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Validation and Comparison of KENO V.a and KENO-VI

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CONTENTS

LIST OF FIGURES	v
LIST OF TABLES.....	vii
ACKNOWLEDGMENTS	ix
ABSTRACT	xi
1. INTRODUCTION.....	1
2. DESCRIPTION OF THE CODE PACKAGE.....	3
2.1. CSAS25 and CSAS26 Sequences	3
2.2. Resonance Processing	3
2.3. BONAMI.....	3
2.4. NITAWL	4
2.5. KENO V.a	4
2.6. KENO-VI	5
2.7. The 27-Group Neutron Cross-Section Library	5
2.8. The 238-Group Neutron Cross-Section Library	6
3. CALCULATIONAL PROCEDURE.....	7
4. PROBLEM DESCRIPTIONS AND RESULTS.....	9
5. DISCUSSION OF RESULTS.....	33
6. CONCLUSIONS.....	55
7. REFERENCES.....	57
APPENDIX A: KENO V.a INPUT DATA USED FOR VALIDATION CASES LISTED IN TABLES 1-6 (238 group)	61
APPENDIX B: KENO-VI INPUT DATA USED FOR VALIDATION CASES LISTED IN TABLES 1-6 (238 group)	179

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Calculated K-effective values from Table 1.....	36
2. Calculated K-effective values from Table 2.....	37
3. Calculated K-effective values from Table 3.....	38
4. Calculated K-effective values from Table 4.....	39
5. Calculated K-effective values from Table 5.....	40
6. Calculated K-effective values from Table 6.....	41
7. KENO V.a k-effective vs. enrichment level low enrichment experiments.....	42
8. KENO-VI k-effective vs. enrichment level low enrichment experiments.....	43
9. KENO V.a k-effective vs. enrichment level high enrichment experiments.....	44
10. KENO-VI k-effective vs. enrichment level high enrichment experiments.....	45
11. KENO V.a and KENO-VI (238 group) k-effective vs. enrichment level low enrichment experiments	46
12. KENO V.a and KENO-VI (238 group) k-effective vs. enrichment level high enrichment experiments.....	47
13. KENO-VI 238-group results for low enriched homogeneous and heterogeneous systems (Table 1)	48
14. KENO-VI 238-group results for large diameter low enriched uranium cylinders in various lattice arrangements (Table 2).....	49
15. KENO-VI 238-group results for low enriched homogeneous uranium systems (Table 3).....	50
16. KENO-VI 238-group results for highly enriched uranium solutions (Table 4)	51
17. KENO-VI 238-group results for highly enriched uranium metal systems (Table 5)	52
18. KENO-VI 238 group results for highly enriched uranium solution systems (Table 5).....	53
19. KENO-VI 238-group results for highly enriched uranium solution systems (Table 6).	54

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. KENO V.a and KENO-VI comparison, Calculated k_{eff} for low enriched homogeneous and heterogeneous uranium systems.....	10
2. KENO V.a and KENO-VI comparison, Calculated k_{eff} for large diameter low enriched uranium cylinders in various lattice arrangements	13
3. KENO V.a and KENO-VI comparison, Calculated k_{eff} for low enriched homogeneous uranium systems.....	15
4. KENO V.a and KENO-VI comparison, Calculated k_{eff} for highly enriched uranium solution systems	20
5. KENO V.a and KENO-VI comparison, Calculated k_{eff} highly enriched uranium metal and solution systems	22
6. KENO V.a and KENO-VI comparison, Calculated k_{eff} for highly enriched uranium solution systems	29
7. Average calculated k_{eff} value by table.....	34
A.1. Table 1 input data.....	64
A.2. Table 2 input data	76
A.3. Table 3 input data	94
A.4. Table 4 input data	142
A.5. Table 5 input data	150
A.6. Table 6 input data	167
B.1. Table 1 input data.....	182
B.2. Table 2 input data	199
B.3. Table 3 input data	218
B.4. Table 4 input data	252
B.5. Table 5 input data	262
B.6. Table 6 input data	285

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ABSTRACT

This report documents the validation and comparison of KENO V.a and KENO-VI using the SCALE 27-group ENDF/B-IV and 238-group ENDF/B-V cross-section libraries against critical experiments. Experiments considered were primarily high- or low-enriched uranium systems. The results indicate that KENO V.a and KENO-VI Monte Carlo Criticality Programs accurately calculate a broad range of critical experiments. A number of the calculations showed a positive or negative bias in excess of 1½% in k-effective (k_{eff}). Classes of criticals that show a bias include 3% enriched green blocks, highly-enriched uranyl fluoride slab arrays, and highly-enriched uranyl nitrate arrays. If these biases are properly taken into account, KENO V.a and KENO-VI can be used with confidence for the design and criticality safety analysis of uranium-containing systems. KENO V.a and KENO-VI calculate the same k_{eff} for a system within statistics and thus may be used interchangeably as long as the geometry of the problem can be modeled.

1. INTRODUCTION

The intent of this study is to validate the KENO V.a¹ and KENO-VI² Monte Carlo criticality programs against critical experiments. KENO V.a and KENO-VI are part of the SCALE computer code system.³ The sequences being validated are for KENO V.a the CSAS25 sequence of CSAS and for KENO-VI the CSAS26 sequence of CSAS6. Both are documented in the SCALE manual.³ The 27-group ENDF/B-IV and 238-group ENDF/B-V libraries were used for both the KENO V.a and KENO-VI calculations. Comparisons of KENO V.a and KENO-VI results, both 27- and 238-group, are reported in Section 4.

ANSI Standard ANS-8.1⁴ requires that calculational methods used for criticality safety be validated and any bias be determined by correlating the results of critical experiments with calculations. It is essential that the computational methods used for nuclear criticality safety purposes be sufficiently accurate so that one can be confident of subcriticality when adequate safety margins are applied. It is also important that the applied safety margins not be unduly conservative.

The purpose of this report is to validate the use of KENO-VI for several types of applications. This validation is based primarily on uranium experiments.⁵⁻⁹ Low-enriched (< 5% ^{235}U) and highly-enriched (~ 90% ^{235}U) experiments from ORNL/TM-238¹⁰ were selected to validate and compare KENO V.a and KENO-VI. These experiments include various solution systems, varying fuel density systems, and uranium oxide and metal systems.

2. DESCRIPTION OF THE CODE PACKAGE

2.1. CSAS25 and CSAS26 Sequences

The CSAS25 and CSAS26 control sequences in SCALE allow simplified data input to the functional modules (i.e., BONAMI, NITAWL and KENO V.a / KENO-VI, respectively). These sequences will calculate atomic densities for both mixtures and standard solutions. They also generate input data for BONAMI and NITAWL, allowing various options for treatment of the cross sections in the resonance region for both homogeneous and heterogeneous systems.

2.2. Resonance Processing

BONAMI and NITAWL perform resonance processing in the SCALE sequences. Both of these codes are able to process resolved and unresolved resonance data using different methods discussed in the following sections. A common characteristic of both modules is that neither BONAMI nor NITAWL treat resonance overlap or resonance interference. Several system characteristics may cause problems with the resonance treatments. One such problem, resonance overlap, which occurs when two nuclides in a mixture have resonances at the same or nearly the same energies, as discussed in Sect. M7.A of the SCALE manual. When resonance overlap is ignored, the flux used to shield the cross section is incorrect and thus the group cross section can be in error. Another form of improper resonance processing can occur when the same resonance nuclide appears in different regions (mixtures) of a geometry specification, because SCALE currently only processes one region at a time. Again, because an incorrect flux is used to shield the cross sections, the group cross sections can be in error. An example of this is in a dissolver where a fuel lump is surrounded by fissile solution containing the same resonance absorbers.

Resonance interference is similar to resonance overlap. When two resonances are close together, the higher-energy resonance affects the flux shape in the lower-energy resonance, because the flux does not recover to the asymptotic slowing-down flux form over the lower-energy resonance. Resonance interference can occur between resonances of different nuclides or two closely spaced resonances of the same nuclide. The limitations and approximations used in BONAMI and NITAWL will be discussed below.

NITAWL performs temperature broadening during resonance processing. If temperature data are included in the library, BONAMI performs temperature broadening at the user-specified problem temperature during resonance processing. Starting with SCALE 4.3, NITAWL also performs a temperature interpolation of thermal-scattering data on the master library.

2.3. BONAMI

The BONAMI module self-shields cross sections with Bondarenko data using the shielding-factor methodology. Nuclides with Bondarenko data carry an infinite dilute cross section on the master library and tables of dilution-dependent shielding factors. BONAMI performs an iteration for each nuclide and each energy group that has shielding factors. Convergence is achieved when the shielded total cross section changes by less than some ϵ for all nuclides, groups, and zones. In this manner, the problem-dependent self-shielded cross sections for each nuclide and group are determined while accounting for interactions. When CSAS calls BONAMI, heterogenous geometry effects are accounted for in the escape cross section that is passed to BONAMI.

The escape cross section is determined based on the system geometry specified in the cross-section processing portion of the SCALE input. The geometry type, materials, characteristic dimensions, and the Dancoff factor are all used to determine an escape cross section that has units equivalent to a macroscopic cross-section. The escape cross section is added to other cross sections to account for geometry effects. This method allows all nuclides to be processed by BONAMI as infinite homogeneous media in the CSAS sequences.

The performance of data shielded by the Bondarenko method depends on the adequacy of the approximations used to generate the Bondarenko data. The typical approach is to use the narrow resonance approximation to generate these data, which is adequate for a broad range of applications. When a resonance is not narrow relative to the slowing down in the system, the narrow resonance approximation breaks down and the resonance corrections for the cross sections can be in error. This breakdown has been observed for libraries that use the Bondarenko method to shield the low-energy resolved resonances for ^{238}U for systems with low hydrogen moderation¹¹ and for many nuclides when the principal moderator is an intermediate-mass nuclide. The solution to this type of breakdown is to either carry sufficient cross-section energy groups to march across the resonance and/or to use more appropriate flux-generating methods to compute the Bondarenko factors. This problem does not occur in the SCALE END/B-IV and ENDF/B-V libraries because Bondarenko data are only used in the unresolved resonance range.

2.4. NITAWL

The NITAWL-II module shields cross sections with resonance data utilizing the Nordheim integral transport method. In the SCALE implementation, the infinite-dilute multi-group cross sections are adjusted by a correction value determined by NITAWL. The correction is calculated by first determining the infinite dilute contribution of each resonance to the group cross section and then by calculating what the contribution would be if the resonance was shielded for the specific problem. The geometry type, materials, characteristic dimensions, and Dancoff factor are all passed to NITAWL for determining the details of the approximations used to self-shield the cross sections. NITAWL uses two internal moderators when reconstructing the shielded flux. The slowing-down mass and scatter cross section for the principal material (first moderator) mixed with the fuel are used explicitly. The remaining materials (second moderator) are treated using an averaged slowing-down mass and scatter cross section.

