.0051e-04
26057.70c 2.3012e-06 26058.70c 3.0682e-07
29063.70c 3.5528e-05 29065.70c 1.5836e-05
mt1 lwtr.10t
totnu
c print

```

Table A-15. Input file for u233-sol-therm-001-case-3

```

CSEWG: ORNL-7 1.0274 g/l Unreflected 27.24" Sphere; U233-SOL-THERM-001 #3
1 1 0.10026 -1 $ Spherical Solution U(NO3)2-H2O
2 2 0.060275 1 -2 $ Spherical Shell of Al-1100
3 0 2

1 so 34.595 $ Inner Radius of Al-1100 Sphell
2 so 34.915 $ Outer RAdius of Al-1100 Sphell

mode n
imp:n 1 1 0
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad d1
sc1 Spherical Source
sil 34.595
c Solution
c Materials specified with atom densities
m1 1001.70c 6.6413e-02
    5010.70c 5.1591e-07
    5011.70c 2.0766e-06
    7014.70c 1.2772e-04
    8016.70c 3.3661e-02      8017.70c 1.3470e-05
    90232.70c 2.1331e-07
    92233.70c 4.6768e-05     92234.70c 7.7216e-07
    92235.70c 1.8984e-08     92238.70c 2.9991e-07
c Al-1100
m2 13027.70c 5.9881e-02
    14028.70c 2.0097E-04     14029.70c 1.0176E-05
    14030.70c 6.7549E-06
    25055.70c 1.4853e-05
    26054.70c 6.4652e-06     26056.70c 1.0051e-04
    26057.70c 2.3012e-06     26058.70c 3.0682e-07
    29063.70c 3.5528e-05     29065.70c 1.5836e-05
mt1 lwtr.10t
totnu

```

Table A-16. Input file for u233-sol-therm-001-case-4

```

CSEWG: ORNL-8 1.0275 g/l Unreflected 27.24" Sphere; U233-SOL-THERM-001 #4
1 1 0.10017 -1 $ Spherical Solution U(NO3)2-H2O
2 2 0.060275 1 -2 $ Spherical Shell of Al-1100
3 0 2

1 so 34.595 $ Inner Radius of Al-1100 Sphell
2 so 34.915 $ Outer RADIUS of Al-1100 Sphell

mode n
imp:n 1 1 0
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad d1
sc1 Spherical Source
sil 34.595
c Solution
c Materials specified with atom densities
m1 1001.70c 6.6337e-02
    5010.70c 7.6312e-07 5011.70c 3.0716e-06
    7014.70c 1.3173e-04
    8016.70c 3.3640e-02 8017.70c 1.3461e-05
    90232.70c 2.2133e-07
    92233.70c 4.8433e-05 92234.70c 7.9965e-07
    92235.70c 1.9660e-08 92238.70c 3.1059e-07
c Al-1100
m2 13027.70c 5.9881e-02
    14028.70c 2.0097E-04 14029.70c 1.0176E-05
    14030.70c 6.7549E-06
    25055.70c 1.4853e-05
    26054.70c 6.4652e-06 26056.70c 1.0051e-04
    26057.70c 2.3012e-06 26058.70c 3.0682e-07
    29063.70c 3.5528e-05 29065.70c 1.5836e-05
mt1 lwtr.10t
totnu

```

Table A-17. Input file for u233-sol-therm-001-case-5

```

CSEWG: ORNL-9 1.0286 g/l Unreflected 27.24" Sphere; U233-SOL-THERM-001 #5
1 1 0.10019 -1 $ Spherical Solution U(NO3)2-H2O
2 2 0.060275 1 -2 $ Spherical Shell of Al-1100
3 0 2

1 so 34.595 $ Inner Radius of Al-1100 Sphell
2 so 34.915 $ Outer RADIUS of Al-1100 Sphell

mode n
imp:n 1 1 0
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad d1
sc1 Spherical Source
sil 34.595
c Solution
c Materials specified with atom densities
m1 1001.70c 6.6329e-02
    5010.70c 1.0114e-06 5011.70c 4.0708e-06
    7014.70c 1.3586e-04
    8016.70c 3.3653e-02 8017.70c 1.3466e-05
    90232.70c 2.2691e-07
    92233.70c 5.0043e-05 92234.70c 8.2623e-07
    92235.70c 2.0314e-08 92238.70c 3.2091e-07
c Al-1100
m2 13027.70c 5.9881e-02
    14028.70c 2.0097E-04 14029.70c 1.0176E-05
    14030.70c 6.7549E-06
    25055.70c 1.4853e-05
    26054.70c 6.4652e-06 26056.70c 1.0051e-04
    26057.70c 2.3012e-06 26058.70c 3.0682e-07
    29063.70c 3.5528e-05 29065.70c 1.5836e-05
mt1 lwtr.10t
totnu

```

Table A-18. Input file for u233-sol-therm-008

```

U233-SOL-THERM-008 (CSEWG ORNL-11) Unreflected sphere of U233 nitrate
1 1 9.99353e-02 -1
2 2 6.02743e-02 -2 1
3 0 2

1 so 61.011
2 so 61.786

kcode 10000 1.0 100 600
sdef cel=1 erg=d1 rad=d2 pos=0.0 0.0 0.0
sp1 -3
si2 0.0 61.011
sp2 -21 2
imp:n 1.0 1.0 0.0
c uranyl nitrate
m1 1001.70c 6.6357e-02
7014.70c 7.4943e-05
8016.70c 3.3456e-02 8017.70c 1.3388e-05
90232.70c 1.4756e-07
92233.70c 3.3441e-05 92234.70c 5.2503e-07
92235.70c 1.0184e-08 92238.70c 2.5474e-07
mt1 lwtr.10t
c al 1100
m2 13027.70c 5.9881e-02
14028.70c 2.0097e-04 14029.70c 1.0176e-05
14030.70c 6.7549e-06
25055.70c 1.4853e-05 26054.70c 6.4652e-06
26056.70c 1.0051e-04 26057.70c 2.3012e-06
26058.70c 3.0682e-07 29063.70c 3.5529e-05
29065.70c 1.5836e-05

end of input

```

## A.2 HEU Input Files

The input files for the HEU benchmarks are given in Tables A-19 through A-58.

Table A-19. Input file for heu-met-fast-001

```

Godiva Solid Bare HEU sphere HEU-MET-FAST-001 CSEWG:F-5
1 1 4.7984e-02 -1 imp:n=1
2 0 1 imp:n=0

1 so 8.7407

kcode 10000 1.0 100 600
sdef cel=1 erg=d1 rad=d2 pos=0.0 0.0 0.0
sp1 -3
si2 0.0 8.7407
sp2 -21 2
totnu
m1 92234.70c 4.9184e-04 92235.70c 4.4994e-02
 92238.70c 2.4984e-03

end of input

```

Table A-20. Input file for heu-met-fast-003-case-1

```

Topsy 2-in Tu tamper Sphere from LA-1114: HEU-MET-FAST-003
1 1 4.8009e-02 -1 imp:n=1
2 2 4.7817e-02 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 6.7820
2 so 11.8620

c Materials specified with atom densities
m1 92235.70c 4.4917e-02 92238.70c 2.5993e-03 92234.70c 4.9210e-04
m2 92235.70c 3.4428e-04 92238.70c 4.7470e-02 92234.70c 2.6299e-06
kcode 10000 1. 100 600
ksrc 0. 0. 0.

```

Table A-21. Input file for heu-met-fast-003-case-2

```

Topsy 3-in Tu tamper Sphere from LA-1114: HEU-MET-FAST-003
1 1 4.8009e-02 -1 imp:n=1
2 2 4.7817e-02 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 6.4423
2 so 14.0623

c Materials specified with atom densities
m1 92235.70c 4.4917e-02 92238.70c 2.5993e-03 92234.70c 4.9210e-04
m2 92235.70c 3.4428e-04 92238.70c 4.7470e-02 92234.70c 2.6299e-06
kcode 10000 1. 100 600
ksrc 0. 0. 0.

```

Table A-22. Input file for heu-met-fast-003-case-3

```

Topsy 4-in Tu tamper Sphere from LA-1114: HEU-MET-FAST-003
1 1 4.8009e-02 -1 imp:n=1
2 2 4.7817e-02 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 6.2851
2 so 16.4451

c Materials specified with atom densities
m1 92235.70c 4.4917e-02 92238.70c 2.5993e-03 92234.70c 4.9210e-04
m2 92235.70c 3.4428e-04 92238.70c 4.7470e-02 92234.70c 2.6299e-06
kcode 10000 1. 100 600
ksrc 0. 0. 0.

```

Table A-23. Input file for heu-met-fast-003-case-4

```

Topsy 5-in Tu tamper Sphere from LA-1114: HEU-MET-FAST-003
1 1 4.8009e-02 -1 imp:n=1
2 2 4.7817e-02 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 6.1535
2 so 18.8535

c Materials specified with atom densities
m1 92235.70c 4.4917e-02 92238.70c 2.5993e-03 92234.70c 4.9210e-04
m2 92235.70c 3.4428e-04 92238.70c 4.7470e-02 92234.70c 2.6299e-06
kcode 10000 1. 100 600
ksrc 0. 0. 0.

```

Table A-24. Input file for heu-met-fast-003-case-5

```

Topsy 7-in Tu tamper Sphere from LA-1114: HEU-MET-FAST-003
1 1 4.8009e-02 -1 imp:n=1
2 2 4.7817e-02 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 6.0740
2 so 23.8540

c Materials specified with atom densities
m1 92235.70c 4.4917e-02 92238.70c 2.5993e-03 92234.70c 4.9210e-04
m2 92235.70c 3.4428e-04 92238.70c 4.7470e-02 92234.70c 2.6299e-06
kcode 10000 1. 100 600
ksrc 0. 0. 0.

```



Table A-25. Input file for heu-met-fast-003-case-6

```
Topsy 8-in Tu tamper Sphere from LA-1114: HEU-MET-FAST-003
1 1 4.8009e-02 -1 imp:n=1
2 2 4.7817e-02 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 6.0509
2 so 26.3709

c Materials specified with atom densities
m1 92235.70c 4.4917e-02 92238.70c 2.5993e-03 92234.70c 4.9210e-04
m2 92235.70c 3.4428e-04 92238.70c 4.7470e-02 92234.70c 2.6299e-06
kcode 10000 1. 100 600
ksrc 0. 0. 0.
```

Table A-26. Input file for heu-met-fast-003-case-7

```
Topsy 11-in Tu tamper Sphere from LA-1114: HEU-MET-FAST-003
1 1 4.8009e-02 -1 imp:n=1
2 2 4.7817e-02 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 6.0276
2 so 33.9676

c Materials specified with atom densities
m1 92235.70c 4.4917e-02 92238.70c 2.5993e-03 92234.70c 4.9210e-04
m2 92235.70c 3.4428e-04 92238.70c 4.7470e-02 92234.70c 2.6299e-06
kcode 10000 1. 100 600
ksrc 0. 0. 0.
```

Table A-27. Input file for heu-met-fast-003-case-8

```
1.9" WC tamper Sphere from LA-1114: HEU-MET-FAST-003
1 1 0.048009 -1 imp:n=1
2 2 0.096114 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 6.6020
2 so 11.4280

c Materials specified with atom densities
m1 92234.70c 4.9210e-04 92235.70c 4.4917e-02
92238.70c 2.5993e-03
m2 6000.70c 4.8057e-02
74182.70c 1.2697e-02 74183.70c 6.8626e-03
74184.70c 1.4754e-02 74186.70c 1.3744e-02
kcode 10000 1. 100 600
ksrc 0. 0. 0.
```

Table A-28. Input file for heu-met-fast-003-case-9

```

2.9" WC tamper Sphere from LA-1114: HEU-MET-FAST-003
1  1  0.048009  -1      imp:n=1
2  2  0.096114   1 -2    imp:n=1
3  0                      2      imp:n=0

1  so    6.2527
2  so   13.6187

c      Materials specified with atom densities
m1  92234.70c 4.9210e-04      92235.70c 4.4917e-02
    92238.70c 2.5993e-03
m2  6000.70c 4.8057e-02
    74182.70c 1.2697e-02      74183.70c 6.8626e-03
    74184.70c 1.4754e-02      74186.70c 1.3744e-02
kcode 10000 1. 100 600
ksrc  0. 0. 0.
c  print

```

Table A-29. Input file for heu-met-fast-003-case-10

```

4.5" WC tamper Sphere from LA-1114 : HEU-MET-FAST-003
1  1  0.048009  -1      imp:n=1
2  2  0.096114   1 -2    imp:n=1
3  0                      2      imp:n=0

1  so    6.0509
2  so   17.4809

c      Materials specified with atom densities
m1  92234.70c 4.9210e-04      92235.70c 4.4917e-02
    92238.70c 2.5993e-03
m2  6000.70c 4.8057e-02
    74182.70c 1.2697e-02      74183.70c 6.8626e-03
    74184.70c 1.4754e-02      74186.70c 1.3744e-02
kcode 10000 1. 100 600
ksrc  0. 0. 0.

```

Table A-30. Input file for heu-met-fast-003-case-11

```

6.5" WC tamper Sphere from LA-1114: HEU-MET-FAST-003
1 1 0.048009 -1 imp:n=1
2 2 0.096114 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 6.0159
2 so 22.5259

c Materials specified with atom densities
m1 92234.70c 4.9210e-04 92235.70c 4.4917e-02
    92238.70c 2.5993e-03
m2 6000.70c 4.8057e-02
    74182.70c 1.2697e-02 74183.70c 6.8626e-03
    74184.70c 1.4754e-02 74186.70c 1.3744e-02
kcode 10000 1. 100 600
ksrc 0. 0. 0.

```

Table A-31. Input file for heu-met-fast-003-case-12

```

8.0" Ni tamper Sphere from LA-1114: HEU-MET-FAST-003
1 1 0.048009 -1 imp:n=1
2 2 0.091322 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 6.4627
2 so 26.7827

c Materials specified with atom densities
m1 92234.70c 4.9210e-4 92235.70c 4.4917e-2
    92238.70c 2.5993e-3
m2 28058.70c 6.23455-2 28060.70c 2.38350-2
    28061.70c 1.03194-3 28062.70c 3.27846-3
    28064.70c 8.31030-4
kcode 10000 1. 100 600
ksrc 0. 0. 0.
c print

```

Table A-32. Input file for heu-met-fast-004-case-1

```

HEU-MET-FAST-004 case 1 Idealized Oy sphere (97.675 w/o) on Lucite ring in H2O
c Transactions of ANS 27, 412 (11/77)
1      1      0.048143      -1      $ oralloy sphere
2      2      0.10827      5      -6      -7      8      $ seat as hollow cyl.
3      3      0.10021      1      2      -3      -4
                                     #2      $ water
6      0      -2:3:4

1      so      6.5537      $ radius of oralloy sphere
2      pz      -32.500      $ lower surface of water
3      cz      30.000      $ outer radius of water
4      pz      23.054      $ upper surface of water
5      cz      3.974      $ inner radius of seat
6      cz      12.700      $ outer radius of seat
7      pz      -5.212      $ top of seat
8      pz      -7.752      $ bottom of seat

mode      n
kcode     10000      1.0      100      600
imp:n     1.0      2r      0.0
sdef      cel=1      erg=d1      rad=d2      pos=0.0 0.0 0.0
sp1       -3
si2       0.0      0.65537
sp2       -21      2
c         Oy (97.67 w/o)
m1        92234.70c      0.011150      92235.70c      0.97694
          92236.70c      0.0019919      92238.70c      0.0099250
c         Lucite
m2        1001.70c      0.53334
          6000.70c      0.33333
          8016.70c      0.13328      8017.70c      0.000053333
mt2       lwtr.10t
c         Water
m3        1001.70c      0.66667
          8016.70c      0.33320      8017.70c      0.00013333
mt3       lwtr.10t
totnu

end of input

```

Table A-33. Input file for heu-met-fast-008

```

Bare HEU Sphere, VNIITF: HEU-MET-FAST-008
1 0 -1 -10 $ cavity
2 0 12 -2 $ cav
3 1 4.7319e-2 1 -3 7 -10 $ bottom inner U
4 1 4.7319e-2 2 -4 8 12 16 $ top inner U
5 2 4.8146e-2 3 -5 -10 16 $ bottom outer U
6 2 4.8146e-2 4 -6 12 16 $ top outer U
7 0 1 -3 -7 -10 $ bottom groove
8 0 2 -4 -8 12 $ top groove
9 0 10 -11 -15 $ gap
10 3 8.1174e-2 11 -12 -20 17 $ diaphragm Fe
11 0 5 -15 -10 13 $ bottom outside
12 0 6 -15 12 $ top outside
13 4 8.2365e-2 18 -9 -13 -10 $ Cu cup
14 3 8.1174e-2 9 19 -14 -10 $ Fe cylinder
15 0 9 -15 14 -13 -10 $ void under Cu cup
16 0 3 -5 -16 -10 $ bottom polar hole
17 0 2 -6 -16 12 $ top polar hole
18 0 11 -12 -17 $ diaphr hole
19 0 5 -13 -18 -10 $ gap over cup
20 0 -14 -15 -19 $ void under cyl
21 0 11 -12 -15 20 $ void outside diaphragm
22 0 15 $ outside

1 so 2
2 sz 1.207 2
3 so 9.15
4 sz 1.207 9.15
5 so 10.15
6 sz 1.207 10.15
7 cy 0.6
8 c/y 0 1.207 0.6
9 so 10.44
10 pz 0
11 pz 1.007
12 pz 1.207
13 cz 8.7
14 cz 2.5
15 so 16
16 cz 1.1
17 cz 9.8
18 so 10.29
19 pz -14.74
20 cz 15

imp:n 1 20r 0
totnu
kcode 10000 1. 100 600
ksrc 0 0 -3
c Materials specified with atom densities
m1 92235.70c 4.1031e-2 92238.70c 4.1021e-3
92234.70c 5.2273e-4 92236.70c 8.8071e-5
6000.70c 3.8642e-4
26054.70c 8.0016e-6 26056.70c 1.2439e-4
26057.70c 2.8480e-6 26058.70c 3.7974e-7

```

Table A-33. Input file for heu-met-fast-008 (Cont'd)

	74182.70c	3.2652e-6	74183.70c	1.7729e-6
	74184.70c	3.8114e-6	74186.70c	3.5507e-6
	28058.70c	2.2503e-4	28060.70c	8.6028e-5
	28061.70c	3.7246e-6	28062.70c	1.1833e-5
	28064.70c	2.9995e-6		
	29063.70c	4.9132e-4	29065.70c	2.1899e-4
m2	92235.70c	4.2698e-2	92238.70c	4.0143e-3
	92234.70c	5.3154e-4	92236.70c	1.7489e-4
	6000.70c	1.4403e-4		
	26054.70c	2.2404e-6	26056.70c	3.4828e-5
	26057.70c	7.9741e-7	26058.70c	1.0632e-7
	13027.70c	5.4473e-4		
	74182.70c	1.5966e-7	74183.70c	8.6691e-8
	74184.70c	1.8637e-7	74186.70c	1.7363e-7
m3	26054.70c	4.7893e-3	26056.70c	7.4453e-2
	26057.70c	1.7047e-3	26058.70c	2.2729e-4
m4	29063.70c	5.6972e-2	29065.70c	2.5393e-2

Table A-34. Input file for heu-met-fast-009-case-1

```

Be-Reflected HEU Sphere, Keff=0.9992+-0.0015: HEU-MET-FAST-009
1 0 -17 -3 $ equ hole
2 0 -16 6 -8 12 $ polar hole in Refl
3 1 4.7328-2 -3 17 $ U sphere
4 0 3 -4 12 $ spheric crit gap
5 1 4.7328-2 3 -5 -10 17 $ bottom U
6 1 4.7328-2 4 -6 12 18 $ top U
7 2 1.2103-1 5 -7 -19 $ bot refl
8 2 1.2103-1 6 -8 20 16 $ top refl
9 0 3 10 -11 -15 $ crit gap
10 3 8.1174-2 2 11 -12 -15 $ diaphr
11 0 7 -15 -10 13 21 $ bot void
12 0 8 -15 12 -22 $ top void
13 4 8.2365-2 7 -9 -13 -10 $ Cu cup
14 3 8.1174-2 9 -15 -14 -10 21 $ Fe shaft
15 0 9 -15 14 -13 -10 21 $ bot void 2
16 0 3 -2 11 -12 $ void in diaphr
17 0 5 -7 19 -10 $ bot Be cut
18 0 6 -8 12 -20 $ top Be cut
19 0 -10 3 -5 -17 $ bot U groove
20 0 4 -6 12 -18 $ top U groove
23 0 15:-21:22 $ out

```

```

2 cz 7.75
3 so 7.55
4 sz 2.06 7.55
5 so 8.35
6 sz 2.06 8.35
7 so 11
8 sz 2.06 11
9 so 11.15
10 pz 0
11 pz 1.86
12 pz 2.06
13 cz 9.7
14 cz 2.5
15 cz 14
16 cz 1.1
17 cy 0.6
18 c/y 0 2.06 0.6
19 pz -0.15
20 pz 2.21
21 pz -14.15
22 pz 14

```

```

imp:n 1 19r 0
kcode 10000 1. 100 600
ksrc 0 0 3
c Materials specified with atom densities
m1 92235.70c 4.1000-2 92238.70c 4.0977-3
92234.70c 5.2195-4 92236.70c 8.8422-5
6000.70c 3.9932-4
29063.70c 5.0725-4 29065.70c 2.2609-4
26054.70c 7.9833-6 26056.70c 1.2411-4
26057.70c 2.8415-6 26058.70c 3.7887-7

```

Table A-34. Input file for heu-met-fast-009-case-1 (Cont'd)

	28058.70c	2.3232-4	28060.70c	8.8816-5
	28061.70c	3.8453-6	28062.70c	1.2216-5
	28064.70c	3.0966-6		
	74182.70c	3.2730-6	74183.70c	1.7771-6
	74184.70c	3.8206-6	74186.70c	3.5593-6
m2	4009.70c	1.2080-1		
	6000.70c	1.0019-4		
	8016.70c	8.2053-5		
	26054.70c	3.0050-6	26056.70c	4.6715-5
	26057.70c	1.0696-6	26058.70c	1.4261-7
mt2	be.10t			
m3	26054.70c	4.7893-3	26056.70c	7.4453-2
	26057.70c	1.7047-3	26058.70c	2.2729-4
m4	29063.70c	5.6972-2	29065.70c	2.5393-2



Table A-35. Input file for heu-met-fast-009-case-2

```

BeO-Reflected Sphere, Keff=0.9992+/- 0.0015: HEU-MET-FAST-009
1  0          1  -3 -17          $ equat hole
2  0          -16  6  -8  12      $ polar hole in Refl
3  1  4.7335-2  1  -3  17          $ U sphere
4  0          3  -4  12          $ spheric crit gap
5  1  4.7335-2  3  -5 -10  17      $ bottom U
6  1  4.7335-2  4  -6  12  18      $ top U
7  2  1.3527-1  5  -7 -19          $ bot refl
8  2  1.3527-1  6  -8  20  16      $ top refl
9  0          3  10 -11 -15        $ crit gap
10 3  8.1174-2  2  11 -12 -15       $ diaphr
11 0          7 -15 -10  13  21     $ bot void
12 0          8 -15  12 -22        $ top void
13 4  8.2365-2  7  -9 -13 -10       $ Cu cup
14 3  8.1174-2  9  21 -14 -10       $ Fe shaft
15 0          9 -15  14 -13 -10  21 $ bot void 2
16 0          3  -2  11 -12        $ void gap
17 0          5  -7  19 -10        $ bot Be cut
18 0          6  -8  12 -20        $ top Be cut
19 0          -10  3  -5 -17       $ bot U groove
20 0          4  -6  12 -18        $ top U groove
21 0          -1                    $ central cavity
23 0          15:-21:22           $ out

```

```

1  so  1.4
2  cz  7.75
3  so  7.55
4  sz  2.74  7.55
5  so  8.35
6  sz  2.74  8.35
7  so  11
8  sz  2.74  11
9  so  11.15
10 pz  0
11 pz  2.54
12 pz  2.74
13 cz  9.7
14 cz  2.5
15 cz  14
16 cz  1.1
17 cy  0.6
18 c/y 0  2.74  0.6
19 pz -0.15
20 pz  2.89
21 pz -14.15
22 pz  14

```

```

imp:n 1 20r 0
kcode 10000 1. 100 600
ksrc 0 0 -3

```

```

c  Materials specified with atom densities
m1 92235.70c 4.1011-2 92238.70c 4.0989-3
    92234.70c 5.2209-4 92236.70c 8.8453-5
    6000.70c 3.9946-4
    29063.70c 5.0447-4 29065.70c 2.2485-4

```

Table 35. Input file for heu-met-fast-009-case-2

	26054.70c	7.9862-6		
	26056.70c	1.2415-4		
	26057.70c	2.8426-6		
	26058.70c	3.7901-7		
	28058.70c	2.3105-4		
	28060.70c	8.8330-5		
	28061.70c	3.8243-6		
	28062.70c	1.2150-5		
	28064.70c	3.0797-6		
	74182.70c	3.2744-6	74183.70c	1.7779-6
	74184.70c	3.8222-6	74186.70c	3.5607-6
m2	4009.70c	6.7634-2		
	8016.70c	6.7634-2		
mt2	o/be.10t	be/o.10t		\$ ENDF/B-VII.0
c mt2	beo.60t			\$ ENDF/B-VI
m3	26054.70c	4.78927-3	26056.70c	7.44528-2
	26057.70c	1.70465-3	26058.70c	2.27287-4
m4	29063.70c	5.69719-2	29065.70c	2.53931-2

Table A-36. Input file for heu-met-fast-011

```

CH2 Reflected HEU sphere: HEU-MET-FAST-011
1  0          -2          $ central cavity
3  1  4.7392-2  2  -3          $ core
4  0          3  -4  11      $ spheric gap
5  0          3  -5  6  -11   $ diaphr void
6  0          3  -6  10  -14  $ gap
7  2  1.1714-1  3  -7  -10    $ bottom refl
8  2  1.1714-1  4  -8  11     $ top refl
9  3  8.1174-2  5  6  -11  -14  $ diaphr
11 0          7  -10  -14    $ bot void
12 0          8  11  -14    $ top void
15 0          14          $ outer

2  so  2
3  so  7.55
4  sz  1.96  7.55
5  cz  8.5
6  pz  1.66
7  so  18
8  sz  1.96  18
10 pz  0
11 pz  1.96
14 so  21.5

imp:n 1 9r 0
kcode 10000 1. 100 600
ksrc 0 0 -3
c      Materials specified with atom densities
m1  92235.70c  4.1018-2  92238.70c  4.0942-3
    92234.70c  5.1969-4  92236.70c  8.9938-5
    6000.70c   4.0450-4
    26054.70c  8.4199-6  26056.70c  1.3089-4
    26057.70c  2.9969-6  26058.70c  3.9959-7
    74182.70c  3.2599-6  74183.70c  1.7700-6
    74184.70c  3.8053-6  74186.70c  3.5450-6
    29063.70c  5.2491-4  29065.70c  2.3397-4
    28058.70c  2.4042-4  28060.70c  9.1914-5
    28061.70c  3.9794-6  28062.70c  1.2643-5
    28064.70c  3.2047-6
m2  6000.70c  3.9047-2
    1001.70c  7.8094-2
mt2  poly.10t
m3  26054.70c  4.7893-3  26056.70c  7.4453-2
    26057.70c  1.7047-3  26058.70c  2.2729-4

```

Table A-37. Input file for heu-met-fast-012

```

Al Reflected HEU Sphere: HEU-MET-FAST-012
1 0 -1 -14 16 $ source cavity
2 0 -1 3 -5 -10 $ bottom equat hollow
3 1 4.7297e-2 -3 #1 $ core
4 0 3 -4 11 $ crescent gap
5 1 4.7297e-2 1 3 -5 -10 $ bot shell
6 1 4.7297e-2 4 -6 11 18 $ top shell
7 2 5.8566e-2 5 -7 -10 $ bott refl
8 2 5.8566e-2 6 -8 11 $ top shell
9 0 -2 3 -11 17 $ diaphr void
10 3 8.1174e-2 2 -11 -15 17 $ diaphragm
11 0 7 -10 12 -15 $ bot void
12 0 8 11 -15 $ top void
13 4 8.2365e-2 7 -9 -10 -12 $ cup
14 3 8.1174e-2 9 -10 -13 -15 $ shaft
15 0 9 -10 -12 13 -15 $ under cup
16 0 4 -6 11 -18 $ top equa hollow
17 0 3 10 -15 -17 $ gap
18 0 15

1 cy 0.6
2 cz 7.75
3 so 7.55
4 sz 1.17 7.55
5 so 9.15
6 sz 1.17 9.15
7 so 10
8 sz 1.17 12
9 so 10.15
10 pz 0
11 pz 1.17
12 cz 8.7
13 cz 2.5
14 py 0.5
15 so 14
16 py -0.5
17 pz 0.97
18 c/y 0 1.17 0.6

imp:n 1 16r 0
kcode 10000 1. 100 600
ksrc 0 0 -1
c Materials specified with atom densities
m1 92235.70c 4.0999e-2 92238.70c 4.0989e-3
92234.70c 5.2246e-4 92236.70c 8.7970-5
6000.70c 3.8652e-4
26054.70c 7.9910-6 26056.70c 1.2423-4
26057.70c 2.8442-6 26058.70c 3.7923-7
74182.70c 3.2649-6 74183.70c 1.7727-6
74184.70c 3.8111-6 74186.70c 3.5504-6
29063.70c 4.9836-4 29065.70c 2.2213-4
28058.70c 2.2825-4 28060.70c 8.7260-5
28061.70c 3.7779-6 28062.70c 1.2002-5
28064.70c 3.0424-6
m2 13027.70c 5.8566-2

```

Table A-37. Input file for heu-met-fast-012 (Cont'd)

m3	26054.70c	4.7893-3	26056.70c	7.4453-2
	26057.70c	1.7047-3	26058.70c	2.2729-4
m4	29063.70c	5.6972-2	29065.70c	2.5393-2

Table A-38. Input file for heu-met-fast-013

Fe (Steel) Reflected HEU Sphere: HEU-MET-FAST-013

```

1  0          -1
2  0          1 -3 -14
3  1  4.7336e-2  1 -3  14
4  0          3 -4  11
5  1  4.7336e-2  3 -5 -10  14
6  1  4.7336e-2  4 -6  11  16
7  2  8.4191e-2  5 -7 -10
8  2  8.4191e-2  6 -8  11
9  0          -2  3  10 -11
10 3  8.1174e-2  2 10 -11 -15
11 0          7 -15 -10  12
12 0          8  11 -15
13 4  8.2365e-2  7 -9 -12 -10
14 3  8.1174e-2  9 -15 -13 -10
15 0          9 -15 -12  13 -10
16 0          3 -5 -10 -14
17 0          4 -6  11 -16
18 0          15

```

```

1  so  1.4
2  cz  7.75
3  so  7.55
4  sz  0.2  7.55
5  so  8.35
6  sz  0.2  8.35
7  so  12
8  sz  0.2  12
9  so  12.15
10 pz  0
11 pz  0.2
12 cz  9.7
13 cz  2.5
14 cy  0.6
15 so  15
16 c/y 0  0.2  0.6

```

imp:n 1 16r 0

kcode 10000 1. 100 600

ksrc 0 0 -2

c Materials specified with atom densities

```

m1  92235.70c  4.1011e-02  92238.70c  4.0989e-03
    92234.70c  5.2209e-04  92236.70c  8.8453e-05
    6000.70c   3.9946e-04
    29063.70c  5.0447e-04  29065.70c  2.2485e-04
    26054.70c  7.9862e-06  26056.70c  1.2415e-04
    26057.70c  2.8426e-06  26058.70c  3.7901e-07
    28058.70c  2.3105e-04  28060.70c  8.8330e-05
    28061.70c  3.8243e-06  28062.70c  1.2150e-05
    28064.70c  3.0797e-06
    74182.70c  3.2744e-06  74183.70c  1.7779e-06
    74184.70c  3.8222e-06  74186.70c  3.5607e-06
m2  26054.70c  4.8708e-03  26056.70c  7.5719e-02
    26057.70c  1.7337e-03  26058.70c  2.3115e-04
    6000.70c  7.7554e-04

```

Table A-38. Input file for heu-met-fast-013 (Cont'd)

	14028.70c	3.2119e-04	14029.70c	1.6263e-05
	14030.70c	1.0796e-05		
	24050.70c	2.9190e-06	24052.70c	5.6291e-05
	24053.70c	6.3822e-06	24054.70c	1.5888e-06
	25055.70c	4.4508e-04		
m3	26054.70c	4.7893e-03	26056.70c	7.4453e-02
	26057.70c	1.7047e-03	26058.70c	2.2729e-04
m4	29063.70c	5.6972e-02	29065.70c	2.5393e-02

Table A-39. Input file for heu-met-fast-014

```

D38 Depleted Uranium Reflected HEU sphere: HEU-MET-FAST-014
1 0 -1 -10 $ bottom central cavity
2 0 12 -2 $ top centr cav
3 1 4.7330e-2 1 -3 -10 16 18 $ bot core
4 1 4.7330e-2 2 -4 12 16 19 $ top core
5 2 4.7065e-2 3 -5 -10 17 $ bot inn refl
6 2 4.7065e-2 4 -6 12 17 $ top inn
7 2 4.7065e-2 5 -7 -10 $ bot outer refl
8 2 4.7065e-2 6 -8 12 20 $ top out refl
9 0 10 -11 -15 $ gap
10 3 8.1174e-2 11 -12 -15 $ diaphr
11 0 7 -15 -10 13
12 0 8 -15 12
13 4 6.0426e-2 7 -9 -13 -10 $ Dural Cup
14 4 6.0426e-2 9 -15 -14 -10 $ Dural shaft
15 0 9 -15 14 -13 -10
16 0 1 -3 -10 -16
17 0 2 -4 12 -16
18 0 3 -5 -17 -10
19 0 4 -6 12 -17
20 0 1 -3 -10 16 -18
21 0 2 -4 12 16 -19
22 0 6 -8 12 -20
23 0 15

1 so 3.15
2 sz 0.64 3.15
3 so 8.35
4 sz 0.64 8.35
5 so 9.15
6 sz 0.64 9.15
7 so 13
8 sz 0.64 13
9 so 13.2
10 pz 0
11 pz 0.44
12 pz 0.64
13 cz 11
14 cz 2.5
15 so 16
16 cz 1.1
17 cz 1.75
18 cy 0.6
19 c/y 0 0.64 0.6
20 cz 0.5

imp:n 1 21r 0
kcode 10000 1. 100 600
ksrc 3 3 -3
c Materials specified with atom densities
m1 92235.70c 4.1032-2 92238.70c 4.1010-3
92234.70c 5.2275-4 92236.70c 8.8021-5
6000.70c 3.9536-4
29063.70c 4.9284-4 29065.70c 2.1967-4
26054.70c 7.9721-6 26056.70c 1.2393-4

```



Table A-39. Input file for heu-met-fast-014 (Cont'd)

	26057.70c	2.8375-6	26058.70c	3.7834-7	
	28058.70c	2.2571-4	28060.70c	8.6292-5	
	28061.70c	3.7360-6	28062.70c	1.1869-5	
	28064.70c	3.0086-6			
	74182.70c	3.2680-6	74183.70c	1.7744-6	
	74184.70c	3.8148-6	74186.70c	3.5538-6	
m2	92235.70c	2.3832-4	92238.70c	4.6826-2	
m3	26054.70c	4.7893-3	26056.70c	7.4453-2	
	26057.70c	1.7047-3	26058.70c	2.2729-4	
m4	13027.70c	5.8077-2			
c	12000.62c	1.0332-3			\$ ENDF/B-VI
	12024.70c	8.1613-4	12025.70c	1.0332-4	\$ ENDF/B-VII.0
	12026.70c	1.1376-4			\$ ENDF/B-VII.0
	25055.70c	1.8284-4			
	29063.70c	7.8363-4	29065.70c	3.4927-4	

Table A-40. Input file for heu-met-fast-015

```

Bare HEU Cylinder, VNIITF: HEU-MET-FAST-015
1  1  4.7832e-2  (5 -8 -1) #2      imp:n=1  $ bottom U
2  0                               4 -6 -1      imp:n=1  $ source cavity
3  0                               1 -8 -2      imp:n=1  $ gap
4  2  4.7767e-2  2 -8 -3  7      imp:n=1  $ top U
5  0                               2 -7 -3      imp:n=1  $ top axial hole
6  3  8.1133e-2  11 -10 -5      imp:n=1  $ steel plate
7  0                               11 10 -8 -5     imp:n=1  $ bot hollows
8  3  8.1133e-2  2 -12  8 -13     imp:n=1  $ diaphragm
9  0                               (-9 -11):(-9 -2 8) imp:n=1  $ inner OUTSIDE 1
10 0                               (-9 3):(-9 8 12)  imp:n=1  $ inner outside 2
11 0                               2 -9 -12 13     imp:n=1  $ outside diaphr
12 0                               9               imp:n=0  $ outer OUTSIDE

1  pz  0
2  pz  0.05
3  pz  5.22
4  pz  -1.0
5  pz  -5.96
6  cz  0.6
7  cz  1.75
8  cz  9.995
9  so  15
10 cz  9.8
11 pz  -6.17
12 pz  0.26
13 cz  13

mode n
totnu
kcode 10000 1. 100 600
ksrc 0 0 -2
c      Materials specified with atom densities
m1  92235.70c  4.5774e-2  92238.70c  1.3381e-3
    92234.70c  5.6597e-4
    6000.70c   1.0270e-4
    26054.70c  2.9619e-6    26056.70c  4.6044e-5
    26057.70c  1.0542e-6    26058.70c  1.4056e-7
    74182.70c  3.2083e-7    74183.70c  1.7420e-7
    74184.70c  3.7451e-7    74186.70c  3.4889e-7
m2  92235.70c  4.5708e-2  92238.70c  1.3404e-3
    92234.70c  5.6404e-4
    6000.70c   1.0256e-4
    26054.70c  2.9577e-6    26056.70c  4.5980e-5
    26057.70c  1.0528e-6    26058.70c  1.4037e-7
    74182.70c  3.2041e-7    74183.70c  1.7397e-7
    74184.70c  3.7402e-7    74186.70c  3.4843e-7
m3  26054.70c  4.7869e-3  26056.70c  7.4415e-2
    26057.70c  1.7038e-3  26058.70c  2.2717e-4

```

Table A-41. Input file for heu-met-fast-018-case-2

```
Simplified Bare HEU Sphere, VNIIEF; HEU-MET-FAST-018 case 2
C W-180 fraction added to W-182 because of cross sections
C Cell Cards
1 0 -1
2 1 4.8302e-2 1 -2
3 0 2

C Surface Cards
1 so 1.000
2 so 9.154

C Data Cards
imp:n 1 1 0
totnu
kcode 10000 1. 100 600
ksrc 2 0 0

C Material Cards
c Materials specified with atom densities
m1 92234.70c 5.2111e-4 92235.70c 4.2064e-2
92238.70c 4.3626e-3
6000.70c 1.1074e-3
26054.70c 1.1399e-5 26056.70c 1.7720e-4
26057.70c 4.0572e-6 26058.70c 5.4096e-7
74182.70c 1.4213e-5 74183.70c 7.6824e-6
74184.70c 1.6416e-5 74186.70c 1.5386e-5
```

Table A-42. Input file for heu-met-fast-019-case-2

```

Graphite Reflected HEU Sphere, VNIIEF; HEU-MET-FAST-019 case 2
C W-180 fraction added to W-182 because of cross sections
C Graphite thermal S(alpha,Beta) treatment applied at 300K
C Cell Cards
1 0 -1
2 1 4.8493e-2 1 -2
3 2 7.6716e-2 2 -3
4 0 3

C Surface Cards
1 so 4.029
2 so 9.150
3 so 12.60

C Data Cards
imp:n 1 1 1 0
totnu
kcode 10000 1. 100 600
ksrc 6 0 0
C Material Cards
c Materials specified with atom densities
m1 92234.70c 5.2315e-4 92235.70c 4.2256e-2
92238.70c 4.3799e-3
6000.70c 1.0894e-3
26054.70c 1.1281e-5 26056.70c 1.7538e-4
26057.70c 4.0154e-6 26058.70c 5.3539e-7
74182.70c 1.4008e-5 74183.70c 7.5711e-6
74184.70c 1.6277e-5 74186.70c 1.5163e-5
m2 6000.70c 7.6716e-2
mt2 grph.10t

```

Table A-43. Input file for heu-met-fast-020-case-2

```

Polyethylene reflected HEU Sphere, VNIIEF; HEU-MET-FAST-020 case 2
C W-180 fraction added to W-182 because of cross sections
C Polyethylene thermal S(alpha, beta) treatment applied at 300K
C Cell Cards
1  1  4.8522e-2  -1
2  2  1.1657e-1  1 -2
3  0                                     2

C Surface Cards
1  so  8.350
2  so  9.80

C Data Cards
imp:n 1 1 0
totnu
kcode 10000 1. 100 600
ksrc 0 0 0
C Material Cards
c      Materials specified with atom densities
m1  92234.70c  5.2428e-4      92235.70c  4.2315e-2
     92238.70c  4.3901e-3
     6000.70c   1.0548e-3
     26054.70c  1.0990e-5      26056.70c  1.7085e-4
     26057.70c  3.9117e-6      26058.70c  5.2156e-7
     74182.70c  1.3749e-5      74183.70c  7.4313e-6
     74184.70c  1.5976e-5      74186.70c  1.4883e-5
m2   6000.70c  3.8856e-2
     1001.70c  7.7699e-2      1002.70c  1.1657e-5
mt2  poly.10t

```

Table A-44. Input file for heu-met-fast-021-case-2

```

Steel Reflected HEU Sphere, VNIIEF: HEU-MET-FAST-021 case 2
C W-180 fraction added to W-182 because of cross sections
C Cell Cards
1 0 -1
2 1 4.8246e-2 1 -2
3 2 8.1737e-2 2 -3
4 3 8.1354e-2 3 -4
5 0 4

C Surface Cards
1 so 0.890
2 so 7.550
3 so 11.00
4 so 17.25

C Data Cards
imp:n 1 1 1 1 0
totnu
kcode 10000 1. 100 600
ksrc 2 0 0
C Material Cards
c Materials specified with atom densities
m1 92234.70c 5.2087e-4 92235.70c 4.2023e-2
92238.70c 4.3613e-3
26054.70c 1.1467e-5 26056.70c 1.7826e-4
26057.70c 4.0814e-6 26058.70c 5.4418e-7
6000.70c 1.0919e-3
74182.70c 1.4544e-5 74183.70c 7.8611e-6
74184.70c 1.6900e-5 74186.70c 1.5744e-5
m2 26054.70c 4.6856e-3 26056.70c 7.2841e-2
26057.70c 1.6678e-3 26058.70c 2.2237e-4
6000.70c 1.1269e-3
14028.70c 1.4817e-4 14029.70c 7.5024e-6
14030.70c 4.9802e-6
24050.70c 1.1311e-5 24052.70c 2.1812e-4
24053.70c 2.4730e-5 24054.70c 6.1566e-6
25055.70c 3.2851e-4
28058.70c 1.5745e-4 28060.70c 6.0194e-5
28061.70c 2.6061e-6 28062.70c 8.2796e-6
28064.70c 2.0987e-6
29063.70c 1.4734e-4 29065.70c 6.5671e-5
m3 26054.70c 4.6637e-3 26056.70c 7.2500e-2
26057.70c 1.6600e-3 26058.70c 2.2133e-4
6000.70c 1.1217e-3
14028.70c 1.4748e-4 14029.70c 7.4673e-6
14030.70c 4.9569e-6
24050.70c 1.1258e-5 24052.70c 2.1710e-4
24053.70c 2.4615e-5 24054.70c 6.1277e-6
25055.70c 3.2697e-4
28058.70c 1.5671e-4 28060.70c 5.9913e-5
28061.70c 2.5939e-6 28062.70c 8.2409e-6
28064.70c 2.0889e-6
29063.70c 1.4665e-4 29065.70c 6.5363e-5

```

Table A-45. Input file for heu-met-fast-022-case-2

```

Duralumin Reflected HEU SPHERE, VNIIEF; HEU-MET-FAST-022 case 2
C W-180 fraction added to W-182 because of cross sections
C Cell Cards
1 0 -1
2 1 4.8224e-2 1 -2
3 2 5.5937e-2 2 -3
4 0 3

C Surface Cards
1 so 1.018
2 so 8.350
3 so 12.25

C Data Cards
imp:n 1 1 1 0
totnu
kcode 10000 1. 100 600
ksrc 2 0 0
C Material Cards
c Materials specified with atom densities
m1 92234.70c 5.2104e-4 92235.70c 4.2055e-2
92238.70c 4.3629e-3
26054.70c 1.0923e-5 26056.70c 1.6981e-4
26057.70c 3.8879e-6 26058.70c 5.1839e-7
6000.70c 1.0482e-3
74182.70c 1.3663e-5 74183.70c 7.3846e-6
74184.70c 1.5876e-5 74186.70c 1.4790e-5
m2 13027.70c 5.3934e-2
26054.70c 5.8234e-5 26056.70c 9.0530e-4
26057.70c 2.0727e-5 26058.70c 2.7637e-6
29063.70c 7.0284e-4 29065.70c 3.1326e-4

```

Table A-46. Input file for heu-met-fast-026-case-c-11

```

Tinkertoy 2 HEU-MET-FAST-026 3x3x3 Array C-11 Paraffin Rfl
c STS 18.720 cm 7.6-cm thick reflector
1 1 0.048033 -1 #2 #3 7 -8 u=1 $ HEU Cylinder
2 2 0.087058 -2 u=1 $ Left SS Rod
3 2 0.087058 -3 u=1 $ Right SS Rod
4 0 1 7 -8 u=1 $ Side Void
5 0 #2 #3 -7 u=1 $ Bottom Void
6 0 #2 #3 8 u=1 $ Top Void
7 0 -9 6 -15 14 -25 22 u=2
lat=1 fill=-1:1 -1:1 -1:1 1 26r $ 3x3x3 Array
8 0 5 -10 13 -16 19 -28 fill=2 $ Core
9 0 4 -5 12 -17 20 -21 $ Left Void
10 0 4 -5 12 -17 23 -24 $ Center Void
11 0 4 -5 12 -17 26 -27 $ Right Void
12 3 0.122273 4 -5 12 -17 18 -29
#9 #10 #11 $ Lower Reflector
13 0 10 -11 12 -17 20 -21 $ Left Void
14 0 10 -11 12 -17 23 -24 $ Center Void
15 0 10 -11 12 -17 26 -27 $ Right Void
16 3 0.122273 10 -11 12 -17 18 -29
#13 #14 #15 $ Upper Reflector
17 3 0.122273 5 -10 12 -13 18 -29 $ Back Reflector
18 3 0.122273 5 -10 16 -17 18 -29 $ Front Reflector
19 3 0.122273 5 -10 13 -16 18 -19 $ Left Reflector
20 3 0.122273 5 -10 13 -16 28 -29 $ Right Reflector
21 0 -4:11:-12:17:-18:29

1 cz 5.742 $ Radius of HEU Cylinder
2 c/z 0 -4.2735 0.254 $ Radius of Left SS Rod
3 c/z 0 4.2735 0.254 $ Radius of Right SS Rod
4 pz -51.8275 $ Bottom of Lower Paraffin Sheet
5 pz -44.2275 $ Top of Lower Paraffin Sheet
6 pz -14.7425 $ Bottom of Cell
7 pz -5.3825 $ Bottom of HEU Cylinder
8 pz 5.3825 $ Top of HEU Cylinder
9 pz 14.7425 $ Top of Cell
10 pz 44.2275 $ Bottom of Upper Paraffin Sheet
11 pz 51.8275 $ Top of Upper Paraffin Sheet
12 py -52.906 $ Front Edge of Front Paraffin Sheet
13 py -45.306 $ Back Edge of Front Paraffin Sheet
14 py -15.102 $ Front Edge of Cell
15 py 15.102 $ Back Edge of Cell
16 py 45.306 $ Front Edge of Back Paraffin Sheet
17 py 52.906 $ Back Edge of Back Paraffin Sheet
18 px -52.906 $ Left Edge of Left Paraffin Sheet
19 px -45.306 $ Right Edge of Left Paraffin Sheet
20 px -30.458 $ Left Edge of Left Paraffin Gap
21 px -29.950 $ Right Edge of Left Paraffin Gap
22 px -15.102 $ Left Edge of Cell
23 px -0.254 $ Left Edge of Center Paraffin Gap
24 px 0.254 $ Right Edge of Center Paraffin Gap
25 px 15.102 $ Right Edge of Cell
26 px 29.950 $ Left Edge of Right Paraffin Gap
27 px 30.458 $ Right Edge of Right Paraffin Ggap

```



Table A-46. Input file for heu-met-fast-026-case-c-11 (Cont'd)