A fundamental assumption of the Nordheim method is that resonances are widely spaced, both within a particular nuclide and between nuclides. If this assumption is not correct, the flux used to construct the resonance contribution to the group cross section is incorrect. Breakdowns have been observed when NITAWL was used to self-shield cross sections of fissile nuclides with overlapping resonances in dissolver-type systems¹² and in systems with intermediate-mass moderators and intermediate-mass resonance materials.

2.5. KENO V.a

KENO V.a is a Monte Carlo criticality program that includes an enhanced geometry package that allows modeling of a wide variety of complex three-dimensional geometries. The geometry package allows nested arrays and “holes” to be placed in the geometry model. The code allows the use of reflector options, including mirror reflection, periodic reflection, and differential albedo reflection. Automated biasing provides the capability to use reflector region weighting functions that are based on one-dimensional adjoint calculations for common reflector materials. The reflector options simplify geometry data input and/or reduce the running time of a specific problem. The CSAS control module handles

cross-section input and atom density input. Most of the major KENO parameters have defaults that work for a wide variety of problems, but which can be overridden by the analyst.

2.6. KENO-VI

KENO-VI is an extension of the KENO V.a Monte Carlo criticality program. KENO-VI contains features currently in KENO V.a plus a more complex geometry package. The geometry package in KENO-VI is capable of modeling any volume that can be constructed using quadratic equations. In addition, such features as geometry intersections, body rotation, hexagonal arrays, and array boundaries have been included to make the code more flexible. These features allow the user to readily solve large geometrically complex problems whose computer storage requirements and geometric complexity preclude solution by the previous versions of KENO.

A set of 13 predefined geometry shapes has been incorporated into KENO-VI. Additional volumes can be constructed using the QUADRATIC geometry card that allows the user to specify any volume that can be modeled using quadratic equations. The ability to intersect the volumes makes it possible to exactly model such things as pipe intersections, which was previously impossible in KENO V.a. The ability to rotate bodies means volumes no longer must be positioned parallel to a major axis. Hexagonal arrays were added to simplify the construction of triangular pitch arrays. The use of array boundaries makes it possible to fill a noncuboidal volume with an array, specifying the boundary where a particle leaves and enters the array.

KENO-VI is primarily an eigenvalue k -effective code. Other calculated quantities include lifetime, generation time, energy-dependent leakages, energy- and region-dependent absorptions, fissions, fluxes, and fission densities.

KENO-VI retains the KENO V.a features such as flexible data input, the capability of supergrouping energy-dependent data, a P_n scattering model in the cross sections, a procedure for matching lethargy boundaries between albedos and cross sections to extend the usefulness of the albedo feature, and restart capabilities. However, due to the increased flexibility in the geometric modeling capabilities, KENO-VI usually requires more CPU time than KENO V.a to solve the same problem.

2.7. The 27-Group Neutron Cross-Section Library

The 27-group ENDF/B-IV library is the broad-group companion library to the 218-group ENDF/B-IV library. The 218-group library was flux collapsed using MALOCS and the MT 1099 flux file carried with the fine-group cross sections. (This flux file is the energy group representation of the original weighting spectrum used to generate the 218-group cross sections from ENDF/B-IV data.) Because of the $1/(E\sigma_i)$ weighting in the resolved resonance range, the broad-group library calculates many systems nearly as well as the fine-group library does. Trends and biases in the 218-group library are preserved in the 27-group library. The library has 14 fast groups and 13 thermal groups (below 3 eV). The group structure was chosen to match the 16-group Hansen-Roach structure with two additional fast groups and nine additional thermal groups. The additional groups were chosen such that, for the systems considered, the broad-group calculations meet an acceptance criterion of $\Delta k/k < 0.3\%$ when compared with the reference 218-group calculation using the XSDRNPM code. This criterion was relaxed to 1% for ^{238}U in systems where the median fission energy was $> 1 \text{ eV}$ and $< 100 \text{ eV}$. The resonance data and the thermal-scattering data carried with the 27-group library and the 218-group library are the same and are processed by NITAWL-II. This library was conceived as a general purpose criticality analysis library, with a special interest in applicability to shipping cask analysis and thermal neutron systems.

The 27-group library has been extensively validated against critical experiments.^{7, 10, 13-21} Areas of validation include highly-enriched uranium metal, compound and solution systems, moderated low-enriched uranium, heterogeneous and homogeneous systems, and plutonium metal and solution systems.

2.8. The 238-Group Neutron Cross-Section Library

The 238-group ENDF/B-V library²² is a general purpose criticality analysis library, and the most complete library available in SCALE. This library is also known as the LAW (Library to Analyze Radioactive Waste) Library. It was initially released in version 4.3 of SCALE. The library contains data for all nuclides (more than 300) available in ENDF/B-V processed by the AMPX-77 system.²³ It also contains data for ENDF/B-VI evaluations of ¹⁴N, ¹⁵N, ¹⁶O, ¹⁵⁴Eu, and ¹⁵⁵Eu. The library has 148 fast groups and 90 thermal groups (below 3 eV).

Most resonance nuclides in the 238-group ENDF/B-V library have resonance data (to be processed by NITAWL-II) in the resolved resonance range and Bondarenko factors (to be processed by BONAMI) for the unresolved range. This library contains resolved resonance data for *s*-wave, *p*-wave, and *d*-wave resonances (R = 0, R = 1, and R = 2, respectively). These data can have a significant effect on results for undermoderated, intermediate-energy problems. Resonance structures in several light-to-intermediate mass nonresonance ENDF nuclides (i.e., ⁷Li, ¹⁹F, ²⁷Al, ²⁸Si) are accounted for using Bondarenko shielding factors. These structures can also be important in intermediate-energy problems. The ²³⁵U ENDF/B-V data result in slightly too much fission, while the ²³⁸U data result in slightly too much capture. Although better than the ENDF/B-IV data, the thermal-plutonium data still appear to have problems.

All nuclides in the 238-group LAW Library use the same weighting spectrum, consisting of

1. Maxwellian spectrum (peak at 300 K) from 10^{-5} to 0.125 eV,
2. a 1/E spectrum from 0.125 eV to 67.4 keV,
3. a fission spectrum (effective temperature at 1.273 MeV) from 67.4 keV to 10 MeV, and
4. a 1/E spectrum from 10 to 20 MeV.

The use of this spectrum (as opposed to the $1/(E\sigma t)$ spectrum used to generate the 218-group library) makes it difficult to collapse a general-purpose broad-group library that is valid over a wide range of problems.

All nuclides use a P₅ Legendre expansion to fit the elastic and discrete-level inelastic scattering processes in the fast range, thereby making the library suitable for both reactor and shielding applications. A P₃ fit was used for thermal scattering. Thermal scattering kernels are provided at temperatures (K) as presented in Table M4.2.7 (Sect. M4) of the SCALE manual. All other scattering processes use P₀ fits.

3. CALCULATIONAL PROCEDURE

In the validation and comparison process, many of the available options in CSAS25, CSAS26, KENO V.a and KENO-VI were exercised. These options include the automatic atomic density generation features, the various treatments in NITAWL, and the geometry options in KENO V.a and KENO-VI. The majority of the calculations are repeat calculations, which were modeled by different people at different times. Usually there are multiple ways that a problem may be specified, all of which are equally correct. The original input data were left substantially unchanged in the KENO V.a models. In the original input data, most problems were run for 203 generations of 600 neutrons per generation; therefore, the KENO-VI problems were run in a similar manner. KENO V.a and KENO-VI defaults have now been changed to 1000 neutrons per generation. Complete listings of the input data for KENO V.a and KENO-VI using the 238-group library are given in Appendices A and B, respectively.

With KENO V.a and KENO-VI, there is no single k_{eff} that is “the answer” for the problem. The code starts with an initial neutron distribution and calculates the effective multiplication for a generation of neutrons. The next generation uses a starting distribution based on the fission points of the previous generation and calculates the effective multiplication for the current generation. Since 203 generations were run, there are 203 different answers. In the ideal situation, once the source has converged and the original (and usually arbitrary) starting distribution has decayed, the difference in the batch-to-batch k_{eff} may be attributed to the statistical nature of the Monte Carlo calculation, and the “best” answer should be the average of the remaining calculations. The common practice in KENO V.a and KENO-VI is to tabulate the average k_{eff} as a function of the number of generations skipped. Judgment is then required in determining the answer. Many calculations do not approach the ideal situation. For example, undersampling may exist where the number of neutrons per generation is not sufficient to sustain a proper source distribution, or the number of generations is insufficient to converge the source distribution. In order to remove the element of judgment from the interpretation of the results and to mechanize the process of validating and comparing results to previous validation, the average k_{eff} by generation skipped with the lowest calculated standard deviation is reported here. This number appears as the “final value” in the plot of the average k_{eff} by generation skipped in the KENO V.a and KENO-VI output.

4. PROBLEM DESCRIPTIONS AND RESULTS

Brief problem descriptions and results are presented in Tables 1–6. Low-enrichment results are presented in Tables 1–3 while high-enrichment results are presented in Tables 4–6.

The experimental models used to generate Table 1 are from low-enriched uranium experiments obtained from ref. 9. These include experiments for homogeneous single-unit criticals, both reflected and unreflected, as well as heterogeneous uranium metal cylinders in water. The fissile compounds considered were UO_2F_2 , U metal, and U_3O_8 , all at 4.89% ^{235}U enrichment. The moderating materials were water, stereotex, and UO_2F_2 solution.

The experimental models used to generate Table 2 are from low-enriched uranium experiments. These 3.85% enriched uranium metal cylinders and annuli in water were obtained from ref. 24. The critical experiments were modeled in detail from descriptions in the experiment logbook.

Table 3 includes models from ref. 8. These experiments are single-unit criticals both reflected and unreflected, at several enrichments ranging from 1.4 to 4.98%. The first part of the table includes UF_4 /paraffin-moderated systems and UO_2F_2 solution systems at various moderation levels. The remainder of the table is 4.46% enriched damp oxide experiments performed at Rocky Flats.

Highly-enriched uranium experiments from ref. 9 were used to generate Table 4. These are UO_2F_2 and $\text{UO}_2(\text{NO}_3)_2$ solution systems. Both single-unit and array systems were analyzed under a variety of reflection conditions including unreflected, fully water reflected, concrete reflected, and Plexiglas reflected.

Table 5 includes experiments from ref. 7. Single-unit reflected and unreflected systems for uranium metal, uranium alloy, UO_2F_2 solution and $\text{UO}_2(\text{NO}_3)_2$ solutions were considered. Calculations were performed on arrays, including (1) arrays of metal units with and without interstitial moderation, (2) arrays of UO_2F_2 slab systems, and (3) arrays of 5-liter containers of $\text{UO}_2(\text{NO}_3)_2$ having varying thickness of paraffin and/or Plexiglas.

Table 6 contains the experimental models and results from the eta experiments performed at Y-12.²⁵⁻²⁶ These experiments are $\text{UO}_2(\text{NO}_3)_2$ solution experiments in simple unreflected geometry. The systems are typically very dilute. The experiments included boron poisoned solutions and ^{233}U systems.

Table 1. KENO V.a and KENO-VI comparison
Calculated k_{eff} for low enriched homogeneous and heterogeneous uranium systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAA01	Experiment 1A. 401 – 4.89% U rods, 0.762-cm diam, 30-cm long, 1.3-cm pitch, H ₂ O moderated and reflected	27	0.992 ± 0.003	0.989 ± 0.002	0.988 ± 0.003	0.991 ± 0.002
CAA04	Experiment 6A. 203 – 4.89% U rods, 0.762-cm diam, 30-cm long, 2.05-cm pitch, H ₂ O moderated and reflected	27	0.991 ± 0.003	0.991 ± 0.002	0.992 ± 0.003	0.992 ± 0.002
CAA06	Experiment 14A. 398 – 4.89% U rods, 0.762-cm diam, 30-cm long, 1.3-cm pitch, H ₂ O top reflector, Plexiglas bottom reflector, Pb reflected 1 face	27	0.996 ± 0.003	0.997 ± 0.002	0.998 ± 0.003	0.996 ± 0.002
CAA08	Experiment 28A. 255 – 4.89% U rods, 0.762-cm diam, 30-cm long, 1.3-cm pitch, H ₂ O moderated, H ₂ O top reflector, Plexiglas bottom reflector, Pb reflected 4 faces	27	0.995 ± 0.002	0.997 ± 0.002	0.993 ± 0.002	0.992 ± 0.003
CAA10	Experiment 30C. 494 – 4.89% U rods, 0.762-cm diam, 30-cm long, 1.3-cm pitch, H ₂ O moderated, H ₂ O top reflector, Plexiglas bottom reflector, Pb reflected 4 faces, boral in row 6	27	1.001 ± 0.003	1.001 ± 0.002	1.002 ± 0.002	1.001 ± 0.002
CAA11	Experiment 31C. 494 – 4.89% U rods, 0.762-cm diam, 30-cm long, 1.3-cm pitch, H ₂ O moderated, H ₂ O top reflector, Plexiglas bottom reflector, Pb reflected 4 faces, Cd in row 6	27	0.998 ± 0.003	0.997 ± 0.002	0.997 ± 0.003	0.997 ± 0.002

Table 1 (continued)
Calculated k_{eff} for low enriched homogeneous and heterogeneous uranium systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAA14	Experiment 36S, 9 × 10 array of 4.89% U rods in ~300 g U/l UO_2F_2 solution, 0.762-cm diam, 2.453-cm pitch in 95.88-cm-diam tank	27	0.988 ± 0.002	0.989 ± 0.002	0.990 ± 0.002	0.990 ± 0.002
CAA16	Experiment 42S. 6 × 7 array of 4.89% U rods in ~300 g U/l UO_2F_2 solution, 1.31-cm diam, 3.40-cm pitch, in 95.88-cm diam tank	27	0.987 ± 0.002	0.989 ± 0.003	0.991 ± 0.002	0.987 ± 0.003
CAA17	Experiment 44S. 6 × 7 array of 4.89% U rods in ~300 g U/l UO_2F_2 solution, 1.31-cm diam, 3.94-cm pitch, in 95.88-cm diam tank	27	0.990 ± 0.002	0.990 ± 0.002	0.989 ± 0.002	0.992 ± 0.002
CAA20	4.89% U_3O_8 – Stereotex blocks 40.6 g U-235/l (H/X = 395.0), unreflected	28	1.000 ± 0.003	1.000 ± 0.004	1.002 ± 0.002	1.003 ± 0.003
CAA22	4.89% U_3O_8 – Stereotex blocks 33.3 g U-235/l (H/X = 503.6), unreflected	28	0.997 ± 0.002	0.997 ± 0.002	0.994 ± 0.002	1.000 ± 0.002
CAA25	4.89% U_3O_8 – Stereotex blocks 40.6 g U-235/l (H/X = 396.7), paraffin top reflector, H_2O reflected bottom and sides	28	0.990 ± 0.003	0.993 ± 0.002	0.997 ± 0.003	0.995 ± 0.002
CAA27	4.89% U_3O_8 – Stereotex blocks 81.1 g U-235/l (H/X = 146.8), paraffin top reflector, H_2O reflected bottom and sides	28	0.991 ± 0.003	0.990 ± 0.002	0.990 ± 0.003	0.989 ± 0.003
CAA29	4.89% U_3O_8 – Stereotex blocks 33.3 g U-235/l (H/X = 504.1), paraffin top reflector, H_2O reflected bottom and sides	28	0.995 ± 0.002	0.998 ± 0.002	0.998 ± 0.002	0.998 ± 0.002

Table 1 (continued)
Calculated k_{eff} for low enriched homogeneous and heterogeneous uranium systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAA30	4.89% UO_2F_2 – solution 42.54 g U-235/l (H/X = 524), in a 20-in.-diam SS cylinder, unreflected	28	0.989 ± 0.003	0.990 ± 0.003	0.995 ± 0.002	0.994 ± 0.003
CAA33	4.89% UO_2F_2 – solution 24.04 g U-235/l (H/X = 1002), in a 27.3-in.-diam aluminum sphere, unreflected	28	0.988 ± 0.002	0.991 ± 0.002	0.992 ± 0.002	0.996 ± 0.002
CAA35	4.89% UO_2F_2 – solution 42.54 g U-235/l (H/X = 524), in a 15-in.-diam SS cylinder, H_2O reflected	28	1.002 ± 0.003	0.999 ± 0.003	0.998 ± 0.003	1.002 ± 0.003
CAA37	4.89% UO_2F_2 – solution 31.79 g U-235/l (H/X = 735), in a 15-in.-diam SS cylinder, H_2O reflected	28	0.997 ± 0.002	0.997 ± 0.002	1.001 ± 0.002	1.000 ± 0.002
CAA39	4.89% UO_2F_2 – solution 24.22 g U-235/l (H/X = 994), in a 20-in.-diam SS cylinder, H_2O reflected	28	0.996 ± 0.002	0.996 ± 0.002	1.001 ± 0.001	0.998 ± 0.002

Table 2. KENO V.a and KENO-VI comparison
Calculated k_{eff} for large diameter low enriched uranium cylinders in various lattice arrangements

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAB01	(EBJ.1) lattice 2. 15-3.85% U rods, 7.2 in. diam \times 30 in. long in square lattice, 7.2 in. center-to-center, 77.8 cm water height	29	1.003 \pm 0.002	0.999 \pm 0.002	1.000 \pm 0.002	0.996 \pm 0.002
CAB07	(EBJ.4) lattice 3. 16-3.85% U rods, 7.2 in. diam \times 30 in. long in triangular lattice, 7.45 in. center-to-center, 53.1 cm water height	29	0.992 \pm 0.002	0.991 \pm 0.002	0.984 \pm 0.002	0.985 \pm 0.002
CAB10	(EBJ.8) lattice 5. 6-3.85% U rods, 7.2 in. OD \times 2.6 in. ID \times 30 in. long in square lattice, 7.95 in. center-to-center, 91.4 cm water height (2 subcritical)	29	1.008 \pm 0.002	1.013 \pm 0.002	0.995 \pm 0.002	0.997 \pm 0.003
CAB12	(EBJ.10) lattice 14. 20-3.85% U rods, 7.2 in. OD \times 2.6 in. ID \times 30 in. long in square lattice, 9.07 in. center-to-center, 79 cm water height	29	1.007 \pm 0.002	1.006 \pm 0.002	0.997 \pm 0.002	0.998 \pm 0.002
CAB13	(EBJ.13) lattice 9. 15-3.85% U rods, 2.5 in. diam \times 30 in. long in square lattice, 3.25 in. center-to-center, 64.8 cm water height	29	1.006 \pm 0.002	1.008 \pm 0.002	1.003 \pm 0.002	0.996 \pm 0.002
CAB15	(EBJ.13) lattice 9. 15-3.85% U rods, 2.5 in. diam \times 30 in. long in square lattice, 3.25 in. center-to-center, 64.8 cm water height	29	1.007 \pm 0.002	1.009 \pm 0.002	0.991 \pm 0.002	0.990 \pm 0.002

Table 2 (continued)
 Calculated k_{eff} for large diameter low enriched uranium cylinders in various lattice arrangements

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAB16	(EBJ.14) lattice 2. 23- 3.85% U rods, 2.5 in. diam \times 30 in. long in square lattice 4.00 in. center-to-center, 68.9 cm water height	29	1.000 \pm 0.002	0.999 \pm 0.002	0.992 \pm 0.002	0.990 \pm 0.002

Table 3. KENO V.a and KENO-VI comparison
Calculated k_{eff} for low enriched homogeneous uranium systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS04	An unreflected rectangular parallelepiped of homogeneous U(1.4) F ₄ and paraffin with an H/U-235 atomic ratio of 421.8; 93.1 cm × 93.0 cm × 123.8 cm	30	0.987 ± 0.002	0.988 ± 0.002	0.993 ± 0.002	0.993 ± 0.002
CAS05	An unreflected rectangular parallelepiped of homogeneous U(1.4) F ₄ and paraffin with an H/U-235 atomic ratio of 421.8; 100.0 cm × 99.9 cm × 103.1 cm	30	0.989 ± 0.002	0.986 ± 0.002	0.992 ± 0.002	0.991 ± 0.002
CAS06	An unreflected rectangular parallelepiped of homogeneous U(1.4)F ₄ and paraffin with an H/U-235 atomic ratio of 421.8; 130.7 cm × 130.6 cm × 74.2 cm	30	0.985 ± 0.002	0.985 ± 0.002	0.994 ± 0.002	0.992 ± 0.002
CAS11	A reflected rectangular parallelepiped of homogeneous U(2) F ₄ and paraffin with an H/U-235 atomic ratio of 421.8	31	0.994 ± 0.003	0.995 ± 0.003	1.001 ± 0.002	1.000 ± 0.003
CAS12	An unreflected rectangular parallelepiped of homogeneous U(2)F ₄ and paraffin with an H/U-235 atomic ratio of 195.2; 71.47 cm × 71.47 cm × 94.14 cm	31	0.992 ± 0.002	0.996 ± 0.002	0.995 ± 0.002	0.995 ± 0.002