```

28 px      45.306          $ Left Edge of Right Paraffin Sheet
29 px      52.906          $ Right Edge of Right Paraffin Sheet

mode      n
totnu
kcode     10000      1.0    100    600
imp:n     1.0      19r    0.0
ksrc      0         0      0
          30.204    0      0
          -30.204  0      0
          0        30.204  0
          30.204    30.204  0
          -30.204  30.204  0
          0        -30.204  0
          30.204   -30.204  0
          -30.204 -30.204  0
          0         0      29.485
          30.204    0      29.485
          -30.204  0      29.485
          0        30.204  29.485
          30.204    30.204  29.485
          -30.204  30.204  29.485
          0        -30.204  29.485
          30.204   -30.204  29.485
          -30.204 -30.204  29.485
          0         0      -29.485
          30.204    0      -29.485
          -30.204  0      -29.485
          0        30.204  -29.485
          30.204    30.204  -29.485
          -30.204  30.204  -29.485
          0        -30.204  -29.485
          30.204   -30.204  -29.485
          -30.204 -30.204  -29.485

c         HEU
m1  92234.70c    4.8271e-4    92235.70c    4.4797e-2
     92236.70c    9.5723e-5    92238.70c    2.6577e-3

c         Stainless steel
m2  6000.70c     3.1691e-4
     14028.70c   1.5624e-3    14029.70c    7.9110e-5
     14030.70c   5.2514e-5
     24050.70c   7.1571e-4    24052.70c    1.3802e-2
     24053.70c   1.5648e-3    24054.70c    3.8956e-4
     25055.70c   1.7321e-3
     26054.70c   3.5612e-3    26056.70c    5.5362e-2
     26057.70c   1.2676e-3    26058.70c    1.6901e-4
     28058.70c   4.4262e-3    28060.70c    1.6922e-3
     28061.70c   7.3262e-5    28062.70c    2.3275e-4
     28064.70c   5.8999e-5

c         Paraffin with Polyethylene Scattering Law
m3  1001.70c     8.2574e-2
     6000.70c     3.9699e-2

mt3  poly.10t

end of input

```

Table A-47. Input file for heu-met-fast-028

```

HEU-MET-FAST-028  FLATTOP-25  HEU Sphere Reflected by Normal U  CSEWG: F-22
1      1      0.0476745      -1      $ HEU Sphere
2      2      0.0480697      1  -2  $ Normal U Reflector
3      0

```

```

1      so      6.1156
2      so      24.1242

```

```

kcode  10000  1.0  100  600
imp:n   1.0   1.0   0.0
sdef   cel=1  erg=d1
sp1    -3
vol     958.09  58809.48      0.0
area   469.99  7313.34
totnu
c      Uranium (93.24 wt.% U-235)
m1     92234.70c  4.8869e-4      92235.70c  4.4482e-2
       92238.70c  2.7038e-3
c      Normal Uranium Reflector
m2     92234.70c  2.6438e-6      92235.70c  3.4610e-4
       92238.70c  4.7721e-2

```

```

end of input

```

Table A-48. Input file for heu-comp-inter-003-case-6

HEU-COMP-INTER-003	Case 6	DU	Inner	Refl,	No	Outer	Reflector
1	15	0.060240	-11	12	-13		imp:n=1
2	11	0.048066	9	-10	13	-33	imp:n=1
3	11	0.048066	-6	13	-14		imp:n=1
4	14	0.069986	-4	14	-15		imp:n=1
5	14	0.069986	4	-6	14	-15	imp:n=1
6	14	0.069986	-6	15	-16		imp:n=1
7	1	0.101798	-4	16	-17		imp:n=1
9	14	0.069986	4	-6	16	-17	imp:n=1
10	14	0.069986	-6	17	-18		imp:n=1
11	14	0.069986	-6	18	-19		imp:n=1
12	10	0.098912	-4	19	-20		imp:n=1
14	14	0.069986	4	-6	19	-20	imp:n=1
15	14	0.069986	-6	20	-21		imp:n=1
17	15	0.060240	1	-2	21	-24	imp:n=1
18	0		-6	21	-24	#17	imp:n=1
20	14	0.069986	-6	24	-25		imp:n=1
21	6	0.096378	-4	25	-26		imp:n=1
23	14	0.069986	4	-6	25	-26	imp:n=1
24	14	0.069986	-6	26	-27		imp:n=1
25	14	0.069986	-6	27	-28		imp:n=1
26	3	0.101868	-4	28	-29		imp:n=1
28	14	0.069986	4	-6	28	-29	imp:n=1
29	14	0.069986	-6	29	-30		imp:n=1
30	14	0.069986	4	-6	30	-31	imp:n=1
31	14	0.069986	-4	30	-31		imp:n=1
32	11	0.048066	-6	31	-32		imp:n=1
33	0		6	-7	13	-33	imp:n=1
34	14	0.069986	7	-8	13	-33	imp:n=1
35	0		8	-9	13	-33	imp:n=1
36	0		-6	32	-33		imp:n=1
37	0		10	-11	13	-33	imp:n=1
38	0		11:-12:33				imp:n=0
1	cz	6.0325					
2	cz	6.3500					
4	cz	7.5050					
6	cz	7.5438					
7	cz	7.5489					
8	cz	7.6759					
9	cz	7.7013					
10	cz	10.0432					
11	cz	15.1409					
12	pz	-1.2700					
13	pz	0.0000					
14	pz	2.3400					
15	pz	2.4988					
16	pz	2.5242					
17	pz	5.5248					
18	pz	5.5502					
19	pz	5.5756					
20	pz	8.5849					
21	pz	8.6103					
24	pz	9.1622					
25	pz	9.1876					

Table A-48. Input file for heu-comp-inter-003-case-6 (Cont'd)

```

26 pz 12.1832
27 pz 12.2086
28 pz 12.2340
29 pz 15.2061
30 pz 15.2315
31 pz 15.3903
32 pz 17.7303
33 pz 19.9085

kcode 10000 1.0 100 600
ksrc 0 0 4.02415
c UH3 Part I: Part Number 6625 (Run Number 1)
m1 1001.70c 7.3871E-02
    8016.70c 8.5519E-04 8017.70c 3.4221E-07
    6000.70c 1.4562E-04
    7014.70c 1.3593E-03
    26054.70c 2.1639E-06 26056.70c 3.3640E-05
    26057.70c 7.7022E-07 26058.70c 1.0270E-07
    79197.70c 3.3980E-04
    92234.70c 2.5279E-04 92235.70c 2.3450E-02
    92236.70c 1.1027E-04 92238.70c 1.3421E-03
c UH3 Part II: Part Number 6626 (Run Number 3)
m3 1001.70c 7.5396E-02
    8016.70c 5.6680E-04 8017.70c 2.2681E-07
    6000.70c 1.9943E-04
    7014.70c 1.9699E-04
    26054.70c 2.2577E-06 26056.70c 3.5098E-05
    26057.70c 8.0359E-07 26058.70c 1.0715E-07
    79197.70c 3.3787E-04
    92234.70c 2.5484E-04 92235.70c 2.3409E-02
    92236.70c 1.0757E-04 92238.70c 1.3371E-03
c UH3 Part III: Part Number 6627 (Run Number 6)
m6 1001.70c 6.9913E-02
    8016.70c 4.8405E-04 8017.70c 1.9370E-07
    6000.70c 1.5288E-04
    7014.70c 2.0644E-04
    26054.70c 6.1159E-07 26056.70c 9.5077E-06
    26057.70c 2.1769E-07 26058.70c 2.9025E-08
    79197.70c 3.4242E-04
    92234.70c 2.5651E-04 92235.70c 2.3550E-02
    92236.70c 1.0829E-04 92238.70c 1.3584E-03
c UH3 Part IV: Part Number 6633 (Run Number 10)
m10 1001.70c 7.2725E-02
    8016.70c 6.3689E-04 8017.70c 2.5486E-07
    6000.70c 1.5539E-04
    7014.70c 2.4400E-04
    26054.70c 1.2044E-05 26056.70c 1.8723E-04
    26057.70c 4.2867E-06 26058.70c 5.7156E-07
    79197.70c 3.4196E-04
    92234.70c 2.4873E-04 92235.70c 2.2939E-02
    92236.70c 1.0390E-04 92238.70c 1.3117E-03
c Depleted Uranium
m11 92235.70c 9.7360E-05 92238.70c 4.7969E-02

```

Table A-48. Input file for heu-comp-inter-003-case-6 (Cont'd)

```
c Stainless Steel SAE 1020
m14    6000.70c  5.4977E-04
        25055.70c 1.6969E-04
        26054.70c 4.0868E-03    26056.70c  6.3532E-02
        26057.70c 1.4546E-03    26058.70c  1.9395E-04
c aluminum
m15    13027.70c 6.0239E-02
totnu

end of input
```

Table A-49. Input file for heu-met-inter-006-case-1

```

ZEUS-1 10 Uniform Units, 10*8.05888 cm C/Unit HEU-MET-INTER-006, case 1
c      Platen and Alignment Tube
1      2      0.059114      11 -12 50 -51      $ Platen
2      2      0.059114      9  -25 47 -48      $ Alignment Tube
c      Reflector Regions
3      4      0.082780      1  -4  5  -8      10 -44
                                     52      $ Below Top Reflector
4      4      0.082780      1  -4  5  -8      44 -45 $ Upper Reflector
5      4      0.082780      1  -4  5  -8      45 -46
                                     #43      $ Hollow Reflector
6      4      0.082780      12 -13 49 -51      $ Bottom Reflector
c      Column of Platters
7      3      0.085380      13 -14 49 -51      $ Unit 1, Lwr Graphite
8      1      0.048146      14 -15 49 -51      $ Unit 1, HEU
9      3      0.085380      15 -16 49 -51      $ Unit 1, Upr Graphite
10     3      0.085380      16 -17 49 -51      $ Unit 2, Lwr Graphite
11     1      0.048146      17 -18 49 -51      $ Unit 2, HEU
12     3      0.085380      18 -19 49 -51      $ Unit 2, Upr Graphite
13     3      0.085380      19 -20 49 -51      $ Unit 3, Lwr Graphite
14     1      0.048146      20 -21 49 -51      $ Unit 3, HEU
15     3      0.085380      21 -22 49 -51      $ Unit 3, Upr Graphite
16     3      0.085380      22 -23 49 -51      $ Unit 4, Lwr Graphite
17     1      0.048146      23 -24 49 -51      $ Unit 4, HEU
18     3      0.085380      24 -25 49 -51      $ Unit 4, Upr Graphite
19     3      0.085380      25 -26 -51      $ Unit 5, Lwr Graphite
20     1      0.048146      26 -27 -51      $ Unit 5, HEU
21     3      0.085380      27 -28 -51      $ Unit 5, Upr Graphite
22     3      0.085380      28 -29 -51      $ Unit 6, Lwr Graphite
23     1      0.048146      29 -30 -51      $ Unit 6, HEU
24     3      0.085380      30 -31 -51      $ Unit 6, Upr Graphite
25     3      0.085380      31 -32 -51      $ Unit 7, Lwr Graphite
26     1      0.048146      32 -33 -51      $ Unit 7, HEU
27     3      0.085380      33 -34 -51      $ Unit 7, Upr Graphite
28     3      0.085380      34 -35 -51      $ Unit 8, Lwr Graphite
29     1      0.048146      35 -36 -51      $ Unit 8, HEU
30     3      0.085380      36 -37 -51      $ Unit 8, Upr Graphite
31     3      0.085380      37 -38 -51      $ Unit 9, Lwr Graphite
32     1      0.048146      38 -39 -51      $ Unit 9, HEU
33     3      0.085380      39 -40 -51      $ Unit 9, Upr Graphite
34     3      0.085380      40 -41 -51      $ Unit 10, Lwr Graphite
35     1      0.048146      41 -42 -51      $ Unit 10, HEU
36     3      0.085380      42 -43 -51      $ Unit 10, Upr Graphite
c      Internal Voids
37     0      11 -12 48 -50      $ A-Tube - Platen Gap
38     0      10 -11 48 -52      $ A-Tube - Refl Gap
39     0      9  -25 -47      $ Inside Alignment Tube
40     0      12 -25 48 -49      $ Tube-Platter Gap
41     0      11 -44 51 -52      $ Platter-Rfl Gap
42     0      43 -44 -51      $ Below top Reflector
43     0      2  -3  6  -7      45 -46 $ Above Top Reflector
c      External Voids
44     0      -1  10      $ Outside Refl (Left)
45     0      4  10      $ Outside Refl (Right)
46     0      1  -4  -5  10      $ Outside Refl (Front)
47     0      1  -4  8  10      $ Outside Refl (Back)

```

Table A-49. Input file for heu-met-inter-006-case-1 (Cont'd)

48	0	1	-4	5	-8	46	\$ Above Reflector
49	0	-10	#2	#39			\$ Below Reflector
1	px	-44.14520					\$ Left Refl Edge
2	px	-27.94000					\$ Left Inside Refl Edge
3	px	27.94000					\$ Right Inside Refl Edge
4	px	44.14520					\$ Right Refl Edge
5	py	-44.14520					\$ Front Refl Edge
6	py	-27.94000					\$ Front Inside Refl Edge
7	py	27.94000					\$ Back Inside Refl Edge
8	py	44.14520					\$ Back Refl Edge
9	pz	-5.79120					\$ Bottom of Align Tube
10	pz	0.0					\$ Bottom of Reflector
11	pz	3.49720					\$ Bottom of Platen
12	pz	9.84720					\$ Top of Platen
13	pz	24.27440					\$ Column Reflector
14	pz	28.30384					\$ 1st Unit: Lwr Graphite
15	pz	28.60356					\$ 1st Unit: HEU
16	pz	32.63300					\$ 1st Unit: Upr Graphite
17	pz	36.66244					\$ 2nd Unit: Lwr Graphite
18	pz	36.96216					\$ 2nd Unit: HEU
19	pz	40.99160					\$ 2nd Unit: Upr Graphite
20	pz	45.02104					\$ 3rd Unit: Lwr Graphite
21	pz	45.32076					\$ 3rd Unit: HEU
22	pz	49.35020					\$ 3rd Unit: Upr Graphite
23	pz	53.37964					\$ 4th Unit: Lwr Graphite
24	pz	53.67936					\$ 4th Unit: HEU
25	pz	57.70880					\$ 4th Unit: Upr Graphite
26	pz	61.73824					\$ 5th Unit: Lwr Graphite
27	pz	62.03796					\$ 5th Unit: HEU
28	pz	66.06740					\$ 5th Unit: Upr Graphite
29	pz	70.09684					\$ 6th Unit: Lwr Graphite
30	pz	70.39656					\$ 6th Unit: HEU
31	pz	74.42600					\$ 6th Unit: Upr Graphite
32	pz	78.45544					\$ 7th Unit: Lwr Graphite
33	pz	78.75516					\$ 7th Unit: HEU
34	pz	82.78460					\$ 7th Unit: Upr Graphite
35	pz	86.81404					\$ 8th Unit: Lwr Graphite
36	pz	87.11376					\$ 8th Unit: HEU
37	pz	91.14320					\$ 8th Unit: Upr Graphite
38	pz	95.17264					\$ 9th Unit: Lwr Graphite
39	pz	95.47236					\$ 9th Unit: HEU
40	pz	99.50180					\$ 9th Unit: Upr Graphite
41	pz	103.53124					\$ 10th Unit: Lwr Graphite
42	pz	103.83096					\$ 10th Unit: HEU
43	pz	107.86040					\$ 10th Unit: Upr Graphite
44	pz	108.61040					\$ Reflector-Column Gap
45	pz	123.03760					\$ Solid Reflector
46	pz	123.90120					\$ Hollow Reflector
47	<td>2.5400</td> <td></td> <td></td> <td></td> <td></td> <td>\$ 1.0-in Radius</td>	2.5400					\$ 1.0-in Radius
48	<td>3.1496</td> <td></td> <td></td> <td></td> <td></td> <td>\$ 1.24-in. Radius</td>	3.1496					\$ 1.24-in. Radius
49	<td>3.1750</td> <td></td> <td></td> <td></td> <td></td> <td>\$ 1.25-in. Radius</td>	3.1750					\$ 1.25-in. Radius
50	<td>4.7625</td> <td></td> <td></td> <td></td> <td></td> <td>\$ 1.875-in. Radius</td>	4.7625					\$ 1.875-in. Radius
51	<td>26.6700</td> <td></td> <td></td> <td></td> <td></td> <td>\$ Platter OR</td>	26.6700					\$ Platter OR
52	<td>26.7970</td> <td></td> <td></td> <td></td> <td></td> <td>\$ Corner Rfl IR</td>	26.7970					\$ Corner Rfl IR

Table A-49. Input file for heu-met-inter-006-case-1 (Cont'd)

```

mode      n
kcode    10000    1.0    100    600
imp:n    1.0      42r    0.0    5r
ksrc     0.0    -15.0   28.45370    0.0    15.0    28.45370
          -15.0    0.0    28.45370    15.0    0.0    28.45370
          0.0    -15.0   36.81230    0.0    15.0    36.81230
          -15.0    0.0    36.81230    15.0    0.0    36.81230
          0.0    -15.0   45.17090    0.0    15.0    45.17090
          -15.0    0.0    45.17090    15.0    0.0    45.17090
          0.0    -15.0   53.52950    0.0    15.0    53.52950
          -15.0    0.0    53.52950    15.0    0.0    53.52950
          0.0    -15.0   61.88810    0.0    15.0    61.88810
          -15.0    0.0    61.88810    15.0    0.0    61.88810
          0.0    -15.0   70.24670    0.0    15.0    70.24670
          -15.0    0.0    70.24670    15.0    0.0    70.24670
          0.0    -15.0   78.60530    0.0    15.0    78.60530
          -15.0    0.0    78.60530    15.0    0.0    78.60530
          0.0    -15.0   86.96390    0.0    15.0    86.96390
          -15.0    0.0    86.96390    15.0    0.0    86.96390
          0.0    -15.0   95.32250    0.0    15.0    95.32250
          -15.0    0.0    95.32250    15.0    0.0    95.32250
          0.0    -15.0  103.68110    0.0    15.0   103.68110
          -15.0    0.0  103.68110    15.0    0.0   103.68110
c         Average U (93.23 w/o enriched)
m1        92234.70c    4.9483e-4    92235.70c    4.4918e-2
          92236.70c    1.5917e-4    92238.70c    2.5740e-3
c         Aluminum 6061 (2.70 g/cc)
c m2      12000.62c    6.6049e-4
m2        12024.70c    5.2172e-4    12025.70c    6.6049e-5    $ ENDF/B-VI
          12026.70c    7.2720e-5    $ ENDF/B-VII.0
          13027.70c    5.7816e-2    $ ENDF/B-VII.0
          14028.70c    3.1630e-4    14029.70c    1.6016e-5
          14030.70c    1.0631e-5
c         22000.62c    2.5146e-5    $ ENDF/B-VI
          22046.70c    2.0745e-6    22047.70c    1.8708e-6    $ ENDF/B-VII.0
          22048.70c    1.8537e-5    22049.70c    1.3603e-6    $ ENDF/B-VII.0
          22050.70c    1.3025e-6    $ ENDF/B-VII.0
          24050.70c    3.3536e-6    24052.70c    6.4673e-5
          24053.70c    7.3325e-6    24054.70c    1.8254e-6
          25055.70c    2.1915e-5
          26054.70c    5.9360e-6    26056.70c    9.2280e-5
          26057.70c    2.1128e-6    26058.70c    2.8171e-7
          29063.70c    4.8053e-5    29065.70c    2.1418e-5
c         Graphite (1.7029 g/cc)
m3        6000.70c    0.085380
c         Average Copper (8.7351 g/cc)
m4        29063.70c    5.7259e-2    29065.70c    2.5521e-2
mt3       grph.10t
totnu

end of input

```



Table A-50. Input file for heu-met-inter-006-case-2

ZEUS-2	9 Units, 6 C Plates/Unit	Final	Bmark	Model	HEU-MET-INTER-006, case 2			
c	Comet Hardware							
1	2	0.059114	11	-12	47	-48		\$ Platen
2	2	0.059114	9	-19	44	-45		\$ Alignment Tube
c	Reflector Regions							
3	4	0.082780	1	-4	5	-8	10	-41
			49					\$ Below Top Reflector
4	4	0.082780	1	-4	5	-8	41	-42
								\$ Upper Reflector
5	4	0.082780	1	-4	5	-8	42	-43
			#40					\$ Hollow Reflector
6	4	0.082780	12	-13	46	-48		\$ Bottom Reflector
c	Column of Platters							
7	3	0.085821	13	-14	46	-48		\$ Unit 1, Lwr Gr
8	1	0.048176	14	-15	46	-48		\$ Unit 1, Inner HEU
9	3	0.085821	15	-16	46	-48		\$ Unit 1, Upr Gr
10	3	0.085821	16	-17	46	-48		\$ Unit 2, Lwr Gr
11	1	0.048176	17	-18	46	-48		\$ Unit 2, Inner HEU
12	3	0.085821	18	-19	46	-48		\$ Unit 2, Upr Gr
13	3	0.085821	19	-20	-48			\$ Unit 3, Lwr
14	1	0.048176	20	-21	-48			\$ Unit 3, Inner HEU
15	3	0.085821	21	-22	-48			\$ Unit 3, Upr Gr
16	3	0.085821	22	-23	-48			\$ Unit 4, Lwr Gr
17	1	0.048176	23	-24	-48			\$ Unit 4, Inner HEU
18	3	0.085821	24	-25	-48			\$ Unit 4, Upr Gr
19	3	0.085821	25	-26	-48			\$ Unit 5, Lwr Gr
20	1	0.048176	26	-27	-48			\$ Unit 5, Inner HEU
21	3	0.085821	27	-28	-48			\$ Unit 5, Upr Gr
22	3	0.085821	28	-29	-48			\$ Unit 6, Lwr Gr
23	1	0.048176	29	-30	-48			\$ Unit 6, Inner HEU
24	3	0.085821	30	-31	-48			\$ Unit 6, Upr Gr
25	3	0.085821	31	-32	-48			\$ Unit 7, Lwr Gr
26	1	0.048176	32	-33	-48			\$ Unit 7, Inner HEU
27	3	0.085821	33	-34	-48			\$ Unit 7, Upr Gr
28	3	0.085821	34	-35	-48			\$ Unit 8, Lwr Gr
29	1	0.048176	35	-36	-48			\$ Unit 8, Inner HEU
30	3	0.085821	36	-37	-48			\$ Unit 8, Upr Gr
31	3	0.085821	37	-38	-48			\$ Unit 9, Lwr Gr
32	1	0.048176	38	-39	-48			\$ Unit 9, Inner HEU
33	3	0.085821	39	-40	-48			\$ Unit 9, Upr Gr
c	Internal Voids							
34	0		11	-12	45	-47		\$ A-Tube - Platen Gap
35	0		10	-11	45	-49		\$ A-Tube - Refl Gap
36	0		9	-19	-44			\$ Inside Alignment Tube
37	0		12	-19	45	-46		\$ Tube-Platter Gap
38	0		11	-41	48	-49		\$ Platter-Rfl Gap
39	0		40	-41	-48			\$ Column-Upr Rfl Gap
40	0		2	-3	6	-7	42	-43
								\$ Above Top Reflector
c	External Voids							
41	0		-1	10				\$ Left of Side Rfls
42	0		4	10				\$ Right of Side Rfls
43	0		1	-4	-5	10		\$ Front of Side Rfls
44	0		1	-4	8	10		\$ Behind Side Rfls
45	0		1	-4	5	-8	43	\$ Above Side Reflectors
46	0		-10	#2	#36			\$ Below Reflectors

Table A-50. Input file for heu-met-inter-006-case-2 (Cont'd)

1	px	-44.14520					\$ Left Rfl Edge
2	px	-27.94000					\$ Left Int Rfl Edge
3	px	27.94000					\$ Right Int Rfl Edge
4	px	44.14520					\$ Right Rfl Edge
5	py	-44.14520					\$ Front Rfl Edge
6	py	-27.94000					\$ Front Int Rfl Edge
7	py	27.94000					\$ Back Int Rfl Edge
8	py	44.14520					\$ Back Rfl Edge
9	pz	-5.79120					\$ Bottom of Alignment Tube
10	pz	0.0					\$ Bottom of Reflectors
11	pz	24.24384					\$ Bottom of Platen
12	pz	30.59384					\$ Top of Platen
13	pz	45.02104					\$ Column Reflector
14	pz	48.04312					\$ 1st Unit: Lwr Gr
15	pz	48.34284					\$ 1st Unit: HEU
16	pz	51.36492					\$ 1st Unit: Upr Gr
17	pz	54.38700					\$ 2nd Unit: Lwr Gr
18	pz	54.68672					\$ 2nd Unit: HEU
19	pz	57.70880					\$ 2nd Unit: Upr Gr
20	pz	60.73088					\$ 3rd Unit: Lwr Gr
21	pz	61.03060					\$ 3rd Unit: HEU
22	pz	64.05268					\$ 3rd Unit: Upr Gr
23	pz	67.07476					\$ 4th Unit: Lwr Gr
24	pz	67.37448					\$ 4th Unit: HEU
25	pz	70.39656					\$ 4th Unit: Upr Gr
26	pz	73.41864					\$ 5th Unit: Lwr Gr
27	pz	73.71836					\$ 5th Unit: HEU
28	pz	76.74044					\$ 5th Unit: Upr Gr
29	pz	79.76252					\$ 6th Unit: Lwr Gr
30	pz	80.06224					\$ 6th Unit: HEU
31	pz	83.08432					\$ 6th Unit: Upr Gr
32	pz	86.10640					\$ 7th Unit: Lwr Gr
33	pz	86.40612					\$ 7th Unit: HEU
34	pz	89.42820					\$ 7th Unit: Upr Gr
35	pz	92.45028					\$ 8th Unit: Lwr Gr
36	pz	92.75000					\$ 8th Unit: HEU
37	pz	95.77208					\$ 8th Unit: Upr Gr
38	pz	98.79416					\$ 9th Unit: Lwr Gr
39	pz	99.09388					\$ 9th Unit: HEU
40	pz	102.11596					\$ 9th Unit: Upr Gr
41	pz	102.89540					\$ Top of Crnr Refls
42	pz	117.32260					\$ Top Reflector
43	pz	123.90120					\$ Top of Side Refls
44	cz	2.5400					\$ 1.0-in Radius
45	cz	3.1496					\$ 1.24-in. Radius
46	cz	3.1750					\$ 1.25-in. Radius
47	cz	4.7625					\$ 1.875-in. Radius
48	cz	26.6700					\$ Platter OR
49	cz	26.7970					\$ Corner Rfl IR

mode	n						
kcode	10000	1.0	100	600			
imp:n	1.0	39r	0.0	5r			
ksrc	0.0	-15.0	48.17287	0.0	15.0	48.17287	
	-15.0	0.0	48.17287	15.0	0.0	48.17287	

Table A-50. Input file for heu-met-inter-006-case-2 (Cont'd)

	0.0	-15.0	54.52084	0.0	15.0	52.52084	
	-15.0	0.0	54.52084	15.0	0.0	52.52084	
	0.0	-15.0	61.15252	0.0	15.0	61.15252	
	-15.0	0.0	61.15252	15.0	0.0	61.15252	
	0.0	-15.0	67.51164	0.0	15.0	67.51164	
	-15.0	0.0	67.51164	15.0	0.0	67.51164	
	0.0	-15.0	73.85198	0.0	15.0	73.85198	
	-15.0	0.0	73.85198	15.0	0.0	73.85198	
	0.0	-15.0	80.19334	0.0	15.0	80.19334	
	-15.0	0.0	80.19334	15.0	0.0	80.19334	
	0.0	-15.0	86.53822	0.0	15.0	86.53822	
	-15.0	0.0	86.53822	15.0	0.0	86.53822	
	0.0	-15.0	92.87829	0.0	15.0	92.87829	
	-15.0	0.0	92.87829	15.0	0.0	92.87829	
	0.0	-15.0	99.21454	0.0	15.0	99.21454	
	-15.0	0.0	99.21454	15.0	0.0	99.21454	
c	Average HEU (93.22 wt.%)						
m1	92234.70c	4.9576e-4		92235.70c	4.4941e-2		
	92236.70c	1.5931e-4		92238.70c	2.5799e-3		
c	Aluminum 6061 (2.70 g/cc)						
c m2	12000.62c	6.6049e-4				\$ ENDF/B-VI	
m2	12024.70c	5.2172e-4		12025.70c	6.6049e-5	\$ ENDF/B-VII.0	
	12026.70c	7.2720e-5				\$ ENDF/B-VII.0	
	13027.70c	5.7816e-2					
	14028.70c	3.1630e-4		14029.70c	1.6016e-5		
	14030.70c	1.0631e-5					
c	22000.62c	2.5146e-5				\$ ENDF/B-VI	
	22046.70c	2.0745e-6		22047.70c	1.8708e-6	\$ ENDF/B-VII.0	
	22048.70c	1.8537e-5		22049.70c	1.3603e-6	\$ ENDF/B-VII.0	
	22050.70c	1.3025e-6				\$ ENDF/B-VII.0	
	24050.70c	3.3536e-6		24052.70c	6.4673e-5		
	24053.70c	7.3325e-6		24054.70c	1.8254e-6		
	25055.70c	2.1915e-5					
	26054.70c	5.9360e-6		26056.70c	9.2280e-5		
	26057.70c	2.1128e-6		26058.70c	2.8171e-7		
	29063.70c	4.8053e-5		29065.70c	2.1418e-5		
c	Graphite (1.7117 g/cc)						
m3	6000.70c	0.085821					
c	Pure Copper (Average: 8.7351 g/cc)						
m4	29063.70c	5.7259e-2		29065.70c	2.5521e-2		
mt3	grph.10t						
totnu							
end of input							

Table A-51. Input file for heu-met-inter-006-case-3

ZEUS-3		9 Units, 4 C Plates/Unit		HEU-MET-INTER-006, case 3			
c		Comet Hardware					
1	1	0.059114	11	-12	47	-49	\$ Platen
2	1	0.059114	9	-25	44	-45	\$ Alignment Tube
c		Reflector Regions					
3	3	0.082780	1	-4	5	-8	10 -41
			50				\$ Below Top Reflector
4	3	0.082780	1	-4	5	-8	41 -42 \$ Upper Reflector
5	3	0.082780	1	-4	5	-8	42 -43 \$ Hollow Reflector
			#41				\$ Bottom Reflector
6	3	0.082780	12	-13	46	-49	\$ Bottom Reflector
c		Column of Platters					
7	2	0.086431	13	-14	46	-49	\$ Unit 1, Lwr Graphite
8	4	0.048158	14	-15	46	-48	\$ Unit 1, Inner HEU
9	0		14	-15	48	-49	\$ Unit 1, Outer Void
10	2	0.086431	15	-16	46	-49	\$ Unit 1, Upr Graphite
11	2	0.086431	16	-17	46	-49	\$ Unit 2, Lwr Graphite
12	4	0.048158	17	-18	46	-49	\$ Unit 2, HEU
13	2	0.086431	18	-19	46	-49	\$ Unit 2, Upr Graphite
14	2	0.086431	19	-20	46	-49	\$ Unit 3, Lwr Graphite
15	4	0.048158	20	-21	46	-49	\$ Unit 3, HEU
16	2	0.086431	21	-22	46	-49	\$ Unit 3, Upr Graphite
17	2	0.086431	22	-23	46	-49	\$ Unit 4, Lwr Graphite
18	4	0.048158	23	-24	46	-49	\$ Unit 4, HEU
19	2	0.086431	24	-25	46	-49	\$ Unit 4, Upr Graphite
20	2	0.086431	25	-26	-49		\$ Unit 5, Lwr Graphite
21	4	0.048158	26	-27	-49		\$ Unit 5, HEU
22	2	0.086431	27	-28	-49		\$ Unit 5, Upr Graphite
23	2	0.086431	28	-29	-49		\$ Unit 6, Lwr Graphite
24	4	0.048158	29	-30	-49		\$ Unit 6, HEU
25	2	0.086431	30	-31	-49		\$ Unit 6, Upr Graphite
26	2	0.086431	31	-32	-49		\$ Unit 7, Lwr Graphite
27	4	0.048158	32	-33	-49		\$ Unit 7, HEU
28	2	0.086431	33	-34	-49		\$ Unit 7, Upr Graphite
29	2	0.086431	34	-35	-49		\$ Unit 8, Lwr Graphite
30	4	0.048158	35	-36	-49		\$ Unit 8, HEU
31	2	0.086431	36	-37	-49		\$ Unit 8, Upr Graphite
32	2	0.086431	37	-38	-49		\$ Unit 9, Lwr Graphite
33	4	0.048158	38	-39	-49		\$ Unit 9, HEU
34	2	0.086431	39	-40	-49		\$ Unit 9, Upr Graphite
c		Internal Voids					
35	0		9	-25	-44		\$ Inside Alignment Tube
36	0		10	-11	45	-50	\$ A-Tube - Refl Gap
37	0		11	-12	45	-47	\$ A-Tube - Platen Gap
38	0		12	-25	45	-46	\$ A-Tube - Platter Gap
39	0		11	-41	49	-50	\$ Platter-Rfl Gap
40	0		40	-41	-49		\$ Column-Upr Rfl Gap
41	0		2	-3	6	-7	42 -43 \$ Above Upr Reflector
c		External Voids					
42	0		-1	10	-43		\$ Left of Reflectors
43	0		4	10	-43		\$ Right of Reflectors
44	0		-5	10	-43		\$ Front of Reflectors
45	0		8	10	-43		\$ Behind Reflectors
46	0		43				\$ Above Reflectors
47	0		-10	#2	#35		\$ Below Reflectors

Table A-51. Input file for heu-met-inter-006-case-3 (Cont'd)

1	px	-44.14520					\$ Left Rfl Edge
2	px	-27.94000					\$ Left Int Rfl Edge
3	px	27.94000					\$ Right Int Rfl Edge
4	px	44.14520					\$ Right Rfl Edge
5	py	-44.14520					\$ Front Rfl Edge
6	py	-27.94000					\$ Front Int Rfl Edge
7	py	27.94000					\$ Back Int Rfl Edge
8	py	44.14520					\$ Back Rfl Edge
9	pz	-5.79120					\$ Bottom of Alignment Tube
10	pz	0.0					\$ Bottom of Reflectors
11	pz	19.61496					\$ Bottom of Platen
12	pz	25.96496					\$ Top of Platen
13	pz	40.39216					\$ Column Reflector
14	pz	42.40688					\$ 1st Unit: Lwr Graphite
15	pz	42.70660					\$ 1st Unit: HEU
16	pz	44.72132					\$ 1st Unit: Upr Graphite
17	pz	46.73604					\$ 2nd Unit: Lwr Graphite
18	pz	47.03576					\$ 2nd Unit: HEU
19	pz	49.05048					\$ 2nd Unit: Upr Graphite
20	pz	51.06520					\$ 3rd Unit: Lwr Graphite
21	pz	51.36492					\$ 3rd Unit: HEU
22	pz	53.37964					\$ 3rd Unit: Upr Graphite
23	pz	55.39436					\$ 4th Unit: Lwr Graphite
24	pz	55.69408					\$ 4th Unit: HEU
25	pz	57.70880					\$ 4th Unit: Upr Graphite
26	pz	59.72352					\$ 5th Unit: Lwr Graphite
27	pz	60.02324					\$ 5th Unit: HEU
28	pz	62.03796					\$ 5th Unit: Upr Graphite
29	pz	64.05268					\$ 6th Unit: Lwr Graphite
30	pz	64.35240					\$ 6th Unit: HEU
31	pz	66.36712					\$ 6th Unit: Upr Graphite
32	pz	68.38184					\$ 7th Unit: Lwr Graphite
33	pz	68.68156					\$ 7th Unit: HEU
34	pz	70.69628					\$ 7th Unit: Upr Graphite
35	pz	72.71100					\$ 8th Unit: Lwr Graphite
36	pz	73.01072					\$ 8th Unit: HEU
37	pz	75.02544					\$ 8th Unit: Upr Graphite
38	pz	77.04016					\$ 9th Unit: Lwr Graphite
39	pz	77.33988					\$ 9th Unit: HEU
40	pz	79.35460					\$ 9th Unit: Upr Graphite
41	pz	79.59745					\$ Reflector-Column Gap
42	pz	94.02465					\$ Upper Reflector
43	pz	123.90120					\$ Hollow Reflector
44	cz	2.5400					\$ 1.0-in Radius
45	cz	3.1496					\$ 1.24-in. Radius
46	cz	3.1750					\$ 1.25-in. Radius
47	cz	4.7625					\$ 1.875-in. Radius
48	cz	19.0500					\$ 7.5-in. Radius
49	cz	26.6700					\$ Platter OR
50	cz	26.7970					\$ Reflector IR
mode	n						
kcode	10000	1.0	100	600			
imp:n	1.0	40r	0.0	5r			
ksrc	0.0	-15.0	42.55674	0.0	15.0	42.55674	

Table A-51. Input file for heu-met-inter-006-case-3 (Cont'd)

	-15.0	0.0	42.55674	15.0	0.0	42.55674	
	0.0	-15.0	46.88590	0.0	15.0	46.88590	
	-15.0	0.0	46.88590	15.0	0.0	46.88590	
	0.0	-15.0	51.21506	0.0	15.0	51.21506	
	-15.0	0.0	51.21506	15.0	0.0	51.21506	
	0.0	-15.0	55.54422	0.0	15.0	55.54422	
	-15.0	0.0	55.54422	15.0	0.0	55.54422	
	0.0	-15.0	59.87338	0.0	15.0	59.87338	
	-15.0	0.0	59.87338	15.0	0.0	59.87338	
	0.0	-15.0	64.20254	0.0	15.0	64.20254	
	-15.0	0.0	64.20254	15.0	0.0	64.20254	
	0.0	-15.0	68.53170	0.0	15.0	68.53170	
	-15.0	0.0	68.53170	15.0	0.0	68.53170	
	0.0	-15.0	72.86086	0.0	15.0	72.86086	
	-15.0	0.0	72.86086	15.0	0.0	72.86086	
	0.0	-15.0	77.19002	0.0	15.0	77.19002	
	-15.0	0.0	77.19002	15.0	0.0	77.19002	
c	Aluminum 6061 (2.70 g/cc)						
c m1	12000.62c	6.6049e-4					\$ ENDF/B-VI
m1	12024.70c	5.2172e-4	12025.70c	6.6049e-5			\$ ENDF/B-VII.0
	12026.70c	7.2720e-5					\$ ENDF/B-VII.0
	13027.70c	5.7816e-2					
	14028.70c	3.1630e-4	14029.70c	1.6016e-5			
	14030.70c	1.0631e-5					
c	22000.62c	2.5146e-5					\$ ENDF/B-VI
	22046.70c	2.0745e-6	22047.70c	1.8708e-6			\$ ENDF/B-VII.0
	22048.70c	1.8537e-5	22049.70c	1.3603e-6			\$ ENDF/B-VII.0
	22050.70c	1.3025e-6					\$ ENDF/B-VII.0
	24050.70c	3.3536e-6	24052.70c	6.4673e-5			
	24053.70c	7.3325e-6	24054.70c	1.8254e-6			
	25055.70c	2.1915e-5					
	26054.70c	5.9360e-6	26056.70c	9.2280e-5			
	26057.70c	2.1128e-6	26058.70c	2.8171e-7			
	29063.70c	4.8053e-5	29065.70c	2.1418e-5			
c	Graphite (1.72386 g/cc)						
m2	6000.70c	0.086431					
c	Average Copper						
m3	29063.70c	5.7259e-2	29065.70c	2.5521e-2			
c	Average HEU Plate (93.24 wt.% enriched)						
m4	92234.70c	4.9568e-4	92235.70c	4.4930e-2			
	92236.70c	1.5647e-4	92238.70c	2.5757e-3			
mt2	grph.10t						
totnu							
end of input							

Table A-52. Input file for heu-met-inter-006-case-4

ZEUS-4 9 Units, 2 Graphite Plates/Unit HEU-MET-INTER-006, case 4									
c	Comet Hardware								
1	2	0.059114	12	-14	18	-19			\$ Platen and Adapter
2	2	0.059114	9	-10	16	-29			\$ Alignment Tube
c	Reflector Regions								
3	4	0.082780	1	-4	5	-8	15	17	
			-48						\$ Below Upr Reflector
4	4	0.082780	1	-4	5	-8	48	-49	\$ Upper Reflector
5	4	0.082780	1	-4	5	-8	49	-50	
			#41						\$ Hollow Reflector
6	4	0.082780	11	-14	19	-20			\$ Bottom Reflector
c	Column of Platters								
7	3	0.086552	11	-14	20	-21			\$ Unit 1, Gr Plate
8	1	0.048180	11	-13	21	-22			\$ Unit 1, HEU
9	0		13	-14	21	-22			\$ Unit 1, Void
10	3	0.086552	11	-14	22	-23			\$ Unit 1, Gr Plate
11	3	0.086552	11	-14	23	-24			\$ Unit 2, Gr Plate
12	1	0.048180	11	-14	24	-25			\$ Unit 2, HEU
13	3	0.086552	11	-14	25	-26			\$ Unit 2, Gr Plate
14	3	0.086552	11	-14	26	-27			\$ Unit 3, Gr Plate
15	1	0.048180	11	-14	27	-28			\$ Unit 3, HEU
16	3	0.086552	11	-14	28	-29			\$ Unit 3, Gr Plate
17	3	0.086552	-14	29	-30				\$ Unit 4, Gr Plate
18	1	0.048180	-14	30	-31				\$ Unit 4, HEU
19	3	0.086552	-14	31	-32				\$ Unit 4, Gr Plate
20	3	0.086552	-14	32	-33				\$ Unit 5, Gr Plate
21	1	0.048180	-14	33	-34				\$ Unit 5, HEU
22	3	0.086552	-14	34	-35				\$ Unit 5, Gr Plate
23	3	0.086552	-14	35	-36				\$ Unit 6, Gr Plate
24	1	0.048180	-14	36	-37				\$ Unit 6, HEU
25	3	0.086552	-14	37	-38				\$ Unit 6, Gr Plate
26	3	0.086552	-14	38	-39				\$ Unit 7, Gr Plate
27	1	0.048180	-14	39	-40				\$ Unit 7, HEU
28	3	0.086552	-14	40	-41				\$ Unit 7, Gr Plate
29	3	0.086552	-14	41	-42				\$ Unit 8, Gr Plate
30	1	0.048180	-14	42	-43				\$ Unit 8, HEU
31	3	0.086552	-14	43	-44				\$ Unit 8, Gr Plate
32	3	0.086552	-14	44	-45				\$ Unit 9, Gr Plate
33	1	0.048180	-14	45	-46				\$ Unit 9, HEU
34	3	0.086552	-14	46	-47				\$ Unit 9, Gr Plate
c	Internal Voids								
35	0		10	-15	17	-18			\$ A-Tube - Refl Gap
36	0		10	-12	18	-19			\$ A-Tube - Platen Gap
37	0		-9	16	-29				\$ Inside Alignment Tube
38	0		10	-11	19	-29			\$ A-Tube - Platter Gap
39	0		14	-15	18	-48			\$ Platter-Rfl Gap
40	0		-14	47	-48				\$ Column-Upr Rfl Gap
41	0		2	-3	6	-7	49	-50	\$ Above Upr Reflector
c	External Voids								
42	0		-1	17					\$ Left of Reflectors
43	0		4	17					\$ Right of Reflectors
44	0		1	-4	-5	17			\$ Front of Reflectors
45	0		1	-4	8	17			\$ Behind Reflectors
46	0		1	-4	5	-8	50		\$ Above Reflectors
47	0		-17	#2	#37				\$ Below Reflectors

Table A-52. Input file for heu-met-inter-006-case-4 (Cont'd)

1	px	-44.14520					\$ Left Rfl Edge
2	px	-27.94000					\$ Left Int Rfl Edge
3	px	27.94000					\$ Right Int Rfl Edge
4	px	44.14520					\$ Right Rfl Edge
5	py	-44.14520					\$ Front Rfl Edge
6	py	-27.94000					\$ Front Int Rfl Edge
7	py	27.94000					\$ Back Int Rfl Edge
8	py	44.14520					\$ Back Rfl Edge
9	cz	2.5400					\$ 1.0-in Radius
10	cz	3.1496					\$ 1.24-in. Radius
11	cz	3.1750					\$ 1.25-in. Radius
12	cz	4.7625					\$ 1.875-in. Radius
13	cz	19.0500					\$ 7.5-in. Radius
14	cz	26.6700					\$ Platter OR
15	cz	26.7970					\$ Corner Rfl IR
16	pz	-5.79120					\$ Bottom of Alignment Tube
17	pz	0.0					\$ Bottom of Reflectors
18	pz	29.98828					\$ Bottom of Platen
19	pz	36.33828					\$ Top of Platen Adapter
20	pz	50.76548					\$ Bottom Reflector
21	pz	51.77284					\$ 1st Unit: Gr Plate
22	pz	52.07256					\$ 1st Unit: HEU
23	pz	53.07992					\$ 1st Unit: Gr Plate
24	pz	54.08728					\$ 2nd Unit: Gr Plate
25	pz	54.38700					\$ 2nd Unit: HEU
26	pz	55.39436					\$ 2nd Unit: Gr Plate
27	pz	56.40172					\$ 3rd Unit: Gr Plate
28	pz	56.70144					\$ 3rd Unit: HEU
29	pz	57.70880					\$ 3rd Unit: Gr Plate
30	pz	58.71616					\$ 4th Unit: Gr Plate
31	pz	59.01588					\$ 4th Unit: HEU
32	pz	60.02324					\$ 4th Unit: Gr Plate
33	pz	61.03060					\$ 5th Unit: Gr Plate
34	pz	61.33032					\$ 5th Unit: HEU
35	pz	62.33768					\$ 6th Unit: Gr Plate
36	pz	63.34504					\$ 6th Unit: Gr Plate
37	pz	63.64476					\$ 6th Unit: HEU
38	pz	64.65212					\$ 6th Unit: Gr Plate
39	pz	65.65948					\$ 7th Unit: Gr Plate
40	pz	65.95920					\$ 7th Unit: HEU
41	pz	66.96656					\$ 7th Unit: Gr Plate
42	pz	67.97392					\$ 8th Unit: Gr Plate
43	pz	68.27364					\$ 8th Unit: HEU
44	pz	69.28100					\$ 8th Unit: Gr Plate
45	pz	70.28836					\$ 9th Unit: Gr Plate
46	pz	70.58808					\$ 9th Unit: HEU
47	pz	71.59544					\$ 9th Unit: Gr Plate
48	pz	71.83755					\$ Corner Reflectors
49	pz	86.26475					\$ Top Reflector
50	pz	123.90120					\$ Side Reflectors
mode n							
kcode	10000	1.0	100	600			
imp:n	1.0	40r	0.0	5r			
ksrc	0.0	-15.0	51.89982	0.0	15.0	51.89982	



Table A-52. Input file for heu-met-inter-006-case-4 (Cont'd)

	-15.0	0.0	51.89982	15.0	0.0	51.89982	
	0.0	-15.0	54.22122	0.0	15.0	54.22122	
	-15.0	0.0	54.22122	15.0	0.0	54.22122	
	0.0	-15.0	56.55794	0.0	15.0	56.55794	
	-15.0	0.0	56.55794	15.0	0.0	56.55794	
	0.0	-15.0	58.86856	0.0	15.0	58.86856	
	-15.0	0.0	58.86856	15.0	0.0	58.86856	
	0.0	-15.0	61.18808	0.0	15.0	61.18808	
	-15.0	0.0	61.18808	15.0	0.0	61.18808	
	0.0	-15.0	63.50760	0.0	15.0	63.50760	
	-15.0	0.0	63.50760	15.0	0.0	63.50760	
	0.0	-15.0	65.82712	0.0	15.0	65.82712	
	-15.0	0.0	65.82712	15.0	0.0	65.82712	
	0.0	-15.0	68.14664	0.0	15.0	68.14664	
	-15.0	0.0	68.14664	15.0	0.0	68.14664	
	0.0	-15.0	70.46210	0.0	15.0	70.46210	
	-15.0	0.0	70.46210	15.0	0.0	70.46210	
c	Average HEU for All Plates						
m1	92234.70c	4.9591e-4		92235.70c	4.4949e-2		
	92236.70c	1.5651e-4		92238.70c	2.5779e-3		
c	Aluminum 6061 (2.70 g/cc)						
c m2	12000.62c	6.6049e-4				\$ ENDF/B-VI	
m2	12024.70c	5.2172e-4		12025.70c	6.6049e-5	\$ ENDF/B-VII.0	
	12026.70c	7.2720e-5				\$ ENDF/B-VII.0	
	13027.70c	5.7816e-2					
	14028.70c	3.1630e-4		14029.70c	1.6016e-5		
	14030.70c	1.0631e-5					
c	22000.62c	2.5146e-5				\$ ENDF/B-VI	
	22046.70c	2.0745e-6		22047.70c	1.8708e-6	\$ ENDF/B-VII.0	
	22048.70c	1.8537e-5		22049.70c	1.3603e-6	\$ ENDF/B-VII.0	
	22050.70c	1.3025e-6				\$ ENDF/B-VII.0	
	24050.70c	3.3536e-6		24052.70c	6.4673e-5		
	24053.70c	7.3325e-6		24054.70c	1.8254e-6		
	25055.70c	2.1915e-5					
	26054.70c	5.9360e-6		26056.70c	9.2280e-5		
	26057.70c	2.1128e-6		26058.70c	2.8171e-7		
	29063.70c	4.8053e-5		29065.70c	2.1418e-5		
c	Graphite (1.7263 g/cc)						
m3	6000.70c	0.086552					
c	Copper (8.7351 g/cc)						
m4	29063.70c	5.7259e-2		29065.70c	2.5521e-2		
mt3	grph.10t						
totnu							
end of input							

Table A-53. Input file for u233-comp-therm-001-case-6