Table 3 (continued)
Calculated k_{eff} for low enriched homogeneous uranium systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS14	An unreflected rectangular parallelepiped of homogeneous U(2) F ₄ and paraffin with an H/U-235 atomic ratio of 293.9; 56.22 cm × 56.22 cm × 122.47 cm	31	0.997 ± 0.002	0.997 ± 0.002	1.000 ± 0.002	1.002 ± 0.002
CAS15	An unreflected rectangular parallelepiped of homogeneous U(2) F ₄ and paraffin with an H/U-235 atomic ratio of 406.3; 53.67 cm × 53.67 cm × 54.29 cm, reflected with 15.2 cm of paraffin on top and sides and 15.2 cm of Plexiglas on the bottom	31	0.995 ± 0.002	0.998 ± 0.002	0.999 ± 0.002	1.003 ± 0.002
CAS16	A reflected rectangular parallelepiped of homogeneous U(2) F ₄ and paraffin with an H/U-235 atomic ratio of 495.9; 46.00 cm × 46.00 cm × 96.57 cm, reflected with 15.2 cm of paraffin on top and sides and 15.2 cm of Plexiglas on the bottom	31	0.997 ± 0.002	0.999 ± 0.002	0.994 ± 0.002	0.999 ± 0.002
CAS19	A reflected rectangular parallelepiped of homogeneous U(2)F ₄ and paraffin with an H/U-235 atomic ratio of 971.7; 76.51 cm × 76.44 cm × 82.42 cm, reflected with 5.2 cm of polyethylene on top and sides and 15.2 cm of Plexiglas on the bottom	31	0.988 ± 0.002	0.986 ± 0.002	0.997 ± 0.002	0.997 ± 0.002

Table 3 (continued)
Calculated k_{eff} for low enriched homogeneous uranium systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS20	An unreflected rectangular parallelepiped of homogeneous U(2)F ₄ and paraffin with an H/U-235 atomic ratio of 971.7; 81.45 cm × 86.70 cm × 88.22 cm	31	0.987 ± 0.002	0.981 ± 0.002	0.991 ± 0.002	0.991 ± 0.002
CAS22	A reflected rectangular parallelepiped of homogeneous U(3)F ₄ and paraffin with an H/U-235 atomic ratio of 133.4, 43.47 cm × 43.47 cm × 86.39 cm, reflected with 15.2 cm of paraffin on top and sides and 15.2 cm of Plexiglas on the bottom	31	1.007 ± 0.002	1.009 ± 0.002	1.001 ± 0.002	1.015 ± 0.002
CAS24	A reflected rectangular parallelepiped of homogeneous U(3)F ₄ and paraffin with an H/U-235 atomic ratio of 133.4; 56.25 cm × 56.25 cm × 43.41 cm, reflected with 15.2 cm of paraffin on top and sides and 15.2 cm of Plexiglas on the bottom	31	1.008 ± 0.003	1.011 ± 0.003	1.011 ± 0.002	1.012 ± 0.002
CAS26	An unreflected rectangular parallelepiped of homogeneous U(3)F ₄ and paraffin with an H/U-235 atomic ratio of 133.4; 56.47 cm × 56.47 cm × 86.64 cm	31	1.014 ± 0.003	1.012 ± 0.003	1.013 ± 0.002	1.013 ± 0.002

Table 3 (continued)
Calculated k_{eff} for low enriched homogeneous uranium systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS28	An unreflected rectangular parallelepiped of homogeneous U(3)F ₄ and paraffin with an H/U-235 atomic ratio of 133.4; 61.4 cm × 61.4 cm × 66.0 cm	31	1.006 ± 0.002	1.009 ± 0.002	1.014 ± 0.002	1.014 ± 0.002
CAS30	An unreflected rectangular parallelepiped of homogeneous U(3)F ₄ and paraffin with an H/U-235 atomic ratio of 276.9; 40.90 cm × 40.93 cm × 116.80 cm	31	1.010 ± 0.003	1.010 ± 0.002	1.016 ± 0.003	1.016 ± 0.003
CAS33	A composite cadmium/steel/water side reflected stainless steel cylinder of 0.079 cm wall thickness and 19.545 cm IR filled to a height of 54.45 cm with (4.98)O ₂ F ₂ solution at an H/U-235 atomic ratio of 488	31	1.000 ± 0.003	1.000 ± 0.003	1.001 ± 0.002	1.007 ± 0.002
CAS36	An unreflected stainless steel cylinder of 0.07874 cm wall thickness and a 19.55 cm IR filled to a height of 101.7 cm with U(4.98)O ₂ F ₂ solution at an H/U-235 atomic ratio of 496	33	0.993 ± 0.003	1.004 ± 0.003	0.998 ± 0.003	0.994 ± 0.003
CAR01	Experiment 1. 4.46% enriched U ₃ O ₈ H/U = 0.77, 42 fuel cans with 2.44 cm interstitial moderation, plastic reflected	34	1.010 ± 0.002	1.016 ± 0.004	1.016 ± 0.002	1.015 ± 0.002

Table 3 (continued)
Calculated k_{eff} for low enriched homogeneous uranium systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAR05	Experiment 2. 4.46% enriched U_3O_8 $\text{H}/\text{U} = 0.77$, 98 fuel cans with 0.929 cm interstitial moderation, concrete reflected	34	1.003 ± 0.002	0.999 ± 0.003	0.999 ± 0.002	1.003 ± 0.003
CAR11	Experiment A. 4.46% enriched U_3O_8 $\text{H}/\text{U} = 1.25$, 38 fuel cans with 2.44 cm interstitial moderation, plastic reflected	36	1.011 ± 0.003	1.010 ± 0.004	1.009 ± 0.002	1.015 ± 0.002
CAR13	Experiment C. 4.46% enriched U_3O_8 $\text{H}/\text{U} = 1.25$, 80 fuel cans with 0.929 cm interstitial moderation, plastic reflected	36	1.014 ± 0.003	1.014 ± 0.004	1.017 ± 0.003	1.019 ± 0.003
CAR15	4.46% enriched U_3O_8 $\text{H}/\text{U} = 1.255$, driven by high concentration (12,400 kg 351.65 g U/l), 93.17% enriched $\text{UO}_2(\text{NO}_3)_2$, 119 + 2S fuel cans, plastic reflected	36	0.994 ± 0.003	1.003 ± 0.003	0.994 ± 0.003	1.001 ± 0.003
CAR20	Experiment E. 4.46% enriched U_3O_8 $\text{H}/\text{U} =$ 2.03, driven by 93.12% enriched hollow uranium metal sphere (12.786 kg), 120 + 4S fuel cans, plastic reflected	37	0.991 ± 0.003	1.000 ± 0.002	0.997 ± 0.002	0.999 ± 0.002

Table 4. KENO V.a and KENO-VI comparison
Calculated k_{eff} for highly enriched uranium solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAA01	U(93.2) O ₂ F ₂ solution sphere, H/X = 1112, unreflected	38	1.004 ± 0.002	1.002 ± 0.002	1.006 ± 0.002	1.007 ± 0.002
CAA04	U(93.2) O ₂ F ₂ solution sphere, H/X = 76.1, H ₂ O reflected	38	1.004 ± 0.003	1.007 ± 0.003	1.004 ± 0.003	1.007 ± 0.003
CAA07	U(93.2) O ₂ F ₂ solution sphere, H/X = 268.8, H ₂ O reflected	39	1.008 ± 0.003	1.008 ± 0.003	1.001 ± 0.004	1.001 ± 0.003
CAA10	U(93.2) O ₂ F ₂ solution sphere, H/X = 239.3, H ₂ O reflected	39	1.028 ± 0.003	1.028 ± 0.003	1.017 ± 0.003	1.021 ± 0.003
CAA13	U(93.2) O ₂ (NO ₃) ₂ solution 357.71 g U/l, 28.01 cm diam cylinder, unreflected	40	1.016 ± 0.003	1.010 ± 0.003	1.003 ± 0.001	1.007 ± 0.003
CAA16	U(93.2) O ₂ (NO ₃) ₂ solution 357.71 g U/l, 28.01 cm diam cylinder, unreflected	40	1.004 ± 0.003	0.998 ± 0.003	1.000 ± 0.003	0.995 ± 0.003
CAA19	U(93.2) O ₂ (NO ₃) ₂ solution 144.38 g U/l, 33.01 cm diam cylinder, concrete reflected	40	1.013 ± 0.002	1.010 ± 0.004	1.006 ± 0.003	1.000 ± 0.003
CAA22	U(93.2) O ₂ (NO ₃) ₂ solution 334.77 g U/l, 33.01 cm diam cylinder, concrete reflected	40	1.006 ± 0.003	1.006 ± 0.004	0.998 ± 0.003	1.002 ± 0.003
CAA25	U(93.2) O ₂ (NO ₃) ₂ solution 147.66 g U/l, 33.01 cm diam cylinder, Plexiglas reflected	40	1.004 ± 0.003	1.002 ± 0.003	1.000 ± 0.003	1.000 ± 0.003
CAA28	U(93.2) O ₂ (NO ₃) ₂ solution 345.33 g U/l, 33.01 cm diam cylinder, concrete reflected	40	1.008 ± 0.003	1.011 ± 0.003	1.005 ± 0.003	1.000 ± 0.003

Table 4 (continued)
Calculated k_{eff} for highly enriched uranium solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAA30	U(93.2) $O_2(NO_3)_2$ solution 364.11 g U/l, 21.12 cm diam cylinder, in a 4×4 array, concrete reflected	40	1.009 \pm 0.003	1.001 \pm 0.003	1.000 \pm 0.003	0.998 \pm 0.003
CAA32	U(93.2) $O_2(NO_3)_2$ solution 76.09 g U/l, 21.12 cm diam cylinder, in a 2×2 array, concrete reflected	40	1.011 \pm 0.003	1.012 \pm 0.003	1.007 \pm 0.003	1.008 \pm 0.003
CAA34	U(93.2) $O_2(NO_3)_2$ solution 364.11 g U/l, 21.12 cm diam cylinder, in a 2×2 array, concrete reflected	40	1.003 \pm 0.003	0.996 \pm 0.003	0.991 \pm 0.003	0.993 \pm 0.003
CAA36	U(93.2) $O_2(NO_3)_2$ solution 359.55 g U/l, 16.12 cm diam cylinder, in a 2×4 array, concrete reflected	40	1.011 \pm 0.002	1.009 \pm 0.003	1.010 \pm 0.003	1.011 \pm 0.003
CAA38	U(93.2) $O_2(NO_3)_2$ solution 76.09 g U/l, 21.12 cm diam cylinder, in a 2×2 array, concrete reflected	40	0.998 \pm 0.003	1.000 \pm 0.003	0.999 \pm 0.002	0.994 \pm 0.003
CAA40	U(93.2) $O_2(NO_3)_2$ solution 355.94 g U/l, 16.12 cm diam cylinder, in a 4×4 array, Plexiglas reflected	40	1.001 \pm 0.003	1.001 \pm 0.003	0.999 \pm 0.003	0.995 \pm 0.003
CAA42	U(93.2) $O_2(NO_3)_2$ solution 355.94 g U/l, 21.12 cm diam cylinder, in a 2×2 array, Plexiglas reflected	40	1.009 \pm 0.003	1.001 \pm 0.004	0.999 \pm 0.002	1.007 \pm 0.003

Table 5. KENO V.a and KENO-VI comparison
Calculated k_{eff} highly enriched uranium metal and solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS01	93.8% U metal sphere, unreflected (GODIVA)	41	1.003 ± 0.003	0.999 ± 0.003	0.991 ± 0.002	0.990 ± 0.002
CAS05	93.2% UO_2F_2 solution, 19.992 g U/l, in Al sphere, unreflected	38	1.001 ± 0.002	1.001 ± 0.002	1.006 ± 0.002	1.002 ± 0.002
CAS07	93.5% U metal hemispherical shell, H_2O reflected	42	1.009 ± 0.002	1.012 ± 0.003	1.006 ± 0.002	1.005 ± 0.002
CAS09	94% U metal cuboid, natural U reflected	42	1.008 ± 0.002	1.011 ± 0.002	1.000 ± 0.002	0.999 ± 0.002
CAS11	93.1% U metal hemispherical shell, steel center and oil reflected	43	1.007 ± 0.002	1.004 ± 0.002	0.994 ± 0.002	0.995 ± 0.003
CAS03	93.172% $\text{UO}_2(\text{NO}_3)_2$ solution, 346.7 g U/l, in SS cylinder, unreflected	48	1.016 ± 0.003	1.011 ± 0.003	1.006 ± 0.004	1.013 ± 0.003
CAS25	93.2% U metal cylinders, $2 \times 2 \times 2$ array, each unit in the array is a smaller cylinder capped on each end by a larger cylinder, unreflected	44	1.002 ± 0.002	1.003 ± 0.002	0.996 ± 0.002	0.992 ± 0.003
CAS29	92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $3 \times 3 \times 3$ array, unreflected	45	0.994 ± 0.003	0.992 ± 0.003	0.991 ± 0.003	0.989 ± 0.003

Table 5 (continued)
Calculated k_{eff} for highly enriched uranium metal and solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS13	92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 63.3 g U/l, in Plexiglas cylinders, $3 \times 3 \times 3$ array, unreflected	45	0.988 ± 0.003	0.991 ± 0.003	0.992 ± 0.003	0.991 ± 0.003
CAS15	93.2% U metal cylinders, $2 \times 2 \times 2$ array, graphite moderated and polyethylene reflected	46	1.002 ± 0.002	1.002 ± 0.002	0.993 ± 0.002	0.994 ± 0.002
CAS17	92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $3 \times 3 \times 3$ array, paraffin reflected	45	1.019 ± 0.003	1.020 ± 0.003	1.016 ± 0.003	1.019 ± 0.003
CAS19	93.1% $\text{UO}_2(\text{NO}_3)_2$ solution, 450.8 g U/l, in SS containers, square central column with 8 perpendicular cylindrical arms unreflected	48, 49	1.036 ± 0.003	1.035 ± 0.003	1.023 ± 0.003	1.028 ± 0.003
CAS21	93.17% $\text{UO}_2(\text{NO}_3)_2$ solution, 364.1 g U/l, in Al cylinders, 4×4 array, concrete reflected	40	1.024 ± 0.003	1.024 ± 0.003	1.020 ± 0.003	1.020 ± 0.003
CAS33	Problem S333SP1R 93.2% UO_2F_2 solution 81.8 g U/l, in Al slabs, 3 7.62 cm slabs in 3×1 array, 2.54 cm separation, H_2O reflected	49	1.003 ± 0.002	0.998 ± 0.003	0.993 ± 0.003	1.000 ± 0.003

Table 5 (continued)
Calculated k_{eff} highly enriched uranium metal and solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS39	Problem S333SP5R 93.2% UO_2F_2 solution 81.8 g U/l, in Al slabs, 3 7.62 cm slabs in 3×1 array, 13.97 cm separation, H_2O reflected	49	0.999 ± 0.003	1.006 ± 0.003	1.005 ± 0.003	0.998 ± 0.002
CAS41	Problem S36SP15 93.2% UO_2F_2 solution 81.8 g U/l, in Al slabs, 7.62 cm and 14.834 cm slabs in 2×1 array, 38.1 cm separation, unreflected	49	0.976 ± 0.003	0.980 ± 0.003	0.973 ± 0.003	0.979 ± 0.003
CAS45	Problem S363SPO 93.2% UO_2F_2 solution 81.8 g U/l, in Al slabs, 7.62 cm and 14.834 cm slabs in 3×1 array, 0 cm separation, unreflected	49	0.988 ± 0.003	0.983 ± 0.003	0.979 ± 0.003	0.984 ± 0.003
CAS47	Problem S363SP20 93.2% UO_2F_2 solution 81.8 g U/l, in Al slabs, 7.62 cm and 14.834 cm slabs in 2×1 array, 38.1 cm separation, unreflected	49	0.977 ± 0.003	0.976 ± 0.003	0.978 ± 0.003	0.974 ± 0.003
CAS49	Problem S63SP12 93.2% UO_2F_2 solution 81.8 g U/l, in Al slabs, one slab is made up from two 7.62 cm slabs snugly fit together, the other is 7.62 cm, 2×1 array, 30.48 cm separation, unreflected	49	0.986 ± 0.003	0.983 ± 0.003	0.987 ± 0.003	0.982 ± 0.003

Table 5 (continued)
Calculated k_{eff} highly enriched uranium metal and solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS51	Problem S63SP30 93.2% UO_2F_2 solution 81.8 g U/l, in Al slabs, one slab is made up from two 7.62 cm slabs snugly fit together, the other is 7.62 cm, 2 × 1 array, 76.2 cm separation, unreflected	49	0.981 ± 0.003	0.985 ± 0.003	0.977 ± 0.003	0.982 ± 0.003
CAS58	Problem S63SP6 93.2% UO_2F_2 solution 81.8 g U/l, in Al slabs, one slab is 14.834 and the other is made of from two 7.62 cm slabs snugly fit together 2 × 1 array, 15.24 cm separation, unreflected	49	0.983 ± 0.003	0.982 ± 0.003	0.983 ± 0.003	0.978 ± 0.003
CAS57	Problem S66SP48 93.2% UO_2F_2 solution 81.8 g U/l, in Al slabs, one slab is 14.834 and the other is made of from two 7.62 cm slabs snugly fit together 2 × 1 array, 121.92 cm separation, unreflected	49	0.984 ± 0.003	0.987 ± 0.003	0.986 ± 0.003	0.980 ± 0.003
CAS91	Problem U6B271F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 63.3 g U/l, in Plexiglas cylinders, 3 × 3 × 3 array, unreflected, walls, floor, and tank in experiment room included	45	1.008 ± 0.003	1.007 ± 0.003	1.003 ± 0.004	1.000 ± 0.003
CAS61	Problem U2B81F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 279 g U/l, in Plexiglas cylinders, 2 × 2 × 2 array, unreflected, walls, floor, and tank in experiment room included	45	1.007 ± 0.003	1.006 ± 0.003	1.001 ± 0.003	0.997 ± 0.003

Table 5 (continued)
Calculated k_{eff} highly enriched uranium metal and solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS63	Problem U4B271F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $3 \times 3 \times 3$ array, unreflected, walls, floor, and tank in experiment room included	45	0.998 ± 0.003	1.001 ± 0.003	0.991 ± 0.003	0.990 ± 0.004
CAS90	Problem U4U2B27. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 63.3 g U/l, in Plexiglas cylinders, $3 \times 3 \times 3$ array, unreflected, walls, floor, and tank in experiment room included	45	1.001 ± 0.003	1.000 ± 0.003	0.999 ± 0.003	0.995 ± 0.003
CAS67	Problem U4R27B1F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $3 \times 3 \times 3$ array, reflected, 15.24 cm paraffin on bottom, 2.54 cm Plexiglas on other faces.	45	1.018 ± 0.003	1.017 ± 0.003	1.004 ± 0.003	1.005 ± 0.003
CAS71	Problem U4R27F1F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $3 \times 3 \times 3$ array, reflected, 15.24 cm paraffin on bottom, 7.62 cm paraffin on other faces.	45	1.031 ± 0.003	1.034 ± 0.003	1.023 ± 0.003	1.027 ± 0.003
CAS73	Problem U4R27H1F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $3 \times 3 \times 3$ array, reflected, 1.27 cm paraffin all faces	45	1.009 ± 0.003	1.008 ± 0.003	1.002 ± 0.003	1.004 ± 0.003

Table 5 (continued)
Calculated k_{eff} highly enriched uranium metal and solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS76	Problem U4R27H1F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $2 \times 2 \times 2$ array, reflected, 15.24 cm paraffin on bottom, 1.27 cm Plexiglas on other faces	45	1.019 ± 0.004	1.008 ± 0.003	1.005 ± 0.003	1.004 ± 0.003
CAS79	Problem U4R8D1F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $2 \times 2 \times 2$ array, reflected, 15.24 cm paraffin on bottom, 2.54 cm Plexiglas on other faces	45	1.012 ± 0.003	1.012 ± 0.003	1.012 ± 0.003	1.007 ± 0.003
CAS81	Problem U4R28F1F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $2 \times 2 \times 2$ array, reflected, 15.24 cm paraffin on bottom, 6.35 cm Plexiglas on other faces	45	1.022 ± 0.003	1.028 ± 0.003	1.012 ± 0.003	1.019 ± 0.003
CAS84	Problem U4R8I1F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $2 \times 2 \times 2$ array, reflected, 15.24 cm paraffin on bottom, 7.62 cm Plexiglas on other faces	45	1.022 ± 0.004	1.022 ± 0.003	1.013 ± 0.003	1.009 ± 0.003
CAS86	Problem U4R8K1F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $2 \times 2 \times 2$ array, reflected, 1.27 cm paraffin on all faces	45	1.012 ± 0.003	1.011 ± 0.003	1.004 ± 0.003	1.009 ± 0.003