```

BAPL SB Crits Core 5 U-235 Seed, ThO2 Blanket U233-COMP-THERM-001, case 6
c U233-COMP-THERM-001 Case 6
c Universe 1: Seed Pin Cell
1 6 0.082231 -2 11 -15 u=1 $ Seed Pin
2 1 0.043036 -2 -11 u=1 $ ENDF/B-VII.0 Bottom End Plug
c 2 1 0.042537 -2 -11 u=1 $ ENDF/B-V Bottom End Plug
3 1 0.043036 -2 15 u=1 $ ENDF/B-VII.0 Top End Plug
c 3 1 0.042537 -2 15 u=1 $ ENDF/B-VI Top End Plug
4 0 2 -3 u=1 $ Void
5 1 0.043036 3 -4 u=1 $ ENDF/B-VII.0 Cladding
c 5 1 0.042537 3 -4 u=1 $ ENDF/B-VI Cladding
6 2 0.118281 4 -5 12 -13 u=1 $ Polyethylene Ring
7 3 0.100103 4 #6 u=1 $ Water
c Universe 2: Blanket Pin Cell
8 8 0.064923 -6 11 -15 u=2 $ ThO2 Pin
9 1 0.043036 -6 -11 u=2 $ ENDF/B-VII.0 Bottom End Plug
c 9 1 0.042537 -6 -11 u=2 $ ENDF/B-VI Bottom End Plug
10 1 0.043036 -6 15 u=2 $ ENDF/B-VII.0 Top End Plug
c 10 1 0.042537 -6 15 u=2 $ ENDF/B-VI Top End Plug
11 0 6 -7 u=2 $ Void
12 1 0.043036 7 -8 u=2 $ ENDF/B-VII.0 Cladding
c 12 1 0.042537 7 -8 u=2 $ ENDF/B-VI Cladding
13 3 0.100103 8 u=2 $ Water
14 3 0.100103 -1 u=3 $ Water
15 4 0.088821 14 -17 28 -31 24 -25 $ Control Blade C
16 4 0.088821 14 -17 28 -31 26 -27 $ Control Blade D
17 4 0.088821 14 -17 28 -31 19 -20 $ Control Blade A
18 4 0.088821 14 -17 28 -31 21 -22 $ Control Blade B
c Fuel Pin Array with Water Boundary
19 0 -30 29 -32 34 -33 35
lat=2 u=4 fill=-21:21 -21:21 0:0
3 42r
3 20r 2 20r 3
3 19r 2 21r 3
3 18r 2 22r 3
3 17r 2 23r 3
3 16r 2 24r 3
3 15r 2 25r 3
3 14r 2 26r 3
3 13r 2 27r 3
3 12r 2 28r 3
3 11r 2 29r 3
3 10r 2 30r 3
3 9r 2 31r 3
3 8r 2 11r 1 8r 2 11r 3
3 7r 2 11r 1 9r 2 11r 3
3 6r 2 11r 1 10r 2 11r 3
3 5r 2 11r 1 11r 2 11r 3
3 4r 2 11r 1 12r 2 11r 3
3 3r 2 11r 1 13r 2 11r 3
3 2r 2 11r 1 14r 2 11r 3
3 3 2 11r 1 15r 2 11r 3
3 2 11r 1 16r 2 11r 3
3 2 11r 1 15r 2 11r 3 3
3 2 11r 1 14r 2 11r 3 2r

```

Table 53. Input file for u233-comp-therm-001-case-6 (Cont'd)

```

3      2 11r 1 13r 2 11r 3 3r
3      2 11r 1 12r 2 11r 3 4r
3      2 11r 1 11r 2 11r 3 5r
3      2 11r 1 10r 2 11r 3 6r
3      2 11r 1 9r 2 11r 3 7r
3      2 11r 1 8r 2 11r 3 8r
3      2 31r          3 9r
3      2 30r          3 10r
3      2 29r          3 11r
3      2 28r          3 12r
3      2 27r          3 13r
3      2 26r          3 14r
3      2 25r          3 15r
3      2 24r          3 16r
3      2 23r          3 17r
3      2 22r          3 18r
3      2 21r          3 19r
3      2 20r          3 20r
3 42r
20    0      10 -16 18 -23 -36 -37 38
      39 #15 #16 #17 #18 fill=4 $ Core
21    3 0.100103 -1 16 -17 #15 #16 #17 #18 $ Top Reflector
22    3 0.100103 -1 9 -10          $ Bottom Reflector
23    3 0.100103 -1 10 -16 -18     $ Front Reflector
24    3 0.100103 -1 10 -16 23      $ Back Reflector
25    3 0.100103 -1 10 -16 18 -23 36 $ BR Reflector
26    3 0.100103 -1 10 -16 18 -23 -36 37 $ BL Reflector
27    3 0.100103 -1 10 -16 18 -23 -38 $ FL Reflector
28    3 0.100103 -1 10 -16 18 -23 38 -39 $ FR Reflector
29    0      1:-9:17

1    cz 60.28 $ Reflector Outer Radius
2    cz 0.26797 $ Seed Fuel Outer Radius
3    cz 0.27940 $ Seed Clad Inner Radius
4    cz 0.32385 $ Seed Clad Outer Radius
5    cz 0.72517 $ Poly Ring Outer Radius
6    cz 0.62103 $ Blanket Fuel Outer Radius
7    cz 0.63373 $ Blanket Clad Inner Radius
8    cz 0.72390 $ Blanket Clad Outer Radius
9    pz -56.2991 $ Bottom of Reactor
10   pz -25.8191 $ Bottom of End Plug
11   pz -19.05 $ Bottom of Fuel
12   pz -0.3175 $ Bottom of Polyethylene Ring
13   pz 0.3175 $ Top of Polyethylene Ring
14   pz 15.765 $ Bottom of Control Blades
15   pz 19.05 $ Top of Fuel
16   pz 25.8191 $ Top of End Plug
17   pz 56.2991 $ Top of Reflector
18   py -26.37666 $ Front of Core
19   py 1.75006 $ Front Edge of Control Blade A
20   py 1.92786 $ Back Edge of Control Blade A
21   py 5.42798 $ Front Edge of Control Blade B
22   py 5.60578 $ Back Edge of Control Blade B
23   py 26.37666 $ Back of Core
24   py -5.60578 $ Front Edge of Control Blade C

```

Table 53. Input file for u233-comp-therm-001-case-6 (Cont'd)

```

25  py      -5.42798                $ Back Edge of Control Blade C
26  py      -1.92786                $ Front Edge of Control Blade D
27  py      -1.75006                $ Back Edge of Control Blade D
28  px      -3.81                   $ Left Edge of Control Blades
29  px      -0.72517                $ Front Edge of Fuel Pin Cell
30  px       0.72517                $ Back Edge of Fuel Pin Cell
31  px       3.81                   $ Right Edge of Control Blades
32  p        1.0  1.7320508076  0.0  1.45034 $
33  p       -1.0  1.7320508076  0.0  1.45034 $
34  p        1.0  1.7320508076  0.0 -1.45034 $
35  p       -1.0  1.7320508076  0.0 -1.45034 $
36  p        1.7320508076  1.0  0.0  52.75331 $
37  p        1.7320508076 -1.0  0.0  52.75331 $
38  p        1.7320508076  1.0  0.0 -52.75331 $
39  p        1.7320508076 -1.0  0.0 -52.75331 $

mode      n
kcode    10000  1.0  100  600
rand     hist=7314730
imp:n    1.0  27r  0.0
totnu
sdef     x=d1  y=d2  z=d3
si1     -11.0   11.0
sp1      0       1
si2     -11.0   11.0
sp2      0       1
si3     -19.0   19.0
sp3      0       1
c        Zircaloy-2 Cladding
m1       40090.70c  2.1885e-2          40091.70c  4.7727e-3
         40092.70c  7.2951e-3          40094.70c  7.3929e-3
         40096.70c  1.1910e-3
         50112.70c  4.8420e-6          50114.70c  3.2447e-6  $ ENDF/B-VII.0
         50115.70c  1.6972e-6          50116.70c  7.2581e-5  $ ENDF/B-VII.0
         50117.70c  3.8337e-5          50118.70c  1.2090e-4  $ ENDF/B-VII.0
         50119.70c  4.2880e-5          50120.70c  1.6268e-4  $ ENDF/B-VII.0
         50122.70c  2.3112e-5          50124.70c  2.8902e-5  $ ENDF/B-VII.0
c        Polyethylene (0.9183 g/cc)  N-tot=0.11828
m2       1001.70c  7.8854e-2
         6000.70c  3.9427e-2
mt2      poly.10t
c        Water at 20 DegreesC (0.9982 g/cc)  N-tot=0.100103
m3       1001.70c  6.6735e-2
         8016.70c  3.3355e-2          8017.70c  1.3347e-5
mt3      lwtr.10t
c        Borated Steel for Control Blade  N-tot=0.088821
m4       5010.70c  3.7488e-3
         24050.70c  7.5725e-4          24052.70c  1.4603e-2
         24053.70c  1.6557e-3          24054.70c  4.1217e-4
         25055.70c  8.6816e-4
         26054.70c  3.4963e-3          26056.70c  5.4352e-2
         26057.70c  1.2444e-3          26058.70c  1.6593e-4
         28058.70c  5.1319e-3          28060.70c  1.9620e-3
         28061.70c  8.4943e-5          28062.70c  2.6986e-4
         28064.70c  6.8406e-5

```

Table 53. Input file for u233-comp-therm-001-case-6 (Cont'd)

c	UO2-ZrO2 Seed Fuel (97.19 w/o U-233) N-tot=0.080898			
m5	8016.70c	5.3910e-2	8017.70c	2.1573e-5
	40090.70c	1.1765e-2	40091.70c	2.5657e-3
	40092.70c	3.9217e-3	40094.70c	3.9743e-3
	40096.70c	6.4028e-4		
	92233.70c	3.9891e-3	92234.70c	6.3690e-5
	92238.70c	4.5759e-5		
c	UO2-ZrO2 Seed Fuel (92.73 w/o U-235) N-tot=0.082231			
m6	8016.70c	5.4799e-2	8017.70c	2.1928e-5
	40090.70c	1.1958e-2	40091.70c	2.6078e-3
	40092.70c	3.9860e-3	40094.70c	4.0395e-3
	40096.70c	6.5078e-4		
	92234.70c	3.7302e-5	92235.70c	3.8783e-3
	92238.70c	2.5273e-4		
c	UO2-ThO2 Blanket Fuel (97.19 w/o U-233, 5 PPM Gd) N-tot=0.064620			
m7	8016.70c	4.3063e-2	8017.70c	1.7232e-5
	64152.70c	3.1447e-10	64154.70c	3.4277e-9
	64155.70c	2.3270e-8	64156.70c	3.2186e-8
	64157.70c	2.4607e-8	64158.70c	3.9057e-8
	64160.70c	3.4371e-8		
	90232.70c	2.1311e-2		
	92233.70c	2.2283e-4	92234.70c	3.5385e-6
	92238.70c	2.7607e-6		
c	ThO2 Blanket Fuel (2.9 PPM Gd) N-tot=0.064923			
m8	8016.70c	4.3265e-2	8017.70c	1.7313e-5
	64152.70c	1.8521e-10	64154.70c	2.0188e-9
	64155.70c	1.3706e-8	64156.70c	1.8957e-8
	64157.70c	1.4493e-8	64158.70c	2.3003e-8
	64160.70c	2.0244e-8		
	90232.70c	2.1641e-2		

end of input

Table A-54. Input file for heu-sol-therm-013-case-1

```

ORNL-1 Uranyl nitrate in H2O Sphere; HEU-SOL-THERM-013 case #1
c and CSEWG: T-1
1 1 9.992137412e-2 -1 imp:n=1
2 2 6.0317237e-2 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 34.5948
2 so 34.9148

mode n
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad d1
sc1 Spherical Source
sil 34.5
c material cards
c Materials specified with atom densities
m1 92234.70c 5.3850e-7 92235.70c 4.8042e-5
    92236.70c 1.3862e-7 92238.70c 2.8050e-6
    7014.70c 1.8685e-4
    8016.70c 3.3629e-2 8017.70c 1.3457e-5
    1001.70c 6.6041e-2
m2 13027.70c 5.9699e-2
    14028.70c 5.0913e-4 14029.70c 2.5779e-5
    14030.70c 1.7113e-5
    25055.70c 1.4853e-5
    29063.70c 3.5529e-5 29065.70c 1.5835e-5
mt1 lwtr.10t
totnu

```

Table A-55. Input file for heu-sol-therm-013-case-2

```

ORNL-2 Uranyl nitrate in H2O Sphere; HEU-SOL-THERM-013 case #2
c and CSEWG: T-2
1 1 9.983721129e-2 -1 imp:n=1
2 2 6.0317237e-2 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 34.5948
2 so 34.9148

mode n
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad d1
sc1 Spherical Source
sil 34.5
c material cards
c Materials specified with atom densities
m1 92234.70c 6.2962e-7 92235.70c 5.6171e-5
    92236.70c 1.6207e-7 92238.70c 3.2796e-6
    7014.70c 2.1276e-4
    5010.70c 1.0366e-6 5011.70c 4.1724e-6
    8016.70c 3.3654e-2 8017.70c 1.3467e-5
    1001.70c 6.5892e-2
m2 13027.70c 5.9699e-2
    14028.70c 5.0913e-4 14029.70c 2.5779e-5
    14030.70c 1.7113e-5
    25055.70c 1.4853e-5
    29063.70c 3.5529e-5 29065.70c 1.5836e-5
mt1 lwtr.10t
totnu

```

Table A-56. Input file for heu-sol-therm-013-case-3

```

ORNL-3 Uranyl nitrate in H2O Sphere; HEU-SOL-THERM-013 case #3
c and CSEWG: T-3
1 1 9.985904038e-2 -1 imp:n=1
2 2 6.0317237e-2 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 34.5948
2 so 34.9148

mode n
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad d1
sc1 Spherical Source
sil 34.5
c material cards
c Materials specified with atom densities
m1 92234.70c 7.1630e-7 92235.70c 6.3904e-5
    92236.70c 1.8438e-7 92238.70c 3.7311e-6
    7014.70c 2.3909e-4
    5010.70c 2.0725e-6 5011.70c 8.3421e-6
    8016.70c 3.3713e-2 8017.70c 1.3490e-5
    1001.70c 6.5815e-2
m2 13027.70c 5.9699e-2
    14028.70c 5.0913e-4 14029.70c 2.5779e-5
    14030.70c 1.7113e-5
    25055.70c 1.4853e-5
    29063.70c 3.5529e-5 29065.70c 1.5835e-5
mt1 lwtr.10t
totnu
c print

```



Table A-57. Input file for heu-sol-therm-013-case-4

```

ORNL-4 Uranyl nitrate in H2O Sphere; HEU-SOL-THERM-013 case #4
c and CSEWG: T-4
1 1 1.00161279e-1 -1 imp:n=1
2 2 6.0317237e-2 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 34.5948
2 so 34.9148

mode n
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad d1
sc1 Spherical Source
sil 34.5
c material cards
c Materials specified with atom densities
m1 92234.70c 7.6139e-7 92235.70c 6.7926e-5
    92236.70c 1.9599e-7 92238.70c 3.9659e-6
    7014.70c 2.5463e-4
    5010.70c 2.5472e-6 5011.70c 1.0253e-5
    8016.70c 3.3843e-2 8017.70c 1.3543e-5
    1001.70c 6.5964e-2
m2 13027.70c 5.9699e-2
    14028.70c 5.0913e-4 14029.70c 2.5779e-5
    14030.70c 1.7113e-5
    25055.70c 1.4853e-5
    29063.70c 3.5529e-5 29065.70c 1.5835e-5
mt1 lwtr.10t
totnu
c print

```

Table A-58. Input file for heu-sol-therm-032

```

ICSBEP HEU-SOL-THERM-032 (ORNL-10) CSEWG: T-5
c or2511 u235 expt 10 in nse
1 1 1.0016089e-01 -1
2 2 6.0274697e-02 -2 1
3 0 2

1 so 61.011
2 so 61.786

kcode 10000 1.0 100 600
sdef cel=1 erg=d1 rad=d2 pos=0.0 0.0 0.0
sp1 -3
si2 0.0 61.011
sp2 -21 2
totnu
imp:n 1.0 1.0 0.0
c uranyl nitrate
m1 1001.70c 6.6409e-02
    7014.70c 1.1212e-04
    8016.70c 3.3588e-02 8017.70c 1.3440e-05
    92233.70c 3.9124e-09 92234.70c 4.0905e-07
    92235.70c 3.6157e-05 92236.70c 2.0858e-07
    92238.70c 1.9878e-06
mt1 lwtr.10t
c al 1100
m2 13027.70c 5.9881e-02
    14028.70c 2.0097e-04 14029.70c 1.0176e-05
    14030.70c 6.7549e-06
    25055.70c 1.4853e-05 26054.70c 6.4652e-06
    26056.70c 1.0051e-04 26057.70c 2.3012e-06
    26058.70c 3.0682e-07 29063.70c 3.5529e-05
    29065.70c 1.5836e-05

end of input

```

### A.3 IEU Input Files

The input files for the IEU benchmarks are given in Tables A-59 through A-75.

Table A-59. Input file for ieu-met-fast-001-case-1

```

Jemima #1, Idealized Model; IEU-MET-FAST-001 Case 1
c
c Lower uranium pole.
1 5 4.55477e-02 101 -129 -2
c Lower uranium disks (without fillers).
51 4 4.79550e-02 101 -105 2 -12
52 3 4.80424e-02 105 -106 2 -12
53 4 4.79550e-02 106 -109 2 -12
54 3 4.80424e-02 109 -110 2 -12
55 4 4.79550e-02 110 -113 2 -12
56 3 4.80424e-02 113 -114 2 -12
57 4 4.79550e-02 114 -117 2 -12
58 3 4.80424e-02 117 -118 2 -12
59 4 4.79550e-02 118 -121 2 -12
60 3 4.80424e-02 121 -122 2 -12
61 4 4.79550e-02 122 -125 2 -12
62 3 4.80424e-02 125 -126 2 -12
63 4 4.79550e-02 126 -129 2 -12
c Upper Tu and Oy disks (homogenized).
64 3 4.80424e-02 129 -131 -10 *** tailored Tu disk **
65 4 4.79550e-02 131 -134 -12
66 3 4.80424e-02 134 -136 -12
67 4 4.79550e-02 136 -138 -12
68 3 4.80424e-02 138 -140 -12
69 4 4.79550e-02 140 -142 -12
70 3 4.80424e-02 142 -144 -12
71 4 4.79550e-02 144 -146 -12
c Extra tuballoy on top (disk equiv. to 1 pie + 1 filler).
72 3 4.80424e-02 146 -161 -12
c Cells defining support structures for uranium disks.
103 1 6.02041e-02 129 -131 10 -17
106 0 201 -101 -8
107 0 202 -201 3 -8
108 1 6.02041e-02 202 -101 8 -18
110 1 6.02041e-02 203 -201 -3
111 1 6.02041e-02 205 -203 -7
112 1 6.02041e-02 204 -202 12 -14
113 0 (204 -202 3 -12) (203: 7)
114 0 204 -202 14 -21
118 1 6.02041e-02 205 -204 11 -19
119 0 205 -204 7 -11
120 2 8.63195e-02 206 -205 -20
121 0 (202 -161 12 -21) (-129: 131: 17) (101: 18)
122 0 205 -204 19 -21
123 0 206 -205 20 -21
c External cell.
200 0 -206: 161: 21

c Cylindrical surfaces defining uranium disks and surrounding supports.
2 cz 1.11125 *** inner radius of uranium disks **
3 cz 1.74625 *** rad. of upper Al filler support cylinder **
7 cz 4.60375 *** rad. of lower Al filler support cylinder **
8 cz 12.06500 *** inner radius of lower Al support ring **
10 cz 12.66939 *** idlzd. Tu/Al bndry in upper supp. ring **
11 cz 12.70000 *** o.r. unique Tu disk; i.r. spacer platform **

```

Table A-59. Input file for ieu-met-fast-001-case-1 (Cont'd)

```

12 cz 13.33500 $** outer radius of uranium disks **
14 cz 13.67711 $** outer rad. of idealized Al rect. spacers **
17 cz 15.29416 $** outer edge of idlzd. Al upper supp. ring **
18 cz 15.82055 $** outer rad. of idealized lower Al ring **
19 cz 17.19650 $** outer rad. of idealized Al platform spacer **
20 cz 19.22627 $** rad. of cyl. equiv. to 12"x15" Fe plate **
21 cz 21.00000 $** inner rad. ext. cell (idealized models) **
c Horizontal planes defining uranium disks and fillers.
101 pz 0.000 $** lower surface of bottom uranium disk **
105 pz 0.804
106 pz 1.408
109 pz 2.212
110 pz 2.816
113 pz 3.620
114 pz 4.224
117 pz 5.028
118 pz 5.632
121 pz 6.436
122 pz 7.040
125 pz 7.844
126 pz 8.448
129 pz 9.252 $** parting plane **
131 pz 9.856
134 pz 10.660
136 pz 11.264
138 pz 12.068
140 pz 12.672
142 pz 13.476
144 pz 14.080
146 pz 14.884
161 pz 14.9631
c Horizontal planes defining structural support below uranium disks.
201 pz -0.3175
202 pz -0.9525
203 pz -3.1750
204 pz -4.7625
205 pz -6.0325
206 pz -8.5725

kcode 10000 1. 100 600
ksrc 8. 0. 00.402 0. 8. 00.402 -8. 0. 00.402 0. -8. 00.402
0. 0. 00.402
8. 0. 01.810 0. 8. 01.810 -8. 0. 01.810 0. -8. 01.810
0. 0. 01.810
8. 0. 03.218 0. 8. 03.218 -8. 0. 03.218 0. -8. 03.218
0. 0. 03.218
8. 0. 04.626 0. 8. 04.626 -8. 0. 04.626 0. -8. 04.626
0. 0. 04.626
8. 0. 06.034 0. 8. 06.034 -8. 0. 06.034 0. -8. 06.034
0. 0. 06.034
8. 0. 07.442 0. 8. 07.442 -8. 0. 07.442 0. -8. 07.442
0. 0. 07.442
8. 0. 08.850 0. 8. 08.850 -8. 0. 08.850 0. -8. 08.850
0. 0. 08.850
8. 0. 10.258 0. 8. 10.258 -8. 0. 10.258 0. -8. 10.258

```

Table A-59. Input file for ieu-met-fast-001-case-1 (Cont'd)

```

0. 0. 10.258
8. 0. 11.666 0. 8. 11.666 -8. 0. 11.666 0. -8. 11.666
0. 0. 11.666
8. 0. 13.074 0. 8. 13.074 -8. 0. 13.074 0. -8. 13.074
0. 0. 13.074
8. 0. 14.482 0. 8. 14.482 -8. 0. 14.482 0. -8. 14.482
0. 0. 14.482
imp:n 1 37r 0
totnu
c      Materials specified with atom fractions
c m1  12000.62c  1.71000e-2          $ ENDF/B-VI
m1    12024.70c  1.35073e-2          12025.70c  1.71000e-3  $ ENDF/B-VII.0
      12026.70c  1.88271e-3          $ ENDF/B-VII.0
      13027.70c  9.61193e-1
      25055.70c  2.52173e-3
      29063.70c  1.32704e-2          29065.70c  5.91480e-3
m2    24050.70c  8.32154e-3          24052.70c  1.60475e-1
      24053.70c  1.81944e-2          24054.70c  4.52945e-3
      26054.70c  4.32510e-2          26056.70c  6.72370e-1
      26057.70c  1.53944e-2          26058.70c  2.05259e-3
      28058.70c  5.14835e-2          28060.70c  1.96824e-2
      28061.70c  8.52151e-4          28062.70c  2.70728e-3
      28064.70c  6.86246e-4
m3    92234.70c  5.50000e-5          92235.70c  7.20000e-3
      92238.70c  9.92745e-1
m4    92234.70c  1.02505e-2          92235.70c  9.34717e-1
      92238.70c  5.50328e-2
m5    92234.70c  5.61200e-3          92235.70c  5.12718e-1
      92238.70c  4.81670e-1

```

Table A-60. Input file for ieu-met-fast-001-case-2

```

Jemima #2, Idealized Model; IEU-MET-FAST-001 Case 2
c Note ... no uranium fillers.
1 0 101 -148 -2
c Uranium disks (without fillers).
51 4 4.79558e-02 101 -105 2 -12
52 3 4.80510e-02 105 -106 2 -12
53 4 4.79558e-02 106 -109 2 -12
54 3 4.80510e-02 109 -110 2 -12
55 4 4.79558e-02 110 -113 2 -12
56 3 4.80510e-02 113 -114 2 -12
57 4 4.79558e-02 114 -117 2 -12
58 3 4.80510e-02 117 -118 2 -12
59 4 4.79558e-02 118 -121 2 -12
60 3 4.80510e-02 121 -122 2 -12
61 4 4.79558e-02 122 -125 2 -12
62 3 4.80510e-02 125 -126 2 -12
63 4 4.79558e-02 126 -129 2 -12
64 3 4.80510e-02 129 -131 2 -10 $** tailored Tu disk **
65 4 4.79558e-02 131 -134 2 -12
66 3 4.80510e-02 134 -136 2 -12
67 4 4.79558e-02 136 -138 2 -12
68 3 4.80510e-02 138 -140 2 -12
69 4 4.79558e-02 140 -142 2 -12
70 3 4.80510e-02 142 -144 2 -12
71 4 4.79558e-02 144 -146 2 -12
72 3 4.80510e-02 146 -148 2 -12
c Note ... no extra tuballoy on top for this configuration.
c Cells defining support structures for uranium disks.
103 1 6.02041e-02 129 -131 10 -17
106 0 201 -101 -8
107 0 202 -201 3 -8
108 1 6.02041e-02 202 -101 8 -18
110 1 6.02041e-02 203 -201 -3
111 1 6.02041e-02 205 -203 -7
112 1 6.02041e-02 204 -202 12 -14
113 0 (204 -202 3 -12) (203: 7)
114 0 204 -202 14 -21
118 1 6.02041e-02 205 -204 11 -19
119 0 205 -204 7 -11
120 2 8.63195e-02 206 -205 -20
121 0 (202 -148 12 -21) (-129: 131: 17) (101: 18)
122 0 205 -204 19 -21
123 0 206 -205 20 -21
c External cell.
200 0 -206: 148: 21

c Cylindrical surfaces defining uranium disks and surrounding supports.
2 cz 1.11125 $** inner radius of uranium disks **
3 cz 1.74625 $** rad. of upper Al filler support cylinder **
7 cz 4.60375 $** rad. of lower Al filler support cylinder **
8 cz 12.06500 $** inner radius of lower Al support ring **
10 cz 12.66939 $** idlzd. Tu/Al bndry in upper supp. ring **
11 cz 12.70000 $** o.r. unique Tu disk; i.r. spacer platform **
12 cz 13.33500 $** outer radius of uranium disks **
14 cz 13.67711 $** outer rad. of idealized Al rect. spacers **

```

Table A-60. Input file for ieu-met-fast-001-case-2 (Cont'd)

```

17 cz 15.29416 $** outer edge of idlzd. Al upper supp. ring **
18 cz 15.82055 $** outer rad. of idealized lower Al ring **
19 cz 17.19650 $** outer rad. of idealized Al platform spacer **
20 cz 19.22627 $** rad. of cyl. equiv. to 12"x15" Fe plate **
21 cz 21.00000 $** inner rad. ext. cell (idealized models) **
c Horizontal planes defining uranium disks and fillers.
101 pz 0.000 $** lower surface of bottom uranium disk **
105 pz 0.804
106 pz 1.408
109 pz 2.212
110 pz 2.816
113 pz 3.620
114 pz 4.224
117 pz 5.028
118 pz 5.632
121 pz 6.436
122 pz 7.040
125 pz 7.844
126 pz 8.448
129 pz 9.252 $** parting plane **
131 pz 9.856
134 pz 10.660
136 pz 11.264
138 pz 12.068
140 pz 12.672
142 pz 13.476
144 pz 14.080
146 pz 14.884
148 pz 15.488
c Horizontal planes defining structural support below uranium disks.
201 pz -0.3175
202 pz -0.9525
203 pz -3.1750
204 pz -4.7625
205 pz -6.0325
206 pz -8.5725

imp:n 1 37r 0
totnu
kcode 10000 1. 100 600
ksrc 8. 0. 00.402 0. 8. 00.402 -8. 0. 00.402 0. -8. 00.402
      8. 0. 01.810 0. 8. 01.810 -8. 0. 01.810 0. -8. 01.810
      8. 0. 03.218 0. 8. 03.218 -8. 0. 03.218 0. -8. 03.218
      8. 0. 04.626 0. 8. 04.626 -8. 0. 04.626 0. -8. 04.626
      8. 0. 06.034 0. 8. 06.034 -8. 0. 06.034 0. -8. 06.034
      8. 0. 07.442 0. 8. 07.442 -8. 0. 07.442 0. -8. 07.442
      8. 0. 08.850 0. 8. 08.850 -8. 0. 08.850 0. -8. 08.850
      8. 0. 10.258 0. 8. 10.258 -8. 0. 10.258 0. -8. 10.258
      8. 0. 11.666 0. 8. 11.666 -8. 0. 11.666 0. -8. 11.666
      8. 0. 13.074 0. 8. 13.074 -8. 0. 13.074 0. -8. 13.074
      8. 0. 14.482 0. 8. 14.482 -8. 0. 14.482 0. -8. 14.482
c      Materials specified with atom fractions
c m1 12000.62c 1.71000e-02 $ ENDF/B-VI
m1 12024.70c 1.35073e-2 12025.70c 1.71000e-3 $ ENDF/B-VII.0
    12026.70c 1.88271e-3 $ ENDF/B-VII.0

```

Table A-60. Input file for ieu-met-fast-001-case-2 (Cont'd)

	13027.70c	9.61193e-1		
	25055.70c	2.52173e-3		
	29063.70c	1.32704e-2	29065.70c	5.91480e-3
m2	24050.70c	8.32154e-3	24052.70c	1.60475e-1
	24053.70c	1.81944e-2	24054.70c	4.52945e-3
	26054.70c	4.32510e-2	26056.70c	6.72370e-1
	26057.70c	1.53944e-2	26058.70c	2.05259e-3
	28058.70c	5.14835e-2	28060.70c	1.96824e-2
	28061.70c	8.52151e-4	28062.70c	2.70728e-3
	28064.70c	6.86246e-4		
m3	92234.70c	5.50000e-5	92235.70c	7.20000e-3
	92238.70c	9.92745e-1		
m4	92234.70c	1.02505e-2	92235.70c	9.34717e-1
	92238.70c	5.50328e-2		



Table A-61. Input file for ieu-met-fast-001-case-3

```

Jemima #3, Idealized Model; IEU-MET-FAST-001 Case 3
c Homogenized Tu and Oy disks.
51 3 4.80323e-02 101 -103 -12
52 4 4.79707-02 103 -106 -12
53 3 4.80323e-02 106 -108 -12
54 3 4.80323e-02 108 -109 -12
55 4 4.79707-02 109 -112 -12
56 3 4.80323e-02 112 -114 -12
57 3 4.80323e-02 114 -115 -12
58 4 4.79707-02 115 -118 -12
59 3 4.80323e-02 118 -120 -12
60 3 4.80323e-02 120 -121 -12
61 4 4.79707-02 121 -124 -12
62 3 4.80323e-02 124 -126 -12
63 3 4.80323e-02 126 -127 -12
64 4 4.79707-02 127 -130 -12
65 3 4.80323e-02 130 -132 -12
66 3 4.80323e-02 132 -133 -12
67 4 4.79707-02 133 -136 -12
68 3 4.80323e-02 136 -138 -12
69 3 4.80323e-02 138 -139 -12
70 4 4.79707-02 139 -142 -12
71 3 4.80323e-02 142 -144 -12
72 3 4.80323e-02 144 -146 -10 $** tailored Tu disk **
73 4 4.79707-02 146 -149 -12
74 3 4.80323e-02 149 -151 -12
75 3 4.80323e-02 151 -153 -12
76 4 4.79707-02 153 -155 -12
77 3 4.80323e-02 155 -157 -12
78 3 4.80323e-02 157 -159 -12
79 4 4.79707-02 159 -161 -12
80 3 4.80323e-02 161 -163 -12
81 3 4.80323e-02 163 -165 -12
82 4 4.79707-02 165 -167 -12
83 3 4.80323e-02 167 -169 -12
84 3 4.80323e-02 169 -171 -12
85 4 4.79707-02 171 -173 -12
86 3 4.80323e-02 173 -175 -12
87 3 4.80323e-02 175 -177 -12
c Extra tuballoy on top (disk equiv. to three pies).
88 3 4.80323e-02 177 -179 -12
c Cells defining support structure below uranium disks.
103 1 6.02041e-02 144 -146 10 -17
106 0 201 -101 -8
107 0 202 -201 3 -8
108 1 6.02041e-02 202 -101 8 -18
110 1 6.02041e-02 203 -201 -3
111 1 6.02041e-02 205 -203 -7
112 1 6.02041e-02 204 -202 12 -14
113 0 (204 -202 3 -12) (203: 7)
114 0 204 -202 14 -21
118 1 6.02041e-02 205 -204 11 -19
119 0 205 -204 7 -11
120 2 8.63195e-02 206 -205 -20
121 0 (202 -179 12 -21) (-144: 146: 17) (101: 18)

```

Table A-61. Input file for ieu-met-fast-001-case-3 (Cont'd)

```

122 0 205 -204 19 -21
123 0 206 -205 20 -21
c External cell.
200 0 -206: 179: 21

c Cylindrical surfaces defining uranium disks and surrounding supports.
3 cz 1.74625 $** rad. of upper Al filler support cylinder **
7 cz 4.60375 $** rad. of lower Al filler support cylinder **
8 cz 12.06500 $** inner radius of lower Al support ring **
10 cz 12.66939 $** idlzd. Tu/Al bndry in upper supp. ring **
11 cz 12.70000 $** o.r. unique Tu disk; i.r. spacer platform **
12 cz 13.33500 $** outer radius of uranium disks **
14 cz 13.67711 $** outer rad. of idealized Al rect. spacers **
17 cz 15.29416 $** outer edge of idlzd. Al upper supp. ring **
18 cz 15.82055 $** outer rad. of idealized lower Al ring **
19 cz 17.19650 $** outer rad. of idealized Al platform spacer **
20 cz 19.22627 $** rad. of cyl. equiv. to 12"x15" Fe plate **
21 cz 21.00000 $** inner rad. ext. cell (idealized models) **
c Horizontal planes defining uranium disks and fillers.
101 pz 0.000 $** lower surface of bottom uranium disk **
103 pz 0.604
106 pz 1.408
108 pz 2.012
109 pz 2.616
112 pz 3.420
114 pz 4.024
115 pz 4.628
118 pz 5.432
120 pz 6.036
121 pz 6.640
124 pz 7.444
126 pz 8.048
127 pz 8.652
130 pz 9.456
132 pz 10.060
133 pz 10.664
136 pz 11.468
138 pz 12.072
139 pz 12.676
142 pz 13.480
144 pz 14.084 $** parting plane **
146 pz 14.688
149 pz 15.492
151 pz 16.096
153 pz 16.700
155 pz 17.504
157 pz 18.108
159 pz 18.712
161 pz 19.516
163 pz 20.120
165 pz 20.724
167 pz 21.528
169 pz 22.132
171 pz 22.736
173 pz 23.540

```

Table A-61. Input file for ieu-met-fast-001-case-3 (Cont'd)

```

175 pz 24.144
177 pz 24.748
179 pz 24.9729
c Horizontal planes defining structural support below uranium disks.
201 pz -0.3175
202 pz -0.9525
203 pz -3.1750
204 pz -4.7625
205 pz -6.0325
206 pz -8.5725

imp:n 1 52r 0
totnu
kcode 10000 1. 100 600
ksrc 0. 0. 01.006
      8. 0. 01.006 0. 8. 01.006 -8. 0. 01.006 0. -8. 01.006
      0. 0. 03.018
      8. 0. 03.018 0. 8. 03.018 -8. 0. 03.018 0. -8. 03.018
      0. 0. 05.030
      8. 0. 05.030 0. 8. 05.030 -8. 0. 05.030 0. -8. 05.030
      0. 0. 07.042
      8. 0. 07.042 0. 8. 07.042 -8. 0. 07.042 0. -8. 07.042
      0. 0. 09.054
      8. 0. 09.054 0. 8. 09.054 -8. 0. 09.054 0. -8. 09.054
      0. 0. 11.066
      8. 0. 11.066 0. 8. 11.066 -8. 0. 11.066 0. -8. 11.066
      0. 0. 13.078
      8. 0. 13.078 0. 8. 13.078 -8. 0. 13.078 0. -8. 13.078
      8. 0. 15.090 0. 8. 15.090 -8. 0. 15.090 0. -8. 15.090
      0. 0. 15.090
      8. 0. 17.102 0. 8. 17.102 -8. 0. 17.102 0. -8. 17.102
      0. 0. 17.102
      8. 0. 19.114 0. 8. 19.114 -8. 0. 19.114 0. -8. 19.114
      0. 0. 19.114
      8. 0. 21.126 0. 8. 21.126 -8. 0. 21.126 0. -8. 21.126
      0. 0. 21.126
      8. 0. 23.138 0. 8. 23.138 -8. 0. 23.138 0. -8. 23.138
      0. 0. 23.138
c      Materials specified with atom fractions
c m1 12000.62c 1.71000e-02 $ ENDF/B-VI
m1 12024.70c 1.35073e-2 12025.70c 1.71000e-3 $ ENDF/B-VII.0
    12026.70c 1.88271e-3 $ ENDF/B-VII.0
    13027.70c 9.61193e-1
    25055.70c 2.52173e-3
m2 29063.70c 1.32704e-2 29065.70c 5.91480e-3
    24050.70c 8.32154e-3 24052.70c 1.60475e-1
    24053.70c 1.81044e-2 24054.70c 4.52945e-3
    26054.70c 4.32510e-2 26056.70c 6.72370e-1
    26057.70c 1.53944e-2 26058.70c 2.05259e-3
    28058.70c 5.14835e-2 28060.70c 1.96824e-2
    28061.70c 8.52151e-4 28062.70c 2.70728e-3
    28064.70c 6.86246e-4
m3 92234.70c 5.50000e-5 92235.70c 7.20000e-3
    92238.70c 9.92745e-1
m4 92234.70c 1.02504e-2 92235.70c 9.34915e-1

```

Table A-61. Input file for ieu-met-fast-001-case-3 (Cont'd)

```
      92238.70c  5.48350e-2  
c  print
```

Table A-62. Input file for ieu-met-fast-001-case-4

```

Jemima #4, Idealized Model; IEU-MET-FAST-001 Case 4
c Note ... no uranium fillers.
1 0 101 -180 -2
c Uranium disks (without fillers).
51 3 4.80510e-02 101 -103 2 -12
52 4 4.79730e-02 103 -106 2 -12
53 3 4.80510e-02 106 -108 2 -12
54 3 4.80510e-02 108 -109 2 -12
55 4 4.79730e-02 109 -112 2 -12
56 3 4.80510e-02 112 -114 2 -12
57 3 4.80510e-02 114 -115 2 -12
58 4 4.79730e-02 115 -118 2 -12
59 3 4.80510e-02 118 -120 2 -12
60 3 4.80510e-02 120 -121 2 -12
61 4 4.79730e-02 121 -124 2 -12
62 3 4.80510e-02 124 -126 2 -12
63 3 4.80510e-02 126 -127 2 -12
64 4 4.79730e-02 127 -130 2 -12
65 3 4.80510e-02 130 -132 2 -12
66 3 4.80510e-02 132 -133 2 -12
67 4 4.79730e-02 133 -136 2 -12
68 3 4.80510e-02 136 -138 2 -12
69 3 4.80510e-02 138 -139 2 -12
70 4 4.79730e-02 139 -142 2 -12
71 3 4.80510e-02 142 -144 2 -12
72 3 4.80510e-02 144 -146 2 -10 $** tailored Tu disk **
73 4 4.79730e-02 146 -149 2 -12
74 3 4.80510e-02 149 -151 2 -12
75 3 4.80510e-02 151 -153 2 -12
76 4 4.79730e-02 153 -155 2 -12
77 3 4.80510e-02 155 -157 2 -12
78 3 4.80510e-02 157 -159 2 -12
79 4 4.79730e-02 159 -161 2 -12
80 3 4.80510e-02 161 -163 2 -12
81 3 4.80510e-02 163 -165 2 -12
82 4 4.79730e-02 165 -167 2 -12
83 3 4.80510e-02 167 -169 2 -12
84 3 4.80510e-02 169 -171 2 -12
85 4 4.79730e-02 171 -173 2 -12
86 3 4.80510e-02 173 -175 2 -12
87 3 4.80510e-02 175 -177 2 -12
88 4 4.79730e-02 177 -179 2 -12
c Extra tuballoy on top (disk equiv. to six pies).
89 3 4.80510e-02 179 -180 2 -12
c Cells defining support structure below uranium disks.
103 1 6.02041e-02 144 -146 10 -17
106 0 201 -101 -8
107 0 202 -201 3 -8
108 1 6.02041e-02 202 -101 8 -18
110 1 6.02041e-02 203 -201 -3
111 1 6.02041e-02 205 -203 -7
112 1 6.02041e-02 204 -202 12 -14
113 0 (204 -202 3 -12) (203: 7)
114 0 204 -202 14 -21
118 1 6.02041e-02 205 -204 11 -19

```

Table A-62. Input file for ieu-met-fast-001-case-4 (Cont'd)

```

119 0 205 -204 7 -11
120 2 8.63195e-02 206 -205 -20
121 0 (202 -180 12 -21) (-144: 146: 17) (101: 18)
122 0 205 -204 19 -21
123 0 206 -205 20 -21
c External cell.
200 0 -206: 180: 21

c Cylindrical surfaces defining uranium disks and surrounding supports.
2 cz 1.11125 $** inner radius of uranium disks **
3 cz 1.74625 $** rad. of upper Al filler support cylinder **
7 cz 4.60375 $** rad. of lower Al filler support cylinder **
8 cz 12.06500 $** inner radius of lower Al support ring **
10 cz 12.66939 $** idlzd. Tu/Al bndry in upper supp. ring **
11 cz 12.70000 $** o.r. unique Tu disk; i.r. spacer platform **
12 cz 13.33500 $** outer radius of uranium disks **
14 cz 13.67711 $** outer rad. of idealized Al rect. spacers **
17 cz 15.29416 $** outer edge of idlzd. Al upper supp. ring **
18 cz 15.82055 $** outer rad. of idealized lower Al ring **
19 cz 17.19650 $** outer rad. of idealized Al platform spacer **
20 cz 19.22627 $** rad. of cyl. equiv. to 12"x15" Fe plate **
21 cz 21.00000 $** inner rad. ext. cell (idealized models) **
c Horizontal planes defining uranium disks and fillers.
101 pz 0.000 $** lower surface of bottom uranium disk **
103 pz 0.604
106 pz 1.408
108 pz 2.012
109 pz 2.616
112 pz 3.420
114 pz 4.024
115 pz 4.628
118 pz 5.432
120 pz 6.036
121 pz 6.640
124 pz 7.444
126 pz 8.048
127 pz 8.652
130 pz 9.456
132 pz 10.060
133 pz 10.664
136 pz 11.468
138 pz 12.072
139 pz 12.676
142 pz 13.480
144 pz 14.084 $** parting plane **
146 pz 14.688
149 pz 15.492
151 pz 16.096
153 pz 16.700
155 pz 17.504
157 pz 18.108
159 pz 18.712
161 pz 19.516
163 pz 20.120
165 pz 20.724

```

Table A-62. Input file for ieu-met-fast-001-case-4 (Cont'd)

```

167 pz 21.528
169 pz 22.132
171 pz 22.736
173 pz 23.540
175 pz 24.144
177 pz 24.748
179 pz 25.552
180 pz 26.005
c Horizontal planes defining structural support below uranium disks.
201 pz -0.3175
202 pz -0.9525
203 pz -3.1750
204 pz -4.7625
205 pz -6.0325
206 pz -8.5725

imp:n 1 54r 0
totnu
kcode 10000 1. 100 600
ksrc 8. 0. 01.006 0. 8. 01.006 -8. 0. 01.006 0. -8. 01.006
      8. 0. 03.018 0. 8. 03.018 -8. 0. 03.018 0. -8. 03.018
      8. 0. 05.030 0. 8. 05.030 -8. 0. 05.030 0. -8. 05.030
      8. 0. 07.042 0. 8. 07.042 -8. 0. 07.042 0. -8. 07.042
      8. 0. 09.054 0. 8. 09.054 -8. 0. 09.054 0. -8. 09.054
      8. 0. 11.066 0. 8. 11.066 -8. 0. 11.066 0. -8. 11.066
      8. 0. 13.078 0. 8. 13.078 -8. 0. 13.078 0. -8. 13.078
      8. 0. 15.090 0. 8. 15.090 -8. 0. 15.090 0. -8. 15.090
      8. 0. 17.102 0. 8. 17.102 -8. 0. 17.102 0. -8. 17.102
      8. 0. 19.114 0. 8. 19.114 -8. 0. 19.114 0. -8. 19.114
      8. 0. 21.126 0. 8. 21.126 -8. 0. 21.126 0. -8. 21.126
      8. 0. 23.138 0. 8. 23.138 -8. 0. 23.138 0. -8. 23.138
c      Materials specified with atom fractions
c m1 12000.62c 1.71000e-02 $ ENDF/B-VI
m1 12024.70c 1.35073e-2 12025.70c 1.71000e-3 $ ENDF/B-VII.0
    12026.70c 1.88271e-3 $ ENDF/B-VII.0
    13027.70c 9.61193e-1
    25055.70c 2.52173e-3
    29063.70c 1.32704e-2 29065.70c 5.91480e-3
m2 24050.70c 8.32154e-3 24052.70c 1.60475e-1
    24053.70c 1.81944e-2 24054.70c 4.52945e-3
    26054.70c 4.32510e-2 26056.70c 6.72370e-1
    26057.70c 1.53944e-2 26058.70c 2.05259e-3
    28058.70c 5.14835e-2 28060.70c 1.96824e-2
    28061.70c 8.52151e-4 28062.70c 2.70728e-3
    28064.70c 6.86246e-4
m3 92234.70c 5.50000e-5 92235.70c 7.20000e-3
    92238.70c 9.92745e-1
m4 92234.70c 1.02504e-2 92235.70c 9.34915e-1
    92238.70c 5.48350e-2

```

Table A-63. Input file for ieu-met-fast-002