Table 5 (continued)
Calculated k_{eff} highly enriched uranium metal and solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS88	Problem U4R8N1F. 92.6% $\text{UO}_2(\text{NO}_3)_2$ solution, 415 g U/l, in Plexiglas cylinders, $2 \times 2 \times 2$ array, reflected, 7.62 cm paraffin on all faces	45	1.016 ± 0.003	1.023 ± 0.003	1.013 ± 0.004	1.012 ± 0.003

Table 6. KENO V.a and KENO-VI comparison
Calculated k_{eff} for highly enriched uranium solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS01	Experiment 1. U(93.2) O ₂ (NO ₃) ₂ H/X = 1378 in 27.24-in. diam sphere	25, 26	0.999 ± 0.002	0.997 ± 0.002	0.996 ± 0.002	1.003 ± 0.002
CAS02	Experiment 2. U(93.2) O ₂ (NO ₃) ₂ H/X = 1177, B poisoned, in 27.24-in. diam sphere	25, 26	0.998 ± 0.002	1.001 ± 0.002	1.003 ± 0.002	0.998 ± 0.002
CAS03	Experiment 3. U(93.2) O ₂ (NO ₃) ₂ H/X = 1033, B poisoned, in 27.24-in. diam sphere	25, 26	0.996 ± 0.002	0.993 ± 0.002	0.993 ± 0.002	0.993 ± 0.002
CAS04	Experiment 4. U(93.2) O ₂ (NO ₃) ₂ H/X = 972, B poisoned, in 27.24-in. diam sphere	25, 26	0.995 ± 0.002	0.998 ± 0.002	0.998 ± 0.002	1.000 ± 0.002
CAS05	Experiment 5. U-233 O ₂ (NO ₃) ₂ H/X = 1533, in 27.24-in. diam sphere	25, 26	0.998 ± 0.002	1.003 ± 0.002	0.995 ± 0.002	0.999 ± 0.002
CAS06	Experiment 6. U-233 O ₂ (NO ₃) ₂ H/X = 1470, B poisoned, in 27.24-in. diam sphere	25, 26	1.002 ± 0.002	0.999 ± 0.002	0.996 ± 0.002	0.994 ± 0.002
CAS07	Experiment 7. U-233 O ₂ (NO ₃) ₂ H/X = 1417, B poisoned, in 27.24-in. diam sphere	25, 26	1.002 ± 0.002	0.999 ± 0.002	0.997 ± 0.002	0.995 ± 0.002
CAS08	Experiment 8. U-233 O ₂ (NO ₃) ₂ H/X = 1368, B poisoned, in 27.24-in. diam sphere	25, 26	1.003 ± 0.002	1.003 ± 0.002	0.993 ± 0.002	0.991 ± 0.002
CAS09	Experiment 9. U-233 O ₂ (NO ₃) ₂ H/X = 1308, B poisoned, in 27.24-in. diam sphere	25, 26	1.005 ± 0.002	1.006 ± 0.002	1.000 ± 0.002	0.996 ± 0.002

Table 6 (continued)
Calculated k_{eff} for highly enriched uranium solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS10	Experiment 10. U(93.2) O ₂ (NO ₃) ₂ H/X = 1835, in 48.04-in. diam sphere	25, 26	0.998 ± 0.002	0.995 ± 0.001	1.000 ± 0.002	0.998 ± 0.001
CAS11	Experiment 11. U-233 O ₂ (NO ₃) ₂ H/X = 1986, in 48.04-in. diam sphere	25, 26	0.994 ± 0.002	1.000 ± 0.001	0.996 ± 0.002	0.994 ± 0.001
CAS12	Experiment 12. U(93.2) O ₂ (NO ₃) ₂ H/X = 1604, in 60.92-in. diam cylinder	25, 26	0.991 ± 0.002	0.992 ± 0.002	0.996 ± 0.001	0.994 ± 0.002
CAS13	Experiment 13. U(93.2) O ₂ (NO ₃) ₂ H/X = 1634, in 60.92-in. diam cylinder	25, 26	0.994 ± 0.002	0.992 ± 0.001	0.999 ± 0.002	0.995 ± 0.002
CAS14	Experiment 14. U(93.2) O ₂ (NO ₃) ₂ H/X = 1821, in 60.92-in. diam cylinder	25, 26	0.999 ± 0.001	0.997 ± 0.001	0.997 ± 0.002	1.000 ± 0.001
CAS15	Experiment 15. U(93.2) O ₂ (NO ₃) ₂ H/X = 1905, in 60.92-in. diam cylinder	25, 26	0.999 ± 0.001	0.999 ± 0.001	0.999 ± 0.002	1.002 ± 0.001
CAS16	Experiment 16. U(93.2) O ₂ (NO ₃) ₂ H/X = 1981, in 60.92-in. diam cylinder	25, 26	0.996 ± 0.001	0.995 ± 0.001	0.996 ± 0.001	1.003 ± 0.001
CAS17	Experiment 17. U-233 O ₂ (NO ₃) ₂ H/X = 1819, in 60.92-in. diam cylinder	25, 26	0.993 ± 0.001	0.992 ± 0.002	0.993 ± 0.001	0.991 ± 0.002
CAS18	Experiment 18. U-233 O ₂ (NO ₃) ₂ H/X = 1900, in 60.92-in. diam cylinder	25, 26	0.996 ± 0.001	0.996 ± 0.001	0.995 ± 0.001	0.997 ± 0.001

Table 6 (continued)
Calculated k_{eff} for highly enriched uranium solution systems

Case	Experimental description	Ref.	$k_{eff} \pm \sigma$			
			27 group		238 group	
			KENO V.a	KENO-VI	KENO V.a	KENO-VI
CAS19	Experiment 19. U-233 O ₂ (NO ₃) ₂ H/X = 1996, in 60.92-in. diam cylinder	25, 26	0.994 ± 0.002	0.994 ± 0.001	0.995 ± 0.001	0.997 ± 0.001
CAS20	Experiment 20. U-233 O ₂ (NO ₃) ₂ H/X = 2106, in 60.92-in. diam cylinder	25, 26	0.992 ± 0.002	0.993 ± 0.001	0.995 ± 0.001	0.994 ± 0.002
CAS21	Experiment 21. U(93.2) O ₂ (NO ₃) ₂ H/X = 1955, in 107.7-in. diam cylinder	25, 26	0.993 ± 0.001	0.996 ± 0.001	0.997 ± 0.001	1.002 ± 0.001
CAS22	Experiment 22. U(93.2) O ₂ (NO ₃) ₂ H/X = 2004, in 107.7-in. diam cylinder	25, 26	0.995 ± 0.001	0.994 ± 0.001	0.999 ± 0.001	0.999 ± 0.001
CAS23	Experiment 23. U(93.2) O ₂ (NO ₃) ₂ H/X = 2052, in 107.7-in. diam cylinder	25, 26	0.996 ± 0.001	0.996 ± 0.001	0.999 ± 0.001	1.000 ± 0.001

5. DISCUSSION OF RESULTS

Table 7 gives the mean, median, minimum, and maximum k_{eff} values for each table of results. The deviations for the mean values are the root mean square of each table. The mean values of k_{eff} are in excellent agreement with the experiments.

The spread in data, however, indicates that there may be problems with certain types of calculations. The low-enriched uranium systems reported in Table 3 and the highly-enriched uranium systems in Table 5 show a wide spread in the data. This could be caused by the detail of the descriptions of the experiments.

Figures 1–6 are plots of calculated k_{eff} values for each case from Tables 1–6. These plots show the comparisons between KENO-VI and KENO V.a using both the 27- and 238-group cross-section libraries.

Figures 7–10 show the calculated value of k_{eff} as a function of the assay for low-enriched and high-enriched experiments. Figures 7 and 8 show the comparison of 27- and 238-group cross sections for low-enrichment experiments using KENO V.a and KENO-VI, respectively. Figures 9 and 10 show the same comparison for high-enrichment experiments.

Figure 11 shows the comparison of KENO V.a and KENO-VI for low-enrichment experiments using 238-group cross sections. Figure 12 shows the same comparison for high-enrichment experiments.

Figures 13–19 are plots of k_{eff} versus energy of average lethargy causing fission (EALF) for each table of results. Table 5 was split into two portions because of the large range in EALF. Figure 17 presents the EALF for the uranium metal systems of Table 5 while Figure 18 presents the EALF for the uranium solutions for Table 5. These plots do not show a trend in the results.

Table 7. Average calculated k_{eff} value by table

		Table = 1			
Total Cases		27 group		238 group	
		KENO V.a	KENO-VI	KENO V.a	KENO-VI
19	Mean k_{eff}	0.994 ± 0.005	0.994 ± 0.004	0.995 ± 0.005	0.996 ± 0.005
	Median k_{eff}	0.995 ± 0.002	0.993 ± 0.002	0.995 ± 0.002	0.996 ± 0.002
	Minimum k_{eff}	0.987 ± 0.002	0.989 ± 0.002	0.988 ± 0.003	0.989 ± 0.003
	Maximum k_{eff}	1.002 ± 0.003	1.001 ± 0.002	1.002 ± 0.002	1.003 ± 0.003

		Table = 2			
Total Cases		27 group		238 group	
		KENO V.a	KENO-VI	KENO V.a	KENO-VI
7	Mean k_{eff}	1.003 ± 0.006	1.004 ± 0.008	0.995 ± 0.007	0.993 ± 0.005
	Median k_{eff}	1.006 ± 0.002	1.006 ± 0.002	0.995 ± 0.002	0.996 ± 0.002
	Minimum k_{eff}	0.992 ± 0.002	0.991 ± 0.002	0.984 ± 0.002	0.985 ± 0.002
	Maximum k_{eff}	1.008 ± 0.003	1.013 ± 0.002	1.003 ± 0.002	0.998 ± 0.003

		Table = 3			
Total Cases		27 group		238 group	
		KENO V.a	KENO-VI	KENO V.a	KENO-VI
23	Mean k_{eff}	0.999 ± 0.010	1.000 ± 0.009	1.002 ± 0.002	1.003 ± 0.009
	Median k_{eff}	0.997 ± 0.002	0.999 ± 0.002	0.999 ± 0.003	1.001 ± 0.003
	Minimum k_{eff}	0.985 ± 0.002	0.981 ± 0.002	0.986 ± 0.003	0.990 ± 0.003
	Maximum k_{eff}	1.014 ± 0.003	1.016 ± 0.004	1.017 ± 0.003	1.019 ± 0.003

Table 7 (continued)