```

Jemima, Idealized Natural U reflected stack of Natural U and HEU plates;
c IEU-MET-FAST-002
1 1 4.753313e-2 2 -3 -5
2 2 4.80596733e-2 1 -4 -6 #1
3 0 -1:4:6

1 pz 0
2 pz 7.62
3 pz 39.571
4 pz 47.0894
5 cz 19.05
6 cz 26.6446

imp:n 1 1 0
totnu
kcode 10000 1. 100 600
sdef erg=d1 rad=d2 ext=d3 pos 0 0 23.5447 axs 0 0 1
sp1 -3 0.988 2.249
si2 0 26.6446
si3 23.5447
c Materials specified with atom densities
m1 92234.70c 8.4430e-5 92235.70c 7.7777e-3
92238.70c 3.9671e-2
m2 92234.70c 2.6433e-6 92235.70c 3.4603e-4
92238.70c 4.7711e-2

```

Table A-64. Input file for ieu-met-fast-003-case-2

```

Solid Bare IEU sphere IEU-MET-FAST-003
1 1 4.8180e-2 -1 imp:n=1
2 0 1 imp:n=0

1 so 15.3240

m1 6000.70c 7.7389e-4
26054.70c 7.1142e-6 26056.70c 1.1060e-4
26057.70c 2.5322e-6 26058.70c 3.3762e-7
28058.70c 2.8187e-4 28060.70c 1.0776e-4
28061.70c 4.6655e-6 28062.70c 1.4822e-5
28064.70c 3.7572e-6
29063.70c 2.6377e-4 29065.70c 1.1756e-4
74182.70c 2.6729e-6 74183.70c 1.4439e-6
74184.70c 3.0909e-6 74186.70c 2.8673e-6
92234.70c 1.5272e-4 92235.70c 1.7118e-2
92238.70c 2.9211e-2
kcode 10000 1.0 100 600
sdef cel=1 erg=d1 rad=d2 pos=0.0 0.0 0.0
sp1 -3
si2 0.0 15.3240
sp2 -21 2
totnu

end of input

```



Table A-65. Input file for ieu-met-fast-004-case-2

```

IEU-MET-FAST-004  IEU (36 wt.%) Sphere Reflected by Graphite
1      0          -1
2      1  4.7991e-2  1  -2
3      2  7.7716e-2  2  -3
4      0          3

1      so      2.788
2      so     14.000
3      so     17.200

mode      n
kcode    10000  1.0  100  600
imp:n    1.0  1.0  1.0  0.0
sdef     cel=2      erg=d1      rad=d2      pos=0.0 0.0 0.0
sp1      -3
si2      0.0      7.8726
sp2      -21      2
c        IEU
m1       6000.70c  6.5752e-4
        26054.70c  7.1378e-6
        26057.70c  2.5406e-6
        74182.70c  2.6819e-6
        74184.70c  3.1013e-6
        92234.70c  1.5652e-4
        92238.70c  2.9662e-2
        26056.70c  1.1096e-4
        26058.70c  3.3874e-7
        74183.70c  1.4487e-6
        74186.70c  2.8770e-6
        92235.70c  1.7384e-2
c        Graphite Reflector
m2       6000.70c  7.7716e-2
mt2      grph.10t
totnu

end of input

```

Table A-66. Input file for ieu-met-fast-005-case-2

```

Steel Reflected IEU sphere (36 wt.%), VNIIEF; IEU-MET-FAST-005
C ENDF/B-V cross sections, W splitup by atomic abundance
C W-180 fraction added to W-182 because of cross sections
C All Mn taken to Mn-55, the only stable isotope
C Cell Cards
1  0          -1
2  1  4.7948e-2  1 -2
3  2  8.1601e-2  2 -3
4  3  8.2736e-2  3 -4
5  0          4

C Surface Cards
1  so  2.686
2  so  13.25
3  so  15.00
4  so  21.50

C Data Cards
imp:n 1 1 1 1 0
totnu
kcode 10000 1. 100 600
ksrc  3 0 0

C Material Cards
c      Materials specified with atom densities
m1  92234.70c 1.5511e-4  92235.70c 1.7154e-2
    92238.70c 2.9297e-2
    26054.70c 7.2712e-6  26056.70c 1.1304e-4
    26057.70c 2.5880e-6  26058.70c 3.4507e-7
    6000.70c 6.4945e-4
    29063.70c 1.8531e-4  29065.70c 8.2597e-5
    28058.70c 1.9804e-4  28060.70c 7.5711e-5
    28061.70c 3.2779e-6  28062.70c 1.0414e-5
    28064.70c 2.6397e-6
    74182.70c 2.8298e-6  74183.70c 1.5295e-6
    74184.70c 3.2883e-6  74186.70c 3.0633e-6
m2  26054.70c 4.6778e-3  26056.70c 7.2720e-2
    26057.70c 1.6650e-3  26058.70c 2.2200e-4
    6000.70c 1.1251e-3
    14028.70c 1.4792e-4  14029.70c 7.4898e-6
    14030.70c 4.9718e-6
    24050.70c 1.1292e-5  24052.70c 2.1776e-4
    24053.70c 2.4690e-5  24054.70c 6.1464e-6
    25055.70c 3.2796e-4
    28058.70c 1.5719e-4  28060.70c 6.0095e-5
    28061.70c 2.6018e-6  28062.70c 8.2660e-6
    28064.70c 2.0952e-6
    29063.70c 1.4709e-4  29065.70c 6.5560e-5
m3  26054.70c 4.7429e-3  26056.70c 7.3732e-2
    26057.70c 1.6882e-3  26058.70c 2.2509e-4
    6000.70c 1.1407e-3
    14028.70c 1.4998e-4  14029.70c 7.5939e-6
    14030.70c 5.0409e-6
    24050.70c 1.1450e-5  24052.70c 2.2080e-4
    24053.70c 2.5034e-5  24054.70c 6.2320e-6
    25055.70c 3.3253e-4

```

Table A-66. Input file for ieu-met-fast-005-case-2 (Cont'd)

28058.70c	1.5938e-4	28060.70c	6.0931e-5
28061.70c	2.6380e-6	28062.70c	8.3809e-6
28064.70c	2.1233e-6		
29063.70c	1.4914e-4	29065.70c	6.6473e-5

Table A-67. Input file for ieu-met-fast-006-case-2

Duralumin Reflected IEU sphere (36 wt.%), VNIIEF; IEU-MET-FAST-006

C Cell Cards

1	0		-1
2	1	4.7966e-2	1 -2
3	2	5.4286e-2	2 -3
4	3	5.4001e-2	3 -4
5	0		4

C Surface Cards

1	so	2.100
2	so	13.25
3	so	15.00
4	so	25.00

C Data Cards

imp:n 1 1 1 1 0  
totnu  
kcode 10000 1. 100 600  
ksrc 3 0 0

C Material Cards

c Materials specified with atom densities

m1	92234.70c	1.5518e-4	92235.70c	1.7161e-2
	92238.70c	2.9310e-2		
	26054.70c	7.2836e-6	26056.70c	1.1323e-4
	26057.70c	2.5925e-6	26058.70c	3.4566e-7
	6000.70c	6.4888e-4		
	29063.70c	1.8596e-4	29065.70c	8.2486e-5
	28058.70c	1.9777e-4	28060.70c	7.5609e-5
	28061.70c	3.2735e-6	28062.70c	1.0400e-5
	28064.70c	2.6362e-6		
	74182.70c	2.8325e-6	74183.70c	1.5310e-6
	74184.70c	3.2913e-6	74186.70c	3.0662e-6
m2	13027.70c	5.2342e-2		
	26054.70c	5.6515e-5	26056.70c	8.7857e-4
	26057.70c	2.0116e-5	26058.70c	2.6821e-6
	29063.70c	6.8211e-4	29065.70c	3.0403e-4
m3	13027.70c	5.2067e-2		
	26054.70c	5.6219e-5	26056.70c	8.7396e-4
	26057.70c	2.0010e-5	26058.70c	2.6680e-6
	29063.70c	6.7854e-4	29065.70c	3.0243e-4

Table A-68. Input file for ieu-met-fast-007-case-4

```

Big Ten  IEU-MET-FAST-007  Improved Benchmark  Case 4
1      2      0.047609      -3      8      -10      $ Bottom 10% Cyl
2      2      0.047609      -4      10     -11      $ Lower 10% Cyl
3      2      0.047609      -2      11     -13      $ Upper 10% Cyl
4      2      0.047609      -1      13     -14      $ Top 10% Cyl
5      3      0.048196      3      -5      8      -9      $ Bottom NU Plate
6      1      0.048159      2      -5      9      -12
#1     #2     #3
7      3      0.048196      2      -5      12     -13     $ Homog HEU + NU
8      4      0.047779      5      -6      7      -14     $ Top NU Plate
9      4      0.047779      5      -6      7      -14     $ DU Otr Annulus
10     4      0.047779      1      -5      7      -8      $ DU Btm Annulus
11     4      0.047779      1      -5      13     -14     $ DU Top Annulus
11     0
(6:-7:14)

1      cz      2.25014      $ OR of Top 10% Cylinder
2      cz      3.10996      $ OR of Upper 10% Cylinder
3      cz      7.62000      $ OR of Bottom 10% Cylinder
4      cz      12.54604     $ OR of Lower 10% Cylinder
5      cz      26.67000     $ IR of DU Reflector Annulus
6      cz      41.91000     $ OR of DU Reflector Annulus
7      pz      -57.46750    $ Bottom of DU Reflector
8      pz      -41.73361    $ Top of DU Reflector Bottom
9      pz      -38.24644    $ Bottom of Homogenized HEU and Nat U
10     pz      -22.39010    $ Bottom of Bottom 10% Cylinder
11     pz      4.35102     $ Bottom of Lower 10% Cylinder
12     pz      17.16665    $ Top of Homogenized HEU and Nat U
13     pz      23.81250    $ Bottom of DU Reflector Top
14     pz      39.05250    $ Top of DU Reflector

totnu
kcode  10000  1.0  100  600
imp:n  1.0  9r  0.0
sdef  erg=d1  pos = 0 0 -10  axs = 0 0 1  rad=d2  ext=d3
spl  -3
si2  0.0  7.62
si3  -30  30
c  Homogenized HEU, Natural U, and Voids
m1  92234.70c  5.4058e-5  92235.70c  4.9831e-3
    92236.70c  1.3733e-5  92238.70c  4.3108e-2
c  Intermediate Enriched Uranium (10 wt.%)
m2  92234.70c  2.4761e-5  92235.70c  4.8461e-3
    92236.70c  4.3348e-5  92238.70c  4.2695e-2
c  Natural Uranium
m3  92234.70c  2.6518e-6  92235.70c  3.4701e-4
    92238.70c  4.7846e-2
c  Depleted Uranium
m4  92234.70c  2.8672e-7  92235.70c  1.0058e-4
    92236.70c  1.1468e-6  92238.70c  4.7677e-2

end

```

Table A-69. Input file for mix-met-fast-008-case-7

```

ZEBRA Core 8 MIX-MET-FAST-008 Case 7 (ZEBRA 8H)
1 2 0.047133 3 -4 9 -10 13 -14 $ Bottom nat-U plate
2 2 0.047133 3 -4 9 -10 14 -15 $ 2nd nat-U plate
3 2 0.047133 3 -4 9 -10 15 -16 $ 3rd nat-U plate
4 1 0.047402 3 -4 9 -10 16 -17 $ Enriched U plate
5 2 0.047133 3 -4 9 -10 17 -18 $ 4th nat-U plate
6 2 0.047133 3 -4 9 -10 18 -19 $ 5th nat-U plate
7 2 0.047133 3 -4 9 -10 19 -20 $ Top nat-U plate
8 0 2 -3 8 -11 13 -20 $ Left gap
9 0 3 -4 8 -9 13 -20 $ Front gap
10 0 4 -5 8 -11 13 -20 $ Right gap
11 0 3 -4 10 -11 13 -20 $ Back gap
12 3 0.085680 1 -2 7 -12 13 -20 $ Left sheath side
13 3 0.085680 2 -5 7 -8 13 -20 $ Front sheath side
14 3 0.085680 5 -6 7 -12 13 -20 $ Right sheath side
15 3 0.085680 2 -5 11 -12 13 -20 $ Back sheath side
16 0 -1:6:-7:12:-13:20

*1 px -2.62720 $ Left edge of sheath
2 px -2.55100 $ Inside left edge of sheath
3 px -2.53350 $ Left edge of U metal plates
4 px 2.53350 $ Right edge of U metal plates
5 px 2.55100 $ Inside right edge of sheath
*6 px 2.62720 $ Right edge of sheath
*7 py -2.62720 $ Front edge of sheath
8 py -2.55100 $ Inside front edge of sheath
9 py -2.53350 $ Front edge of U metal plates
10 py 2.53350 $ Back edge of U metal plates
11 py 2.55100 $ Inside back edge of sheath
*12 py 2.62720 $ Back edge of sheath
*13 pz -1.11125 $ Bottom of 1st nat-U plate
14 pz -0.79375 $ Top of 1st nat-U plate
15 pz -0.47625 $ Top of 2nd nat-U plate
16 pz -0.15875 $ Top of 3rd nat-U plate
17 pz 0.15875 $ Top of Enriched U plate
18 pz 0.47625 $ Top of 4th nat-U plate
19 pz 0.79375 $ Top of 5th nat-U plate
*20 pz 1.11125 $ Top of 6th nat-U plate

mode n
kcode 10000 1.0 100 600
ksrc -2.5 2.5 -0.9525 -2.5 -2.5 -0.9525
      2.5 -2.5 -0.9525 2.5 2.5 -0.9525
      0.0 0.0 -0.9525
      -2.5 2.5 -0.6350 -2.5 -2.5 -0.6350
      2.5 -2.5 -0.6350 2.5 2.5 -0.6350
      0.0 0.0 -0.6350
      -2.5 2.5 -0.3175 -2.5 -2.5 -0.3175
      2.5 -2.5 -0.3175 2.5 2.5 -0.3175
      0.0 0.0 -0.3175
      -2.5 2.5 -0.1588 -2.5 -2.5 -0.1588
      2.5 -2.5 -0.1588 2.5 2.5 -0.1588
      0.0 0.0 -0.1588
      -2.5 2.5 0.1588 -2.5 -2.5 0.1588
      2.5 -2.5 0.1588 2.5 2.5 0.1588

```

Table A-69. Input file for mix-met-fast-008-case-7 (Cont'd)

	0.0	0.0	0.1588			
	-2.5	2.5	0.3175	-2.5	-2.5	0.3175
	2.5	-2.5	0.3175	2.5	2.5	0.3175
	0.0	0.0	0.3175			
	-2.5	2.5	0.6350	-2.5	-2.5	0.6350
	2.5	-2.5	0.6350	2.5	2.5	0.6350
	0.0	0.0	0.6350			
	-2.5	2.5	0.9525	-2.5	-2.5	0.9525
	2.5	-2.5	0.9525	2.5	2.5	0.9525
	0.0	0.0	0.9525			
imp:n	1.0	14r	0.0			
totnu						
c	Enriched U metal (37.5 w/o)					
m1	1001.70c	4.3978e-05				
	6000.70c	1.8452e-04				
	8016.70c	3.4617e-04	8017.70c	1.3852e-07		
	13027.70c	4.1070e-05				
	14028.70c	3.6390e-05	14029.70c	1.8426e-06		
	14030.70c	1.2231e-06				
	26054.70c	3.5121e-06	26056.70c	5.4598e-05		
	26057.70c	1.2501e-06	26058.70c	1.6668e-07		
	92235.70c	1.7730e-02	92238.70c	2.8957e-02		
c	Reflector (Natural U metal)					
m2	1001.70c	4.3978e-05				
	6000.70c	4.9205e-04				
	14028.70c	1.9408e-04	14029.70c	9.8271e-06		
	14030.70c	6.5233e-06				
	26054.70c	6.2440e-06	26056.70c	9.7067e-05		
	26057.70c	2.2224e-06	26058.70c	2.9632e-07		
	92235.70c	3.3316e-04	92238.70c	4.5948e-02		
c	Sheath					
m3	1001.70c	2.2714e-05				
	6000.70c	7.7829e-04				
	13027.70c	3.4646e-04				
	14028.70c	9.2219e-04	14029.70c	4.6694e-05		
	14030.70c	3.0996e-05				
c	22000.62c	2.9326e-04				\$ ENDF/B-VI
	22046.70c	2.4194e-05	22047.70c	2.1819e-05		\$ ENDF/B-VII.0
	22048.70c	2.1619e-04	22049.70c	1.5865e-05		\$ ENDF/B-VII.0
	22050.70c	1.5191e-05				\$ ENDF/B-VII.0
	23000.70c	9.2127e-05				
	24050.70c	6.9985e-04	24052.70c	1.3496e-02		
	24053.70c	1.5302e-03	24054.70c	3.8093e-04		
	25055.70c	1.1918e-03				
	26054.70c	3.3408e-03	26056.70c	5.1936e-02		
	26057.70c	1.1891e-03	26058.70c	1.5855e-04		
	28058.70c	6.1471e-03	28060.70c	2.3501e-03		
	28061.70c	1.0175e-04	28062.70c	3.2325e-04		
	28064.70c	8.1937e-05				
	29063.70c	5.1084e-05	29065.70c	2.2769e-05		
c	42000.66c	1.4635e-04				\$ ENDF/B-VI
	42092.70c	2.1718e-05	42094.70c	1.3537e-05		\$ ENDF/B-VII.0
	42095.70c	2.3299e-05	42096.70c	2.4411e-05		\$ ENDF/B-VII.0
	42097.70c	1.3976e-05	42098.70c	3.5314e-05		\$ ENDF/B-VII.0
	42100.70c	1.4094e-05				\$ ENDF/B-VII.0

Table A-70. Input file for ieu-comp-therm-002-case-3

MATR 17% - Gd IEU-COMP-THERM-002, case 3

c core  
1 0 -4 5 -3 (101:-121) (102:-121) (103:-121) (104:-121)  
imp:n=1 fill=100  
c water between core and envelope cylinder  
c 2 3 1.001640E-01 4 -6 5 -3 imp:n=1 envelope cylinder  
c 3 2 8.699752E-02 6 -7 2 -3 imp:n=1 outside water  
c 4 3 1.001640E-01 7 -1 2 -3 imp:n=1 bottom water reflector  
c 5 3 1.001640E-01 -8 2 -5 imp:n=1 support cylinder  
c 6 2 8.699752E-02 8 -9 2 -5 imp:n=1 water between support cylinder and envelope cylinder  
c 7 3 1.001640E-01 9 -6 2 -5 imp:n=1 empty tubes for the control rods  
c 8 0 -111 122 -3 imp:n=1  
9 2 8.699752E-02 -101 121 -3 (111:-122) imp:n=1  
10 0 -112 122 -3 imp:n=1  
11 2 8.699752E-02 -102 121 -3 (112:-122) imp:n=1  
12 0 -113 122 -3 imp:n=1  
13 2 8.699752E-02 -103 121 -3 (113:-122) imp:n=1  
14 0 -114 122 -3 imp:n=1  
15 2 8.699752E-02 -104 121 -3 (114:-122) imp:n=1  
c 100 0 -201 202 -203 204 imp:n=1 lat=1 u=100  
fill=-7:7 -7:7 0:0  
4 36r  
2 2 1 1 2 2 4 7r  
2 1 1 1 1 1 2 4 6r  
1 1 1 1 1 1 1 1 4 5r  
1 1 1 1 1 1 1 1 1 4 4r  
2 1 1 1 1 1 1 1 1 1 4 3r  
2 1 1 1 1 3 1 1 1 1 2 4 3r  
1 1 1 1 1 1 1 1 1 2 4 4r  
1 1 1 1 1 1 1 1 1 1 4 5r  
1 1 1 1 1 1 1 1 1 1 4 6r  
2 1 1 1 1 1 2 4 7r  
2 2 1 1 2 2 4 36r  
c  
c universe 1 - fuel rod  
c  
c  
c 1020 2 8.699752E-02 301 -302 402 -407 imp:n=1 u=-1 1-st tube  
c 1-st annular fuel element  
11030 3 1.001640E-01 302 -304 402 -403 imp:n=1 u=-1  
21030 2 8.699752E-02 302 -304 403 -404 imp:n=1 u=-1  
1030 1 3.335478E-02 302 -303 404 -405 imp:n=1 u=-1  
31030 2 8.699752E-02 302 -304 405 -406 imp:n=1 u=-1  
41030 3 1.001640E-01 302 -304 406 -407 imp:n=1 u=-1  
c 2-nd tube  
1040 2 8.699752E-02 303 -304 404 -405 imp:n=1 u=-1  
c water gap

Table A-70. Input file for ieu-comp-therm-002-case-3 (Cont'd)

1050	3	1.001640E-01	304	-305	402	-407	imp:n=1	u=-1	
c									3-rd tube
1060	2	8.699752E-02	305	-306	402	-407	imp:n=1	u=-1	
c									2-nd annular fuel element
11070	3	1.001640E-01	306	-308	402	-403	imp:n=1	u=-1	
21070	2	8.699752E-02	306	-308	403	-404	imp:n=1	u=-1	
1070	1	3.335478E-02	306	-307	404	-405	imp:n=1	u=-1	
31070	2	8.699752E-02	306	-308	405	-406	imp:n=1	u=-1	
41070	3	1.001640E-01	306	-308	406	-407	imp:n=1	u=-1	
c									4-th tube
1080	2	8.699752E-02	307	-308	404	-405	imp:n=1	u=-1	
c									water gap
1090	3	1.001640E-01	308	-309	402	-407	imp:n=1	u=-1	
c									5-th tube
1100	2	8.699752E-02	309	-310	402	-407	imp:n=1	u=-1	
c									bottom plug
1110	2	8.699752E-02		-310	401	-402	imp:n=1	u=-1	
c									top plug
1120	2	8.699752E-02	301	-310	407	-408	imp:n=1	u=-1	
c									water outside of fuel rod
1130	3	1.001640E-01	310		401	-603	imp:n=1	u=1	
c									water above fuel rod
1140	3	1.001640E-01			419		imp:n=1	u=1	
c									water between fuel rod and support plate
1150	3	1.001640E-01	300		602	-401	imp:n=1	u=1	
c									lower lattice plate
1160	3	1.001640E-01		-502		-601	imp:n=1	u=1	
1170	2	8.699752E-02	502			-601	imp:n=1	u=1	
c									support plate
1180	3	1.001640E-01		-501	601	-602	#1500 imp:n=1	u=-1	
1190	2	8.699752E-02	501		601	-602	imp:n=1	u=1	
c									upper lattice plate
1200	3	1.001640E-01	310	-502	603	-604	imp:n=1	u=-1	
1210	2	8.699752E-02	502		603	-604	imp:n=1	u=1	
c									water around top end of fuel rod
1220	3	1.001640E-01	310		604	-408	imp:n=1	u=1	
c									absorber rod
1230	5	6.026200E-02		-311	402	-409	imp:n=1	u=-1	
1240	3	1.001640E-01	311	-301	402	-409	imp:n=1	u=-1	
c									
1250	5	6.026200E-02		-314	409	-410	imp:n=1	u=-1	
1260	3	1.001640E-01	314	-301	409	-410	imp:n=1	u=-1	
c									
1270	5	6.026200E-02		-313	410	-411	imp:n=1	u=-1	
1280	3	1.001640E-01	313	-301	410	-411	imp:n=1	u=-1	
c									
1290	2	8.699752E-02		-311	411	-412	imp:n=1	u=-1	
1300	5	6.026200E-02	311	-313	411	-412	imp:n=1	u=-1	
1310	3	1.001640E-01	313	-301	411	-412	imp:n=1	u=-1	
c									
1320	2	8.699752E-02		-313	412	-413	imp:n=1	u=-1	
1330	3	1.001640E-01	313	-301	412	-413	imp:n=1	u=-1	
c									
1340	4	4.233530E-02		-312	413	-414	imp:n=1	u=-1	
1350	2	8.699752E-02	312	-313	413	-414	imp:n=1	u=-1	



Table A-70. Input file for ieu-comp-therm-002-case-3 (Cont'd)

1360	3	1.001640E-01	313	-301	413	-414	imp:n=1	u=-1	
c									
1370	2	8.699752E-02		-313	414	-415	imp:n=1	u=-1	
1380	3	1.001640E-01	313	-301	414	-415	imp:n=1	u=-1	
c									
1390	2	8.699752E-02		-311	415	-416	imp:n=1	u=-1	
1400	5	6.026200E-02	311	-313	415	-416	imp:n=1	u=-1	
1410	3	1.001640E-01	313	-301	415	-416	imp:n=1	u=-1	
c									
1420	5	6.026200E-02		-313	416	-417	imp:n=1	u=-1	
1430	3	1.001640E-01	313	-301	416	-417	imp:n=1	u=-1	
c									
1440	5	6.026200E-02		-314	417	-418	imp:n=1	u=-1	
1450	3	1.001640E-01	314	-301	417	-418	imp:n=1	u=-1	
c									
1460	5	6.026200E-02		-311	418	-419	imp:n=1	u=-1	
1470	3	1.001640E-01	311	-301	418	-408	imp:n=1	u=-1	
1490	3	1.001640E-01	311		408	-419	imp:n=1	u=1	
c									cone
1500	2	8.699752E-02		-300	400	-401	imp:n=1	u=-1	
c									
c									
c									universe 2 - steel plates with holes and water
									lower lattice plate
201	3	1.001640E-01		-502		-601	imp:n=1	u=2	
202	2	8.699752E-02	502			-601	imp:n=1	u=2	
c									support plate
203	3	1.001640E-01		-501	601	-602	imp:n=1	u=-2	
204	2	8.699752E-02	501		601	-602	imp:n=1	u=2	
c									water
205	3	1.001640E-01			602	-603	imp:n=1	u=2	
c									upper lattice plate
206	3	1.001640E-01		-502	603	-604	imp:n=1	u=-2	
207	2	8.699752E-02	502		603	-604	imp:n=1	u=2	
c									water
208	3	1.001640E-01			604		imp:n=1	u=2	
c									
c									
c									universe 3 - central water-cooled channel
									lower lattice plate
301	3	1.001640E-01		-511		-601	imp:n=1	u=3	
302	2	8.699752E-02	511			-601	imp:n=1	u=3	
c									support plate
303	3	1.001640E-01		-501	601	-602	imp:n=1	u=-3	
304	2	8.699752E-02	501		601	-602	imp:n=1	u=3	
c									water between support plate and water-cooled channel
305	3	1.001640E-01			602	-401	imp:n=1	u=3	
c									central space
306	0			-503	401		imp:n=1	u=3	
c									1-st tube
307	2	8.699752E-02	503	-504	401		imp:n=1	u=3	
c									water
308	3	1.001640E-01	504	-505	401		imp:n=1	u=3	
c									2-nd tube
309	2	8.699752E-02	505	-506	401		imp:n=1	u=3	
c									water
310	3	1.001640E-01	506	-507	401		imp:n=1	u=3	

Table A-70. Input file for ieu-comp-therm-002-case-3 (Cont'd)

```

c
311 2 8.699752E-02 507 -508 401      imp:n=1  u=3      3-rd tube
c
312 0      508 -509 401      imp:n=1  u=3      void gap
c
313 2 8.699752E-02 509 -510 401      imp:n=1  u=3      4-th tube
c
314 3 1.001640E-01 510      401 -603  imp:n=1  u=3      water
c
315 3 1.001640E-01 510 -511 603 -604  imp:n=1  u=-3     upper lattice plate
316 2 8.699752E-02 511      603 -604  imp:n=1  u=3
c
317 3 1.001640E-01 510      604      imp:n=1  u=3      water
c
c
c
401 2 8.699752E-02      -602  imp:n=1  u=4     universe 4 - steel plates and water
402 3 1.001640E-01      602 -603  imp:n=1  u=4
403 2 8.699752E-02      603 -604  imp:n=1  u=4
404 3 1.001640E-01      604      imp:n=1  u=4
c
9999 0 1:-2:3 imp:n=0      supercell

1 cz 60      $ water reflector outer radius
2 pz -19     $ water reflector (envelope cylinder) lower level
3 pz 106     $ water reflector (envelope cylinder) upper level
4 cz 41      $ support/lattice plates radius
5 pz 0      $ bottom support plate lower level
6 cz 42      $ envelope cylinder inner radius
7 cz 44      $ envelope cylinder outer radius
8 cz 40      $ support cylinder inner radius
9 cz 40.5    $ support cylinder outer radius
c
101 c/z -13.74093640671 3.4 1.5
102 c/z 13.74093640671 -3.4 1.5
103 c/z -3.925981830489 13.6 1.5
104 c/z 3.925981830489 -13.6 1.5
c
111 c/z -13.74093640671 3.4 1.2
112 c/z 13.74093640671 -3.4 1.2
113 c/z -3.925981830489 13.6 1.2
114 c/z 3.925981830489 -13.6 1.2
c
121 pz 4.000000000001
122 pz 4.3
c
201 px 2.944486372867
202 px -2.944486372867
203 p -1 1.732050807569 0 5.888972745734
204 p -1 1.732050807569 0 -5.888972745734
c
c
201 p 1.732050807569 1 0 6.8
c
202 p 1.732050807569 1 0 -6.8
c
203 py 3.4
c
204 py -3.4
c
205 p -1.732050807569 1 0 6.8

```

Table A-70. Input file for ieu-comp-therm-002-case-3 (Cont'd)

```

c 206 p -1.732050807569 1 0 -6.8
c
300 kz 2 0.25 1 $ cone
301 cz 1.17 $ 1-st tube inner radius
302 cz 1.2 $ 1-st tube outer radius
303 cz 1.43 $ 2-nd tube inner radius
304 cz 1.4640 $ 2-nd tube outer radius
305 cz 1.7968 $ 3-rd tube inner radius
306 cz 1.83 $ 3-rd tube outer radius
307 cz 2.06 $ 4-th tube inner radius
308 cz 2.09 $ 4-th tube outer radius
309 cz 2.26 $ 5-th tube inner radius
310 cz 2.29 $ 5-th tube outer radius
c
311 cz 0.3 $ tail outer radius
312 cz 0.52 $ absorber element tube inner radius
313 cz 0.55 $ absorber element tube outer radius
314 cz 1.15 $ flange outer radius
c
400 pz 3 $ lower cone plane
401 pz 4 $ lower surface of fuel rod bottom plug
402 pz 4.3 $ upper surface of fuel rod bottom plug
403 pz 5.7 $ lower surface of fuel bottom plug
404 pz 5.9 $ upper surface of fuel bottom plug
405 pz 65.9 $ lower surface of fuel top plug
406 pz 66.2 $ upper surface of fuel top plug
407 pz 68.6 $ lower surface of fuel rod top plug
408 pz 68.9 $ upper surface of fuel rod top plug
c
409 pz 6.3
410 pz 6.8
411 pz 9.9
412 pz 10.9
413 pz 11.9 $ lower surface of absorber element
414 pz 59.9 $ upper surface of absorber element
415 pz 60.9
416 pz 61.9
417 pz 67.4
418 pz 67.9
419 pz 70.4
c
501 cz 0.75 $ radius of hole in support plate
502 cz 2.35 $ radius of hole in lattice plate
503 cz 1.05 $ inner radius of 1-st tube in central channel
504 cz 1.1 $ outer radius of 1-st tube in central channel
505 cz 1.3 $ inner radius of 2-nd tube in central channel
506 cz 1.5 $ outer radius of 2-nd tube in central channel
507 cz 1.7 $ inner radius of 3-rd tube in central channel
508 cz 1.9 $ outer radius of 3-rd tube in central channel
509 cz 2.2 $ inner radius of 4-th tube in central channel
510 cz 2.5 $ outer radius of 4-th tube in central channel
511 cz 2.53 $ radius of hole for central channel
c
601 pz 1.5 $ upper surface of bottom lattice plate
602 pz 3.5 $ upper surface of support plate

```

Table A-70. Input file for ieu-comp-therm-002-case-3 (Cont'd)

```

603 pz 66.8          $ lower surface of top lattice plate
604 pz 68.8          $ upper surface of top lattice plate

kcode      10000      1.0      100      600
sdef pos=0 0 35.9 axs=0 0 1 rad=d1 ext=d2
si1      0 10
si2      10
c        UO2 Fuel
m1      8016.70c  2.2387E-02          8017.70c  8.9584E-06
        92234.70c  1.6683E-05          92235.70c  1.8827E-03
        92238.70c  9.0594E-03
c        Steel
m2      6000.70c  4.1748E-04          14029.70c  3.9703E-05
        14028.70c  7.8412E-04
        14030.70c  2.6356E-05
c        22000.62c  4.7376e-4          $ ENDF/B-VI
        22046.70c  3.9085E-05          22047.70c  3.5248E-05  $ ENDF/B-VII.0
        22048.70c  3.4926E-04          22049.70c  2.5630E-05  $ ENDF/B-VII.0
        22050.70c  2.4541E-05          $ ENDF/B-VII.0
        24050.70c  6.8321E-04          24052.70c  1.3175E-02
        24053.70c  1.4938E-03          24054.70c  3.7187E-04
        25055.70c  1.0431E-03
        26054.70c  3.5392E-03          26056.70c  5.5019E-02
        26057.70c  1.2597E-03          26058.70c  1.6796E-04
        28058.70c  5.8050E-03          28060.70c  2.2193E-03
        28061.70c  9.6084E-05          28062.70c  3.0526E-04
        28064.70c  7.7377E-05
c        Water
m3      1001.70c  6.6776E-02          8017.70c  1.3355E-05
        8016.70c  3.3375E-02
mt3     lwtr.10t
c        Alumina with Gadolinia
m4      8016.70c  2.5391E-02          8017.70c  1.0160E-05
        13027.70c  1.4775E-02
        64152.70c  4.3186E-06          64154.70c  4.7073E-05
        64155.70c  3.1958E-04          64156.70c  4.4201E-04
        64157.70c  3.3793E-04          64158.70c  5.3637E-04
        64160.70c  4.7202E-04
c        Aluminum
m5      13027.70c  6.0262E-02

end of input

```

Table A-71. Input file for leu-sol-therm-007-case-14

```

STACY-14 Uranyl Nitrate 9.97 wt.% Enr 313.0 g/l U 46.83 cm
c LEU-SOL-THERM-007 Case 14
1 1 0.086845 1 -2 4 -6 $ Tank Wall
2 1 0.086845 -2 3 -4 $ Tank Bottom
3 1 0.086845 -2 6 -7 $ Tank Top
4 2 0.098524 -1 4 -5 $ Uranyl Nitrate Solution
5 3 4.9425e-5 -1 5 -6 $ Air inside Tank
6 0 2:-3:7

1 cz 29.5 $ Inner Radius of Tank
2 cz 29.8 $ Outer Radius of Tank
3 pz -2.0 $ Bottom of Tank
4 pz 0.0 $ Bottom of Uranyl Nitrate
5 pz 46.83 $ Top of Uranyl Nitrate
6 pz 150.0 $ Top of Air
7 pz 152.5 $ Top of Tank

kcode 10000 1.0 100 600
imp:n 1.0 4r 0.0
totnu
sdef cel=4 erg=d1 pos= 0 0 40
spl -3
c SS304 7.93 g/cc
m1 6000.70c 4.3736e-5
14028.70c 9.8013e-4 14029.70c 4.9628e-5
14030.70c 3.2944e-5
15031.70c 4.3170e-5
c 16000.62c 2.9782e-6 $ ENDF/B-VI
16032.70c 2.8299e-6 16033.70c 2.2337e-8 $ ENDF/B-VII.0
16034.70c 1.2538e-7 16036.70c 5.9564e-10 $ ENDF/B-VII.0
24050.70c 7.2887e-4 24052.70c 1.4056e-2
24053.70c 1.5936e-3 24054.70c 3.9673e-4
25055.70c 1.1561e-3
26054.70c 3.5058e-3 26056.70c 5.4501e-2
26057.70c 1.2478e-3 26058.70c 1.6638e-4
28058.70c 5.6939e-3 28060.70c 2.1768e-3
28061.70c 9.4245e-5 28062.70c 2.9942e-4
28064.70c 7.5897e-5
c Uranyl Nitrate Solution 313.0 g/l U 1.4881 g/cc
m2 1001.70c 5.6707e-2
7014.70c 2.9298e-3 7015.70c 1.0821e-5
8016.70c 3.8069e-2 8017.70c 1.5234e-5
92234.70c 6.4430e-7 92235.70c 7.9954e-5
92236.70c 7.9854e-8 92238.70c 7.1216e-4
mt2 lwtr.10t
c Air as Nitrogen and Oxygen 0.001184 g/cc
m3 7014.70c 3.8872e-5 7015.70c 1.4436e-7
8016.70c 1.0405e-5 8017.70c 4.1636e-9

end of input

```

Table A-72. Input file for leu-sol-therm-007-case-30

```

STACY-30 Uranyl Nitrate 9.97 wt.% Enr 290.7 g/l U 54.20 cm
c LEU-SOL-THERM-007 Case 30
1 1 0.086845 1 -2 4 -6 $ Tank Wall
2 1 0.086845 -2 3 -4 $ Tank Bottom
3 1 0.086845 -2 6 -7 $ Tank Top
4 2 0.098564 -1 4 -5 $ Uranyl Nitrate Solution
5 3 4.9425e-5 -1 5 -6 $ Air inside Tank
6 0 2:-3:7

1 cz 29.5 $ Inner Radius of Tank
2 cz 29.8 $ Outer Radius of Tank
3 pz -2.0 $ Bottom of Tank
4 pz 0.0 $ Bottom of Uranyl Nitrate
5 pz 54.20 $ Top of Uranyl Nitrate
6 pz 150.0 $ Top of Air
7 pz 152.5 $ Top of Tank

kcode 10000 1.0 100 600
imp:n 1.0 4r 0.0
totnu
sdef cel=4 erg=d1 pos= 0 0 40
spl -3
c SS304 7.93 g/cc
m1 6000.70c 4.3736e-5
14028.70c 9.8013e-4 14029.70c 4.9628e-5
14030.70c 3.2944e-5
15031.70c 4.3170e-5
c 16000.62c 2.9782e-6 $ ENDF/B-VI
16032.70c 2.8299e-6 16033.70c 2.2337e-8 $ ENDF/B-VII.0
16034.70c 1.2538e-7 16036.70c 5.9564e-10 $ ENDF/B-VII.0
24050.70c 7.2887e-4 24052.70c 1.4056e-2
24053.70c 1.5936e-3 24054.70c 3.9673e-4
25055.70c 1.1561e-3
26054.70c 3.5058e-3 26056.70c 5.4501e-2
26057.70c 1.2478e-3 26058.70c 1.6638e-4
28058.70c 5.6939e-3 28060.70c 2.1768e-3
28061.70c 9.4245e-5 28062.70c 2.9942e-4
28064.70c 7.5897e-5
c Uranyl Nitrate Solution 290.7 g/l U 1.4571 g/cc
m2 1001.70c 5.7176e-2
7014.70c 2.8052e-3 7015.70c 1.0361e-5
8016.70c 3.7821e-2 8017.70c 1.5134e-5
92234.70c 5.9840e-7 92235.70c 7.4257e-5
92236.70c 7.4165e-8 92238.70c 6.6142e-4
mt2 lwtr.10t
c Air as Nitrogen and Oxygen 0.001184 g/cc
m3 7014.70c 3.8872e-5 7015.70c 1.4436e-7
8016.70c 1.0405e-5 8017.70c 4.1636e-9

end of input

```

Table A-73. Input file for leu-sol-therm-007-case-32

```

STACY-32 Uranyl Nitrate 9.97 wt.% Enr 270.0 g/l U 63.55 cm
c LEU-SOL-THERM-007 Case 32
1 1 0.086845 1 -2 4 -6 $ Tank Wall
2 1 0.086845 -2 3 -4 $ Tank Bottom
3 1 0.086845 -2 6 -7 $ Tank Top
4 2 0.099288 -1 4 -5 $ Uranyl Nitrate Solution
5 3 4.9425e-5 -1 5 -6 $ Air inside Tank
6 0 2:-3:7

1 cz 29.5 $ Inner Radius of Tank
2 cz 29.8 $ Outer Radius of Tank
3 pz -2.0 $ Bottom of Tank
4 pz 0.0 $ Bottom of Uranyl Nitrate
5 pz 63.55 $ Top of Uranyl Nitrate
6 pz 150.0 $ Top of Air
7 pz 152.5 $ Top of Tank

kcode 10000 1.0 100 600
imp:n 1.0 4r 0.0
totnu
sdef cel=4 erg=d1 pos= 0 0 40
spl -3
c SS304 7.93 g/cc
m1 6000.70c 4.3736e-5
14028.70c 9.8013e-4 14029.70c 4.9628e-5
14030.70c 3.2944e-5
15031.70c 4.3170e-5
c 16000.62c 2.9782e-6 $ ENDF/B-VI
16032.70c 2.8299e-6 16033.70c 2.2337e-8 $ ENDF/B-VII.0
16034.70c 1.2538e-7 16036.70c 5.9564e-10 $ ENDF/B-VII.0
24050.70c 7.2887e-4 24052.70c 1.4056e-2
24053.70c 1.5936e-3 24054.70c 3.9673e-4
25055.70c 1.1561e-3
26054.70c 3.5058e-3 26056.70c 5.4501e-2
26057.70c 1.2478e-3 26058.70c 1.6638e-4
28058.70c 5.6939e-3 28060.70c 2.1768e-3
28061.70c 9.4245e-5 28062.70c 2.9942e-4
28064.70c 7.5897e-5
c Uranyl Nitrate Solution 270.0 g/l U 1.4348 g/cc
m2 1001.70c 5.8085e-2
7014.70c 2.6828e-3 7015.70c 9.9091e-6
8016.70c 3.7811e-2 8017.70c 1.5130e-5
92234.70c 5.5579e-7 92235.70c 6.8970e-5
92236.70c 6.8884e-8 92238.70c 6.1432e-4
mt2 lwtr.10t
c Air as Nitrogen and Oxygen 0.001184 g/cc
m3 7014.70c 3.8872e-5 7015.70c 1.4436e-7
8016.70c 1.0405e-5 8017.70c 4.1636e-9

end of input

```

Table A-74. Input file for leu-sol-therm-007-case-36

```

STACY-36 Uranyl Nitrate 9.97 wt.% Enr 253.9 g/l U 83.55 cm
c LEU-SOL-THERM-007 Case 36
1 1 0.086845 1 -2 4 -6 $ Tank Wall
2 1 0.086845 -2 3 -4 $ Tank Bottom
3 1 0.086845 -2 6 -7 $ Tank Top
4 2 0.098947 -1 4 -5 $ Uranyl Nitrate Solution
5 3 4.9425e-5 -1 5 -6 $ Air inside Tank
6 0 2:-3:7

1 cz 29.5 $ Inner Radius of Tank
2 cz 29.8 $ Outer Radius of Tank
3 pz -2.0 $ Bottom of Tank
4 pz 0.0 $ Bottom of Uranyl Nitrate
5 pz 83.55 $ Top of Uranyl Nitrate
6 pz 150.0 $ Top of Air
7 pz 152.5 $ Top of Tank

kcode 10000 1.0 100 600
imp:n 1.0 4r 0.0
totnu
sdef cel=4 erg=d1 pos= 0 0 40
spl -3
c SS304 7.93 g/cc
m1 6000.70c 4.3736e-5
14028.70c 9.8013e-4 14029. 4.9628e-5
14030.70c 3.2944e-5
15031.70c 4.3170e-5
c 16000.62c 2.9782e-6 $ ENDF/B-VI
16032.70c 2.8299e-6 16033.70c 2.2337e-8 $ ENDF/B-VII.0
16034.70c 1.2538e-7 16036.70c 5.9564e-10 $ ENDF/B-VII.0
24050.70c 7.2887e-4 24052.70c 1.4056e-2
24053.70c 1.5936e-3 24054.70c 3.9673e-4
25055.70c 1.1561e-3
26054.70c 3.5058e-3 26056.70c 5.4501e-2
26057.70c 1.2478e-3 26058.70c 1.6638e-4
28058.70c 5.6939e-3 28060.70c 2.1768e-3
28061.70c 9.4245e-5 28062.70c 2.9942e-4
28064.70c 7.5897e-5
c Uranyl Nitrate Solution 253.9 g/l U 1.4102 g/cc
m2 1001.70c 5.8115e-2
7014.70c 2.6195e-3 7015.70c 9.7280e-6
8016.70c 3.7545e-2 8017.70c 1.5024e-5
92234.70c 5.2265e-7 92235.70c 6.4857e-5
92236.70c 6.4776e-8 92238.70c 5.7769e-4
mt2 lwtr.10t
c Air as Nitrogen and Oxygen 0.001184 g/cc
m3 7014.70c 3.8872e-5 7015.70c 1.4436e-7
8016.70c 1.0405e-5 8017.70c 4.1636e-9

end of input

```



Table A-75. Input file for leu-sol-therm-007-case-49

```

STACY-49 Uranyl Nitrate 9.97 wt.% Enr 241.9 g/l U 112.27 cm
c LEU-SOL-THERM-007 Case 49
1 1 0.086845 1 -2 4 -6 $ Tank Wall
2 1 0.086845 -2 3 -4 $ Tank Bottom
3 1 0.086845 -2 6 -7 $ Tank Top
4 2 0.098859 -1 4 -5 $ Uranyl Nitrate Solution
5 3 4.9425e-5 -1 5 -6 $ Air inside Tank
6 0 2:-3:7

1 cz 29.5 $ Inner Radius of Tank
2 cz 29.8 $ Outer Radius of Tank
3 pz -2.0 $ Bottom of Tank
4 pz 0.0 $ Bottom of Uranyl Nitrate
5 pz 112.27 $ Top of Uranyl Nitrate
6 pz 150.0 $ Top of Air
7 pz 152.5 $ Top of Tank

kcode 10000 1.0 100 600
imp:n 1.0 4r 0.0
totnu
sdef cel=4 erg=d1 pos= 0 0 40
spl -3
c SS304 7.93 g/cc
m1 6000.70c 4.3736e-5
14028.70c 9.8013e-4 14029.70c 4.9628e-5
14030.70c 3.2944e-5
15031.70c 4.3170e-5
c 16000.62c 2.9782e-6 $ ENDF/B-VI
16032.70c 2.8299e-6 16033.70c 2.2337e-8 $ ENDF/B-VII.0
16034.70c 1.2538e-7 16036.70c 5.9564e-10 $ ENDF/B-VII.0
24050.70c 7.2887e-4 24052.70c 1.4056e-2
24053.70c 1.5936e-3 24054.70c 3.9673e-4
25055.70c 1.1561e-3
26054.70c 3.5058e-3 26056.70c 5.4501e-2
26057.70c 1.2478e-3 26058.70c 1.6638e-4
28058.70c 5.6939e-3 28060.70c 2.1768e-3
28061.70c 9.4245e-5 28062.70c 2.9942e-4
28064.70c 7.5897e-5
c Uranyl Nitrate Solution 241.9 g/l U 1.3941 g/cc
m2 1001.70c 5.8223e-2
7014.70c 2.5830e-3 7015.70c 9.5404e-6
8016.70c 3.7416e-2 8017.70c 1.4972e-5
92234.70c 4.9795e-7 92235.70c 6.1792e-5
92236.70c 6.1715e-8 92238.70c 5.5039e-4
mt2 lwtr.10t
c Air as Nitrogen and Oxygen 0.001184 g/cc
m3 7014.70c 3.8872e-5 7015.70c 1.4436e-7
8016.70c 1.0405e-5 8017.70c 4.1636e-9

end of input

```

## A.4 LEU Input Files

The input files for the LEU benchmarks are given in Tables A-76 through A-83.

Table A-76. Input file for leu-comp-therm-008-case-1