		Table = 4			
Total Cases		27 group		238 group	
		KENO V.a	KENO-VI	KENO V.a	KENO-VI
17	Mean k_{eff}	1.009 ± 0.007	1.006 ± 0.007	1.002 ± 0.007	1.003 ± 0.007
	Median k_{eff}	1.008 ± 0.003	1.005 ± 0.003	1.000 ± 0.003	1.001 ± 0.003
	Minimum k_{eff}	0.998 ± 0.003	0.996 ± 0.003	0.991 ± 0.003	0.993 ± 0.003
	Maximum k_{eff}	1.028 ± 0.003	1.028 ± 0.004	1.017 ± 0.003	1.021 ± 0.003

Table = 5

		Table = 5			
Total Cases		27 group		238 group	
		KENO V.a	KENO-VI	KENO V.a	KENO-VI
35	Mean k_{eff}	1.005 ± 0.015	1.005 ± 0.015	0.999 ± 0.013	1.004 ± 0.014
	Median k_{eff}	1.007 ± 0.002	1.006 ± 0.003	1.001 ± 0.003	0.998 ± 0.002
	Minimum k_{eff}	0.976 ± 0.003	0.980 ± 0.003	0.973 ± 0.003	0.974 ± 0.003
	Maximum k_{eff}	1.036 ± 0.003	1.035 ± 0.004	1.023 ± 0.003	1.028 ± 0.003

Table = 6

		Table = 6			
Total Cases		27 group		238 group	
		KENO V.a	KENO-VI	KENO V.a	KENO-VI
23	Mean k_{eff}	0.997 ± 0.004	0.997 ± 0.004	0.997 ± 0.003	0.997 ± 0.004
	Median k_{eff}	0.996 ± 0.002	0.996 ± 0.001	0.996 ± 0.001	0.997 ± 0.001
	Minimum k_{eff}	1.005 ± 0.002	1.006 ± 0.002	1.003 ± 0.002	1.003 ± 0.002
	Maximum k_{eff}	1.005 ± 0.002	1.006 ± 0.002	1.003 ± 0.002	1.003 ± 0.002

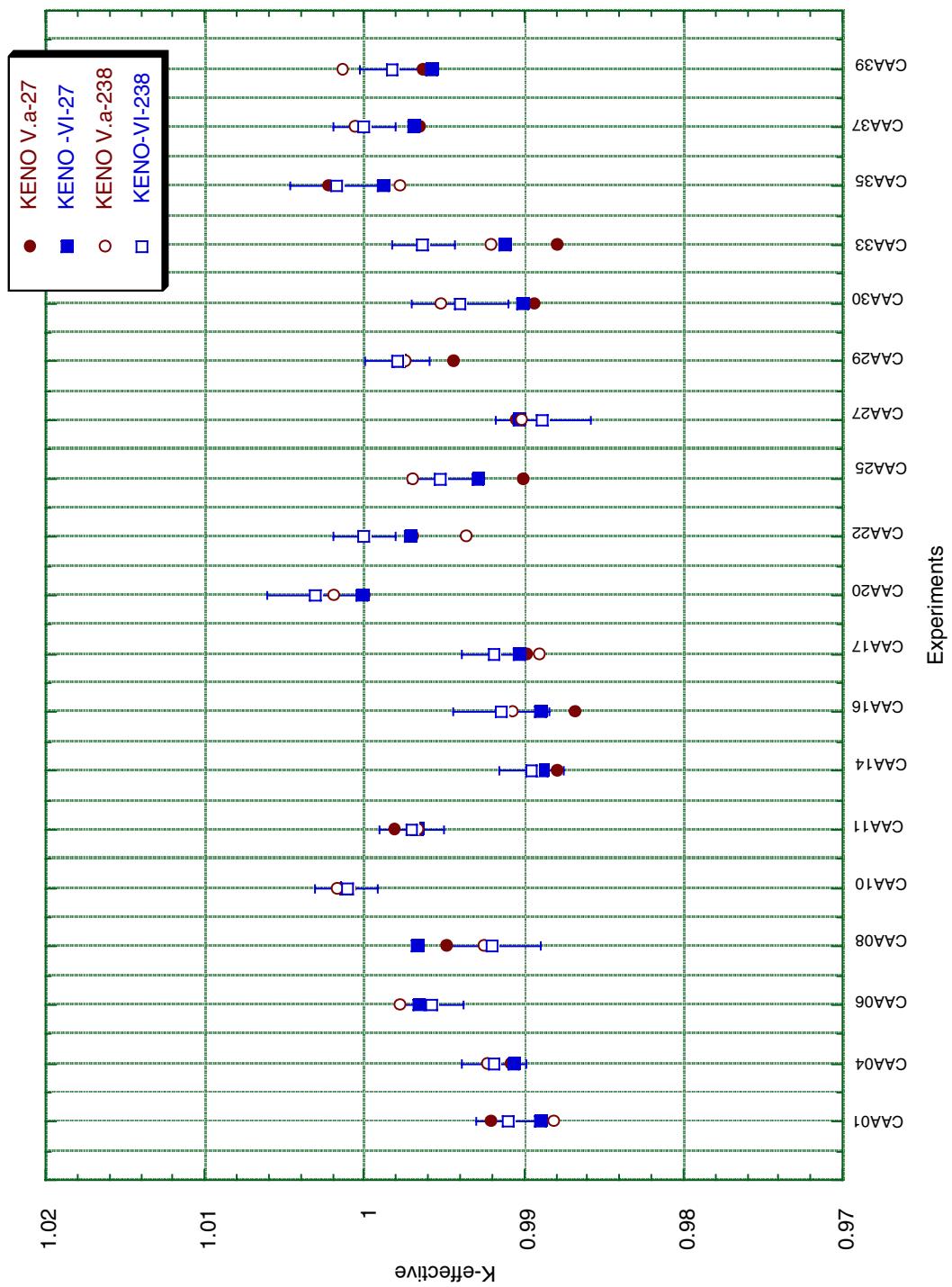


Figure 1. Calculated K-effective values from Table 1.

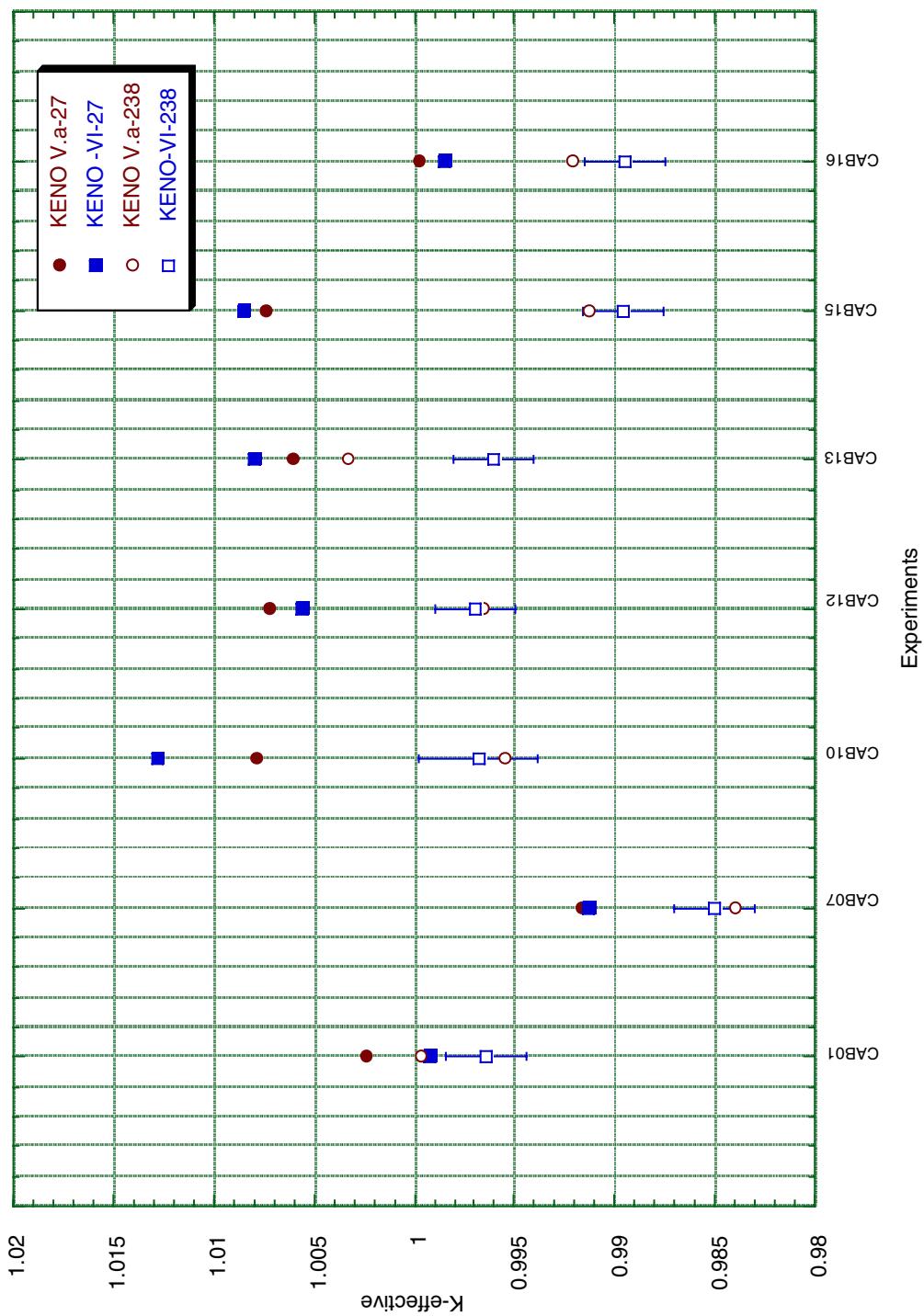


Figure 2. Calculated K-effective values from Table 2.