```

B&W Criticals Core XI Load 1 1511 PPM LEU-COMP-THERM-008 case 1
c Axially uniform quadrant
1 1 0.068525 -18 u=1 $ Fuel Pin
2 2 0.055323 18 -19 u=1 $ Cladding
3 3 0.10019 19 u=1 $ Water
4 0 20 -21 22 -23 u=2 lat=1 fill=1 $ Pin Cell
c 15x15 Assembly Lattice
5 3 0.10019 -21 20 -23 22 u=3 lat=1
fill=-7:7 -7:7 0:0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
6 0 24 -25 26 -27 u=4 lat=1 fill=3 $ Assemblies
7 0 1 -2 3 4 -8 -14 fill=4 $ Inner Core
8 0 1 -2 3 8 -11 -12 fill=2 $ Buffer Zone
9 0 1 -2 8 -10 12 -13 fill=2 $ Buffer Zone
10 0 1 -2 8 -9 13 -14 fill=2 $ Buffer Zone
11 0 1 -2 4 -9 14 -15 fill=2 $ Buffer Zone
12 0 1 -2 4 -7 15 -16 fill=2 $ Buffer Zone
13 0 1 -2 4 -6 16 -17 fill=2 $ Buffer Zone
14 3 0.10019 1 -2 3 -5 11 $ Reflector
15 3 0.10019 1 -2 -5 10 -11 12 $ Reflector
16 3 0.10019 1 -2 -5 9 -10 13 $ Reflector
17 3 0.10019 1 -2 -5 7 -9 15 $ Reflector
18 3 0.10019 1 -2 -5 6 -7 16 $ Reflector
19 3 0.10019 1 -2 4 -5 -6 17 $ Reflector
20 0 -1:2:-3:-4:5

c Problem Boundaries
1 pz -81.662 $ Bottom
2 pz 81.662 $ Top
*3 py 0.0 $ Front Edge
*4 px 0.0 $ Left Edge
5 cz 76.200 $ Tank IR
c Interior Boundaries
6 px 17.17540 $ Buffer
7 px 33.53300 $ Buffer

```

Table A-76. Input file for leu-comp-therm-008-case-1 (Cont'd)

```

8    px    36.80460          $ Inner Core
9    px    49.89060          $ Buffer
10   px    58.06940          $ Buffer
11   px    66.24820          $ Buffer
12   py    17.17540          $ Buffer
13   py    33.53300          $ Buffer
14   py    36.80460          $ Inner Core
15   py    49.89060          $ Buffer
16   py    58.06940          $ Buffer
17   py    66.24820          $ Buffer
c    Pin Cell Boundaries
18   cz     0.514858          $ Pellet OR
19   cz     0.602996          $ Cladding OR
20   px    -0.81788          $ Left Edge
21   px     0.81788          $ Right Edge
22   py    -0.81788          $ Front Edge
23   py     0.81788          $ Back Edge
c    Assembly Boundaries
24   px   -12.26820          $ Left Edge
25   px    12.26820          $ Right Edge
26   py   -12.26820          $ Front Edge
27   py    12.26820          $ Back Edge

mode      n
kcode    10000    1.0    100    600
imp:n    1.0  18r  0.0
sdef     x=d1  y=d2  z=d3
si1      0.1     49.8
sp1       0       1
si2      0.1     49.8
sp2       0       1
si3     -81.6    81.6
sp3       0       1
c        Fuel (2.459 w/o with B-10 for impurities)
m1       5010.70c  2.6055e-7
          8016.70c  4.5665e-2          8017.70c  1.8273e-5
          92234.70c 4.5689e-6          92235.70c  5.6868e-4
          92238.70c 2.2268e-2
c        Aluminum 6061 cladding
c m2     12000.62c  6.2072e-4          $ ENDF/B-VI
m2       12024.70c  4.9031e-4          12025.70c  6.2072e-5  $
ENDF/B-VII.0
          12026.70c  6.8341e-5          $
ENDF/B-VII.0
          13027.70c  5.3985e-2
          14028.70c  2.9726e-4          14029.70c  1.5051e-5
          14030.70c  9.9130e-6
c        22000.62c  4.7263e-5          $ ENDF/B-VI
          22046.70c  3.8992e-6          22047.70c  3.5164e-6  $
ENDF/B-VII.0
          22048.70c  3.4842e-5          22049.70c  2.5569e-6  $
ENDF/B-VII.0
          22050.70c  2.4482e-6          $
ENDF/B-VII.0
          24050.70c  2.5214e-6          24052.70c  4.8622e-5

```

Table A-76. Input file for leu-comp-therm-008-case-1 (Cont'd)

	24053.70c	5.5128e-6	24054.70c	1.3724e-6
	25055.70c	4.1191e-5		
	26054.70c	1.1157e-5	26056.70c	1.7344e-4
	26057.70c	3.9711e-6	26058.70c	5.2948e-7
	29063.70c	4.1054e-5	29065.70c	1.8299e-5
c	Water with 1511 PPM			
m3	1001.70c	6.6737e-2		
	8016.70c	3.3356e-2	8017.70c	1.3348e-5
	5010.70c	1.6769e-5	5011.70c	6.7497e-5
mt3	lwtr.10t			
totnu				
end of input				

Table A-77. Input file for leu-comp-therm-008-case-2

```

B&W Criticals Core XI Load 2 1335.5 PPM LEU-COMP-THERM-008 case 2
c Axially uniform quadrant
1 1 0.068525 -18 u=1 $ Fuel Pin
2 2 0.055323 18 -19 u=1 $ Cladding
3 3 0.10018 19 u=1 $ Water
4 0 20 -21 22 -23 u=2 lat=1 fill=1 $ Pin Cell
c 15x15 Assembly Lattice
5 3 0.10018 -21 20 -23 22 u=3 lat=1
fill=-7:7 -7:7 0:0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 3 1 1 1 3 1 1 1 1 1
1 1 1 3 1 1 1 1 1 1 1 3 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 3 1 1 3 1 1 1 3 1 1 3 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 3 1 1 3 1 1 1 3 1 1 3 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 3 1 1 1 1 1 1 1 3 1 1 1
1 1 1 1 1 3 1 1 1 3 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
6 0 24 -25 26 -27 u=4 lat=1 fill=3 $ Assemblies
7 0 1 -2 3 4 -8 -14 fill=4 $ Inner Core
8 0 1 -2 3 8 -11 -12 fill=2 $ Buffer Zone
9 0 1 -2 8 -10 12 -13 fill=2 $ Buffer Zone
10 0 1 -2 8 -9 13 -14 fill=2 $ Buffer Zone
11 0 1 -2 4 -9 14 -15 fill=2 $ Buffer Zone
12 0 1 -2 4 -7 15 -16 fill=2 $ Buffer Zone
13 0 1 -2 4 -6 16 -17 fill=2 $ Buffer Zone
14 3 0.10018 1 -2 3 -5 11 $ Reflector
15 3 0.10018 1 -2 -5 10 -11 12 $ Reflector
16 3 0.10018 1 -2 -5 9 -10 13 $ Reflector
17 3 0.10018 1 -2 -5 7 -9 15 $ Reflector
18 3 0.10018 1 -2 -5 6 -7 16 $ Reflector
19 3 0.10018 1 -2 4 -5 -6 17 $ Reflector
20 0 -1:2:-3:-4:5

c Problem Boundaries
1 pz -81.662 $ Bottom
2 pz 81.662 $ Top
*3 py 0.0 $ Front Edge
*4 px 0.0 $ Left Edge
5 cz 76.200 $ Tank IR
c Interior Boundaries
6 px 17.17540 $ Buffer
7 px 33.53300 $ Buffer
8 px 36.80460 $ Inner Core
9 px 49.89060 $ Buffer
10 px 58.06940 $ Buffer
11 px 66.24820 $ Buffer
12 py 17.17540 $ Buffer
13 py 33.53300 $ Buffer

```

Table A-77. Input file for leu-comp-therm-008-case-2 (Cont'd)

```

14  py      36.80460                $ Inner Core
15  py      49.89060                $ Buffer
16  py      58.06940                $ Buffer
17  py      66.24820                $ Buffer
c    Pin Cell Boundaries
18  cz      0.514858                $ Pellet OR
19  cz      0.602996                $ Cladding OR
20  px      -0.81788                $ Left Edge
21  px      0.81788                 $ Right Edge
22  py      -0.81788                $ Front Edge
23  py      0.81788                 $ Back Edge
c    Assembly Boundaries
24  px      -12.26820               $ Left Edge
25  px      12.26820                $ Right Edge
26  py      -12.26820               $ Front Edge
27  py      12.26820                $ Back Edge

mode      n
kcode    10000    1.0    100    600
imp:n    1.0    18r    0.0
sdef     x=d1    y=d2    z=d3
si1      0.1      49.8
sp1      0        1
si2      0.1      49.8
sp2      0        1
si3      -81.6    81.6
sp3      0        1
c        Fuel (2.459 w/o with B-10 for impurities)
m1       5010.70c  2.6055e-7
          8016.70c  4.5665e-2      8017.70c  1.8273e-5
          92234.70c 4.5689e-6      92235.70c 5.6868e-4
          92238.70c 2.2268e-2
c        Aluminum 6061 cladding
c m2     12000.62c 6.2072e-4                $ ENDF/B-VI
m2       12024.70c 4.9031e-4      12025.70c 6.2072e-5    $
ENDF/B-VII.0
          12026.70c 6.8341e-5                $
ENDF/B-VII.0
          13027.70c 5.3985e-2
          14028.70c 2.9726e-4      14029.70c 1.5051e-5
          14030.70c 9.9130e-6
c        22000.62c 4.7263e-5                $ ENDF/B-VI
          22046.70c 3.8992e-6      22047.70c 3.5164e-6    $
ENDF/B-VII.0
          22048.70c 3.4842e-5      22049.70c 2.5569e-6    $
ENDF/B-VII.0
          22050.70c 2.4482e-6                $
ENDF/B-VII.0
          24050.70c 2.5214e-6      24052.70c 4.8622e-5
          24053.70c 5.5128e-6      24054.70c 1.3724e-6
          25055.70c 4.1191e-5
          26054.70c 1.1157e-5      26056.70c 1.7344e-4
          26057.70c 3.9711e-6      26058.70c 5.2948e-7
          29063.70c 4.1054e-5      29065.70c 1.8299e-5
c        Water with 1335.5 PPM

```

Table A-77. Input file for leu-comp-therm-008-case-2 (Cont'd)

m3	1001.70c	6.6737e-2		
	8016.70c	3.3356e-2	8017.70c	1.3348e-5
	5010.70c	1.4821e-5	5011.70c	5.9657e-5
mt3	lwtr.10t			
totnu				
end of input				

Table A-78. Input file for leu-comp-therm-008-case-5

```

B&W Criticals Core XI Load 5 1182 PPM LEU-COMP-THERM-008 case 5
c Axially Uniform Quadrant
1 1 0.068525 -18 u=1 $ Fuel Pin
2 2 0.055323 18 -19 u=1 $ Cladding
3 3 0.10017 19 u=1 $ Water
4 4 0.070780 -24 u=2 $ Pyrex Rod
5 3 0.10017 24 u=2 $ Water
6 0 20 -21 22 -23 u=3 lat=1 fill=1 $ Pin Cell
c 15x15 Assembly Lattice
7 3 0.10017 -21 20 -23 22 u=4 lat=1
fill=-7:7 -7:7 0:0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 4 1 1 1 4 1 1 1 1 1
1 1 1 2 1 1 1 1 1 1 1 2 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 4 1 1 4 1 1 1 4 1 1 4 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 4 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 4 1 1 4 1 1 1 4 1 1 4 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 2 1 1 1 1 1 1 1 2 1 1 1
1 1 1 1 1 4 1 1 1 4 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
8 0 25 -26 27 -28 u=5 lat=1 fill=4 $ Assemblies
9 0 1 -2 3 4 -8 -14 fill=5 $ Inner Core
10 0 1 -2 3 8 -11 -12 fill=3 $ Buffer Zone
11 0 1 -2 8 -10 12 -13 fill=3 $ Buffer Zone
12 0 1 -2 8 -9 13 -14 fill=3 $ Buffer Zone
13 0 1 -2 4 -9 14 -15 fill=3 $ Buffer Zone
14 0 1 -2 4 -7 15 -16 fill=3 $ Buffer Zone
15 0 1 -2 4 -6 16 -17 fill=3 $ Buffer Zone
16 3 0.10017 1 -2 3 -5 11 $ Reflector
17 3 0.10017 1 -2 -5 10 -11 12 $ Reflector
18 3 0.10017 1 -2 -5 9 -10 13 $ Reflector
19 3 0.10017 1 -2 -5 7 -9 15 $ Reflector
20 3 0.10017 1 -2 -5 6 -7 16 $ Reflector
21 3 0.10017 1 -2 4 -5 -6 17 $ Reflector
22 0 -1:2:-3:-4:5

c Problem Boundaries
1 pz -81.662 $ Bottom
2 pz 81.662 $ Top
*3 py 0.0 $ Front Edge
*4 px 0.0 $ Left Edge
5 cz 76.200 $ Tank IR
c Interior Boundaries
6 px 17.17540 $ Buffer
7 px 33.53300 $ Buffer
8 px 36.80460 $ Inner Core
9 px 49.89060 $ Buffer
10 px 58.06940 $ Buffer
11 px 66.24820 $ Buffer

```



Table A-78. Input file for leu-comp-therm-008-case-5 (Cont'd)

```

12  py      17.17540                $ Buffer
13  py      33.53300                $ Buffer
14  py      36.80460                $ Inner Core
15  py      49.89060                $ Buffer
16  py      58.06940                $ Buffer
17  py      66.24820                $ Buffer
c    Pin Cell Boundaries
18  cz      0.514858                $ Pellet OR
19  cz      0.602996                $ Cladding OR
20  px      -0.81788                $ Left Edge
21  px      0.81788                 $ Right Edge
22  py      -0.81788                $ Front Edge
23  py      0.81788                 $ Back Edge
c    Pyrex Rod Boundaries
24  cz      0.58500                 $ Pyrex Rod OR
c    Assembly Boundaries
25  px      -12.26820               $ Left Edge
26  px      12.26820                $ Right Edge
27  py      -12.26820               $ Front Edge
28  py      12.26820                $ Back Edge

mode      n
kcode     10000    1.0    100    600
imp:n     1.0    20r    0.0
sdef      x=d1    y=d2    z=d3
si1       0.1     49.8
sp1       0       1
si2       0.1     49.8
sp2       0       1
si3       -81.6   81.6
sp3       0       1
c          Fuel (2.459 w/o with B-10 for impurities)
m1         5010.70c  2.6055e-7
           8016.70c  4.5665e-2
           92234.70c 4.5689e-6      8017.70c  1.8273e-5
           92238.70c 2.2268e-2      92235.70c  5.6868e-4
c          Aluminum 6061 cladding
c m2       12000.62c  6.2072e-4                $ ENDF/B-VI
m2         12024.70c  4.9031e-4      12025.70c  6.2072e-5  $ ENDF/B-VII.0
           12026.70c  6.8341e-5
           13027.70c  5.3985e-2
           14028.70c  2.9726e-4      14029.70c  1.5051e-5
           14030.70c  9.9130e-6
c          22000.62c  4.7263e-6                $ ENDF/B-VI
           22046.70c  3.7810e-6      22047.70c  3.4502e-6  $ ENDF/B-VII.0
           22048.70c  3.4880e-5      22049.70c  2.5995e-6  $ ENDF/B-VII.0
           22050.70c  2.5522e-6                $ ENDF/B-VII.0
           24050.70c  2.5214e-6      24052.70c  4.8622e-5
           24053.70c  5.5128e-6      24054.70c  1.3724e-6
           25055.70c  4.1191e-5
           26054.70c  1.1157e-5      26056.70c  1.7344e-4
           26057.70c  3.9711e-6      26058.70c  5.2948e-7
           29063.70c  4.1054e-5      29065.70c  1.8299e-5
c          Water with 1032.5 PPM
m3         1001.70c  6.6737e-2

```

Table A-78. Input file for leu-comp-therm-008-case-5 (Cont'd)

	8016.70c	3.3356e-2	8017.70c	1.3348e-5
	5010.70c	1.3118e-5	5011.70c	5.2800e-5
mt3	lwtr.10t			
c	Pyrex			
m4	5010.70c	9.7491e-4	5011.70c	3.9241e-3
	8016.70c	4.4811e-2	8017.70c	1.7932e-5
	11023.70c	1.7444e-3		
	13027.70c	1.0018e-3		
	14028.70c	1.6884e-2	14029.70c	8.5489e-4
	14030.70c	5.6749e-4		
totnu				
	end of input			

Table A-79. Input file for leu-comp-therm-008-case-7

```

B&W Criticals Core XI Load 7 1032.5 PPM LEU-COMP-THERM-008 case 7
c Axially Uniform Quadrant
1 1 0.068525 -18 u=1 $ Fuel Pin
2 2 0.055323 18 -19 u=1 $ Cladding
3 3 0.10016 19 u=1 $ Water
4 4 0.070780 -24 u=2 $ Pyrex Rod
5 3 0.10016 24 u=2 $ Water
6 0 20 -21 22 -23 u=3 lat=1 fill=1 $ Pin Cell
c 15x15 Assembly Lattice
7 3 0.10016 -21 20 -23 22 u=4 lat=1
fill=-7:7 -7:7 0:0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 2 1 1 1 2 1 1 1 1 1
1 1 1 4 1 1 1 1 1 1 4 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 1 1 4 1 1 1 4 1 1 2 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 4 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 1 1 4 1 1 1 4 1 1 2 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 4 1 1 1 1 1 1 4 1 1 1 1
1 1 1 1 1 2 1 1 1 2 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
8 0 25 -26 27 -28 u=5 lat=1 fill=4 $ Assemblies
9 0 1 -2 3 4 -8 -14 fill=5 $ Inner Core
10 0 1 -2 3 8 -11 -12 fill=3 $ Buffer Zone
11 0 1 -2 8 -10 12 -13 fill=3 $ Buffer Zone
12 0 1 -2 8 -9 13 -14 fill=3 $ Buffer Zone
13 0 1 -2 4 -9 14 -15 fill=3 $ Buffer Zone
14 0 1 -2 4 -7 15 -16 fill=3 $ Buffer Zone
15 0 1 -2 4 -6 16 -17 fill=3 $ Buffer Zone
16 3 0.10016 1 -2 3 -5 11 $ Reflector
17 3 0.10016 1 -2 -5 10 -11 12 $ Reflector
18 3 0.10016 1 -2 -5 9 -10 13 $ Reflector
19 3 0.10016 1 -2 -5 7 -9 15 $ Reflector
20 3 0.10016 1 -2 -5 6 -7 16 $ Reflector
21 3 0.10016 1 -2 4 -5 -6 17 $ Reflector
22 0 -1:2:-3:-4:5

c Problem Boundaries
1 pz -81.662 $ Bottom
2 pz 81.662 $ Top
*3 py 0.0 $ Front Edge
*4 px 0.0 $ Left Edge
5 cz 76.200 $ Tank IR
c Interior Boundaries
6 px 17.17540 $ Buffer
7 px 33.53300 $ Buffer
8 px 36.80460 $ Inner Core
9 px 49.89060 $ Buffer
10 px 58.06940 $ Buffer
11 px 66.24820 $ Buffer

```

Table A-79. Input file for leu-comp-therm-008-case-7 (Cont'd)

```

12  py      17.17540                $ Buffer
13  py      33.53300                $ Buffer
14  py      36.80460                $ Inner Core
15  py      49.89060                $ Buffer
16  py      58.06940                $ Buffer
17  py      66.24820                $ Buffer
c   Pin Cell Boundaries
18  cz      0.514858                $ Pellet OR
19  cz      0.602996                $ Cladding OR
20  px      -0.81788                $ Left Edge
21  px      0.81788                 $ Right Edge
22  py      -0.81788                $ Front Edge
23  py      0.81788                 $ Back Edge
c   Pyrex Rod Boundaries
24  cz      0.58500                 $ Pyrex Rod OR
c   Assembly Boundaries
25  px      -12.26820               $ Left Edge
26  px      12.26820                $ Right Edge
27  py      -12.26820               $ Front Edge
28  py      12.26820                $ Back Edge

mode      n
kcode     10000    1.0    100    600
imp:n     1.0    20r    0.0
sdef      x=d1    y=d2    z=d3
si1       0.1     49.8
sp1       0       1
si2       0.1     49.8
sp2       0       1
si3       -81.6   81.6
sp3       0       1
c         Fuel (2.459 w/o with B-10 for impurities)
m1        5010.70c  2.6055e-7
          8016.70c  4.5665e-2
          92234.70c 4.5689e-6      8017.70c  1.8273e-5
          92238.70c 2.2268e-2      92235.70c  5.6868e-4
c         Aluminum 6061 cladding
c m2      12000.62c  6.2072e-4                $ ENDF/B-VI
m2        12024.70c  4.9031e-4      12025.70c  6.2072e-5  $ ENDF/B-VII.0
          12026.70c  6.8341e-5                $ ENDF/B-VII.0
          13027.70c  5.3985e-2
          14028.70c  2.9726e-4      14029.70c  1.5051e-5
          14030.70c  9.9130e-6
c         22000.62c  4.7263e-6                $ ENDF/B-VI
          22046.70c  3.7810e-6      22047.70c  3.4502e-6  $ ENDF/B-VII.0
          22048.70c  3.4880e-5      22049.70c  2.5995e-6  $ ENDF/B-VII.0
          22050.70c  2.5522e-6                $ ENDF/B-VII.0
          24050.70c  2.5214e-6      24052.70c  4.8622e-5
          24053.70c  5.5128e-6      24054.70c  1.3724e-6
          25055.70c  4.1191e-5
          26054.70c  1.1157e-5      26056.70c  1.7344e-4
          26057.70c  3.9711e-6      26058.70c  5.2948e-7
          29063.70c  4.1054e-5      29065.70c  1.8299e-5
c         Water with 1032.5 PPM
m3        1001.70c  6.6737e-2

```

Table A-79. Input file for leu-comp-therm-008-case-7 (Cont'd)

	8016.70c	3.3356e-2	8017.70c	1.3348e-5
5010.70c	1.1459e-5		5011.70c	4.6122e-5
mt3	lwtr.10t			
c	Pyrex			
m4	5010.70c	9.7491e-4	5011.70c	3.9241e-3
	8016.70c	4.4811e-2	8017.70c	1.7932e-5
	11023.70c	1.7444e-3		
	13027.70c	1.0018e-3		
	14028.70c	1.6884e-2	14029.70c	8.5489e-4
	14030.70c	5.6749e-4		
totnu				
end of input				

Table A-80. Input file for leu-comp-therm-008-case-8

```

B&W Criticals Core XI Load 8 794 PPM LEU-COMP-THERM-008 case 8
c Axially Uniform Quadrant
1 1 0.068525 -18 u=1 $ Fuel Pin
2 2 0.055323 18 -19 u=1 $ Cladding
3 3 0.10015 19 u=1 $ Water
4 4 0.070780 -24 u=2 $ Pyrex Rod
5 3 0.10015 24 u=2 $ Water
6 0 20 -21 22 -23 u=3 lat=1 fill=1 $ Pin Cell
c 15x15 Assembly Lattice
7 3 0.10015 -21 20 -23 22 u=4 lat=1
fill=-7:7 -7:7 0:0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 2 1 1 1 2 1 1 1 1 1
1 1 1 2 1 1 1 1 1 1 1 2 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 1 1 2 1 1 1 2 1 1 2 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 4 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 1 1 2 1 1 1 2 1 1 2 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 2 1 1 1 1 1 1 1 2 1 1 1
1 1 1 1 1 2 1 1 1 2 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
8 0 25 -26 27 -28 u=5 lat=1 fill=4 $ Assemblies
9 0 1 -2 3 4 -8 -14 fill=5 $ Inner Core
10 0 1 -2 3 8 -11 -12 fill=3 $ Buffer Zone
11 0 1 -2 8 -10 12 -13 fill=3 $ Buffer Zone
12 0 1 -2 8 -9 13 -14 fill=3 $ Buffer Zone
13 0 1 -2 4 -9 14 -15 fill=3 $ Buffer Zone
14 0 1 -2 4 -7 15 -16 fill=3 $ Buffer Zone
15 0 1 -2 4 -6 16 -17 fill=3 $ Buffer Zone
16 3 0.10015 1 -2 3 -5 11 $ Reflector
17 3 0.10015 1 -2 -5 10 -11 12 $ Reflector
18 3 0.10015 1 -2 -5 9 -10 13 $ Reflector
19 3 0.10015 1 -2 -5 7 -9 15 $ Reflector
20 3 0.10015 1 -2 -5 6 -7 16 $ Reflector
21 3 0.10015 1 -2 4 -5 -6 17 $ Reflector
22 0 -1:2:-3:-4:5

c Problem Boundaries
1 pz -81.662 $ Bottom
2 pz 81.662 $ Top
*3 py 0.0 $ Front Edge
*4 px 0.0 $ Left Edge
5 cz 76.200 $ Tank IR
c Interior Boundaries
6 px 17.17540 $ Buffer
7 px 33.53300 $ Buffer
8 px 36.80460 $ Inner Core
9 px 49.89060 $ Buffer
10 px 58.06940 $ Buffer
11 px 66.24820 $ Buffer

```

Table A-80. Input file for leu-comp-therm-008-case-8 (Cont'd)

```

12  py      17.17540                                $ Buffer
13  py      33.53300                                $ Buffer
14  py      36.80460                                $ Inner Core
15  py      49.89060                                $ Buffer
16  py      58.06940                                $ Buffer
17  py      66.24820                                $ Buffer
c    Pin Cell Boundaries
18  cz      0.514858                                $ Pellet OR
19  cz      0.602996                                $ Cladding OR
20  px      -0.81788                                $ Left Edge
21  px      0.81788                                 $ Right Edge
22  py      -0.81788                                $ Front Edge
23  py      0.81788                                 $ Back Edge
c    Pyrex Rod Boundaries
24  cz      0.58500                                 $ Pyrex Rod OR
c    Assembly Boundaries
25  px      -12.26820                                $ Left Edge
26  px      12.26820                                 $ Right Edge
27  py      -12.26820                                $ Front Edge
28  py      12.26820                                 $ Back Edge

mode      n
kcode    10000   1.0   100   600
imp:n    1.0  20r  0.0
sdef     x=d1  y=d2  z=d3
si1      0.1    49.8
sp1      0      1
si2      0.1    49.8
sp2      0      1
si3     -81.6   81.6
sp3      0      1
c        Fuel (2.459 w/o with B-10 for impurities)
m1       5010.70c  2.6055e-7
         8016.70c  4.5665e-2
         92234.70c 4.5689e-6      8017.70c  1.8273e-5
         92238.70c 2.2268e-2      92235.70c  5.6868e-4
c        Aluminum 6061 cladding
c m2     12000.62c 6.2072e-4                                $ ENDF/B-VI
m2       12024.70c 4.9031e-4                                $ ENDF/B-VII.0
         12026.70c 6.8341e-5                                $ ENDF/B-VII.0
         13027.70c 5.3985e-2
         14028.70c 2.9726e-4                                14029.70c  1.5051e-5
         14030.70c 9.9130e-6
c        22000.62c 4.7263e-6                                $ ENDF/B-VI
         22046.70c 3.7810e-6                                22047.70c  3.4502e-6 $ ENDF/B-VII.0
         22048.70c 3.4880e-5                                22049.70c  2.5995e-6 $ ENDF/B-VII.0
         22050.70c 2.5522e-6                                $ ENDF/B-VII.0
         24050.70c 2.5214e-6                                24052.70c  4.8622e-5
         24053.70c 5.5128e-6                                24054.70c  1.3724e-6
         25055.70c 4.1191e-5
         26054.70c 1.1157e-5                                26056.70c  1.7344e-4
         26057.70c 3.9711e-6                                26058.70c  5.2948e-7
         29063.70c 4.1054e-5                                29065.70c  1.8299e-5
c        Water with 794 PPM
m3       1001.   6.6737e-2

```

Table A-80. Input file for leu-comp-therm-008-case-8 (Cont'd)

	8016.	3.3356e-2	8017.70c	1.3348e-5
	5010.	8.8117e-6	5011.70c	3.5468e-5
mt3	lwtr.10t			
c	Pyrex			
m4	5010.70c	9.7491e-4	5011.70c	3.9241e-3
	8016.70c	4.4811e-2	8017.70c	1.7932e-5
	11023.70c	1.7444e-3		
	13027.70c	1.0018e-3		
	14028.70c	1.6884e-2	14029.70c	8.5489e-4
	14030.70c	5.6749e-4		
totnu				
	end of input			



Table A-81. Input file for leu-comp-therm-008-case-11

```

B&W Criticals Core XI Load 11 1384 PPM LEU-COMP-THERM-008 case 11
c Axially uniform quadrant
1 1 0.068525 -18 u=1 $ Fuel Pin
2 2 0.055323 18 -19 u=1 $ Cladding
3 3 0.10018 19 u=1 $ Water
4 4 0.038393 -24 u=2 $ Al2O3 Rod
5 5 0.058854 24 -25 u=2 $ Al2O3 Cladding
6 3 0.10018 25 u=2 $ Water
7 0 20 -21 22 -23 u=3 lat=1 fill=1 $ Fuel Pin Cell
c 15x15 Assembly Lattice
8 3 0.10018 -21 20 -23 22 u=4 lat=1
fill=-7:7 -7:7 0:0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 2 1 1 1 2 1 1 1 1 1
1 1 1 2 1 1 1 1 1 1 1 2 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 1 1 2 1 1 1 2 1 1 2 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 4 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 2 1 1 2 1 1 1 2 1 1 2 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 2 1 1 1 1 1 2 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
9 0 26 -27 28 -29 u=5 lat=1 fill=4 $ Assemblies
10 0 1 -2 3 4 -8 -14 fill=5 $ Inner Core
11 0 1 -2 3 8 -11 -12 fill=3 $ Buffer Zone
12 0 1 -2 8 -10 12 -13 fill=3 $ Buffer Zone
13 0 1 -2 8 -9 13 -14 fill=3 $ Buffer Zone
14 0 1 -2 4 -9 14 -15 fill=3 $ Buffer Zone
15 0 1 -2 4 -7 15 -16 fill=3 $ Buffer Zone
16 0 1 -2 4 -6 16 -17 fill=3 $ Buffer Zone
17 3 0.10018 1 -2 3 -5 11 $ Reflector
18 3 0.10018 1 -2 -5 10 -11 12 $ Reflector
19 3 0.10018 1 -2 -5 9 -10 13 $ Reflector
20 3 0.10018 1 -2 -5 7 -9 15 $ Reflector
21 3 0.10018 1 -2 -5 6 -7 16 $ Reflector
22 3 0.10018 1 -2 4 -5 -6 17 $ Reflector
23 0 -1:2:-3:-4:5

c Problem Boundaries
1 pz -81.662 $ Bottom
2 pz 81.662 $ Top
*3 py 0.0 $ Front Edge
*4 px 0.0 $ Left Edge
5 cz 76.200 $ Tank IR
c Interior Boundaries
6 px 17.17540 $ Buffer
7 px 33.53300 $ Buffer
8 px 36.80460 $ Inner Core
9 px 49.89060 $ Buffer
10 px 58.06940 $ Buffer

```

Table A-81. Input file for leu-comp-therm-008-case-11 (Cont'd)

```

11  px      66.24820                $ Buffer
12  py      17.17540                $ Buffer
13  py      33.53300                $ Buffer
14  py      36.80460                $ Inner Core
15  py      49.89060                $ Buffer
16  py      58.06940                $ Buffer
17  py      66.24820                $ Buffer
c   Pin Cell Boundaries
18  cz      0.514858                $ Pellet OR
19  cz      0.602996                $ Cladding OR
20  px      -0.81788                $ Left Edge
21  px      0.81788                 $ Right Edge
22  py      -0.81788                $ Front Edge
23  py      0.81788                 $ Back Edge
c   Pyrex Rod Boundaries
24  cz      0.46650                 $ Al2O3 Rod OD
25  cz      0.55550                 $ Al2O3 Clad OD
c   Assembly Boundaries
26  px      -12.26820               $ Left Edge
27  px      12.26820                $ Right Edge
28  py      -12.26820               $ Front Edge
29  py      12.26820                $ Back Edge

mode      n
kcode     10000    1.0    100    600
imp:n     1.0    21r    0.0
sdef      x=d1    y=d2    z=d3
si1       0.1      49.8
sp1       0        1
si2       0.1      49.8
sp2       0        1
si3      -81.6     81.6
sp3       0        1
c         Fuel (2.459 w/o with B-10 for impurities)
m1        5010.70c  2.6055e-7
          8016.70c  4.5665e-2      8017.70c  1.8273e-5
          92234.70c 4.5689e-6      92235.70c 5.6868e-4
          92238.70c 2.2268e-2
c         Aluminum 6061 cladding
c m2      12000.62c  6.2072e-4                $ ENDF/B-VI
m2        12024.70c 4.9031e-4      12025.70c 6.2072e-5  $ ENDF/B-VII.0
          12026.70c 6.8341e-5                $ ENDF/B-VII.0
          13027.70c 5.3985e-2
          14028.70c 2.9726e-4      14029.70c 1.5051e-5
          14030.70c 9.9130e-6
c         22000.62c  4.7263e-5                $ ENDF/B-VI
          22046.70c 3.8992e-6      22047.70c 3.5164e-6  $ ENDF/B-VII.0
          22048.70c 3.4842e-5      22049.70c 2.5569e-6  $ ENDF/B-VII.0
          22050.70c 2.4482e-6                $ ENDF/B-VII.0
          24050.70c 2.5214e-6      24052.70c 4.8622e-5
          24053.70c 5.5128e-6      24054.70c 1.3724e-6
          25055.70c 4.1191e-5
          26054.70c 1.1157e-5      26056.70c 1.7344e-4
          26057.70c 3.9711e-6      26058.70c 5.2948e-7
          29063.70c 4.1054e-5      29065.70c 1.8299e-5

```

Table A-81. Input file for leu-comp-therm-008-case-11 (Cont'd)

```

c      Water with 1384 PPM
m3    1001.70c  6.6737e-2
      8016.70c  3.3356e-2      8017.70c  1.3348e-5
      5010.70c  1.5359e-5      5011.70c  6.1824e-5
mt3   lwtr.10t
c     Pyrex
c     Al2O3
m4    8016.70c  2.3027e-2      8017.70c  9.2144e-6
      13027.70c 1.5357e-2
c     Aluminum 6061 cladding for Al2O3 Pins
c m5  12000.62c 1.0035e-4      $ ENDF/B-VI
m5    12024.70c 7.9266e-5      12025.70c 1.0035e-5  $ ENDF/B-VII.0
      12026.70c 1.1049e-5      $ ENDF/B-VII.0
      13027.70c 5.8183e-2
      14028.70c 1.3348e-4      14029.70c 6.7589e-6
      14030.70c 4.4866e-6
c     22000.62c 5.0939e-5      $ ENDF/B-VI
      22046.70c 4.2025e-6      22047.70c 3.7899e-6  $ ENDF/B-VII.0
      22048.70c 3.7552e-5      22049.70c 2.7558e-6  $ ENDF/B-VII.0
      22050.70c 2.6386e-6      $ ENDF/B-VII.0
      24050.70c 2.7174e-6      24052.70c 5.2404e-5
      24053.70c 5.9415e-6      24054.70c 1.4791e-6
      25055.70c 4.4395e-5
      26054.70c 1.2024e-5      26056.70c 1.8693e-4
      26057.70c 4.2798e-6      26058.70c 5.7064e-7
      29063.70c 4.4247e-5      29065.70c 1.9721e-5

totnu

end of input

```

Table A-82. Input file for leu-sol-therm-002-case-1

```

Sphere of 4.9 wt.% UO2F2-H2O reflected by Water LEU-SOL-THERM-002 Case 1
1 1 0.099063 -1 $ UO2F2D2O Solution
2 2 0.060317 1 -2 $ Aluminum 1100 Shell
3 3 0.099988 2 -3 $ Water Reflector
4 0 3

1 so 34.3990 $ OR of Solution
2 so 34.5578 $ OR of Shell
3 so 49.5578 $ OR of Reflector

mode n
totnu
kcode 10000 1.0 100 600
imp:n 1 1 1 0
sdef cel=1 erg=d1
spl -3
c Uranyl Fluoride in Water 4.9 wt.% Enriched
m1 1001.70c 6.2226e-2
8016.70c 3.3389e-2 8017.70c 1.3361e-5
9019.70c 2.2893e-3
92234.70c 2.3271e-7 92235.70c 5.6655e-5
92238.70c 1.0878e-3
c 1100 Aluminum
m2 13027.70c 5.9699e-2
14028.70c 5.0913e-4 14029.70c 2.5779e-5
14030.70c 1.7113e-5
25055.70c 1.4853e-5
29063.70c 3.5528e-5 29065.70c 1.5836e-5
c Water
m3 1001.70c 6.6659e-2
8016.70c 3.3316e-2 8017.70c 1.3332e-5
mt1 lwtr.10t
mt3 lwtr.10t

end of input

```

Table A-83. Input file for leu-comp-therm-002-case-2

```

Bare Sphere of 4.9 wt.% UO2F2-H2O  LEU-SOL-THERM-002  Case 2
1  1  0.098748  -1  $ UO2F2D2O Solution
2  2  0.060317  1  -2  $ Aluminum 1100 Shell
3  0  2

1  so  34.4995  $ OR of Solution
2  so  34.6583  $ OR of Shell

mode n
totnu
kcode  10000  1.0  100  600
imp:n  1  1  0
sdef  cel=1  erg=d1
spl  -3
c  Uranyl Fluoride in Water  4.9 wt.% Enriched
m1  1001.70c  6.1683e-2
    8016.70c  3.3318e-2  8017.70c  1.3332e-5
    9019.70c  2.4893e-3
    92234.70c  2.5304e-7  92235.70c  6.1604e-5
    92238.70c  1.1828e-3
c  1100 Aluminum
m2  13027.70c  5.9699e-2
    14028.70c  5.0913e-4  14029.70c  2.5779e-5
    14030.70c  1.7113e-5
    25055.70c  1.4853e-5
    29063.70c  3.5528e-5  29065.70c  1.5836e-5
mt1  lwtr.10t

end of input

```

## A.5 Plutonium Input Files

The input files for the plutonium benchmarks are given in Tables A-84 through A-119.

Table A-84. Input file for pu-met-fast-001

```

Jezebel PU-MET-FAST-001 bare solid Pu sphere
1 1 0.040290 -1 $ Pu Sphere
2 0 1

1 so 6.3849

kcode 10000 1.0 100 600
imp:n 1.0 0.0
sdef cel=1 erg=d1
spl -3
vol 1090.31 0.0
area 512.29
totnu
c m1 31000.66c 1.3752e-3 $ ENDF/B-VI
m1 31069.70c 8.2663e-4 31071.70c 5.4857e-4 $
ENDF/B-VII.0
94239.70c 3.7047e-2 94240.70c 1.7512e-3
94241.70c 1.1674e-4

end of input

```

Table A-85. Input file for pu-met-fast-002

```

Jezebel-240 PU-MET-FAST-002 Bare Pu sphere 20.1 a/o Pu-240
1 1 0.040553 -1 $ Pu Sphere
2 0 1

1 so 6.6595

kcode 10000 1.0 100 600
imp:n 1.0 0.0
sdef cel=1 erg=d1
spl -3
vol 1237.12 0.0
area 557.31
totnu
c m1 31000.66c 1.3722e-3 $ ENDF/B-VI
m1 31069.70c 8.2483e-4 31071.70c 5.4737e-4 $
ENDF/B-VII.0
94239.70c 2.9934e-2 94240.70c 7.8754e-3
94241.70c 1.2146e-3 94242.70c 1.5672e-4

end of input

```

Table A-86. Input file for pu-met-fast-003-case-103

```

PU-MET-FAST-003 Case 103 3x3x3 Array of Pu Buttons
1 3 0.0058945 1 -2 3 -4 5 -6 $ table support
2 2 0.053031 1 -2 3 -4 6 -7 $ table top
c universe 1: Tube with Plutonium Buttons and Spacers
3 4 0.037051 -8 -32 u=1 $ shoe
4 0 8 -9 -28 u=1 $ bottom spacer
void
5 2 0.060263 8 -9 28 -29 u=1 $ bottom spacer
6 0 8 -9 29 -32 u=1 $ bottom spacer gap
7 0 26 -32 u=1 $ void above sink
8 2 0.060263 32 u=1 $ tube
c Bottom Plutonium Button
9 2 0.028861 9 -10 -31 u=1 $ bottom heat sink
10 3 0.084122 10 -11 -31 u=1 $ steel lid
11 1 0.049163 11 -12 -30 u=1 $ plutonium button
12 2 0.060263 11 -12 30 -31 u=1 $ aluminum shell
13 2 0.060263 12 -13 -31 u=1 $ aluminum bottom
14 2 0.036744 13 -14 -31 u=1 $ top heat sink
15 0 9 -14 31 -32 u=1 $ gap
c Region between Bottom and Middle Buttons
16 0 14 -15 -28 u=1 $ inner spacer void
17 2 0.060263 14 -15 28 -29 u=1 $ spacer
18 0 14 -15 29 -32 u=1 $ outer spacer void
c Middle Plutonium Button
19 2 0.028861 15 -16 -31 u=1 $ bottom heat sink
20 3 0.084122 16 -17 -31 u=1 $ steel lid
21 1 0.049163 17 -18 -30 u=1 $ plutonium button
22 2 0.060263 17 -18 30 -31 u=1 $ aluminum shell
23 2 0.060263 18 -19 -31 u=1 $ aluminum bottom
24 2 0.036744 19 -20 -31 u=1 $ top heat sink
25 0 15 -20 31 -32 u=1 $ gap
c Region between Middle and Top Buttons
26 0 20 -21 -28 u=1 $ inner spacer void
27 2 0.060263 20 -21 28 -29 u=1 $ spacer
28 0 20 -21 29 -32 u=1 $ outer spacer void
c Top Plutonium Button
29 2 0.028861 21 -22 -31 u=1 $ bottom heat sink
30 3 0.084122 22 -23 -31 u=1 $ steel lid
31 1 0.049163 23 -24 -30 u=1 $ plutonium button
32 2 0.060263 23 -24 30 -31 u=1 $ aluminum shell
33 2 0.060263 24 -25 -31 u=1 $ aluminum bottom
34 2 0.036744 25 -26 -31 u=1 $ top heat sink
35 0 21 -26 31 -32 u=1 $ gap
c 3 x 3 x 3 Array
36 0 -33 u=2 fill=1 $ X + Y + tube
37 like 36 but trcl=( 0.0 9.60 0.0) $ X + Y - tube
38 like 36 but trcl=( 0.0 -9.60 0.0) $ X - Y + tube
39 like 36 but trcl=( 9.60 0.0 0.0) $ X + Y - tube
40 like 36 but trcl=( 9.60 9.60 0.0) $ X - Y + tube
41 like 36 but trcl=( 9.60 -9.60 0.0) $ X + Y - tube
42 like 36 but trcl=(-9.60 0.0 0.0) $ X + Y - tube
43 like 36 but trcl=(-9.60 9.60 0.0) $ X - Y + tube
44 like 36 but trcl=(-9.60 -9.60 0.0) $ X + Y - tube
45 0 #36 #37 #38 #39 #40 #41
#42 #43 #44 u=2 $ fuel on table

```

Table 86. Input file for pu-met-fast-003-case-103 (Cont'd)

```

46 0          1  -2   3  -4   7  -27      fill=2 $ above table top
c
47 0          -1:2:-3:4:-5:27

1  px  -66.000      $ left edge
2  px   66.000      $ right edge
3  py  -23.000      $ front edge
4  py   23.000      $ back edge
5  pz  -32.540      $ bottom of table support
6  pz   -2.540      $ bottom of table top
7  pz    0.0        $ top of table top
8  pz   8.300       $ top of shoe
9  pz  14.529       $ top of bottom spacer
10 pz  15.164       $ top of bottom heat sink
11 pz  15.185       $ top of steel lid
12 pz  19.818       $ top of bottom button
13 pz  19.905       $ top of aluminum
14 pz  20.384       $ top of top heat sink
15 pz  22.239       $ top of middle spacer
16 pz  22.874       $ top of bottom heat sink
17 pz  22.895       $ top of steel lid
18 pz  27.528       $ top of middle button
19 pz  27.615       $ top of aluminum
20 pz  28.094       $ top of top heat sink
21 pz  29.949       $ top of top spacer
22 pz  30.584       $ top of bottom heat sink
23 pz  30.605       $ top of steel lid
24 pz  35.238       $ top of middle button
25 pz  35.325       $ top of aluminum
26 pz  35.804       $ top of top heat sink
27 pz  45.733       $ top
28 cz   3.1040      $ spacer IR
29 cz   3.3260      $ spacer OR
30 cz   3.2625      $ button OR
31 cz   3.2995      $ heat sink OR
32 cz   3.4250      $ tube IR
33 cz   3.6090      $ tube OR

kcode  10000   1.0  100  600
imp:n  1.0   45r   0.0
mode   n
totnu
ksrc   -9.60  -9.60  17.50   0.0  -9.60  17.50
        9.60  -9.60  17.50  -9.60  0.0  17.50
        0.0   0.0  17.50   9.60  0.0  17.50
       -9.60  9.60  17.50   0.0   9.60  17.50
        9.60  9.60  17.50  -9.60 -9.60  25.21
        0.0  -9.60  25.21   9.60 -9.60  25.21
       -9.60  0.0  25.21   0.0   0.0  25.21
        9.60  0.0  25.21  -9.60  9.60  25.21
        0.0   9.60  25.21   9.60  9.60  25.21
       -9.60 -9.60  32.92   0.0  -9.60  32.92
        9.60 -9.60  32.92  -9.60  0.0  32.92
        0.0   0.0  32.92   9.60  0.0  32.92
       -9.60  9.60  32.92   0.0   9.60  32.92
        9.60  9.60  32.92

```



Table 86. Input file for pu-met-fast-003-cas3-103 (Cont'd)

```

c   Plutonium
m1  94239.70c  4.6010e-2    94240.70c  2.2936e-3
    94241.70c  2.2433e-4    94242.70c  4.8566e-6
c   Aluminum
m2  13027.70c  6.0263e-2
c   Steel
m3  26054.70c  4.9632e-3    26056.70c  7.7157e-2
    26057.70c  1.7666e-3    26058.70c  2.3554e-4
c   Al 2024
m4  13027.70c  2.9260e-2
    26054.70c  4.5968e-4    26056.70c  7.1460e-3
    26057.70c  1.6361e-4    26058.70c  2.1815e-5

end of input

```

Table A-87. Input file for pu-met-fast-005

```

TUNGSTEN REFLECTED PU(4.9) SPHERE [PLANET]: PU-MET-FAST-005
1  1  0.04070346 -1  imp:n=1
2  2  0.06605308 1 -2 imp:n=1
3  0  2          imp:n=0

1  so  5.0419
2  so  9.7409

kcode 10000 1. 100 600
ksrc  0 0 0
totnu
c  print
c  Materials specified with atom densities
m1  94239.70c  3.7291e-2    94240.  1.9277e-3
    94241.70c  1.2196e-4
c  31000.66c  1.3628e-3          $ ENDF/B-VI
    31069.70c  8.1915e-4    31071.70c  5.4365e-4  $ ENDF/B-VII.0
m2  74182.70c  1.3536e-2    74183.70c  7.3496e-3
    74184.70c  1.5801e-2    74186.70c  1.4720e-2
    28058.70c  6.3066e-3    28060.70c  2.5349e-3
    28061.70c  1.0975e-4    28062.70c  3.4868e-4
    28064.70c  8.8383e-5
    29063.70c  2.8203e-3    29065.70c  1.2571e-3
c  40000.66c  7.9528e-4          $ ENDF/B-VI
    40090.70c  4.0917e-4    40091.70c  8.9230e-5  $ ENDF/B-VII.0
    40092.70c  1.3639e-4    40094.70c  1.3822e-4  $ ENDF/B-VII.0
    40096.70c  2.2268e-5          $ ENDF/B-VII.0

```

Table A-88. Input file for pu-met-fast-006

```

PU-MET-FAST-006  FLATTOP-Pu  Pu Sphere Refl by Normal U
1      1      0.038831      -1      $ Pu Sphere
2      2      0.048070      1  -2  $ Normal U Reflector
3      0

```

```

1      so      4.5332
2      so      24.1420

```

```

kcode  10000  1.0  100  600
imp:n   1.0   1.0  0.0
sdef   cel=1  erg=d1
spl    -3
vol    390.21  58549.54  0.0
area   258.24  7324.14
totnu
c      Plutonium (4.8 at.% Pu-240)
c ml   31000.66c  1.4755e-4      $ ENDF/B-VI
m1     31069.70c  8.8692e-5      31071.70c  5.8858e-5  $ ENDF/B-VII.0
       94239.70c  3.6697e-2      94241.70c  1.1639e-4
       94240.70c  1.8700e-3
c      Normal Uranium Reflector
m2     92234.70c  2.6438e-6      92235.70c  3.4610e-4
       92238.70c  4.7721e-2

```

end of input

Table A-89. Input file for pu-met-fast-008-case-2

```

PU-MET-FAST-008  case 2 THOR  Plutonium sphere reflected by thorium
1      1      0.039454      -1      $ Pu Sphere
2      2      0.030054      1  -2  $ Cylindrical Th Reflector
3      0

```

```

1      sph     0.0  0.0  0.0  5.31
2      rcc     0.0  0.0 -26.67  0.0  0.0  53.34  26.67

```

```

kcode  10000  1.0  100  600
imp:n   1.0   1.0  0.0
totnu
sdef   cel=1  erg=d1
spl    -3
vol    627.15  118565.35  0.0
area   354.32  0.0  8938.32  2234.58  2234.58
c      Plutonium (5.1 at.% Pu-240)
c ml   31000.66c  1.4388e-3      $ ENDF/B-VI
m1     31069.70c  8.0175e-4      31071.70c  5.3205e-4  $ ENDF/B-VII.0
       94239.70c  3.6049e-2      94241.70c  1.1459e-4
       94240.70c  1.9562e-3
c      Thorium Reflector
m2     90232.70c  3.0054e-2

```

end of input

Table A-90. Input file for pu-met-fast-009

```

AL(2014) REFLECTED PU(4.9) SPHERE: PU-MET-FAST-009
1  1  0.04101817  -1      imp:n=1
2  2  0.06080142   1 -2    imp:n=1
3  0                      2      imp:n=0

1  so  5.5118
2  so  13.4366

c      Materials specified with atom densities
m1  94239.70c  3.7592e-2      94240.70c  1.9349e-3
    94241.70c  1.1797e-4
c    31000.66c  1.3733e-3                      $ ENDF/B-VI
    31069.70c  8.2546e-4      31071.70c  5.4784e-4  $ ENDF/B-VII.0
m2  13027.70c  5.8787e-2
    29063.70c  8.1337e-4      29065.70c  3.6253e-4
    14028.70c  2.2308e-4      14029.70c  1.1295e-5
    14030.70c  7.4980e-6
    25055.70c  2.4729e-4
c    12000.66c  3.4936e-4                      $ ENDF/B-VI
    12024.70c  2.7596e-4      12025.70c  3.4936e-5  $ ENDF/B-VII.0
    12026.70c  3.8465e-5                      $ ENDF/B-VII.0
kcode 10000  1.  100  600
ksrc  0 0 0

```

Table A-91. Input file for pu-met-fast-010

```

PU-MET-FAST-010: Pu sphere reflected by normal uranium
1  1  -15.778  -1      imp:n=1
2  2  -18.92  1 -2    imp:n=1
3  0  2                      imp:n=0

1  so  5.0419
2  so  9.1694

mode  n
ksrc  0 0 0
kcode 10000  1.  100  600
totnu
c      Materials specified with atom densities
m1  94239.70c  3.7291e-2      94240.70c  1.9277e-3
    94241.70c  1.2196e-4
c    31000.66c  1.3628e-3                      $ ENDF/B-VI
    31069.70c  8.1915e-4      31071.70c  5.4365e-4  $ ENDF/B-VII.0
m2  92235.70c  3.4902e-4      92238.70c  4.7518e-2

```

Table A-92. Input file for pu-met-fast-011

```

Pu sphere in sphere of H2O  PU-MET-FAST-011
1      1      0.049726      -1      $ Plutonium sphere
2      2      0.100149      1      -2      $ Water sphere
3      0      2

1      so      4.1217      $ radius of plutonium sphere
2      so      29.5217      $ radius of water sphere

mode      n
kcode     10000      1.0      100      600
imp:n     1.0      1.0      0.0
sdef      cel=1      erg=d1      rad=d2      pos=0.0 0.0 0.0
sp1       -3
si2       0.0      4.1217
sp2       -21      2
c          Plutonium (5.18 w/o Pu-240)
m1        94239.70c      4.6982e-2      94240.70c      2.5852e-3
          94241.70c      1.4915e-4      94242.70c      9.9432e-6
c          Water
m2        1001.70c      6.6766e-2
          8016.70c      3.3370e-2      8017.70c      1.3353e-5
mt2       lwtr.10t
totnu

end of input

```

Table A-93. Input file for pu-met-fast-018

```

BERYLLIUM REFLECTED PU SPHERE [PLANET]: PU-MET-FAST-018
1 1 0.04070346 -1 imp:n=1
2 2 0.1212076 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 5.0419
2 so 8.7300

c      Materials specified with atom densities
m1     94239.70c 3.7291e-2      94240.70c 1.9277e-3
       94241.70c 1.2196e-4
c      31000.66c 1.3628e-3      $ ENDF/B-VI
       31069.70c 8.1915e-4      31071.70c 5.4365e-4 $ ENDF/B-VII.0
m2     4009.70c 0.11984
       8016.70c 1.3776e-3
mt2    be.10t
kcode  10000 1. 100 600
ksrc   0 0 0

```

Table A-94. Input file for pu-met-fast-019

```

Be-REFLECTED PU SPHERE [VNIITF FACILITY]: PU-MET-FAST-019
1  0          -1          $ cavity
2  1  4.2157e-2  1  -3          $ Pu Core
3  0          3  -4  12
4  0          3  -5  11  -12
5  2  1.2105e-1  3  -7  -16      $ Bottom Reflector
6  2  1.2105e-1  4  6  -8  12     $ top reflector
7  0          3  10  -11  -15
8  3  8.1174e-2  5  11  -12  -15  $ diaphragm
9  0          7  -10  13  -15
10 0          8  12  -15
11 4  8.2365e-2  7  -9  -13  -10    $ copper cup
12 3  8.1174e-2  9  -10  -14  -15  $ shaft
13 0          9  -10  -13  14  -15
14 0          3  -7  -10  16
15 0          4  -6  -8  12      $ polar hole in Top Reflector
16 0          15

1  so  1.4
3  so  5.35
4  sz  1.05  5.35
5  cz  5.50
6  cz  1.1
7  so  11
8  sz  1.05  11
9  so  11.15
10 pz  0
11 pz  1
12 pz  1.20
13 cz  9.7
14 cz  2.5
15 so  14
16 pz  -0.15

imp:n  1  14r  0
kcode  10000  1.  100  600
ksrc   0  0  -1.41
c      Materials specified with atom densities
m1  94239.70c  3.3930e-2  94240.70c  3.5043e-3
    94241.70c  3.9189e-4
c      31000.66c  2.2105-3      $ ENDF/B-VI
    31069.70c  1.3287e-3  31071.70c  8.8181e-4  $ ENDF/B-VII.0
    6000.70c  3.0246d-4
    28058.70c  9.6855e-4  28060.70c  3.7028e-4
    28061.70c  1.6031e-5  28062.70c  5.0931e-5
    28064.70c  1.2910e-5
    26054.70c  1.91898-5  26056.70c  2.9832e-4
    26057.70c  6.8303e-6  26058.70c  9.1070e-7
    74182.70c  1.9577e-5  74183.70c  1.0581e-5
    74184.70c  2.2749e-5  74186.70c  2.1193e-5
m2  4009.70c  1.2081e-1
    6000.70c  1.0020e-4
    8016.70c  8.2064e-5
    26054.70c  3.0054e-6  26056.70c  4.6721e-5
    26057.70c  1.0697e-6  26058.70c  1.4263e-7

```

Table 94. Input file for pu-met-fast-019 (Cont'd)

mt2	be.10t			
m3	26054.70c	4.7893e-3	26056.70c	7.4453e-2
	26057.70c	1.7047e-3	26058.70c	2.2729e-4
m4	29063.70c	5.6972e-2	29065.70c	2.5393e-2

Table A-95. Input file for pu-met-fast-020

PU SPHERE REFLECTED BY DEPLETED URANIUM [VNIITF]: PU-MET-FAST-020

1	0		-1	-10		
2	0		12	-2		
3	1	4.21575-2	1	-3	-10	
4	1	4.21575-2	2	-4	12	
5	2	4.69754-2	3	-5	-10	17
6	2	4.69754-2	4	-6	12	17
7	2	4.69754-2	5	-7	-10	
8	2	4.69754-2	6	-8	12	18
9	0		10	-11	-15	
10	3	8.1174-2	11	-12	-15	
11	0		7	-15	-10	13
12	0		8	-15	12	
13	4	6.0426-2	7	-9	-13	-10
14	4	6.0426-2	9	-15	-14	-10
15	0		9	-15	14	-13 -10
16	0		3	-5	-17	-10
17	0		4	-6	-17	12
18	0		6	-8	12	-18
19	0		15			

1	so	1.4	
2	sz	0.61	1.4
3	so	5.35	
4	sz	0.61	5.35
5	so	9.15	
6	sz	0.61	9.15
7	so	13	
8	sz	0.61	13
9	so	13.2	
10	pz	0	
11	pz	0.41	
12	pz	0.61	
13	cz	11	
14	cz	2.5	
15	so	16	
17	cz	1.75	
18	cz	0.5	

imp:n 1 17r 0  
kcode 10000 1. 100 600  
ksrc 0 0 -1.41

c Materials specified with atom densities

m1	94239.70c	3.3930e-2	94240.70c	3.5043e-3	
	94241.70c	3.9189e-4			
c	31000.66c	2.2105-3			\$ ENDF/B-VI
	31069.70c	1.3287e-3	31071.70c	8.8181e-4	\$ ENDF/B-VII.0
	6000.70c	3.0246e-4			
	28058.70c	9.6855e-4	28060.70c	3.7028e-4	
	28061.70c	1.6031e-5	28062.70c	5.0931e-5	
	28064.70c	1.2910e-5			
	26054.70c	1.9190e-5	26056.70c	2.9832e-4	
	26057.70c	6.8303e-6	26058.70c	9.1070e-7	
	74182.70c	1.9577e-5	74183.70c	1.0581e-5	
	74184.70c	2.2749e-5	74186.70c	2.1193e-5	

Table 95. Input file for pu-met-fast-020 (Cont'd)

m2	92235.70c	2.3787e-4	92238.70c	4.6738e-2	
m3	26054.70c	4.7893e-3			
	26056.70c	7.4453e-2			
	26057.70c	1.7047e-3			
	26058.70c	2.2729e-4			
m4	13027.70c	5.8077e-2			
c	12000.66c	1.0332-3			\$ ENDF/B-VI
	12024.70c	8.1613e-4	12025.70c	1.0332e-4	\$ ENDF/B-VII.0
	12026.70c	1.1376e-4			\$ ENDF/B-VII.0
	25055.70c	1.8284e-4			
	29063.70c	7.8363e-4	29065.70c	3.4927e-4	



Table A-96. Input file for pu-met-fast-021-case-1

```

PU CYLINDER REFLECTED BY BE, ASSEMBLY 50 (#2115): PU-MET-FAST-021 case 1
1  2  7.6215e-2  11  -7  -1          imp:n=1  $ Fe
2  1  4.6924e-2  12  -7 -11          imp:n=1  $ Pu
3  2  7.6215e-2  13  -7 -12          imp:n=1  $ Fe
4  1  4.6924e-2  14  -7 -13          imp:n=1  $ Pu
5  2  7.6215e-2  15  -7 -14          imp:n=1  $ Fe
6  1  4.6924e-2  16  -7 -15          imp:n=1  $ Pu
7  2  7.6215e-2  17  -7 -16          imp:n=1  $ Fe
8  1  4.6924e-2  18  -7 -17          imp:n=1  $ Pu
9  2  7.6215e-2  19  -7 -18          imp:n=1  $ Fe
10 1  4.6924e-2  20  -7 -19          imp:n=1  $ Pu
11 2  7.6215e-2   5  -7 -20          imp:n=1  $ Fe
12 0                1 -32  -2          imp:n=1  $ vacuum
13 2  7.6215e-2   2  -7 -21          imp:n=1  $ Fe
14 1  4.6924e-2  21  -7 -22          imp:n=1  $ Pu
15 2  7.6215e-2  22  -7 -23          imp:n=1  $ Fe
16 1  4.6924e-2  23  -7 -24          imp:n=1  $ Pu
17 2  7.6215e-2  24  -7 -25          imp:n=1  $ Fe
18 1  4.6924e-2  25  -7 -26          imp:n=1  $ Pu
19 2  7.6215e-2  26  -7 -27          imp:n=1  $ Fe
20 1  4.6924e-2  27  -7 -28          imp:n=1  $ Pu
21 2  7.6215e-2  28  -7 -29          imp:n=1  $ Fe
22 1  4.6924e-2  29  -7 -30          imp:n=1  $ Pu
23 2  7.6215e-2  30  -7  -3          imp:n=1  $ Fe
24 2  7.6215e-2   5   7  -8  -1          imp:n=1  $ Fe
25 2  7.6215e-2   2   7  -8  -3          imp:n=1  $ Fe
26 3  1.2204e-1   6  -9  -5          imp:n=1  $ Be
27 3  1.2204e-1  31  -9  -4          imp:n=1  $ Be
28 0                34 32  -9 -33          imp:n=1  $ vacuum
29 0               -10 #(6 -9 -4)          imp:n=1  $ OUTSIDE
30 4  3.9462e-2  -1   5   8 -32          imp:n=1  $ Al centric rings
31 4  9.0639e-3   2   8 -31 -32          imp:n=1  $ Al basket
32 0                3  -8 -31          imp:n=1  $ top clearance
33 4  6.0426e-2  -9 -31 32 33          imp:n=1  $ Al top support rings
34 4  6.0426e-2   5  -9 32 -34          imp:n=1  $ Al bott centring ring
35 0                10          imp:n=0  $ OUTSIDE

1  pz 0.
2  pz  0.01
3  pz  2.46
4  pz 17.375
5  pz -2.45
6  pz -17.345
7  cz  5.995
8  cz  6.063
9  cz  9.995
10 so 22
11 pz -0.02
12 pz -0.47
13 pz -0.51
14 pz -0.96
15 pz -1.0
16 pz -1.45
17 pz -1.49
18 pz -1.94

```

Table 96. Input file for pu-met-fast-021-case-1 (Cont'd)

```

19 pz -1.98
20 pz -2.43
21 pz 0.03
22 pz 0.48
23 pz 0.52
24 pz 0.97
25 pz 1.01
26 pz 1.46
27 pz 1.5
28 pz 1.95
29 pz 1.99
30 pz 2.44
31 pz 2.48
32 cz 6.263
33 pz 2.28
34 pz -2.25

```

```

mode n
kcode 10000 1. 100 600
ksrc 0 0 -0.2
c Materials specified with atom densities
m1 94239.70c 4.4422e-2 94240. 2.1326e-3
    94241.70c 9.2538e-5
    6000.70c 1.9515e-4
    26054.70c 4.83464e-6 26056.70c 7.51581e-5
    26057.70c 1.72080e-6 26058.70c 2.29440e-7
m2 26054.70c 3.02552e-3 26056.70c 4.70340e-2
    26057.70c 1.07688e-3 26058.70c 1.43584e-4
    6000.70c 3.4757e-4
    14028.70c 8.2255e-4 14029.70c 4.1649e-5
    14030.70c 2.7647e-5
c 22000.62c 6.1034e-4 $ ENDF/B-VI
    22046.70c 5.0353e-5 22047.70c 4.5409e-5 $ ENDF/B-VII.0
    22048.70c 4.4994e-4 22049.70c 3.3019e-5 $ ENDF/B-VII.0
    22050.70c 3.1616e-5 $ ENDF/B-VII.0
    24050.70c 6.2794e-4 24052.70c 1.2109e-2
    24053.70c 1.3729e-3 24054.70c 3.4179e-4
    25055.70c 1.5198e-3
    28058.70c 4.8561e-3 28060.70c 1.8565e-3
    28061.70c 8.0378e-5 28062.70c 2.5536e-4
    28064.70c 6.4729e-5
m3 4009.70c 1.2099e-1
    8016.70c 1.0449e-3
mt3 be.10t
m4 13027.70c 5.8077e-2
c 12000.62c 1.0332e-3 $ ENDF/B-VI
    12024.70c 8.1613E-4 12025.70c 1.0332e-4 $ ENDF/B-VII.0
    12026.70c 1.1376e-4 $ ENDF/B-VII.0
    25055.70c 1.8284e-4
    29063.70c 7.8363e-4 29065.70c 3.4927e-4

```

Table A-97. Input file for pu-met-fast-021-case-2

```

PU CYLINDER REFLECTED BY BEO, ASSEMBLY 51 (#2116): PU-MET-FAST-021 case 2
1  2  7.6215e-2  11  -7  -1      imp:n=1  $ Fe
2  1  4.6924e-2  12  -7 -11      imp:n=1  $ Pu
3  2  7.6215e-2  13  -7 -12      imp:n=1  $ Fe
4  1  4.6924e-2  14  -7 -13      imp:n=1  $ Pu
5  2  7.6215e-2  15  -7 -14      imp:n=1  $ Fe
6  1  4.6924e-2  16  -7 -15      imp:n=1  $ Pu
7  2  7.6215e-2  17  -7 -16      imp:n=1  $ Fe
8  1  4.6924e-2  18  -7 -17      imp:n=1  $ Pu
9  2  7.6215e-2  19  -7 -18      imp:n=1  $ Fe
10 1  4.6924e-2  20  -7 -19      imp:n=1  $ Pu
11 2  7.6215e-2   5  -7 -20      imp:n=1  $ Fe
12 0           1 -32  -2      imp:n=1  $ vacuum
13 2  7.6215e-2   2  -7 -21      imp:n=1  $ Fe
14 1  4.6924e-2  21  -7 -22      imp:n=1  $ Pu
15 2  7.6215e-2  22  -7 -23      imp:n=1  $ Fe
16 1  4.6924e-2  23  -7 -24      imp:n=1  $ Pu
17 2  7.6215e-2  24  -7 -25      imp:n=1  $ Fe
18 1  4.6924e-2  25  -7 -26      imp:n=1  $ Pu
19 2  7.6215e-2  26  -7 -27      imp:n=1  $ Fe
20 1  4.6924e-2  27  -7 -28      imp:n=1  $ Pu
21 2  7.6215e-2  28  -7 -29      imp:n=1  $ Fe
22 1  4.6924e-2  29  -7 -30      imp:n=1  $ Pu
23 2  7.6215e-2  30  -7  -3      imp:n=1  $ Fe
24 2  7.6215e-2   5   7  -8  -1      imp:n=1  $ Fe
25 2  7.6215e-2   2   7  -8  -3      imp:n=1  $ Fe
26 3  1.3808e-1   6  -9  -5      imp:n=1  $ BeO
27 3  1.3808e-1  31  -9  -4      imp:n=1  $ top BeO
28 0           34  32  -9 -33      imp:n=1  $ vacuum
29 0          -10  #(6  -9  -4)      imp:n=1  $ OUTSIDE
30 4  3.9462e-2  -1   5   8 -32      imp:n=1  $ Al centric rings
31 4  9.0639e-3   2   8 -31 -32      imp:n=1  $ Al basket
32 0           3  -8 -31      imp:n=1  $ top clearance
33 4  6.0426e-2  -9 -31  32  33      imp:n=1  $ Al top support rings
34 4  6.0426e-2   5  -9  32 -34      imp:n=1  $ Al bottom aligning ring
35 0           10           imp:n=0  $ OUTSIDE

1  pz  -0.12
2  pz   0.12
3  pz   2.57
4  pz  17.51
5  pz  -2.57
6  pz -17.51
7  cz   5.995
8  cz   6.063
9  cz   9.995
10 so   22
11 pz  -0.14
12 pz  -0.59
13 pz  -0.63
14 pz  -1.08
15 pz  -1.12
16 pz  -1.57
17 pz  -1.61
18 pz  -2.06

```

Table 97. Input file for pu-met-fast-021-case-2 (Cont'd)

```

19 pz -2.10
20 pz -2.55
21 pz 0.14
22 pz 0.59
23 pz 0.63
24 pz 1.08
25 pz 1.12
26 pz 1.57
27 pz 1.61
28 pz 2.06
29 pz 2.10
30 pz 2.55
31 pz 2.59
32 cz 6.263
33 pz 2.39
34 pz -2.37

mode n
kcode 10000 1. 100 600
ksrc 0 0 -0.25
c Materials specified with atom densities
m1 94239.70c 4.4422e-2 94240.70c 2.1326e-3
    94241.70c 9.2538e-5
    6000.70c 1.9515e-4
    26054.70c 4.8346e-6 26056.70c 7.5158e-5
    26057.70c 1.7208e-6 26058.70c 2.2944e-7
m2 26054.70c 3.0255e-3 26056.70c 4.7034e-2
    26057.70c 1.0769e-3 26058.70c 1.4358e-4
    6000.70c 3.4757e-4
    14028.70c 8.2255e-4 14029.70c 4.1649e-5
    14030.70c 2.7647e-5
c 22000.62c 6.1034e-4 $ ENDF/B-VI
    22046.70c 5.0353e-5 22047.70c 4.5409e-5 $ ENDF/B-VII.0
    22048.70c 4.4994e-4 22049.70c 3.3019e-5 $ ENDF/B-VII.0
    22050.70c 3.1616e-5 $ ENDF/B-VII.0
    24050.70c 6.2794e-4 24052.70c 1.2109e-2
    24053.70c 1.3729e-3 24054.70c 3.4179e-4
    25055.70c 1.5198e-3
    28058.70c 4.8561e-3 28060.70c 1.8565e-3
    28061.70c 8.0378e-5 28062.70c 2.5536e-4
    28064.70c 6.4729e-5
m3 4009.70c 6.9041e-2
    8016.70c 6.9041e-2
c mt3 beo.60t $ ENDF/B-VI
mt3 o/be.10t be/o.10t $ ENDF/B-VII.0
m4 13027.70c 5.8077e-2
c 12000.62c 1.0332e-3 $ ENDF/B-VI
    12024.70c 8.1613e-4 12025.70c 1.0332e-4 $ ENDF/B-VII.0
    12026.70c 1.1376e-4 $ ENDF/B-VII.0
    25055.70c 1.8284e-4
    29063.70c 7.83627-4 29065.70c 3.49273-4

```

Table A-98. Input file for pu-met-fast-022-case-2

```

Simplified Bare Plutonium (98%)Sphere, VNIIEF:  PU-MET-FAST-022
1  0  -1
2  1  4.1788e-2  1 -2
3  0  2

1  so  1.400
2  so  6.670

imp:n  1  1  0
totnu
kcode  10000  1.  100  600
ksrc   2  0  0
c      Materials specified with atom densities
m1  94239.70c  3.6623e-2  94240.70c  6.6951e-4
c    31000.66c  2.1979e-3  $ ENDF/B-VI
    31069.70c  1.3211e-3  31071.70c  8.7679e-4  $ ENDF/B-VII.0
    26054.70c  8.4057e-6  26056.70c  1.3067e-4
    26057.70c  2.9919e-6  26058.70c  3.9892e-7
    6000.70c  2.9311e-4
    28058.70c  1.2715e-3  28060.70c  4.8609e-4
    28061.70c  2.1045e-5  28062.70c  6.6860e-5
    28064.70c  1.6948e-5

```

Table A-99. Input file for pu-met-fast-023-case-2

```

Simplified Plutonium Sphere reflected by graphite, VNIIEF:  PU-MET-FAST-023
C Graphite thermal S(alpha,beta) treatment applied at 300K
1  0  -1
2  1  4.1846e-2  1 -2
3  2  9.1842e-2  2 -3
4  0  3

1  so  1.715
2  so  6.000
3  so  8.35

imp:n  1  1  1  0
totnu
kcode  10000  1.  100  600
ksrc   2  0  0
c      Materials specified with atom densities
m1  94239.70c  3.6603e-2  94240.70c  6.6913e-4
c    31000.66c  2.1956e-3  $ ENDF/B-VI
    31069.70c  1.3197e-3  31071.70c  8.7587e-4  $ ENDF/B-VII.0
    26054.70c  8.3107e-6  26056.70c  1.2920e-4
    26057.70c  2.9581e-6  26058.70c  3.9441e-7
    6000.70c  2.8927e-4
    28058.70c  1.3302e-3  28060.70c  5.0853e-4
    28061.70c  2.2017e-5  28062.70c  6.9948e-5
    28064.70c  1.7730e-5
m2  6000.70c  9.1842e-2
mt2  grph.10t

```

Table A-100. Input file for pu-met-fast-024-case-2

```

Simplified Plutonium Sphere reflected by Polyethylene, PU-MET-FAST-024
c VNIIEF
c Polyethylene thermal S(alpha,beta) treatment applied at 300K
1 1 4.1891e-2 -1
2 2 1.1644e-1 1 -2
3 0 2

1 so 6.000
2 so 7.550

imp:n 1 1 0
totnu
kcode 10000 1. 100 600
ksrc 0 0 0
c Materials specified with atom densities
m1 94239.70c 3.6620e-2 94240.70c 6.6944e-4
c 31000.66c 2.1962e-3 $ ENDF/B-VI
31069.70c 1.3201e-3 31071.70c 8.7611e-4 $ ENDF/B-VII.0
26054.70c 8.3343e-6 26056.70c 1.2956e-4
26057.70c 2.9665e-6 26058.70c 3.9553e-7
6000.70c 2.8972e-4
28058.70c 1.3482e-3 28060.70c 5.1542e-4
28061.70c 2.2315e-5 28062.70c 7.0895e-5
28064.70c 1.7971e-5
m2 6000.70c 3.8814e-2
1001.70c 7.7616e-2 1002.70c 1.1644e-5
m2t poly.10t

```

Table A-101. Input file for pu-met-fast-025-case-2

```

Simplified Plutonium Sphere, 1.55 cm Steel Reflector, VNIIEF:  PU-MET-FAST-025
1  1  4.1988e-2  -1
2  2  8.1881e-2  1 -2
3  0  2

1  so  6.000
2  so  7.55

imp:n  1  1  0
totnu
kcode  10000  1.  100  600
ksrc   1  0  0
c      Materials specified with atom densities
m1  94239.70c  3.6704e-2  94240.70c  6.7099e-4
c    31000.66c  2.2013e-3  $ ENDF/B-VI
    31069.70c  1.3232e-3  31071.70c  8.7814e-4  $ ENDF/B-VII.0
    26054.70c  8.3538e-6  26056.70c  1.2987e-4
    26057.70c  2.9734e-6  26058.70c  3.9645e-7
    6000.70c  2.9038e-4
    28058.70c  1.3513e-3  28060.70c  5.1662e-4
    28061.70c  2.2367e-5  28062.70c  7.1061e-5
    28064.70c  1.8013e-5
m2  26054.70c  4.6939e-3  26056.70c  7.2970e-2
    26057.70c  1.6707e-3  26058.70c  2.2276e-4
    6000.70c  1.1289e-3
    14028.70c  1.4843e-4  14029.70c  7.5154e-6
    14030.70c  4.9888e-6
    24050.70c  1.1331e-5  24052.70c  2.1851e-4
    24053.70c  2.4774e-5  24054.70c  6.1675e-6
    25055.70c  3.2909e-4
    28058.70c  1.5773e-4  28060.70c  6.0301e-5
    28061.70c  2.6108e-6  28062.70c  8.2943e-6
    28064.70c  2.1025e-6
    29063.70c  1.4760e-4  29065.70c  6.5785e-5

```

Table A-102. Input file for pu-met-fast-026-case-2

Simplified Plutonium Sphere, 11.9 cm Steel Reflector, VNIIEF: PU-MET-FAST-026

```

1  0          -1
2  1  4.1864e-2  1 -2
3  2  8.1736e-2  2 -3
4  3  8.1225e-2  3 -4
5  0          4

1  so  0.770
2  so  5.350
3  so  11.00
4  so  17.25

imp:n  1  1  1  1  0
totnu
kcode  10000  1.  100  600
ksrc   1  0  0

c      Materials specified with atom densities
m1  94239.70c  3.6603e-2  94240.70c  6.6917e-4
c      31000.66c  2.2043e-3          $ ENDF/B-VI
      31069.70c  1.3250e-3  31071.70c  8.7934e-4  $ ENDF/B-VII.0
      26054.70c  8.2045e-6  26056.70c  1.2755e-4
      26057.70c  2.9203e-6  26058.70c  3.8937e-7
      6000.70c  2.8435e-4
      28058.70c  1.3410e-3  28060.70c  5.1266e-4
      28061.70c  2.2196e-5  28062.70c  7.0515e-5
      28064.70c  1.7874e-5
m2  26054.70c  4.6855e-3  26056.70c  7.2840e-2
      26057.70c  1.6677e-3  26058.70c  2.2237e-4
      6000.70c  1.1269e-3
      14028.70c  1.4817e-4  14029.70c  7.5024e-6
      14030.70c  4.9802e-6
      24050.70c  1.1311e-5  24052.70c  2.1812e-4
      24053.70c  2.4730e-5  24054.70c  6.1566e-6
      25055.70c  3.2850e-4
      28058.70c  1.5745e-4  28060.70c  6.0194e-5
      28061.70c  2.6061e-6  28062.70c  8.2796e-6
      28064.70c  2.0987e-6
      29063.70c  1.4733e-4  29065.70c  6.5668e-5
m3  26054.70c  4.6562e-3  26056.70c  7.2385e-2
      26057.70c  1.6573e-3  26058.70c  2.2097e-4
      6000.70c  1.1199e-3
      14028.70c  1.4724e-4  14029.70c  7.4552e-6
      14030.70c  4.9488e-6
      24050.70c  1.1240e-5  24052.70c  2.1676e-4
      24053.70c  2.4576e-5  24054.70c  6.1180e-6
      25055.70c  3.2645e-4
      28058.70c  1.5646e-4  28060.70c  5.9816e-5
      28061.70c  2.5897e-6  28062.70c  8.2276e-6
      28064.70c  2.0855e-6
      29063.70c  1.4641e-4  29065.70c  6.5258e-5

```



Table A-103. Input file for mix-met-fast-001

```

HEU REFLECTED PU SPHERE, PLANET ASSEMBLY; MIX-MET-FAST-001
1 1 0.04070346 -1 imp:n=1
2 2 0.048126 1 -2 imp:n=1
3 0 2 imp:n=0

1 so 5.0419
2 so 6.7056

c Materials specified with atom densities
m1 94239.70c 0.037291 94240.70c 0.0019277
94241.70c 0.00012196
c 31000.66c 0.0013628 $ ENDF/B-VI
31069.70c 8.1915e-4 31071.70c 5.4365e-4 $ ENDF/B-VII.0
m2 92235.70c 0.044892 92238.70c 0.0032340
kcode 10000 1. 100 600
totnu
ksrc 0 0 0

```

Table A-104. Input file for mix-met-fast-003

```

HEU Reflected Pu Sphere, VNIITF: MIX-MET-FAST-003
1 0 -1 $ central cavity
2 1 4.2162e-2 1 -5 $ Pu
3 0 5 -6 12 $ crescent gap
4 0 5 -2 11 -12 $ diaphragm gap
5 2 4.74202e-2 5 -7 -10 15 $ bottom U
6 2 4.74202e-2 3 6 -8 12 16 $ top U
7 0 5 -7 -10 -15 $ bottom groove in U
8 0 6 -8 12 -16 $ top groove in U
9 0 5 10 -11 -17 $ critical gap
10 5 6.0426e-2 2 11 -12 -17 $ diaphragm
11 0 7 -10 13 -17 $ bottom void
12 0 8 12 -17 $ top void
13 4 8.2365e-2 7 -9 -13 -10 $ cup
14 3 8.1174e-2 9 -10 -14 -17 $ shaft
15 0 9 -10 -13 14 -17 $ void under cup
16 0 -3 6 -8 12 $ hole in top U
17 0 17 $ outer void

1 so 1
2 cz 5.5
3 cz 1.1
5 so 5.35
6 sz 1.225 5.35
7 so 7.55
8 sz 1.225 7.55
9 so 7.7
10 pz 0
11 pz 1.025
12 pz 1.225
13 cz 6.5
14 cz 2.5
15 cy 0.6
16 c/y 0 1.225 0.6
17 so 14

imp:n 1 15r 0
kcode 10000 1. 100 600
ksrc 0 0 -2
totnu
c Materials specified with atom densities
m1 94239.70c 3.3928e-2 94240.70c 3.5032e-3
94241.70c 3.9158e-4
c 31000.66c 2.2104e-3 $ENDF/B-VI
31069.70c 1.3286e-3 31071.70c 8.8177e-4 $ ENDF/B-VII.0
6000.70c 3.0224e-4
26054.70c 1.9189e-5 26056.70c 2.9830e-4
26057.70c 6.8298e-6 26058.70c 9.1064e-7
74182.70c 1.9576e-5 74183.70c 1.0581e-5
74184.70c 2.2747e-5 74186.70c 2.1191e-5
28058.70c 9.7394e-4 28060.70c 3.7234e-4
28061.70c 1.6121e-5 28062.70c 5.1215e-5
28064.70c 1.2982e-5
m2 92235.70c 4.1081e-2 92238.70c 4.1002e-3
92234.70c 5.2253e-4 92236.70c 8.8981e-5

```

Table A-104. Input file for mix-met-fast-003 (Cont'd)

```

    6000.70c  3.8650e-4
    26054.70c 8.8659e-6    26056.70c  1.3783e-4
    26057.70c 3.1557e-6    26058.70c  4.2076e-7
    74182.70c 3.2573e-6    74183.70c  1.7606e-6
    74184.70c 3.7850e-6    74186.70c  3.5261e-6
    28058.70c 2.3324e-4    28060.70c  8.9171e-5
    28061.70c 3.8607e-6    28062.70c  1.2265e-5
    28064.70c 3.1090e-6
    29063.70c 5.0927e-4    29065.70c  2.2699e-4
m3  26054.70c 4.7893e-3    26056.70c  7.4453e-2
    26057.70c 1.7047e-3    26058.70c  2.2729e-4
m4  29063.70c 5.6972e-2    29065.70c  2.5393e-2
m5  13027.70c 5.8077e-2
c   12000.62c 1.0332e-3    $ ENDF/B-VI
    12024.70c 8.1613e-4    12025.70c  1.0332e-4    $ ENDF/B-VII.0
    12026.70c 1.1376e-4    $ ENDF/B-VII.0
    25055.70c 1.8284e-4
    29063.70c 7.8363e-4    29065.70c  3.4927e-4
c  print

```

Table A-105. Input file for pu-comp-inter-001

```

HISS HPG k-inf Benchmark PU-COMP-INTER-001
1      1  0.07534292    1 -2  3 -4  5 -6
2      0                    -1:2:-3:4:-5:6

*1     px    -1.0
*2     px     1.0
*3     py    -1.0
*4     py     1.0
*5     pz    -1.0
*6     pz     1.0

mode   n
imp:n  1    0
kcode  10000  1.0  100  600
sdef   cel=1  erg=d1  sur=0
spl    -3
ml     1001.70c  1.077e-04
       5010.70c  1.015e-04          5011.70c  4.086e-04
       6000.70c  7.090e-02
       8016.70c  2.706e-03          8017.70c  1.083e-06
c      20000.66c  8.280e-4
       20040.70c  8.027e-04          20042.70c  5.357e-06  $ ENDF/B-VI
       20043.70c  1.118e-06          20044.70c  1.727e-05  $ ENDF/B-VII.0
       20046.70c  3.312e-08          20048.70c  1.548e-06  $ ENDF/B-VII.0
       94239.70c  2.735e-04          94240.70c  1.549e-05
       94241.70c  1.072e-06          94242.70c  5.800e-08

mt1    grph.10t
totnu

end of input

```



Table A-106. Input file for mix-comp-therm-002-case-pnl30 (Cont'd)

```

31  5  0.100059      #32                               u=2 imp:n=1  $ Water
32  6  0.059721      (5 -8:9 -10)(-37:38:-39:40) u=2 imp:n=1  $ Al Egg-Crate

c      *****
c      surface cards
c      *****
c
c      Axial Position
c
1   pz  -30.0                                $ bottom of reflector
2   pz   0.0                                $ bottom of Al Plate
3   pz   2.85749                             $ bottom of Fuel Zone
4   pz   2.8575                              $ bottom of clad(plug)
5   pz   3.1750                              $ bottom of B-eggcrate
6   pz   3.5560                              $ bottom of UO2
7   pz   4.0560                              $ bottom of PuO2
8   pz   5.715                               $ top    of B-eggcrate
9   pz  92.3925                             $ bottom of T-eggcrate
10  pz  94.9325                             $ top   of T-eggcrate
11  pz  94.9960                             $ top   of PuO2 (plug)
12  pz  95.8215                             $ top   of clad
13  pz  95.82151                            $ top   of Fuel Zone
14  pz  96.774                              $ top   of lead
15  pz 110.236                              $ critical water height

c
c      Radial Position (core and reflector)
c
*21 px   0.0                                $ X-Axis
22  px  50.6729                             $ X-Fuel Boundary
*23 py   0.0                                $ Y-Axis
24  py  50.6729                             $ Y-Fuel Boundary
25  cz  50.0                                $ Core Radial Boundary

c      fuel cell universe
31  px  -0.889                              $ - X Cell Boundary
32  px   0.889                              $ + X Cell Boundary
33  py  -0.889                              $ - Y Cell Boundary
34  py   0.889                              $ + Y Cell Boundary
35  cz   0.64135                            $ Fuel Outer Radius
36  cz   0.71755                            $ Clad Outer Radius
37  px  -0.73025                            $ - X Egg-Crate Bndry
38  px   0.73025                            $ + X Egg-Crate Bndry
39  py  -0.73025                            $ - Y Egg-Crate Bndry
40  py   0.73025                            $ + Y Egg-Crate Bndry

c      *****
c      data cards
c      *****
mode  n
kcode 10000 1.0 100 600
ksrc   0.1   0.1  45.  1.778  0.1  45.  3.556  0.1  45.  5.334  0.1  45.
       7.112  0.1  45.  8.890  0.1  45. 10.668  0.1  45. 12.446  0.1  45.
       14.224 0.1  45. 16.002  0.1  45. 17.780  0.1  45. 19.558  0.1  45.
       0.1   1.778 45.  1.778  1.778 45.  3.556  1.778 45.  5.334  1.778 45.
       7.112 1.778 45.  8.890  1.778 45. 10.668 1.778 45. 12.446 1.778 45.
       14.224 1.778 45. 16.002  1.778 45. 17.780 1.778 45. 19.558  1.778 45.

```

Table A-106. Input file for mix-comp-therm-002-case-pnl30 (Cont'd)

```

0.1      3.556 45.  1.778  3.556 45.  3.556  3.556 45.  5.334  3.556 45.
7.112   3.556 45.  8.890  3.556 45. 10.668  3.556 45. 12.446  3.556 45.
14.224  3.556 45. 16.002  3.556 45. 17.780  3.556 45. 19.558  3.556 45.
0.1      5.334 45.  1.778  5.334 45.  3.556  5.334 45.  5.334  5.334 45.
7.112   5.334 45.  8.890  5.334 45. 10.668  5.334 45. 12.446  5.334 45.
14.224  5.334 45. 16.002  5.334 45. 17.780  5.334 45. 19.558  5.334 45.
0.1      7.112 45.  1.778  7.112 45.  3.556  7.112 45.  5.334  7.112 45.
7.112   7.112 45.  8.890  7.112 45. 10.668  7.112 45. 12.446  7.112 45.
14.224  7.112 45. 16.002  7.112 45. 17.780  7.112 45. 19.558  7.112 45.
0.1      8.890 45.  1.778  8.890 45.  3.556  8.890 45.  5.334  8.890 45.
7.112   8.890 45.  8.890  8.890 45. 10.668  8.890 45. 12.446  8.890 45.
14.224  8.890 45. 16.002  8.890 45. 17.780  8.890 45. 19.558  8.890 45.
0.1     10.668 45.  1.778 10.668 45.  3.556 10.668 45.  5.334 10.668 45.
7.112  10.668 45.  8.890 10.668 45. 10.668 10.668 45. 12.446 10.668 45.
14.224 10.668 45. 16.002 10.668 45. 17.780 10.668 45. 19.558 10.668 45.
0.1     12.446 45.  1.778 12.446 45.  3.556 12.446 45.  5.334 12.446 45.
7.112  12.446 45.  8.890 12.446 45. 10.668 12.446 45. 12.446 12.446 45.
14.224 12.446 45. 16.002 12.446 45. 17.780 12.446 45.
0.1     14.224 45.  1.778 14.224 45.  3.556 14.224 45.  5.334 14.224 45.
7.112  14.224 45.  8.890 14.224 45. 10.668 14.224 45. 12.446 14.224 45.
14.224 14.224 45. 16.002 14.224 45.
0.1     16.002 45.  1.778 16.002 45.  3.556 16.002 45.  5.334 16.002 45.
7.112  16.002 45.  8.890 16.002 45. 10.668 16.002 45. 12.446 16.002 45.
14.224 16.002 45.
0.1     17.780 45.  1.778 17.780 45.  3.556 17.780 45.  5.334 17.780 45.
7.112  17.780 45.  8.890 17.780 45. 10.668 17.780 45. 12.446 17.780 45.
0.1     19.558 45.  1.778 19.558 45.  3.556 19.558 45.  5.334 19.558 45.
7.112  19.558 45.  8.890 19.558 45. 10.668 19.558 45.
c *****
c material cards
c *****
c      MOX
m1    8016.70c 4.3761e-2   8017.70c 1.7512e-5
      92234.70c 1.2458e-6   92235.70c 1.4886e-4
      92236.70c 2.0936e-9   92238.70c 2.0611e-2
      94238.70c 3.8836e-8   94239.70c 3.9462e-4
      94240.70c 3.3206e-5   94241.70c 1.6081e-6
      94242.70c 1.1882e-7
      95241.70c 1.4954e-6
c      UO2
m2    8016.70c 4.1926e-2   8017.70c 1.6777e-5
      92234.70c 1.2406e-6   92235.70c 1.4824e-4
      92236.70c 2.0848e-9   92238.70c 2.0525e-2
c      Cladding
m3    24050.70c 3.3101e-6   24052.70c 6.3758e-5
      24053.70c 7.2288e-6   24054.70c 1.7958e-6
      26054.70c 5.5951e-6   26056.70c 8.7752e-5
      26057.70c 2.0276e-6   26058.70c 2.6780e-7
      28058.70c 2.0653e-5   28060.70c 7.9541e-6
      28061.70c 3.4583e-7   28062.70c 1.1012e-6
      28064.70c 2.8212e-7
      40090.70c 2.1939e-2   40091.70c 4.7843e-3
      40092.70c 7.3129e-3   40094.70c 7.4110e-3
      40096.70c 1.1939e-3
      50112.70c 4.6878e-6   50114.70c 3.1413e-6   $ ENDF/B-VII.0

```

Table A-106. Input file for mix-comp-therm-002-case-pnl30 (Cont'd)

	50115.70c	1.6432e-6	50116.70c	7.0269e-5	\$ ENDF/B-VII.0
	50117.70c	3.7116e-5	50118.70c	1.1705e-4	\$ ENDF/B-VII.0
	50119.70c	4.1514e-5	50120.70c	1.5750e-4	\$ ENDF/B-VII.0
	50122.70c	2.2376e-5	50124.70c	2.7982e-5	\$ ENDF/B-VII.0
c	Moderator + Aluminum				
m4	1001.70c	2.2276e-2			
	5010.70c	6.2468e-9	5011.70c	2.5302e-8	
	8016.70c	1.1111e-2	8017.70c	4.4552e-6	
c	12000.62c	4.4393e-4			\$ ENDF/B-VI
	12024.70c	3.5066e-4	12025.70c	4.4393e-5	\$ ENDF/B-VII.0
	12026.70c	4.8877e-5			\$ ENDF/B-VII.0
	13027.70c	3.8920e-2			
	14028.70c	2.1260e-4	14029.70c	1.0765e-5	
	14030.70c	7.1458e-6			
c	22000.62c	1.6901e-5			\$ ENDF/B-VI
	22046.70c	1.3943e-6	22047.70c	1.2574e-6	\$ ENDF/B-VII.0
	22048.70c	1.2459e-5	22049.70c	9.1434e-7	\$ ENDF/B-VII.0
	22050.70c	8.7547e-7			\$ ENDF/B-VII.0
	24050.70c	1.8053e-6	24052.70c	3.4775e-5	
	24053.70c	3.9427e-6	24054.70c	9.7945e-7	
	25055.70c	1.4730e-5			
	26054.70c	3.9558e-6	26056.70c	6.2042e-5	
	26057.70c	1.4336e-6	26058.70c	1.8934e-7	
	29063.70c	2.9362e-5	29065.70c	1.3087e-5	
c	Moderator				
m5	1001.70c	6.6706e-2			
	5010.70c	1.8706e-8	5011.70c	7.5770e-5	
	8016.70c	3.3273e-2	8017.70c	1.3341e-5	
c	Aluminum				
c m6	12000.62c	6.6651e-4			\$ ENDF/B-VI
m6	12024.70c	5.2648e-4	12025.70c	6.6651e-5	\$ ENDF/B-VII.0
	12026.70c	7.3383e-5			\$ ENDF/B-VII.0
	13027.70c	5.8433e-2			
	14028.70c	3.1918e-4	14029.70c	1.6161e-5	
	14030.70c	1.0728e-5			
c	22000.62c	2.5375e-5			\$ ENDF/B-VI
	22046.70c	2.0934e-6	22047.70c	1.8879e-6	\$ ENDF/B-VII.0
	22048.70c	1.8706e-5	22049.70c	1.3728e-6	\$ ENDF/B-VII.0
	22050.70c	1.3144e-6			\$ ENDF/B-VII.0
	24050.70c	2.7105e-6	24052.70c	5.2210e-5	
	24053.70c	5.9195e-6	24054.70c	1.4705e-6	
	25055.70c	2.2115e-5			
	26054.70c	5.9389e-6	26056.70c	9.3145e-5	
	26057.70c	2.1522e-6	26058.70c	2.8426e-7	
	29063.70c	4.4083e-5	29065.70c	1.9648e-5	
c	Lead				
m7	82206.70c	7.7539e-3	82207.70c	7.1105e-3	
	82208.70c	1.6859e-2			
c	Water + Aluminum (Reflector)				
m8	1001.70c	4.5010e-2			
	5010.70c	1.2622e-8	5011.70c	5.1125e-8	
	8016.70c	2.2451e-2	8017.70c	9.0020e-6	
c	12000.62c	2.1678e-4			\$ ENDF/B-VI
	12024.70c	1.7123e-4	12025.70c	2.1678e-5	\$ ENDF/B-VII.0
	12026.70c	2.3867e-5			\$ ENDF/B-VII.0



Table A-106. Input file for mix-comp-therm-002-case-pnl30 (Cont'd)

```

13027.70c 1.9006e-2
14028.70c 1.0381e-4  14029.70c 5.2566e-6
14030.70c 3.4894e-6
c      22000.62c 8.2534e-6                                $ ENDF/B-VI
22046.70c 6.8091e-7  22047.70c 6.1405e-7                $ ENDF/B-VII.0
22048.70c 6.0844e-6  22049.70c 4.4651e-7                $ ENDF/B-VII.0
22050.70c 4.2753e-7
24050.70c 8.8161e-7  24052.70c 1.6982e-5
24053.70c 1.9254e-6
24054.70c 4.7830e-7
25055.70c 7.1931e-6
26054.70c 1.9312e-6  26056.70c 3.0289e-5
26057.70c 6.9985e-7
26058.70c 9.2434e-8
29063.70c 1.4338e-5  29065.70c 6.3908e-6
mt4   lwtr.10t
mt5   lwtr.10t
mt8   lwtr.10t

end of input

```

Table A-107. Input file for mix-comp-therm-002-case-pnl31

```

MIX-COMP-THERM-002 PNL-31: square lattice, pitch=1.778 cm, 680.9 PPM
c *****
c cell card
c *****
1 0 21 23 -25 4 -12 fill=11 imp:n=1 $ Cube for Fueled Core
2 5 0.100123 21 23 -25 (1 -2:14 -15) imp:n=1 $ Bottom and Top
Reflector
3 6 0.059721 21 23 -25 2 -4 imp:n=1 $ Aluminum Plate
4 7 0.031724 21 23 -25 12 -14 imp:n=1 $ Lead Shield
5 0 25:-1:15:-21:-23 imp:n=0 $ Out of core
c
c filling universe $ Cube cell filled Fuel
c
6 0 -32 31 -34 33 lat=1 u=11 imp:n=1 fill=0:34 0:34 0:0
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 18r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 18r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 18r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 18r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 18r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 18r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 18r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 18r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 18r
  1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 18r
  1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 18r
  1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 18r
  1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 18r
  1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 18r
  1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 18r
  2 664r
c
c fuel cell universe (u=1)
c
21 1 0.064971 7 -11 -35 u=1 imp:n=1 $ MOX
22 2 0.062618 6 -7 -35 u=1 imp:n=1 $ UO2 layer
c 23 3 0.042843 3 -11 -36 #21 #22 u=1 imp:n=1 $ ENDF/B-VI Clad
23 3 0.043306 3 -11 -36 #21 #22 u=1 imp:n=1 $ ENDF/B-VII.0
Clad
24 6 0.059721 (5 -8:9 -10)(-37:38:-39:40) u=1 imp:n=1 $ Al Egg-Crate
25 5 0.100123 #21 #22 #23 #24 #26 u=1 imp:n=1 $ Moderator
c 26 3 0.042843 11 -13 -36 u=1 imp:n=1 $ ENDF/B-VI Plug
26 3 0.043306 11 -13 -36 u=1 imp:n=1 $ ENDF/B-VII.0
Plug
c
c Part of Radial reflector cell universe (u=2)
c
31 5 0.100123 1 #32 u=2 imp:n=1 $ Water
32 6 0.059721 (5 -8:9 -10)(-37:38:-39:40) u=2 imp:n=1 $ Al Egg-Crate

c *****
c surface cards
c *****
c
c Axial Position

```

Table A-107. Input file for mix-comp-therm-002-case-pnl31 (Cont'd)

```

c
1 pz -30.0 $ bottom of reflector
2 pz 0.0 $ bottom of Al Plate
3 pz 2.85749 $ bottom of Fuel Zone
4 pz 2.8575 $ bottom of clad(plug)
5 pz 3.1750 $ bottom of B-eggcrate
6 pz 3.5560 $ bottom of UO2
7 pz 4.0560 $ bottom of PuO2
8 pz 5.715 $ top of B-eggcrate
9 pz 92.3925 $ bottom of T-eggcrate
10 pz 94.9325 $ top of T-eggcrate
11 pz 94.9960 $ top of PuO2 (plug)
12 pz 95.8215 $ top of clad
13 pz 95.82151 $ top of Fuel Zone
14 pz 96.774 $ top of lead
15 pz 110.236 $ critical water height

c
c Radial Position (core and reflector)
c
*21 px 0.0 $ X-Axis
22 px 27.5589 $ X-Fuel Boundary
*23 py 0.0 $ Y-Axis
24 py 27.5589 $ Y-Fuel Boundary
25 cz 60.0 $ Core Radial Boundary

c fuel cell universe
31 px -0.889 $ - X Cell Boundary
32 px 0.889 $ + X Cell Boundary
33 py -0.889 $ - Y Cell Boundary
34 py 0.889 $ + Y Cell Boundary
35 cz 0.64135 $ Fuel Outer Radius
36 cz 0.71755 $ Clad Outer Radius
37 px -0.73025 $ - X Egg-Crate Bndry
38 px 0.73025 $ + X Egg-Crate Bndry
39 py -0.73025 $ - Y Egg-Crate Bndry
40 py 0.73025 $ + Y Egg-Crate Bndry

c *****
c data cards
c *****
mode n
kcode 10000 1.0 100 600
ksrc 0.1 0.1 45. 1.778 0.1 45. 3.556 0.1 45.
5.334 0.1 45. 7.112 0.1 45. 8.890 0.1 45.
10.668 0.1 45. 12.446 0.1 45. 14.224 0.1 45.
16.002 0.1 45. 17.780 0.1 45. 19.558 0.1 45.
21.336 0.1 45. 23.114 0.1 45. 24.892 0.1 45.
26.670 0.1 45.
0.1 1.778 45. 1.778 1.778 45. 3.556 1.778 45.
5.334 1.778 45. 7.112 1.778 45. 8.890 1.778 45.
10.668 1.778 45. 12.446 1.778 45. 14.224 1.778 45.
16.002 1.778 45. 17.780 1.778 45. 19.558 1.778 45.
21.336 1.778 45. 23.114 1.778 45. 24.892 1.778 45.
26.670 1.778 45.
0.1 3.556 45. 1.778 3.556 45. 3.556 3.556 45.
5.334 3.556 45. 7.112 3.556 45. 8.890 3.556 45.

```

Table A-107. Input file for mix-comp-therm-002-case-pnl31 (Cont'd)

10.668	3.556	45.	12.446	3.556	45.	14.224	3.556	45.
16.002	3.556	45.	17.780	3.556	45.	19.558	3.556	45.
21.336	3.556	45.	23.114	3.556	45.	24.892	3.556	45.
26.670	3.556	45.						
0.1	5.334	45.	1.778	5.334	45.	3.556	5.334	45.
5.334	5.334	45.	7.112	5.334	45.	8.890	5.334	45.
10.668	5.334	45.	12.446	5.334	45.	14.224	5.334	45.
16.002	5.334	45.	17.780	5.334	45.	19.558	5.334	45.
21.336	5.334	45.	23.114	5.334	45.	24.892	5.334	45.
26.670	5.334	45.						
0.1	7.112	45.	1.778	7.112	45.	3.556	7.112	45.
5.334	7.112	45.	7.112	7.112	45.	8.890	7.112	45.
10.668	7.112	45.	12.446	7.112	45.	14.224	7.112	45.
16.002	7.112	45.	17.780	7.112	45.	19.558	7.112	45.
21.336	7.112	45.	23.114	7.112	45.	24.892	7.112	45.
0.1	8.890	45.	1.778	8.890	45.	3.556	8.890	45.
5.334	8.890	45.	7.112	8.890	45.	8.890	8.890	45.
10.668	8.890	45.	12.446	8.890	45.	14.224	8.890	45.
16.002	8.890	45.	17.780	8.890	45.	19.558	8.890	45.
21.336	8.890	45.	23.114	8.890	45.	24.892	8.890	45.
0.1	10.668	45.	1.778	10.668	45.	3.556	10.668	45.
5.334	10.668	45.	7.112	10.668	45.	8.890	10.668	45.
10.668	10.668	45.	12.446	10.668	45.	14.224	10.668	45.
16.002	10.668	45.	17.780	10.668	45.	19.558	10.668	45.
21.336	10.668	45.	23.114	10.668	45.	24.892	10.668	45.
0.1	12.446	45.	1.778	12.446	45.	3.556	12.446	45.
5.334	12.446	45.	7.112	12.446	45.	8.890	12.446	45.
10.668	12.446	45.	12.446	12.446	45.	14.224	12.446	45.
16.002	12.446	45.	17.780	12.446	45.	19.558	12.446	45.
21.336	12.446	45.	23.114	12.446	45.			
0.1	14.224	45.	1.778	14.224	45.	3.556	14.224	45.
5.334	14.224	45.	7.112	14.224	45.	8.890	14.224	45.
10.668	14.224	45.	12.446	14.224	45.	14.224	14.224	45.
16.002	14.224	45.	17.780	14.224	45.	19.558	14.224	45.
21.336	14.224	45.	23.114	14.224	45.			
0.1	16.002	45.	1.778	16.002	45.	3.556	16.002	45.
5.334	16.002	45.	7.112	16.002	45.	8.890	16.002	45.
10.668	16.002	45.	12.446	16.002	45.	14.224	16.002	45.
16.002	16.002	45.	17.780	16.002	45.	19.558	16.002	45.
21.336	16.002	45.						
0.1	17.780	45.	1.778	17.780	45.	3.556	17.780	45.
5.334	17.780	45.	7.112	17.780	45.	8.890	17.780	45.
10.668	17.780	45.	12.446	17.780	45.	14.224	17.780	45.
16.002	17.780	45.	17.780	17.780	45.	19.558	17.780	45.
21.336	17.780	45.						
0.1	19.558	45.	1.778	19.558	45.	3.556	19.558	45.
5.334	19.558	45.	7.112	19.558	45.	8.890	19.558	45.
10.668	19.558	45.	12.446	19.558	45.	14.224	19.558	45.
16.002	19.558	45.	17.780	19.558	45.	19.558	19.558	45.
0.1	21.336	45.	1.778	21.336	45.	3.556	21.336	45.
5.334	21.336	45.	7.112	21.336	45.	8.890	21.336	45.
10.668	21.336	45.	12.446	21.336	45.	14.224	21.336	45.
16.002	21.336	45.	17.780	21.336	45.			
0.1	23.114	45.	1.778	23.114	45.	3.556	23.114	45.
5.334	23.114	45.	7.112	23.114	45.	8.890	23.114	45.

Table A-107. Input file for mix-comp-therm-002-case-pnl31 (Cont'd)

```

10.668 23.114 45. 12.446 23.114 45. 14.224 23.114 45.
 0.1 24.892 45. 1.778 24.892 45. 3.556 24.892 45.
 5.334 24.892 45. 7.112 24.892 45. 8.890 24.892 45.
10.668 24.892 45.
 0.1 26.670 45. 1.778 26.670 45. 3.556 26.670 45.
 5.334 26.670 45.
c *****
c material cards
c *****
c MOX
m1 8016.70c 4.3761e-2 8017.70c 1.7512e-5
92234.70c 1.2458e-6 92235.70c 1.4886e-4
92236.70c 2.0936e-9 92238.70c 2.0611e-2
94238.70c 3.8836e-8 94239.70c 3.9462e-4
94240.70c 3.3206e-5 94241.70c 1.6081e-6
94242.70c 1.1882e-7
95241.70c 1.4954e-6
c UO2
m2 8016.70c 4.1926e-2 8017.70c 1.6777e-5
92234.70c 1.2406e-6 92235.70c 1.4824e-4
92236.70c 2.0848e-9 92238.70c 2.0525e-2
c Cladding
m3 24050.70c 3.3101e-6 24052.70c 6.3758e-5
24053.70c 7.2288e-6 24054.70c 1.7958e-6
26054.70c 5.5951e-6 26056.70c 8.7752e-5
26057.70c 2.0276e-6 26058.70c 2.6780e-7
28058.70c 2.0653e-5 28060.70c 7.9541e-6
28061.70c 3.4583e-7 28062.70c 1.1012e-6
28064.70c 2.8212e-7
40090.70c 2.1929e-2 40091.70c 4.7821e-3
40092.70c 7.3095e-3 40094.70c 7.4075e-3
40096.70c 1.1934e-3
50112.70c 4.6878e-6 50114.70c 3.1413e-6 $ ENDF/B-VII.0
50115.70c 1.6432e-6 50116.70c 7.0269e-5 $ ENDF/B-VII.0
50117.70c 3.7116e-5 50118.70c 1.1705e-4 $ ENDF/B-VII.0
50119.70c 4.1514e-5 50120.70c 1.5750e-4 $ ENDF/B-VII.0
50122.70c 2.2376e-5 50124.70c 2.7982e-5 $ ENDF/B-VII.0
c Moderator + Aluminum
m4 1001.70c 2.2269e-2
5010.70c 2.5325e-6 5011.70c 1.0259e-5
8016.70c 1.1150e-2 8017.70c 4.4616e-6
c 12000.62c 4.4393e-4 $ ENDF/B-VI
12024.70c 3.5066e-4 12025.70c 4.4393e-5 $ ENDF/B-VII.0
12026.70c 4.8877e-5 $ ENDF/B-VII.0
13027.70c 3.8920e-2
14028.70c 2.1260e-4 14029.70c 1.0765e-5
14030.70c 7.1458e-6
c 22000.62c 1.6901e-5 $ ENDF/B-VI
22046.70c 1.3943e-6 22047.70c 1.2574e-6 $ ENDF/B-VII.0
22048.70c 1.2459e-5 22049.70c 9.1434e-7 $ ENDF/B-VII.0
22050.70c 8.7547e-7 $ ENDF/B-VII.0
24050.70c 1.8053e-6 24052.70c 3.4775e-5
24053.70c 3.9427e-6 24054.70c 9.7945e-7
25055.70c 1.4730e-5
26054.70c 3.9558e-6 26056.70c 6.2042e-5

```

Table A-107. Input file for mix-comp-therm-002-case-pnl31 (Cont'd)

	26057.70c	1.4336e-6	26058.70c	1.8934e-7	
	29063.70c	2.9362e-5	29065.70c	1.3087e-5	
c	Moderator				
m5	1001.70c	6.6685e-2			
	5010.70c	7.5838e-6	5011.70c	3.0718e-5	
	8016.70c	3.3387e-2	8017.70c	1.3360e-5	
c	Aluminum				
c m6	12000.62c	6.6651e-4			\$ ENDF/B-VI
m6	12024.70c	5.2648e-4	12025.70c	6.6651e-5	\$ ENDF/B-VII.0
	12026.70c	7.3383e-5			\$ ENDF/B-VII.0
	13027.70c	5.8433e-2			
	14028.70c	3.1918e-4	14029.70c	1.6161e-5	
	14030.70c	1.0728e-5			
c	22000.62c	2.5375e-5			\$ ENDF/B-VI
	22046.70c	2.0934e-6	22047.70c	1.8879e-6	\$ ENDF/B-VII.0
	22048.70c	1.8706e-5	22049.70c	1.3728e-6	\$ ENDF/B-VII.0
	22050.70c	1.3144e-6			\$ ENDF/B-VII.0
	24050.70c	2.7105e-6	24052.70c	5.2210e-5	
	24053.70c	5.9195e-6	24054.70c	1.4705e-6	
	25055.70c	2.2115e-5			
	26054.70c	5.9389e-6	26056.70c	9.3145e-5	
	26057.70c	2.1522e-6	26058.70c	2.8426e-7	
	29063.70c	4.4083e-5	29065.70c	1.9648e-5	
c	Lead				
m7	82206.70c	7.7539e-3	82207.70c	7.1105e-3	
	82208.70c	1.6859e-2			
c	Water + Aluminum (Reflector)				
m8	1001.70c	4.4996e-2			
	5010.70c	5.1171e-6	5011.70c	2.0727e-5	
	8016.70c	2.2528e-2	8017.70c	9.0148e-6	
c	12000.62c	2.1678e-4			\$ ENDF/B-VI
	12024.70c	1.7123e-4	12025.70c	2.1678e-5	\$ ENDF/B-VII.0
	12026.70c	2.3867e-5			\$ ENDF/B-VII.0
	13027.70c	1.9006e-2			
	14028.70c	1.0381e-4	14029.70c	5.2566e-6	
	14030.70c	3.4894e-6			
c	22000.62c	8.2534e-6			\$ ENDF/B-VI
	22046.70c	6.8091e-7	22047.70c	6.1405e-7	\$ ENDF/B-VII.0
	22048.70c	6.0844e-6	22049.70c	4.4651e-7	\$ ENDF/B-VII.0
	22050.70c	4.2753e-7			\$ ENDF/B-VII.0
	24050.70c	8.8161e-7	24052.70c	1.6982e-5	
	24053.70c	1.9254e-6	24054.70c	4.7830e-7	
	25055.70c	7.1931e-6			
	26054.70c	1.9312e-6	26056.70c	3.0289e-5	
	26057.70c	6.9985e-7	26058.70c	9.2434e-8	
	29063.70c	1.4338e-5	29065.70c	6.3908e-6	
mt4	lwtr.10t				
mt5	lwtr.10t				
mt8	lwtr.10t				

end of input

Table A-108. Input file for mix-comp-therm-002-case-pnl32

```

MIX-COMP-THERM-002 PNL-32:  sq lattice, pitch=2.20914 cm, pure water(0.9ppm)
c *****
c cell cards
c *****
1 0 -25 4 -12 fill=11 imp:n=1 $ Cube for Fueled Core
2 5 0.100059 -25 (1 -2:14 -15) imp:n=1 $ Bottom/Top Reflector
3 6 0.059721 -25 2 -4 imp:n=1 $ Aluminum Plate
4 7 0.031723 -25 12 -14 imp:n=1 $ Lead Shield
5 0 25:-1:15 imp:n=0 $ Out of core
c
c filling universe $ Cube cell filled Fuel
c
6 0 -32 31 -34 33 lat=1 u=11 imp:n=1 fill=-27:27 -27:27 0:0
  2 1044r
  2 18r 2 2 2 2 2 2 2 1 1 1 2 2 2 2 2 2 2 2 18r
  2 18r 2 2 2 2 2 2 2 1 1 1 1 1 1 2 2 2 2 2 18r
  2 18r 2 2 2 2 1 1 1 1 1 1 1 1 1 2 2 2 2 2 18r
  2 18r 2 2 2 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 18r
  2 18r 2 2 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 18r
  2 18r 2 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 18r
  2 18r 2 1 1 1 1 1 1 1 1 1 1 1 1 2 2 18r
  2 18r 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 18r
  2 18r 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 18r
  2 18r 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 18r
  2 18r 2 1 1 1 1 1 1 1 1 1 1 1 1 2 2 18r
  2 18r 2 1 1 1 1 1 1 1 1 1 1 1 1 2 2 18r
  2 18r 2 2 1 1 1 1 1 1 1 1 1 1 2 2 2 18r
  2 18r 2 2 2 1 1 1 1 1 1 1 1 2 2 2 2 18r
  2 18r 2 2 2 2 1 1 1 1 1 1 2 2 2 2 2 18r
  2 18r 2 2 2 2 2 1 1 1 1 1 2 2 2 2 2 18r
  2 18r 2 2 2 2 2 2 2 1 1 1 2 2 2 2 2 18r
  2 1044r
c
c fuel cell universe (u=1)
c
21 1 0.064971 7 -11 -35 u=1 imp:n=1 $ MOX
22 2 0.062618 6 -7 -35 u=1 imp:n=1 $ UO2 layer
c 23 3 0.042843 3 -11 -36 #21 #22 u=1 imp:n=1 $ ENDF/B-VI Clad
23 3 0.043306 3 -11 -36 #21 #22 u=1 imp:n=1 $ ENDF/B-VII.0 Clad
24 6 0.059721 (5 -8:9 -10) (-37 38:-39 40:-41 42:-43 44)
u=1 imp:n=1 $ Al Egg-Crate
25 5 0.100059 #21 #22 #23 #24 #26 u=1 imp:n=1 $ Moderator
c 26 3 0.042843 11 -13 -36 u=1 imp:n=1 $ ENDF/B-VI Plug
26 3 0.043306 11 -13 -36 u=1 imp:n=1 $ ENDF/B-VII.0 Plug
c
c Part of Radial reflector cell universe (u=2)
c
31 5 0.100059 #32 u=2 imp:n=1 $ Water
32 6 0.059721 (5 -8:9 -10) (-37 38:39 -40:41 -42:-43 44)
u=2 imp:n=1 $ Al Egg-Crate

c *****
c surface cards
c *****
c

```

Table A-108. Input file for mix-comp-therm-002-case-pnl32 (Cont'd)

```

c   Axial Position
c
1   pz -30.0           $ bottom of reflector
2   pz  0.0           $ bottom of Al Plate
3   pz  2.85749       $ bottom of Fuel Zone
4   pz  2.8575        $ bottom of clad(plug)
5   pz  3.1750        $ bottom of B-eggcrate
6   pz  3.5560        $ bottom of UO2
7   pz  4.0560        $ bottom of PuO2
8   pz  5.715         $ top   of B-eggcrate
9   pz  92.3925       $ bottom of T-eggcrate
10  pz  94.9325       $ top   of T-eggcrate
11  pz  94.9960       $ top   of PuO2 (plug)
12  pz  95.8215       $ top   of clad
13  pz  95.82151     $ top   of Fuel Zone
14  pz  96.774        $ top   of lead
15  pz 100.711       $ critical water height
c
c   Radial Position (core and reflector)
c
21  px -18.777689     $ X-Axis
22  px  18.777689     $ X-Fuel Boundary
23  py -18.777689     $ Y-Axis
24  py  18.777689     $ Y-Fuel Boundary
25  cz  60.0          $ Core Radial Boundary
c   fuel cell universe
31  px -1.10457       $ - X Cell Boundary
32  px  1.10457       $ + X Cell Boundary
33  py -1.10457       $ - Y Cell Boundary
34  py  1.10457       $ + Y Cell Boundary
35  cz  0.64135       $ Fuel Outer Radius
36  cz  0.71755       $ Clad Outer Radius
37  p  1. -1. 0. 1.16204514 $ - X Cell Boundary
38  p  1. -1. 0. 1.04709786 $ - X Cell Boundary
39  p  1. -1. 0. -1.16204514 $ - X Cell Boundary
40  p  1. -1. 0. -1.04709786 $ - X Cell Boundary
41  p  1.  1. 0. -1.16204514 $ - X Cell Boundary
42  p  1.  1. 0. -1.04709786 $ - X Cell Boundary
43  p  1.  1. 0.  1.16204514 $ - X Cell Boundary
44  p  1.  1. 0.  1.04709786 $ - X Cell Boundary
c   *****
c   data cards
c   *****
mode  n
kcode 10000 1.0 100 600
ksrc  -2.20914 -17.67312 45.  0.0      -17.67312 45.  2.20914 -17.67312 45.
      -6.62742 -15.46398 45. -4.41828 -15.46398 45. -2.20914 -15.46398 45.
      0.0      -15.46398 45.  2.20914 -15.46398 45.  4.41828 -15.46398 45.
      -8.83656 -13.25484 45. -6.62742 -13.25484 45. -4.41828 -13.25484 45.
      -2.20914 -13.25484 45.  0.0      -13.25484 45.  2.20914 -13.25484 45.
      4.41828 -13.25484 45.  6.62742 -13.25484 45.  8.83656 -13.25484 45.
      -11.04570 -11.04570 45. -8.83656 -11.04570 45. -6.62742 -11.04570 45.
      -4.41828 -11.04570 45. -2.20914 -11.04570 45.  0.0      -11.04570 45.
      2.20914 -11.04570 45.  4.41828 -11.04570 45.  6.62742 -11.04570 45.

```



Table A-108. Input file for mix-comp-therm-002-case-pnl32 (Cont'd)

8.83656	-11.04570	45.	11.04570	-11.04570	45.			
-13.25484	-8.83656	45.	-11.04570	-8.83656	45.	-8.83656	-8.83656	45.
-6.62742	-8.83656	45.	-4.41828	-8.83656	45.	-2.20914	-8.83656	45.
0.0	-8.83656	45.	2.20914	-8.83656	45.	4.41828	-8.83656	45.
6.62742	-8.83656	45.	8.83656	-8.83656	45.	11.04570	-8.83656	45.
13.25484	-8.83656	45.						
-15.46398	-6.62742	45.	-13.25484	-6.62742	45.	-11.04570	-6.62742	45.
-8.83656	-6.62742	45.	-6.62742	-6.62742	45.	-4.41828	-6.62742	45.
-2.20914	-6.62742	45.	0.0	-6.62742	45.	2.20914	-6.62742	45.
4.41828	-6.62742	45.	6.62742	-6.62742	45.	8.83656	-6.62742	45.
11.04570	-6.62742	45.	13.25484	-6.62742	45.	15.46398	-6.62742	45.
-15.46398	-4.41828	45.	-13.25484	-4.41828	45.	-11.04570	-4.41828	45.
-8.83656	-4.41828	45.	-6.62742	-4.41828	45.	-4.41828	-4.41828	45.
-2.20914	-4.41828	45.	0.0	-4.41828	45.	2.20914	-4.41828	45.
4.41828	-4.41828	45.	6.62742	-4.41828	45.	8.83656	-4.41828	45.
11.04570	-4.41828	45.	13.25484	-4.41828	45.	15.46398	-4.41828	45.
-17.67312	-2.20914	45.	-15.46398	-2.20914	45.	-13.25484	-2.20914	45.
-11.04570	-2.20914	45.	-8.83656	-2.20914	45.	-6.62742	-2.20914	45.
-4.41828	-2.20914	45.	-2.20914	-2.20914	45.	0.0	-2.20914	45.
2.20914	-2.20914	45.	4.41828	-2.20914	45.	6.62742	-2.20914	45.
8.83656	-2.20914	45.	11.04570	-2.20914	45.	13.25484	-2.20914	45.
15.46398	-2.20914	45.	17.67312	-2.20914	45.			
-17.67312	0.0	45.	-15.46398	0.0	45.	-13.25484	0.0	45.
-11.04570	0.0	45.	-8.83656	0.0	45.	-6.62742	0.0	45.
-4.41828	0.0	45.	-2.20914	0.0	45.	0.0	0.0	45.
2.20914	0.0	45.	4.41828	0.0	45.	6.62742	0.0	45.
8.83656	0.0	45.	11.04570	0.0	45.	13.25484	0.0	45.
15.46398	0.0	45.	17.67312	0.0	45.			
-17.67312	2.20914	45.	-15.46398	2.20914	45.	-13.25484	2.20914	45.
-11.04570	2.20914	45.	-8.83656	2.20914	45.	-6.62742	2.20914	45.
-4.41828	2.20914	45.	-2.20914	2.20914	45.	0.0	2.20914	45.
2.20914	2.20914	45.	4.41828	2.20914	45.	6.62742	2.20914	45.
8.83656	2.20914	45.	11.04570	2.20914	45.	13.25484	2.20914	45.
15.46398	2.20914	45.	17.67312	2.20914	45.			
-15.46398	4.41828	45.	-13.25484	4.41828	45.	-11.04570	4.41828	45.
-8.83656	4.41828	45.	-6.62742	4.41828	45.	-4.41828	4.41828	45.
-2.20914	4.41828	45.	0.0	4.41828	45.	2.20914	4.41828	45.
4.41828	4.41828	45.	6.62742	4.41828	45.	8.83656	4.41828	45.
11.04570	4.41828	45.	13.25484	4.41828	45.	15.46398	4.41828	45.
-15.46398	6.62742	45.	-13.25484	6.62742	45.	-11.04570	6.62742	45.
-8.83656	6.62742	45.	-6.62742	6.62742	45.	-4.41828	6.62742	45.
-2.20914	6.62742	45.	0.0	6.62742	45.	2.20914	6.62742	45.
4.41828	6.62742	45.	6.62742	6.62742	45.	8.83656	6.62742	45.
11.04570	6.62742	45.	13.25484	6.62742	45.	15.46398	6.62742	45.
-13.25484	8.83656	45.	-11.04570	8.83656	45.	-8.83656	8.83656	45.
-6.62742	8.83656	45.	-4.41828	8.83656	45.	-2.20914	8.83656	45.
0.0	8.83656	45.	2.20914	8.83656	45.	4.41828	8.83656	45.
6.62742	8.83656	45.	8.83656	8.83656	45.	11.04570	8.83656	45.
13.25484	8.83656	45.						
-11.04570	11.04570	45.	-8.83656	11.04570	45.	-6.62742	11.04570	45.
-4.41828	11.04570	45.	-2.20914	11.04570	45.	0.0	11.04570	45.
2.20914	11.04570	45.	4.41828	11.04570	45.	6.62742	11.04570	45.
8.83656	11.04570	45.	11.04570	11.04570	45.			
-8.83656	13.25484	45.	-6.62742	13.25484	45.	-4.41828	13.25484	45.
-2.20914	13.25484	45.	0.0	13.25484	45.	2.20914	13.25484	45.

Table A-108. Input file for mix-comp-therm-002-case-pnl32 (Cont'd)

	4.41828	13.25484	45.	6.62742	13.25484	45.	8.83656	-13.25484	45.
	-4.41828	15.46398	45.	-2.20914	15.46398	45.	0.0	15.46398	45.
	2.20914	15.46398	45.	4.41828	15.46398	45.	6.62742	15.46398	45.
	-2.20914	17.67312	45.	0.0	17.67312	45.	2.20914	17.67312	45.
c	*****								
c	material cards								
c	*****								
c	MOX								
m1	8016.70c	4.3761e-2		8017.70c	1.7512e-5				
	92234.70c	1.2458e-6		92235.70c	1.4886e-4				
	92236.70c	2.0936e-9		92238.70c	2.0611e-2				
	94238.70c	3.8836e-8		94239.70c	3.9462e-4				
	94240.70c	3.3206e-5		94241.70c	1.6081e-6				
	94242.70c	1.1882e-7							
	95241.70c	1.4954e-6							
c	UO2								
m2	8016.70c	4.1926e-2		8017.70c	1.6777e-5				
	92234.70c	1.2406e-6		92235.70c	1.4824e-4				
	92236.70c	2.0848e-9		92238.70c	2.0525e-2				
c	Cladding								
m3	24050.70c	3.3101e-6		24052.70c	6.3758e-5				
	24053.70c	7.2288e-6		24054.70c	1.7958e-6				
	26054.70c	5.5951e-6		26056.70c	8.7752e-5				
	26057.70c	2.0276e-6		26058.70c	2.6780e-7				
	28058.70c	2.0653e-5		28060.70c	7.9541e-6				
	28061.70c	3.4583e-7		28062.70c	1.1012e-6				
	28064.70c	2.8212e-7							
	40090.70c	2.1939e-2		40091.70c	4.7843e-3				
	40092.70c	7.3129e-3		40094.70c	7.4110e-3				
	40096.70c	1.1939e-3							
	50112.70c	4.6878e-6		50114.70c	3.1413e-6				\$ ENDF/B-VII.0
	50115.70c	1.6432e-6		50116.70c	7.0269e-5				\$ ENDF/B-VII.0
	50117.70c	3.7116e-5		50118.70c	1.1705e-4				\$ ENDF/B-VII.0
	50119.70c	4.1514e-5		50120.70c	1.5750e-4				\$ ENDF/B-VII.0
	50122.70c	2.2376e-5		50124.70c	2.7982e-5				\$ ENDF/B-VII.0
c	Moderator + Aluminum								
m4	1001.70c	5.6593e-2							
	5010.70c	8.4020e-9		5011.70c	3.4033e-8				
	8016.70c	2.8229e-2		8017.70c	1.1319e-5				
c	12000.62c	1.0105e-4							\$ ENDF/B-VI
	12024.70c	7.9819e-5		12025.70c	1.0105e-5				\$ ENDF/B-VII.0
	12026.70c	1.1126e-5							\$ ENDF/B-VII.0
	13027.70c	8.8588e-3							
	14028.70c	4.8390e-5		14029.70c	2.4502e-6				
	14030.70c	1.6265e-6							
c	22000.62c	3.8470e-6							\$ ENDF/B-VI
	22046.70c	3.1738e-7		22047.70c	2.8622e-7				\$ ENDF/B-VII.0
	22048.70c	2.8360e-6		22049.70c	2.0812e-7				\$ ENDF/B-VII.0
	22050.70c	1.9927e-7							\$ ENDF/B-VII.0
	24050.70c	4.1093e-7		24052.70c	7.9153e-6				
	24053.70c	8.9743e-7		24054.70c	2.2294e-7				
	25055.70c	3.3528e-6							
	26054.70c	9.0043e-7		26056.70c	1.4122e-5				
	26057.70c	3.2631e-7		26058.70c	4.3098e-8				
	29063.70c	6.6833e-6		29065.70c	2.9788e-6				

Table A-108. Input file for mix-comp-therm-002-case-pnl32 (Cont'd)

```

m5      1001.70c 6.6706e-2
        5010.70c 9.9034e-9   5011.70c 4.0114e-8
        8016.70c 3.3340e-2   8017.70c 1.3341e-5
c       Aluminum
c m6    12000.62c 6.6651e-4                                $ ENDF/B-VI
m6      12024.70c 5.2648e-4   12025.70c 6.6651e-5
        12026.70c 7.3383e-5                                $ ENDF/B-VII.0
        13027.70c 5.8433e-2
        14028.70c 3.1918e-4   14029.70c 1.6161e-5
        14030.70c 1.0728e-5
c       22000.62c 2.5375e-5                                $ ENDF/B-VI
        22046.70c 2.0934e-5   22047.70c 1.8879e-6   $ ENDF/B-VII.0
        22048.70c 1.8706e-5   22049.70c 1.3728e-6   $ ENDF/B-VII.0
        22050.70c 1.3144e-6                                $ ENDF/B-VII.0
        24050.70c 2.7105e-6   24052.70c 5.2210e-5
        24053.70c 5.9195e-6   24054.70c 1.4705e-6
        25055.70c 2.2115e-5
        26054.70c 5.9389e-6   26056.70c 9.3145e-5
        26057.70c 2.1522e-6   26058.70c 2.8426e-7
        29063.70c 4.4083e-5   29065.70c 1.9648e-5
c       Lead
m7      82206.70c 7.7539e-3   82207.70c 7.1105e-3
        82208.70c 1.6859e-2
c       Water + Aluminum (Reflector)
m8      1001.70c 5.9945e-2
        5010.70c 8.8996e-9   5011.70c 3.6048e-8
        8016.70c 2.9961e-2   8017.70c 1.1989e-5
c       12000.62c 6.7556e-5                                $ ENDF/B-VI
        12024.70c 5.3362e-5   12025.70c 6.7556e-6   $ ENDF/B-VII.0
        12026.70c 7.4379e-6                                $ ENDF/B-VII.0
        13027.70c 5.9226e-3
        14028.70c 3.2352e-5   14029.70c 1.6381e-6
        14030.70c 1.0874e-6
c       22000.62c 2.5720e-6                                $ ENDF/B-VI
        22046.70c 2.1219e-7   22047.70c 1.9136e-7   $ ENDF/B-VII.0
        22048.70c 1.8961e-6   22049.70c 1.3915e-7   $ ENDF/B-VII.0
        22050.70c 1.3323e-7                                $ ENDF/B-VII.0
        24050.70c 2.7473e-7   24052.70c 5.2918e-6
        24053.70c 5.9998e-7   24054.70c 1.4905e-7
        25055.70c 2.2415e-6
        26054.70c 6.0197e-7   26056.70c 9.4411e-6
        26057.70c 2.1815e-7   26058.70c 2.8812e-8
        29063.70c 4.4681e-6   29065.70c 1.9915e-6
mt4     lwtr.10t
mt5     lwtr.10t
mt8     lwtr.10t

```

end of input

Table A-109. Input file for mix-comp-therm-002-case-pnl33

```

MIX-COMP-THERM-002 PNL-33 square lattice pitch=2.20914 cm 1090.4 PPM
c NNDC Pu-238 and Am-241
1 0 21 23 -25 4 -12 fill=11 imp:n=1 $ Cube for Fueled Core
2 5 0.100160 21 23 -25 (1 -2:14 -15) imp:n=1 $ Bottom/Top Reflector
3 6 0.059721 21 23 -25 2 -4 imp:n=1 $ Aluminum Plate
4 7 0.031723 21 23 -25 12 -14 imp:n=1 $ Lead Shield
5 0 25:-1:15:-21:-23 imp:n=0 $ Out of core
c filling universe $ Cube cell filled Fuel
6 0 -32 31 -34 33 lat=1 u=11 imp:n=1 fill=0:32 0:32 0:0
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 16r
    1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 16r
    1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 16r
    1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 16r
    1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 16r
    1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 16r
    2 560r
c fuel cell universe (u=1)
21 1 0.064971 7 -11 -35 u=1 imp:n=1 $ MOX
22 2 0.062618 6 -7 -35 u=1 imp:n=1 $ UO2 layer
c 23 3 0.042843 3 -11 -36 #21 #22 u=1 imp:n=1 $ ENDF/B-VI Clad
23 3 0.043306 3 -11 -36 #21 #22 u=1 imp:n=1 $ ENDF/B-VII.0
Clad
24 6 0.059721 (5 -8:9 -10) (-37 38:39 -40:41 -42:-43 44)
    u=1 imp:n=1 $ Al Egg-Crate
25 5 0.100160 #21 #22 #23 #24 #26 u=1 imp:n=1 $ Moderator
c 26 3 0.042843 11 -13 -36 u=1 imp:n=1 $ ENDF/B-VI Plug
26 3 0.043306 11 -13 -36 u=1 imp:n=1 $ ENDF/B-VII.0
Plug
c
c Part of Radial reflector cell universe (u=2)
c
31 5 0.100160 #32 u=2 imp:n=1 $ Water
32 6 0.059721 (5 -8:9 -10) (-37 38:39 -40:41 -42:-43 44)
    u=2 imp:n=1 $ Al Egg-Crate

1 pz -30.0 $ bottom of reflector
2 pz 0.0 $ bottom of Al Plate
3 pz 2.85749 $ bottom of Fuel Zone
4 pz 2.8575 $ bottom of clad(plug)
5 pz 3.1750 $ bottom of B-eggcrate
6 pz 3.5560 $ bottom of UO2
7 pz 4.0560 $ bottom of PuO2
8 pz 5.715 $ top of B-eggcrate
9 pz 92.3925 $ bottom of T-eggcrate
10 pz 94.9325 $ top of T-eggcrate

```

Table A-109. Input file for mix-comp-therm-002-case-pnl33 (Cont'd)

11	pz	94.9960								\$ top of PuO2 (plug)
12	pz	95.8215								\$ top of clad
13	pz	95.82151								\$ top of Fuel Zone
14	pz	96.774								\$ top of lead
15	pz	110.236								\$ critical water height
*21	px	0.0								\$ X-Axis
22	px	34.241669								\$ X-Fuel Boundary
*23	py	0.0								\$ Y-Axis
24	py	34.241669								\$ Y-Fuel Boundary
25	cz	70.0								\$ Core Radial Boundary
31	px	-1.10457								\$ - X Cell Boundary
32	px	1.10457								\$ + X Cell Boundary
33	py	-1.10457								\$ - Y Cell Boundary
34	py	1.10457								\$ + Y Cell Boundary
35	cz	0.64135								\$ Fuel Outer Radius
36	cz	0.71755								\$ Clad Outer Radius
37	p	1. -1. 0.	1.16204514							\$ - X Cell Boundary
38	p	1. -1. 0.	1.04709786							\$ - X Cell Boundary
39	p	1. -1. 0.	-1.16204514							\$ - X Cell Boundary
40	p	1. -1. 0.	-1.04709786							\$ - X Cell Boundary
41	p	1. 1. 0.	-1.16204514							\$ - X Cell Boundary
42	p	1. 1. 0.	-1.04709786							\$ - X Cell Boundary
43	p	1. 1. 0.	1.16204514							\$ - X Cell Boundary
44	p	1. 1. 0.	1.04709786							\$ - X Cell Boundary
kcode	10000	1.0	100	600						
ksrc	0.11	0.11	45.	2.20914	0.11	45.	4.41828	0.11	45.	
	6.62742	0.11	45.	8.83656	0.11	45.	11.04570	0.11	45.	
	13.25484	0.11	45.	15.46398	0.11	45.	17.67312	0.11	45.	
	19.88226	0.11	45.	22.09140	0.11	45.	24.30054	0.11	45.	
	26.50968	0.11	45.	28.71882	0.11	45.	30.92796	0.11	45.	
	33.13710	0.11	45.							
	0.1	2.20914	45.	2.20914	2.20914	45.	4.41828	2.20914	45.	
	6.62742	2.20914	45.	8.83656	2.20914	45.	11.04570	2.20914	45.	
	13.25484	2.20914	45.	15.46398	2.20914	45.	17.67312	2.20914	45.	
	19.88226	2.20914	45.	22.09140	2.20914	45.	24.30054	2.20914	45.	
	26.50968	2.20914	45.	28.71882	2.20914	45.	30.92796	2.20914	45.	
	33.13710	2.20914	45.							
	0.1	4.41828	45.	2.20914	4.41828	45.	4.41828	4.41828	45.	
	6.62742	4.41828	45.	8.83656	4.41828	45.	11.04570	4.41828	45.	
	13.25484	4.41828	45.	15.46398	4.41828	45.	17.67312	4.41828	45.	
	19.88226	4.41828	45.	22.09140	4.41828	45.	24.30054	4.41828	45.	
	26.50968	4.41828	45.	28.71882	4.41828	45.	30.92796	4.41828	45.	
	33.13710	4.41828	45.							
	0.1	6.62742	45.	2.20914	6.62742	45.	4.41828	6.62742	45.	
	6.62742	6.62742	45.	8.83656	6.62742	45.	11.04570	6.62742	45.	
	13.25484	6.62742	45.	15.46398	6.62742	45.	17.67312	6.62742	45.	
	19.88226	6.62742	45.	22.09140	6.62742	45.	24.30054	6.62742	45.	
	26.50968	6.62742	45.	28.71882	6.62742	45.	30.92796	6.62742	45.	
	33.13710	6.62742	45.							
	0.1	8.83656	45.	2.20914	8.83656	45.	4.41828	8.83656	45.	
	6.62742	8.83656	45.	8.83656	8.83656	45.	11.04570	8.83656	45.	
	13.25484	8.83656	45.	15.46398	8.83656	45.	17.67312	8.83656	45.	
	19.88226	8.83656	45.	22.09140	8.83656	45.	24.30054	8.83656	45.	
	26.50968	8.83656	45.	28.71882	8.83656	45.	30.92796	8.83656	45.	

Table A-109. Input file for mix-comp-therm-002-case-pnl33 (Cont'd)

0.1	11.04570	45.	2.20914	11.04570	45.	4.41828	11.04570	45.
6.62742	11.04570	45.	8.83656	11.04570	45.	11.04570	11.04570	45.
13.25484	11.04570	45.	15.46398	11.04570	45.	17.67312	11.04570	45.
19.88226	11.04570	45.	22.09140	11.04570	45.	24.30054	11.04570	45.
26.50968	11.04570	45.	28.71882	11.04570	45.	30.92796	11.04570	45.
0.1	13.25484	45.	2.20914	13.25484	45.	4.41828	13.25484	45.
6.62742	13.25484	45.	8.83656	13.25484	45.	11.04570	13.25484	45.
13.25484	13.25484	45.	15.46398	13.25484	45.	17.67312	13.25484	45.
19.88226	13.25484	45.	22.09140	13.25484	45.	24.30054	13.25484	45.
26.50968	13.25484	45.	28.71882	13.25484	45.	30.92796	13.25484	45.
0.1	15.46398	45.	2.20914	15.46398	45.	4.41828	15.46398	45.
6.62742	15.46398	45.	8.83656	15.46398	45.	11.04570	15.46398	45.
13.25484	15.46398	45.	15.46398	15.46398	45.	17.67312	15.46398	45.
19.88226	15.46398	45.	22.09140	15.46398	45.	24.30054	15.46398	45.
26.50968	15.46398	45.	28.71882	15.46398	45.			
0.1	17.67312	45.	2.20914	17.67312	45.	4.41828	17.67312	45.
6.62742	17.67312	45.	8.83656	17.67312	45.	11.04570	17.67312	45.
13.25484	17.67312	45.	15.46398	17.67312	45.	17.67312	17.67312	45.
19.88226	17.67312	45.	22.09140	17.67312	45.	24.30054	17.67312	45.
26.50968	17.67312	45.	28.71882	17.67312	45.			
0.1	19.88226	45.	2.20914	19.88226	45.	4.41828	19.88226	45.
6.62742	19.88226	45.	8.83656	19.88226	45.	11.04570	19.88226	45.
13.25484	19.88226	45.	15.46398	19.88226	45.	17.67312	19.88226	45.
19.88226	19.88226	45.	22.09140	19.88226	45.	24.30054	19.88226	45.
26.50968	19.88226	45.						
0.1	22.09140	45.	2.20914	22.09140	45.	4.41828	22.09140	45.
6.62742	22.09140	45.	8.83656	22.09140	45.	11.04570	22.09140	45.
13.25484	22.09140	45.	15.46398	22.09140	45.	17.67312	22.09140	45.
19.88226	22.09140	45.	22.09140	22.09140	45.	24.30054	22.09140	45.
26.50968	22.09140	45.						
0.1	24.30054	45.	2.20914	24.30054	45.	4.41828	24.30054	45.
6.62742	24.30054	45.	8.83656	24.30054	45.	11.04570	24.30054	45.
13.25484	24.30054	45.	15.46398	24.30054	45.	17.67312	24.30054	45.
19.88226	24.30054	45.	22.09140	24.30054	45.	24.30054	24.30054	45.
0.1	26.50968	45.	2.20914	26.50968	45.	4.41828	26.50968	45.
6.62742	26.50968	45.	8.83656	26.50968	45.	11.04570	26.50968	45.
13.25484	26.50968	45.	15.46398	26.50968	45.	17.67312	26.50968	45.
19.88226	26.50968	45.	22.09140	26.50968	45.			
0.1	28.71882	45.	2.20914	28.71882	45.	4.41828	28.71882	45.
6.62742	28.71882	45.	8.83656	28.71882	45.	11.04570	28.71882	45.
13.25484	28.71882	45.	15.46398	28.71882	45.	17.67312	28.71882	45.
0.1	30.92796	45.	2.20914	30.92796	45.	4.41828	30.92796	45.
6.62742	30.92796	45.	8.83656	30.92796	45.	11.04570	30.92796	45.
13.25484	30.92796	45.						
0.1	33.13710	45.	2.20914	33.13710	45.	4.41828	33.13710	45.
6.62742	33.13710	45.						

mode n

totnu

m1

8016.70c	4.3761e-2	8017.70c	1.7512e-5
92235.70c	1.4886e-4	92238.70c	2.0611e-2
92234.70c	1.2458e-6	92236.70c	2.0936e-9
94238.70c	3.8836e-8	94239.70c	3.9462e-4
94240.70c	3.3206e-5	94241.70c	1.6081e-6
94242.70c	1.1882e-7		
95241.70c	1.4954e-6		

\$ MOX

Table A-109. Input file for mix-comp-therm-002-case-pnl33 (Cont'd)

m2	8016.70c	4.1926e-2	8017.70c	1.6777e-5		\$ UO2
	92234.70c	1.2406e-6	92235.70c	1.4824e-4		
	92236.70c	2.0848e-9	92238.70c	2.0525e-2		
m3	24050.70c	3.3101e-6	24052.70c	6.3758e-5		\$ Clad
	24053.70c	7.2288e-6	24054.70c	1.7958e-6		
	26054.70c	5.5951e-6	26056.70c	8.7752e-5		
	26057.70c	2.0276e-6	26058.70c	2.6780e-7		
	28058.70c	2.0653e-5	28060.70c	7.9541e-6		
	28061.70c	3.4583e-7	28062.70c	1.1012e-6		
	28064.70c	2.8212e-7				
	40090.70c	2.1929e-2	40091.70c	4.7821e-3		
	40092.70c	7.3095e-3	40094.70c	7.4110e-3		
	40096.70c	1.1934e-3				
	50112.70c	4.6878e-6	50114.70c	3.1413e-6	\$ ENDF/B-VII.0	
	50115.70c	1.6432e-6	50116.70c	7.0269e-5	\$ ENDF/B-VII.0	
	50117.70c	3.7116e-5	50118.70c	1.1705e-4	\$ ENDF/B-VII.0	
	50119.70c	4.1514e-5	50120.70c	1.5750e-4	\$ ENDF/B-VII.0	
	50122.70c	2.2376e-5	50124.70c	2.7982e-5	\$ ENDF/B-VII.0	
m4	1001.70c	5.6564e-2				\$ Mod.+Al
	5010.70c	1.0211e-5	5011.70c	4.1356e-5		
	8016.70c	2.8349e-2	8017.70c	1.1344e-5		
c	12000.62c	1.0105e-4			\$ ENDF/B-VI	
	12024.70c	7.9819e-5	12025.70c	1.0105e-5	\$ ENDF/B-VII.0	
	12026.70c	1.1126e-5			\$ ENDF/B-VII.0	
	13027.70c	8.8588e-3				
	14028.70c	4.8390e-5	14029.70c	2.4502e-6		
	14030.70c	1.6265e-6				
c	22000.62c	3.8470e-6			\$ ENDF/B-VI	
	22046.70c	3.1738e-7	22047.70c	2.8622e-7	\$ ENDF/B-VII.0	
	22048.70c	2.8360e-6	22049.70c	2.0812e-7	\$ ENDF/B-VII.0	
	22050.70c	1.9927e-7			\$ ENDF/B-VII.0	
	24050.70c	4.1093e-7	24052.70c	7.9153e-6		
	24053.70c	8.9743e-7	24054.70c	2.2294e-7		
	25055.70c	3.3528e-6				
	26054.70c	9.0043e-7	26056.70c	1.4122e-5		
	26057.70c	3.2631e-7	26058.70c	4.3098e-8		
	29063.70c	6.6833e-6	29065.70c	2.9788e-6		
mt4	lwtr.10t					
m5	1001.70c	6.6672e-2				\$ Mod.
	5010.70c	1.2034e-5	5011.70c	4.8746e-5		
	8016.70c	3.3414e-2	8017.70c	1.3371e-5		
mt5	lwtr.10t					
c m6	12000.62c	6.6651e-4			\$ ENDF/B-VI	Al
m6	12024.70c	5.2648e-4	12025.70c	6.6651e-5	\$ ENDF/B-VII.0	Al
	12026.70c	7.3383e-5			\$ ENDF/B-VII.0	
	13027.70c	5.8433e-2				
	14028.70c	3.1918e-4	14029.70c	1.6161e-5		
	14030.70c	1.0728e-5				
c	22000.62c	2.5375e-5			\$ ENDF/B-VI	
	22046.70c	2.0934e-6	22047.70c	1.8879e-6	\$ ENDF/B-VII.0	
	22048.70c	1.8706e-5	22049.70c	1.3728e-6	\$ ENDF/B-VII.0	
	22050.70c	1.3144e-6			\$ ENDF/B-VII.0	
	24050.70c	2.7105e-6	24052.70c	5.2210e-5		
	24053.70c	5.9195e-6	24054.70c	1.4705e-6		
	25055.70c	2.2115e-5				

Table A-109. Input file for mix-comp-therm-002-case-pnl33 (Cont'd)

```

26054.70c 5.9389e-6 26056.70c 9.3145e-5
26057.70c 2.1522e-6 26058.70c 2.8426e-7
29063.70c 4.4083e-5 29065.70c 1.9648e-5
m7 82206.70c 7.7539e-3 82207.70c 7.1105e-3 $ Lead
82208.70c 1.6859e-2
m8 1001.70c 5.9914e-2 $ H2O
(Rf1)
5010.70c 1.0815e-5 5011.70c 4.3805e-5
8016.70c 3.0028e-2 8017.70c 1.2016e-5
c 12000.62c 6.7556e-5 $ ENDF/B-VI
12024.70c 5.3362e-5 12025.70c 6.7556e-6 $ ENDF/B-VII.0
12026.70c 7.4379e-6 $ ENDF/B-VII.0
13027.70c 5.9226e-3
14028.70c 3.2352e-5 14029.70c 1.6381e-6
14030.70c 1.0874e-6
c 22000.62c 2.5720e-6 $ ENDF/B-VI
22046.70c 2.1219e-7 22047.70c 1.9136e-7 $ ENDF/B-VII.0
22048.70c 1.8961e-6 22049.70c 1.3915e-7 $ ENDF/B-VII.0
22050.70c 1.3323e-7 $ ENDF/B-VII.0
24050.70c 2.7473e-7 24052.70c 5.2918e-6
24053.70c 5.9998e-7 24054.70c 1.4905e-7
25055.70c 2.2415e-6
26054.70c 6.0197e-7 26056.70c 9.4411e-6
26057.70c 2.1815e-7 26058.70c 2.8812e-8
29063.70c 4.4681e-6 29065.70c 1.9915e-6
mt8 lwtr.10t
end of input

```





Table A-110. Input file for mix-comp-therm-002-case-pnl34 (Cont'd)

```

c
31 5 1.00059e-1 #32 u=2 imp:n=1 $ Water
32 6 5.97206e-2 (5 -8:9 -10) (-37 38:39 -40:41 -42:-43 44)
u=2 imp:n=1 $ Al Egg-Crate

c *****
c surface cards
c *****
c
c Axial Position
c
1 pz -30.0 $ bottom of reflector
2 pz 0.0 $ bottom of Al Plate
3 pz 2.85749 $ bottom of Fuel Zone
4 pz 2.8575 $ bottom of clad(plug)
5 pz 3.1750 $ bottom of B-eggcrate
6 pz 3.5560 $ bottom of UO2
7 pz 4.0560 $ bottom of PuO2
8 pz 5.715 $ top of B-eggcrate
9 pz 92.3925 $ bottom of T-eggcrate
10 pz 94.9325 $ top of T-eggcrate
11 pz 94.9960 $ top of PuO2 (plug)
12 pz 95.8215 $ top of clad
13 pz 95.82151 $ top of Fuel Zone
14 pz 96.774 $ top of lead
15 pz 97.282 $ critical water height

c
c Radial Position (core and reflector)
c
*21 px 0.0 $ X-Axis
22 px 21.3729949 $ X-Fuel Boundary
*23 py 0.0 $ Y-Axis
24 py 21.3729949 $ Y-Fuel Boundary
25 cz 60.0 $ Core Radial Boundary

c fuel cell universe
31 px -1.257235 $ - X Cell Boundary
32 px 1.257235 $ + X Cell Boundary
33 py -1.257235 $ - Y Cell Boundary
34 py 1.257235 $ + Y Cell Boundary
35 cz 0.64135 $ Fuel Outer Radius
36 cz 0.71755 $ Clad Outer Radius
37 p 1. -1. 0. 1.48174226 $ - X Cell Boundary
38 p 1. -1. 0. 1.03272945 $ - X Cell Boundary
39 p 1. -1. 0. -1.48174226 $ - X Cell Boundary
40 p 1. -1. 0. -1.03272945 $ - X Cell Boundary
41 p 1. 1. 0. -1.48174226 $ - X Cell Boundary
42 p 1. 1. 0. -1.03272945 $ - X Cell Boundary
43 p 1. 1. 0. 1.48174226 $ - X Cell Boundary
44 p 1. 1. 0. 1.03272945 $ - X Cell Boundary

c *****
c data cards
c *****
mode n
kcode 10000 1.0 100 600

```

Table A-110. Input file for mix-comp-therm-002-case-pnl34 (Cont'd)

```

ksrc  0.1      0.1      45.    2.51447  0.1      45.    5.02894  0.1      45.
      7.54341  0.1      45.   10.05788  0.1      45.   12.57235  0.1      45.
      15.08682  0.1      45.   17.60129  0.1      45.   20.11576  0.1      45.
      0.1      2.51447  45.    2.51447  2.51447  45.    5.02894  2.51447  45.
      7.54341  2.51447  45.   10.05788  2.51447  45.   12.57235  2.51447  45.
      15.08682  2.51447  45.   17.60129  2.51447  45.
      0.1      5.02894  45.    2.51447  5.02894  45.    5.02894  5.02894  45.
      7.54341  5.02894  45.   10.05788  5.02894  45.   12.57235  5.02894  45.
      15.08682  5.02894  45.
      0.1      7.54341  45.    2.51447  7.54341  45.    5.02894  7.54341  45.
      7.54341  7.54341  45.   10.05788  7.54341  45.   12.57235  7.54341  45.
      15.08682  7.54341  45.
      0.1      10.05788  45.    2.51447  10.05788  45.    5.02894  10.05788  45.
      7.54341  10.05788  45.   10.05788  10.05788  45.   12.57235  10.05788  45.
      0.1      12.57235  45.    2.51447  12.57235  45.    5.02894  12.57235  45.
      7.54341  12.57235  45.   10.05788  12.57235  45.
      0.1      15.08682  45.    2.51447  15.08682  45.    5.02894  15.08682  45.
      7.54341  15.08682  45.
      0.1      17.60129  45.    2.51447  17.60129  45.
      0.1      20.11576  45.
c      *****
c      material cards
c      *****
c      MOX
m1     8016.70c  4.3761e-2   8017.70c  1.7512e-5
      92234.70c  1.2458e-6   92235.70c  1.4886e-4
      92236.70c  2.0936e-9   92238.70c  2.0611e-2
      94238.70c  3.8836e-8   94239.70c  3.9462e-4
      94240.70c  3.3206e-5   94241.70c  1.6081e-6
      94242.70c  1.1882e-7
      95241.70c  1.4954e-6
c      UO2
m2     8016.70c  4.1926e-2   8017.70c  1.6777e-5
      92234.70c  1.2406e-6   92235.70c  1.4824e-4
      92236.70c  2.0848e-9   92238.70c  2.0525e-2
c      Cladding
m3     24050.70c  3.3101e-6   24052.70c  6.3758e-5
      24053.70c  7.2288e-6   24054.70c  1.7958e-6
      26054.70c  5.5951e-6   26056.70c  8.7752e-5
      26057.70c  2.0276e-6   26058.70c  2.6780e-7
      28058.70c  2.0653e-5   28060.70c  7.9541e-6
      28061.70c  3.4583e-7   28062.70c  1.1012e-6
      28064.70c  2.8212e-7
      40090.70c  2.1939e-2   40091.70c  4.7843e-3
      40092.70c  7.3129e-3   40094.70c  7.4110e-3
      40096.70c  1.1939e-3
      50112.70c  4.6878e-6   50114.70c  3.1413e-6   $ ENDF/B-VII.0
      50115.70c  1.6432e-6   50116.70c  7.0269e-5   $ ENDF/B-VII.0
      50117.70c  3.7116e-5   50118.70c  1.1705e-4   $ ENDF/B-VII.0
      50119.70c  4.1514e-5   50120.70c  1.5750e-4   $ ENDF/B-VII.0
      50122.70c  2.2376e-5   50124.70c  2.7982e-5   $ ENDF/B-VII.0
c      Moderator + Aluminum
m4     1001.70c  3.7551e-2
      5010.70c  9.9110e-9   5011.70c  4.0144e-8
      8016.70c  1.8767e-2   8017.70c  7.5100e-6

```

Table A-110. Input file for mix-comp-therm-002-case-pnl34 (Cont'd)

c	12000.62c	2.9131e-4			\$ ENDF/B-VI
	12024.70c	2.3011e-4	12025.70c	2.9131e-5	\$ ENDF/B-VII.0
	12026.70c	3.2073e-5			\$ ENDF/B-VII.0
	13027.70c	2.5540e-2			
	14028.70c	1.3951e-4	14029.70c	7.0638e-6	
	14030.70c	4.6891e-6			
c	22000.62c	1.1091e-5			\$ ENDF/B-VI
	22046.70c	9.1501e-7	22047.70c	8.2517e-7	\$ ENDF/B-VII.0
	22048.70c	8.1763e-6	22049.70c	6.0002e-7	\$ ENDF/B-VII.0
	22050.70c	5.7451e-7			\$ ENDF/B-VII.0
	24050.70c	1.1847e-6	24052.70c	2.2819e-5	
	24053.70c	2.5872e-6	24054.70c	6.4272e-7	
	25055.70c	9.6659e-6			
	26054.70c	2.5959e-6	26056.70c	4.0713e-5	
	26057.70c	9.4073e-7	26058.70c	1.2425e-7	
	29063.70c	1.9267e-5	29065.70c	8.5877e-6	
c	Moderator				
m5	1001.70c	6.6706e-2			
	5010.70c	1.7606e-8	5011.70c	7.1313e-8	
	8016.70c	3.3340e-2	8017.70c	1.3341e-5	
c	Aluminum				
c m6	12000.62c	6.6651e-4			\$ ENDF/B-VI
m6	12024.70c	5.2648e-4	12025.70c	6.6651e-5	\$ ENDF/B-VII.0
	12026.70c	7.3383e-5			\$ ENDF/B-VII.0
	13027.70c	5.8433e-2			
	14028.70c	3.1918e-4	14029.70c	1.6161e-5	
	14030.70c	1.0728e-5			
c	22000.62c	2.5375e-5			\$ ENDF/B-VI
	22046.70c	2.0934e-6	22047.70c	1.8879e-6	\$ ENDF/B-VII.0
	22048.70c	1.8706e-5	22049.70c	1.3728e-6	\$ ENDF/B-VII.0
	22050.70c	1.3144e-6			\$ ENDF/B-VII.0
	24050.70c	2.7105e-6	24052.70c	5.2210e-5	
	24053.70c	5.9195e-6	24054.70c	1.4705e-6	
	25055.70c	2.2115e-5			
	26054.70c	5.9389e-6	26056.70c	9.3145e-5	
	26057.70c	2.1522e-6	26058.70c	2.8426e-7	
	29063.70c	4.4083e-5	29065.70c	1.9648e-5	
c	Lead				
m7	82206.70c	7.7539e-3	82207.70c	7.1105e-3	
	82208.70c	1.6859e-2			
c	Water + Aluminum (Reflector)				
m8	1001.70c	4.5010e-2			
	5010.70c	1.1880e-8	5011.70c	4.8118e-8	
	8016.70c	2.2496e-2	8017.70c	9.0020e-6	
c	12000.62c	2.1678e-4			\$ ENDF/B-VI
	12024.70c	1.7123e-4	12025.70c	2.1678e-5	\$ ENDF/B-VII.0
	12026.70c	2.3867e-5			\$ ENDF/B-VII.0
	13027.70c	1.9006e-2			
	14028.70c	1.0381e-4	14029.70c	5.2566e-6	
	14030.70c	3.4894e-6			
c	22000.62c	8.2534e-6			\$ ENDF/B-VI
	22046.70c	6.8091e-7	22047.70c	6.1405e-7	\$ ENDF/B-VII.0
	22048.70c	6.0844e-6	22049.70c	4.4651e-7	\$ ENDF/B-VII.0
	22050.70c	4.2753e-7			\$ ENDF/B-VII.0
	24050.70c	8.8161e-7	24052.70c	1.6982e-5	

Table A-110. Input file for mix-comp-therm-002-case-pnl34 (Cont'd)

```
24053.70c 1.9254e-6 24054.70c 4.7830e-7
25055.70c 7.1931e-6
26054.70c 1.9312e-6 26056.70c 3.0289e-5
26057.70c 6.9985e-7 26058.70c 9.2434e-8
29063.70c 1.4338e-5 29065.70c 6.3908e-6
mt4 lwtr.10t
mt5 lwtr.10t
mt8 lwtr.10t

end of input
```

Table A-111. Input file for mix-comp-therm-002-case-pnl35

```

MIX-COMP-THERM-002 PNL-35: square lattice, pitch=2.51447 cm, 767.2 PPM
c *****
c cell cards
c *****
1 0 21 23 -25 4 -12 fill=11 imp:n=1 $ Cube for Fuelled Core
2 5 0.100130 21 23 -25 (1 -2:14 -15) imp:n=1 $ Bottom / Top Reflector
3 6 0.059721 21 23 -25 2 -4 imp:n=1 $ Aluminum Plate
4 7 0.031723 21 23 -25 12 -14 imp:n=1 $ Lead Shield
5 0 25:-1:15:-21:-23 imp:n=0 $ Out of core
c
c filling universe $ Cube cell filled Fuel
c
6 0 -32 31 -34 33 lat=1 u=11 imp:n=1 fill=0:28 0:28 0:0
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 13r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 13r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 13r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 13r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 13r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 13r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 13r
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 13r
  1 1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 13r
  1 1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 13r
  1 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 13r
  1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 13r
  1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 13r
  1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2 13r
  2 405r
c
c fuel cell universe (u=1)
c
21 1 0.064971 7 -11 -35 u=1 imp:n=1 $ MOX
22 2 0.062618 6 -7 -35 u=1 imp:n=1 $ UO2 layer
c 23 3 0.042823 3 -11 -36 #21 #22 u=1 imp:n=1 $ ENDF/B-VI Clad
23 3 0.043306 3 -11 -36 #21 #22 u=1 imp:n=1 $ ENDF/B-VII.0 Clad
24 6 0.059721 (5 -8:9 -10) (-37 38:39 -40:41 -42:-43 44)
  u=1 imp:n=1 $ Al Egg-Crate
25 5 0.100130 #21 #22 #23 #24 #26 u=1 imp:n=1 $ Moderator
c 26 3 0.042823 11 -13 -36 u=1 imp:n=1 $ ENDF/B-VI Top
Plug
26 3 0.043306 11 -13 -36 u=1 imp:n=1 $ ENDF/B-VII.0 Top
Plug
c
c Part of Radial reflector cell universe (u=2)
c
31 5 0.100130 #32 u=2 imp:n=1 $ Water
32 6 0.059721 (5 -8:9 -10) (-37 38:39 -40:41 -42:-43 44)
  u=2 imp:n=1 $ Al Egg-Crate

c *****
c surface cards
c *****
c
c Axial Position

```

Table A-111. Input file for mix-comp-therm-002-case-pnl35 (Cont'd)

```

c
1 pz -30.0 $ bottom of reflector
2 pz 0.0 $ bottom of Al Plate
3 pz 2.85749 $ bottom of Fuel Zone
4 pz 2.8575 $ bottom of clad(plug)
5 pz 3.1750 $ bottom of B-eggcrate
6 pz 3.5560 $ bottom of UO2
7 pz 4.0560 $ bottom of PuO2
8 pz 5.715 $ top of B-eggcrate
9 pz 92.3925 $ bottom of T-eggcrate
10 pz 94.9325 $ top of T-eggcrate
11 pz 94.9960 $ top of PuO2 (plug)
12 pz 95.8215 $ top of clad
13 pz 95.82151 $ top of Fuel Zone
14 pz 96.774 $ top of lead
15 pz 110.236 $ critical water height

c
c Radial Position (core and reflector)
c
*21 px 0.0 $ X-Axis
22 px 36.4598149 $ X-Fuel Boundary
*23 py 0.0 $ Y-Axis
24 py 36.4598149 $ Y-Fuel Boundary
25 cz 70.0 $ Core Radial Boundary

c fuel cell universe
31 px -1.257235 $ - X Cell Boundary
32 px 1.257235 $ + X Cell Boundary
33 py -1.257235 $ - Y Cell Boundary
34 py 1.257235 $ + Y Cell Boundary
35 cz 0.64135 $ Fuel Outer Radius
36 cz 0.71755 $ Clad Outer Radius
37 p 1. -1. 0. 1.48174226 $ - X Cell Boundary
38 p 1. -1. 0. 1.03272945 $ - X Cell Boundary
39 p 1. -1. 0. -1.48174226 $ - X Cell Boundary
40 p 1. -1. 0. -1.03272945 $ - X Cell Boundary
41 p 1. 1. 0. -1.48174226 $ - X Cell Boundary
42 p 1. 1. 0. -1.03272945 $ - X Cell Boundary
43 p 1. 1. 0. 1.48174226 $ - X Cell Boundary
44 p 1. 1. 0. 1.03272945 $ - X Cell Boundary

c *****
c data cards
c *****

mode n
kcode 10000 1.0 100 600
ksrc 0.1 0.1 45. 2.51447 0.1 45. 5.02894 0.1 45.
7.54341 0.1 45. 10.05788 0.1 45. 12.57235 0.1 45.
15.08682 0.1 45. 17.60129 0.1 45. 20.11576 0.1 45.
22.63023 0.1 45. 25.14470 0.1 45. 27.65917 0.1 45.
30.17364 0.1 45. 32.68811 0.1 45. 35.20258 0.1 45.
0.1 2.51447 45. 2.51447 2.51447 45. 5.02894 2.51447 45.
7.54341 2.51447 45. 10.05788 2.51447 45. 12.57235 2.51447 45.
15.08682 2.51447 45. 17.60129 2.51447 45. 20.11576 2.51447 45.
22.63023 2.51447 45. 25.14470 2.51447 45. 27.65917 2.51447 45.
30.17364 2.51447 45. 32.68811 2.51447 45. 35.20258 2.51447 45.

```

Table A-111. Input file for mix-comp-therm-002-case-pnl35 (Cont'd)

0.1	5.02894	45.	2.51447	5.02894	45.	5.02894	5.02894	45.
7.54341	5.02894	45.	10.05788	5.02894	45.	12.57235	5.02894	45.
15.08682	5.02894	45.	17.60129	5.02894	45.	20.11576	5.02894	45.
22.63023	5.02894	45.	25.14470	5.02894	45.	27.65917	5.02894	45.
30.17364	5.02894	45.	32.68811	5.02894	45.	35.20258	5.02894	45.
0.1	7.54341	45.	2.51447	7.54341	45.	5.02894	7.54341	45.
7.54341	7.54341	45.	10.05788	7.54341	45.	12.57235	7.54341	45.
15.08682	7.54341	45.	17.60129	7.54341	45.	20.11576	7.54341	45.
22.63023	7.54341	45.	25.14470	7.54341	45.	27.65917	7.54341	45.
30.17364	7.54341	45.	32.68811	7.54341	45.	35.20258	7.54341	45.
0.1	10.05788	45.	2.51447	10.05788	45.	5.02894	10.05788	45.
7.54341	10.05788	45.	10.05788	10.05788	45.	12.57235	10.05788	45.
15.08682	10.05788	45.	17.60129	10.05788	45.	20.11576	10.05788	45.
22.63023	10.05788	45.	25.14470	10.05788	45.	27.65917	10.05788	45.
30.17364	10.05788	45.	32.68811	10.05788	45.	35.20258	10.05788	45.
0.1	12.57235	45.	2.51447	12.57235	45.	5.02894	12.57235	45.
7.54341	12.57235	45.	10.05788	12.57235	45.	12.57235	12.57235	45.
15.08682	12.57235	45.	17.60129	12.57235	45.	20.11576	12.57235	45.
22.63023	12.57235	45.	25.14470	12.57235	45.	27.65917	12.57235	45.
30.17364	12.57235	45.	32.68811	12.57235	45.	35.20258	12.57235	45.
0.1	15.08682	45.	2.51447	15.08682	45.	5.02894	15.08682	45.
7.54341	15.08682	45.	10.05788	15.08682	45.	12.57235	15.08682	45.
15.08682	15.08682	45.	17.60129	15.08682	45.	20.11576	15.08682	45.
22.63023	15.08682	45.	25.14470	15.08682	45.	27.65917	15.08682	45.
30.17364	15.08682	45.	32.68811	15.08682	45.			
0.1	17.60129	45.	2.51447	17.60129	45.	5.02894	17.60129	45.
7.54341	17.60129	45.	10.05788	17.60129	45.	12.57235	17.60129	45.
15.08682	17.60129	45.	17.60129	17.60129	45.	20.11576	17.60129	45.
22.63023	17.60129	45.	25.14470	17.60129	45.	27.65917	17.60129	45.
30.17364	17.60129	45.	32.68811	17.60129	45.			
0.1	20.11576	45.	2.51447	20.11576	45.	5.02894	20.11576	45.
7.54341	20.11576	45.	10.05788	20.11576	45.	12.57235	20.11576	45.
15.08682	20.11576	45.	17.60129	20.11576	45.	20.11576	20.11576	45.
22.63023	20.11576	45.	25.14470	20.11576	45.	27.65917	20.11576	45.
30.17364	20.11576	45.						
0.1	22.63023	45.	2.51447	22.63023	45.	5.02894	22.63023	45.
7.54341	22.63023	45.	10.05788	22.63023	45.	12.57235	22.63023	45.
15.08682	22.63023	45.	17.60129	22.63023	45.	20.11576	22.63023	45.
22.63023	22.63023	45.	25.14470	22.63023	45.	27.65917	22.63023	45.
0.1	25.14470	45.	2.51447	25.14470	45.	5.02894	25.14470	45.
7.54341	25.14470	45.	10.05788	25.14470	45.	12.57235	25.14470	45.
15.08682	25.14470	45.	17.60129	25.14470	45.	20.11576	25.14470	45.
22.63023	25.14470	45.	25.14470	25.14470	45.			
0.1	27.65917	45.	2.51447	27.65917	45.	5.02894	27.65917	45.
7.54341	27.65917	45.	10.05788	27.65917	45.	12.57235	27.65917	45.
15.08682	27.65917	45.	17.60129	27.65917	45.	20.11576	27.65917	45.
22.63023	27.65917	45.						
0.1	30.17364	45.	2.51447	30.17364	45.	5.02894	30.17364	45.
7.54341	30.17364	45.	10.05788	30.17364	45.	12.57235	30.17364	45.
15.08682	30.17364	45.	17.60129	30.17364	45.	20.11576	30.17364	45.
0.1	32.68811	45.	2.51447	32.68811	45.	5.02894	32.68811	45.
7.54341	32.68811	45.	10.05788	32.68811	45.	12.57235	32.68811	45.
15.08682	32.68811	45.	17.60129	32.68811	45.			
0.1	35.20258	45.	2.51447	35.20258	45.	5.02894	35.20258	45.
7.54341	35.20258	45.	10.05788	35.20258	45.	12.57235	35.20258	45.



Table A-111. Input file for mix-comp-therm-002-case-pnl35 (Cont'd)

```

c *****
c material cards
c *****
c      MOX
m1    8016.70c 4.3761e-2   8017.70c 1.7512e-5
      92234.70c 1.2458e-6  92235.70c 1.4886e-4
      92236.70c 2.0936e-9  92238.70c 2.0611e-2
      94238.70c 3.8836e-8  94239.70c 3.9462e-4
      94240.70c 3.3206e-5  94241.70c 1.6081e-6
      94242.70c 1.1882e-7
      95241.70c 1.4954e-6
c      UO2
m2    8016.70c 4.1926e-2   8017.70c 1.6777e-5
      92234.70c 1.2406e-6  92235.70c 1.4824e-4
      92236.70c 2.0848e-9  92238.70c 2.0525e-2
c      Cladding
m3    24050.70c 3.3101e-6  24052.70c 6.3758e-5
      24053.70c 7.2288e-6  24054.70c 1.7958e-6
      26054.70c 5.5951e-6  26056.70c 8.7752e-5
      26057.70c 2.0276e-6  26058.70c 2.6780e-7
      28058.70c 2.0653e-5  28060.70c 7.9541e-6
      28061.70c 3.4583e-7  28062.70c 1.1012e-6
      28064.70c 2.8212e-7
      40090.70c 2.1939e-2   40091.70c 4.7843e-3
      40092.70c 7.3129e-3   40094.70c 7.4110e-3
      40096.70c 1.1939e-3
      50112.70c 4.6878e-6   50114.70c 3.1413e-6   $ ENDF/B-VII.0
      50115.70c 1.6432e-6   50116.70c 7.0269e-5   $ ENDF/B-VII.0
      50117.70c 3.7116e-5   50118.70c 1.1705e-4   $ ENDF/B-VII.0
      50119.70c 4.1514e-5   50120.70c 1.5750e-4   $ ENDF/B-VII.0
      50122.70c 2.2376e-5   50124.70c 2.7982e-5   $ ENDF/B-VII.0
c      Moderator + Aluminum
m4    1001.70c 3.7537e-2
      5010.70c 4.7622e-6   5011.70c 1.9289e-5
      8016.70c 1.8796e-2   8017.70c 7.5216e-6
c      12000.62c 2.9131e-4                                     $ ENDF/B-VI
      12024.70c 2.3011e-4   12025.70c 2.9131e-5   $ ENDF/B-VII.0
      12026.70c 3.2073e-5                                     $ ENDF/B-VII.0
      13027.70c 2.5540e-2
      14028.70c 1.3951e-4   14029.70c 7.0638e-6
      14030.70c 4.6891e-6
c      22000.62c 1.1091e-5                                     $ ENDF/B-VI
      22046.70c 9.1501e-7   22047.70c 8.2517e-7   $ ENDF/B-VII.0
      22048.70c 8.1763e-6   22049.70c 6.0002e-7   $ ENDF/B-VII.0
      22050.70c 5.7451e-7                                     $ ENDF/B-VII.0
      24050.70c 1.1847e-6   24052.70c 2.2819e-5
      24053.70c 2.5872e-6   24054.70c 6.4272e-7
      25055.70c 9.6659e-6
      26054.70c 2.5959e-6   26056.70c 4.0713e-5
      26057.70c 9.4073e-7   26058.70c 1.2425e-7
      29063.70c 1.9267e-5   29065.70c 8.5877e-6
c      Moderator
m5    1001.70c 6.6682e-2
      5010.70c 8.4597e-6   5011.70c 3.4266e-5
      8016.70c 3.3392e-2   8017.70c 1.3362e-5

```

Table A-111. Input file for mix-comp-therm-002-case-pnl35 (Cont'd)

```

c      Aluminum
c m6   12000.62c 6.6651e-4          $ ENDF/B-VI
m6     12024.70c 5.2648e-4  12025.70c 6.6651e-5  $ ENDF/B-VII.0
      12026.70c 7.3383e-5          $ ENDF/B-VII.0
      13027.70c 5.8433e-2
      14028.70c 3.1918e-4  14029.70c 1.6161e-5
      14030.70c 1.0728e-5
c      22000.62c 2.5375e-5          $ ENDF/B-VI
      22046.70c 2.0934e-6  22047.70c 1.8879e-6  $ ENDF/B-VII.0
      22048.70c 1.8706e-5  22049.70c 1.3728e-6  $ ENDF/B-VII.0
      22050.70c 1.3144e-6          $ ENDF/B-VII.0
      24050.70c 2.7105e-6  24052.70c 5.2210e-5
      24053.70c 5.9195e-6  24054.70c 1.4705e-6
      25055.70c 2.2115e-5
      26054.70c 5.9389e-6  26056.70c 9.3145e-5
      26057.70c 2.1522e-6  26058.70c 2.8426e-7
      29063.70c 4.4083e-5  29065.70c 1.9648e-5
c      Lead
m7     82206.70c 7.7539e-3  82207.70c 7.1105e-3
      82208.70c 1.6859e-2
c      Water + Aluminum (Reflector)
m8     1001.70c 4.4994e-2
      5010.70c 5.7082e-6  5011.70c 2.3121e-5
      8016.70c 2.2531e-2  8017.70c 9.0160e-6
c      12000.62c 2.1678e-4          $ ENDF/B-VI
      12024.70c 1.7123e-4  12025.70c 2.1678e-5  $ ENDF/B-VII.0
      12026.70c 2.3867e-5          $ ENDF/B-VII.0
      13027.70c 1.9006e-2
      14028.70c 1.3951e-4  14029.70c 7.0638e-6
      14030.70c 4.6891e-6
c      22000.62c 8.2534e-6          $ ENDF/B-VI
      22046.70c 6.8091e-7  22047.70c 6.1405e-7  $ ENDF/B-VII.0
      22048.70c 6.0844e-6  22049.70c 4.4651e-7  $ ENDF/B-VII.0
      22050.70c 4.2753e-7          $ ENDF/B-VII.0
      24050.70c 8.8161e-7  24052.70c 1.6982e-5
      24053.70c 1.9254e-6  24054.70c 4.7830e-7
      25055.70c 7.1931e-6
      26054.70c 1.9312e-6  26056.70c 3.0289e-5
      26057.70c 6.9985e-7  26058.70c 9.2434e-8
      29063.70c 1.4338e-5  29065.70c 6.3908e-6
mt4    lwtr.10t
mt5    lwtr.10t
mt8    lwtr.10t

end of input

```

Table A-112. Input file for pu-sol-therm-009-case-3a

```

PU-SOL-THERM-009 Case 3A Plutonium Nitrate Solution in Al-1100 Sphere
1 1 0.100416 -1
2 2 0.060325 -2 1
3 0 2

1 so 60.964
2 so 61.734

kcode 10000 1.0 100 600
sdef cel=1 erg=d1 rad=d2 pos=0.0 0.0 0.0
sp1 -3
si2 0.0 60.9
sp2 -21 2
totnu
imp:n 1.0 1.0 0.0
c plutonium nitrate
m1 1001.70c 6.5121e-02
7014.70c 7.6076e-04
8016.70c 3.4496e-02 8017.70c 1.3804e-05
94238.70c 9.5696e-10 94239.70c 2.3201e-05
94240.70c 5.9809e-07 94241.70c 1.7720e-08
94242.70c 3.2939e-09
mt1 lwtr.10t
c al 1100
m2 13027.70c 5.9881e-02
14028.70c 3.4835e-04 14029.70c 1.7639e-05
14030.70c 1.1709e-05
25055.70c 1.4853e-05
29063.70c 3.5529e-05 29065.70c 1.5836e-05

end of input

```

Table A-113. Input file for pu-sol-therm-011-case-16-5

```

PNL-5 16" Bare Sphere, 43.43g Pu/l, 4.17 wt% Pu-240 PU-SOL-THERM-011 Case 16-5
c CSEWG: T-17
1 1 1.002582e-1 -1 imp:n=1 $ Pu(NO3)4 Solution
2 2 8.6914e-2 1 -2 imp:n=1 $ SS347 Sphere
3 0 2 imp:n=0 $ Outside Everything

1 so 20.1206 $ Sphere Inner Radius
2 so 20.2476 $ Sphere Outer Radius

mode n
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad dl
scl Spherical Source about origin
sil 20.1205
c Materials specified with atom densities
m1 94239.70c 1.0484e-4 94240.70c 4.5432e-6
    7014.70c 2.7369e-3
    1001.70c 6.0233e-2
    8016.70c 3.7162e-2 8017.70c 1.4871e-5
    26054.70c 1.1388e-7 26056.70c 1.7704e-6
    26057.70c 4.0534e-8 26058.70c 5.4046e-9
mt1 lwtr.10t
m2 26054.70c 3.5628e-3 26056.70c 5.5386e-2
    26057.70c 1.2681e-3 26058.70c 1.6908e-4
    24050.70c 7.2466e-4 24052.70c 1.3975e-2
    24053.70c 1.5844e-3 24054.70c 3.9444e-4
    28058.70c 6.7249e-3 28060.70c 2.5710e-3
    28061.70c 1.1131e-4 28062.70c 3.5363e-4
    28064.70c 8.9639e-5
totnu

```

Table A-114. Input file for pu-sol-therm-011-case-18-1

```

PNL-3 18" Cadmium-covered Bare Sphere of Pu Nitrate 22.35 gPu/l 4.2 wt% Pu-240
c  PU-SOL-THERM-011 Case 18-1 and CSEWG T-15
1  1  1.004758e-1  -1      imp:n=1  $ Pu(NO3)4 Solution
2  2  8.6914e-2    1 -2    imp:n=1  $ SS347 Sphere
3  3  4.6340e-2    2 -3    imp:n=1  $ Cadmium Cover
4  0                                3      imp:n=0  $ Outside Everything

1  so  22.6974    $ Sphere Inner Radius
2  so  22.8244    $ Sphere Outer Radius
3  so  22.8752    $ Cadmium Cover Outer Radius

mode      n
kcode     10000 1. 100 600
sdef      pos 0.0 0.0 0.0 rad d1
sc1       Spherical Source about origin
sil       22.6973
c         Materials specified with atom densities
m1        94239.70c 5.3938e-5      94240.70c 2.3549e-6    $ Solution
          7014.70c 7.3930e-4
          1001.70c 6.5147e-2
          8016.70c 3.4520e-2      8017.70c 1.3814e-5
          26054.70c 7.6346e-8    26056.70c 1.1869e-6
          26057.70c 2.7174e-8    26058.70c 3.6232e-9
mt1       lwtr.10t
m2        26054.70c 3.5628e-3    26056.70c 5.5386e-2
          26057.70c 1.2681e-3    26058.70c 1.6908e-4
          24050.70c 7.2466e-4    24052.70c 1.3975e-2
          24053.70c 1.5844e-3    24054.70c 3.9444e-4
          28058.70c 6.7249e-3    28060.70c 2.5710e-3
          28061.70c 1.1131e-4    28062.70c 3.5363e-4
          28064.70c 8.9639e-5
m3        48106.70c 5.7925e-4    48108.70c 4.1243e-4
          48110.70c 5.7879e-3    48111.70c 5.9315e-3
          48112.70c 1.1182e-2    48114.70c 1.3314e-2
          48116.70c 3.4709e-3
totnu

```

Table A-115. Input file for pu-sol-therm-011-case-18-6

```

PNL-4 18" Cadmium-covered Bare Sphere of Pu Nitrate, 27.49 g Pu/l
c 4.2 wt% Pu-240
c PU-SOL-THERM-011 Case 18-6 and CSEWG: T-16
1 1 1.003191e-1 -1 imp:n=1 $ Pu(NO3)4 Solution
2 2 8.6914e-2 1 -2 imp:n=1 $ SS347 Sphere
3 3 4.6340e-2 2 -3 imp:n=1 $ Cadmium Cover
4 0 3 imp:n=0 $ Outside Everything

1 so 22.6974 $ Sphere Inner Radius
2 so 22.8244 $ Sphere Outer Radius
3 so 22.8752 $ Cadmium Cover Outer Radius

mode n
kcode 10000 1. 100 600
sdef pos 0.0 0.0 0.0 rad d1
scl Spherical Source about origin
sil 22.6973
c Materials specified with atom densities
m1 94239.70c 6.6343e-5 94240.70c 2.8964e-6
7014.70c 2.7753e-3
1001.70c 6.0264e-2
8016.70c 3.7194e-2 8017.70c 1.4884e-5
26054.70c 8.9704e-8 26056.70c 1.3945e-6
26057.70c 3.1928e-8 26058.70c 4.2571e-9
mt1 lwtr.10t
m2 26054.70c 3.5628e-3 26056.70c 5.5386e-2
26057.70c 1.2681e-3 26058.70c 1.6908e-4
24050.70c 7.2466e-4 24052.70c 1.3975e-2
24053.70c 1.5844e-3 24054.70c 3.9444e-4
28058.70c 6.7249e-3 28060.70c 2.5710e-3
28061.70c 1.1131e-4 28062.70c 3.5363e-4
28064.70c 8.9639e-5
m3 48106.70c 5.7925e-4 48108.70c 4.1243e-4
48110.70c 5.7879e-3 48111.70c 5.9315e-3
48112.70c 1.1182e-2 48114.70c 1.3314e-2
48116.70c 3.4709e-3
totnu

```

Table A-116. Input file for pu-sol-therm-018-case-9

```

PNL-11  PU-SOL-THERM-018 case 9  42.9 wt.% Pu-240  Water-Reflected
c  tank with plutonium nitrate solution with traces of Am and Gd
1   1  0.100115  -104 126 -128      $ Fissile Solution
2   2  0.086320   100 -110 120 -122  $ Bottom of Reflector Tank
3   2  0.086320   100 -102 122 -124  $ Support Pipe
4   2  0.086320  -106 124 -126      $ Bottom of Solution Tank
5   2  0.086320   104 -106 126 -130  $ Wall of Solution Tank
6   2  0.086320  -106 130 -132      $ Top of Solution Tank
7   2  0.086320   108 -110 122 -134  $ Wall of Reflector Tank
8   3  0.100037   102 -108 122 -124  $ Water Surrounding Pipe
9   3  0.100037   106 -108 124 -132  $ Water Surrounding Tank
10  0                -100 120 -124  $ Center of Support Pipe
11  0                -104 128 -130  $ Void In Solution Tank
12  0                -108 132 -134  $ Void Above Solution Tank
13  0                110:-120:134

100  cz      2.555                $ Pipe Inner Radius
102  cz      2.860                $ Pipe Outer Radius
104  cz     30.514                $ Solution Tank Inner Radius
106  cz     30.593                $ Solution Tank Outer Radius
108  cz     50.523                $ Reflector Tank Inner Radius
110  cz     50.800                $ Reflector Tank Outer Radius
120  pz      0                    $ Bottom of Reflector Tank
122  pz     0.277                $ Bottom of Water Reflector
124  pz     21.227                $ Top of Support Pipe
126  pz     22.177                $ Bottom of Solution Tank
128  pz    103.097                $ Fissile Solution Height
130  pz    127.828                $ Top of Solution Tank
132  pz    127.907                $ Water Reflector Height
134  pz    143.000                $ Top of Reflector Tank

kcode  10000  1.0  100  600
imp:n   1.0  11r  0.0
sdef   cel=1  erg=d1  rad=d2  pos 0.0 0.0 62.6
spl    -3
si2    0.0  30.0
totnu

c      Plutonium Nitrate Solution, with Am and Gd
m1    1001.70c  6.3362e-02
      7014.70c  1.2902e-03
      8016.70c  3.5098e-02      8017.70c  1.4045e-05
      64152.70c 2.7662e-11      64154.70c  3.0152e-10
      64155.70c 2.0470e-09      64156.70c  2.8312e-09
      64157.70c 2.1646e-09      64158.70c  3.4357e-09
      64160.70c 3.0235e-09
      94238.70c 2.0831e-07      94239.70c  4.2266e-05
      94240.70c 4.3641e-05      94241.70c  1.1029e-05
      94242.70c 4.7482e-06
      95241.70c 1.0949e-06

mt1   lwtr.10t
c     Stainless Steel 304
m2    26054.70c 3.6986e-03      26056.70c  5.8060e-02
      26057.70c 1.3409e-03      26058.70c  1.7844e-04
      24050.70c 7.1832e-04      24052.70c  1.3852e-02
      24053.70c 1.5707e-03      24054.70c  3.9098e-04

```

Table A-116. Input file for pu-sol-therm-018-case-9 (Cont'd)

```

28058.70c 4.4315e-03      28060.70c 1.7070e-03
28061.70c 7.4202e-05      28062.70c 2.3659e-04
28064.70c 6.0252e-05
c      Water
m3     1001.70c 6.6691e-02
      8016.70c 3.3333e-02      8017.70c 1.3338e-05
mt3    lwtr.10t

```

Table A-117. Input file for pu-sol-therm-021-case-1

```

PNL-1 PU-SOL-THERM-021 case 1 Unreflected sphere of plutonium-nitrate solution
c CSEWG T13
1  1  0.100785  -1          $ Plutonium-nitrate solution
2  2  0.086240  1  -2        $ Stainless steel shell
3  0                      2

1  so 19.3304          $ Outer radius of solution
2  so 19.4523          $ Outer radius of shell

kcode 10000 1. 100 600
imp:n  1 1 0
sdef   pos 0.0 0.0 0.0 rad d1
scl    Spherical Source
sil    19.3
totnu

c      Materials specified with atom densities
m1     1001.70c 6.5515e-2
      7014.70c 6.3382e-4
      8016.70c 3.4524e-2      8017.70c 1.3815e-5
      94238.70c 5.9197e-9     94239.70c 9.3366e-5
      94240.70c 4.5680e-6     94241.70c 2.7573e-7
      94242.70c 8.7324e-9
mt1    lwtr.10t
c      Stainless Steel
m2     24050.70c 7.5725e-4     24052.70c 1.4603e-2
      24053.70c 1.6557e-3     24054.70c 4.1217e-4
      25055.70c 1.7363e-3
      26054.70c 3.5019e-3     26056.70c 5.4440e-2
      26057.70c 1.2465e-3     26058.70c 1.6619e-4
      28058.70c 5.2706e-3     28060.70c 2.0150e-3
      28061.70c 8.7239e-5     28062.70c 2.7716e-4
      28064.70c 7.0255e-5

```



Table A-118. Input file for pu-sol-therm-021-case-3

```

PNL-6  PU-SOL-THERM-021 Case 3  15.2-inch Sphere of Plutonium Nitrate
c  CSEWG: T-14
1  1  0.099270          -1          $ Plutonium Nitrate Solution
2  2  0.086240          -2  1          $ Stainless Steel Container
3  0                      2

1  so  19.3163
2  so  19.4382

kcode  10000  1.0  100  600
imp:n  1.0  1.0  0.0
sdef  cel=1  erg=d1
spl  -3
c  Plutonium Nitrate Solution
m1  1001.70c  5.4377e-02
    7014.70c  4.6867e-03
    8016.70c  3.9757e-02  8017.70c  1.5909e-05
    94239.70c  4.1249e-04  94240.70c  2.0181e-05
    94241.70c  1.2181e-06  94242.70c  3.8579e-08
mt1  lwtr.10t
c  Stainless Steel
m2  24050.70c  7.5725e-04  24052.70c  1.4603e-02
    24053.70c  1.6557e-03  24054.70c  4.1217e-04
    25055.70c  1.7363e-03
    26054.70c  3.5019e-03  26056.70c  5.4440e-02
    26057.70c  1.2465e-03  26058.70c  1.6619e-04
    28058.70c  5.2706e-03  28060.70c  2.0150e-03
    28061.70c  8.7239e-05  28062.70c  2.7716e-04
    28064.70c  7.0255e-05
totnu

end of input

```

Table A-119. Input file for pu-sol-therm-034-case-1

```

PNL-10  PU-SOL-THERM-034  case 1  8.3 wt.% Pu-240  116 gPu/l
c  Water-reflected SS304L cylindrical tank with plutonium nitrate solution
1  0          -100 120 -124          $ Center of Support Pipe
2  0          -104 128 -130          $ Void In Solution Tank
3  0          -108 132 -134          $ Void Above Solution Tank
4  1  .100476 -104 126 -128          $ Fissile Solution
5  2  .086320  100 -110 120 -122     $ Bottom of Reflector Tank
6  2  .086320  100 -102 122 -124     $ Support Pipe
7  2  .086320 -106 124 -126          $ Bottom of Solution Tank
8  2  .086320  104 -106 126 -130     $ Wall of Solution Tank
9  2  .086320 -106 130 -132          $ Top of Solution Tank
10 2  .086320  108 -110 122 -134     $ Wall of Reflector Tank
11 3  .100037  102 -108 122 -124     $ Water Surrounding Pipe
12 3  .100037  106 -108 124 -132     $ Water Surrounding Tank
13 0          110:-120:134          $ Room

100 cz  2.555          $ Pipe Inner Radius
102 cz  2.860          $ Pipe Outer Radius
104 cz  30.514         $ Solution Tank Inner Radius
106 cz  30.593         $ Solution Tank Outer Radius
108 cz  50.523         $ Reflector Tank Inner Radius
110 cz  50.800         $ Reflector Tank Outer Radius
120 pz  0              $ Bottom of Reflector Tank
122 pz  0.277         $ Bottom of Water Reflector
124 pz  21.227        $ Top of Support Pipe
126 pz  22.177        $ Bottom of Solution Tank
128 pz  37.617        $ Fissile Solution Height
130 pz  127.828       $ Top of Solution Tank
132 pz  127.907       $ Water Reflector Height
134 pz  143.000       $ Top of Reflector Tank

kcode  10000  1.0  100  600
imp:n  1.0  11r  0.0
sdef  cel=4  erg=d1  rad=d2  pos 0.0 0.0 30.0
spl  -3
si2  0.0  30.0
c  Plutonium Nitrate Solution
m1  1001.70c  6.0973e-2
    7014.70c  2.3203e-3
    8016.70c  3.6875e-2          8017.70c  1.4756e-5
    94238.70c 1.2912e-7          94239.70c  2.6498e-4
    94240.70c 2.4383e-5          94241.70c  2.4661e-6
    94242.70c 1.4141e-7
mt1  lwtr.10t
c  Stainless Steel
m2  26054.70c 3.6986e-3          26056.70c  5.8060e-2
    26057.70c 1.3409e-3          26058.70c  1.7844e-4
    24050.70c 7.1832e-4          24052.70c  1.3852e-2
    24053.70c 1.5707e-3          24054.70c  3.9098e-4
    28058.70c 4.4315e-3          28060.70c  1.7070e-3
    28061.70c 7.4202e-5          28062.70c  2.3659e-4
    28064.70c 6.0252e-5
c  Water
m3  1001.70c  6.6691E-2
    8016.70c  3.3333E-2          8017.70c  1.3338e-5

```

Table A-119. Input file for pu-sol-therm-034-case-1 (Cont'd)

mt3 lwtr.10t