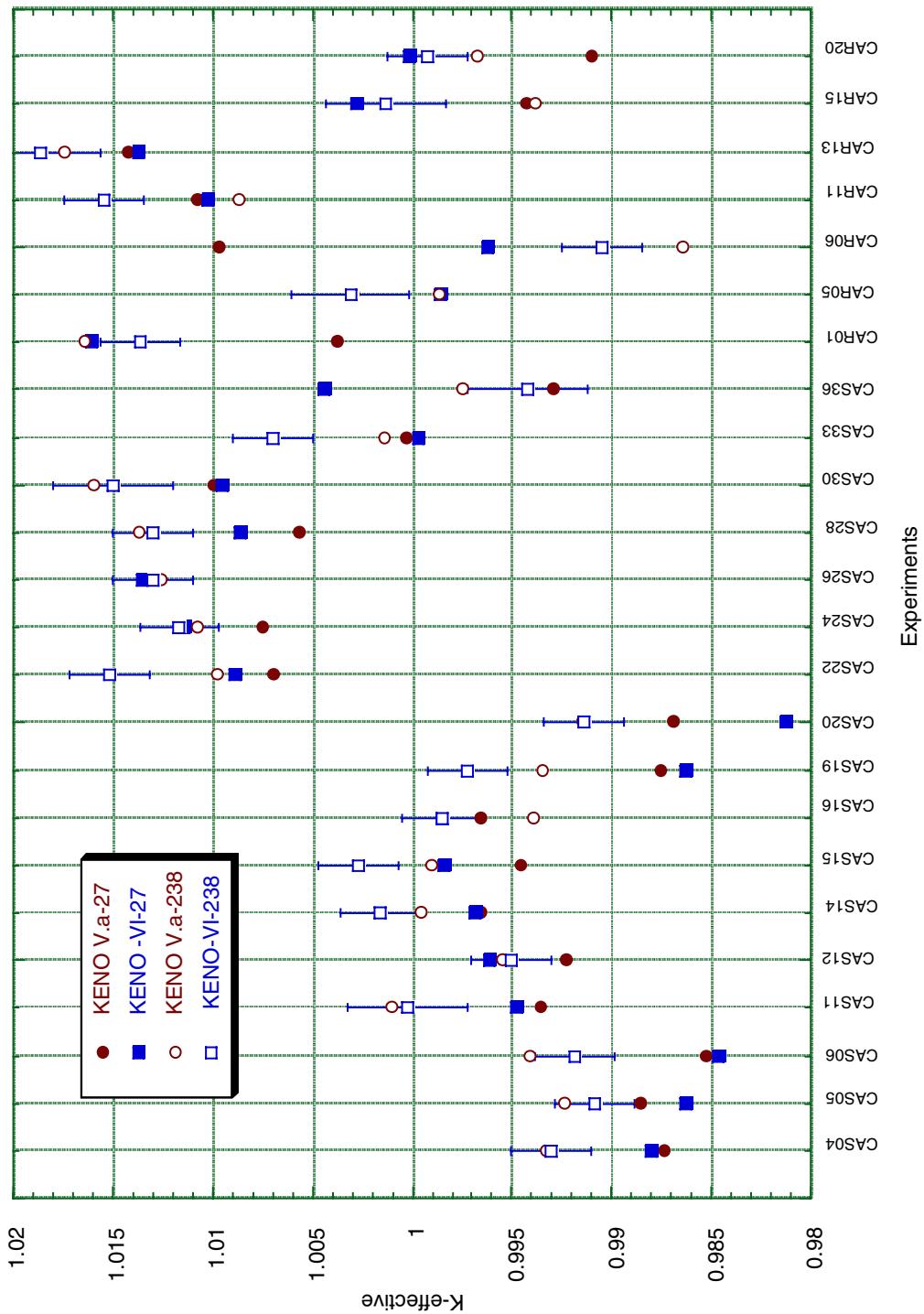


Figure 3. Calculated K-effective values from Table 3.

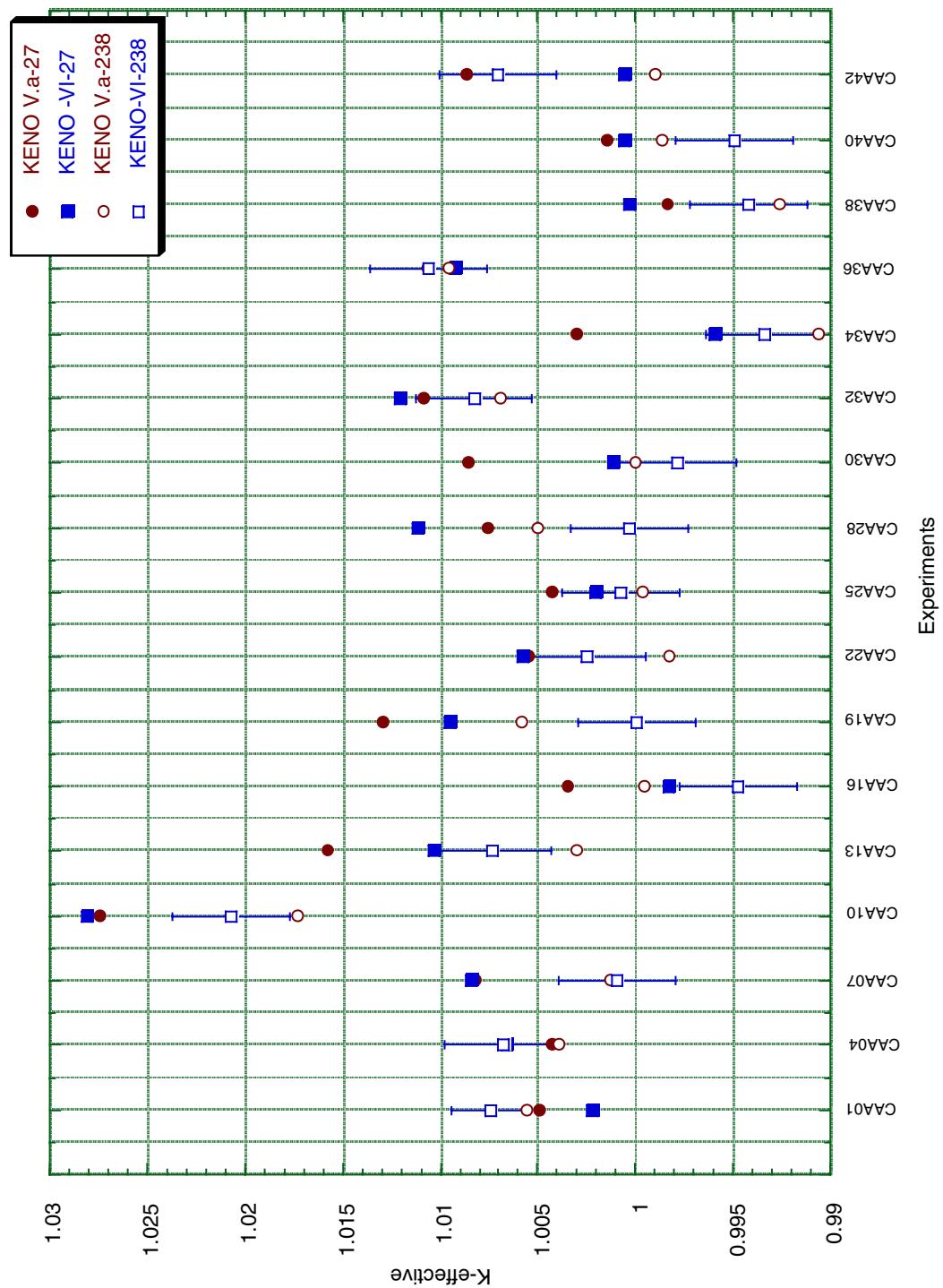


Figure 4. Calculated K-effective values from Table 4.

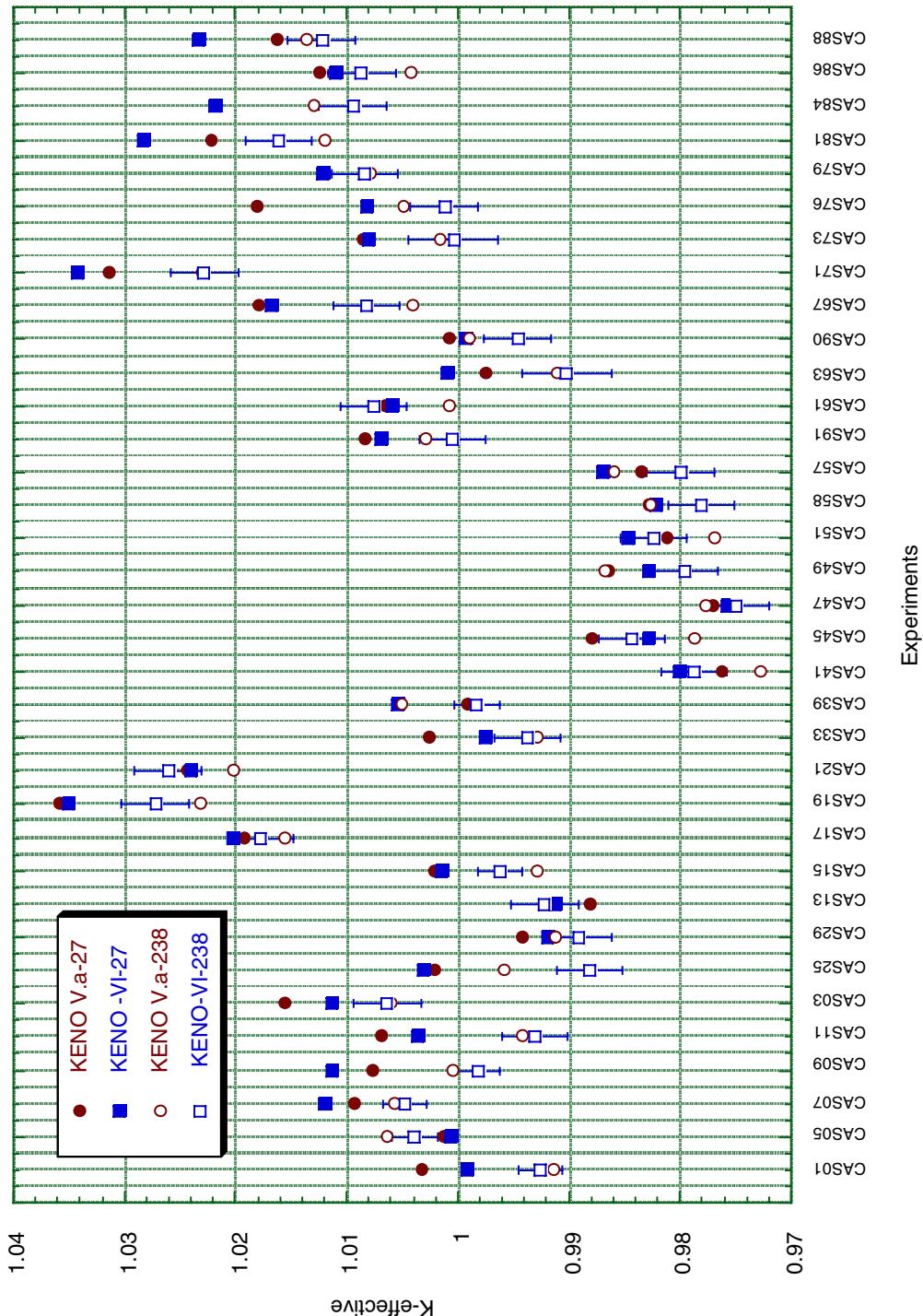


Figure 5. Calculated K-effective values from Table 5.

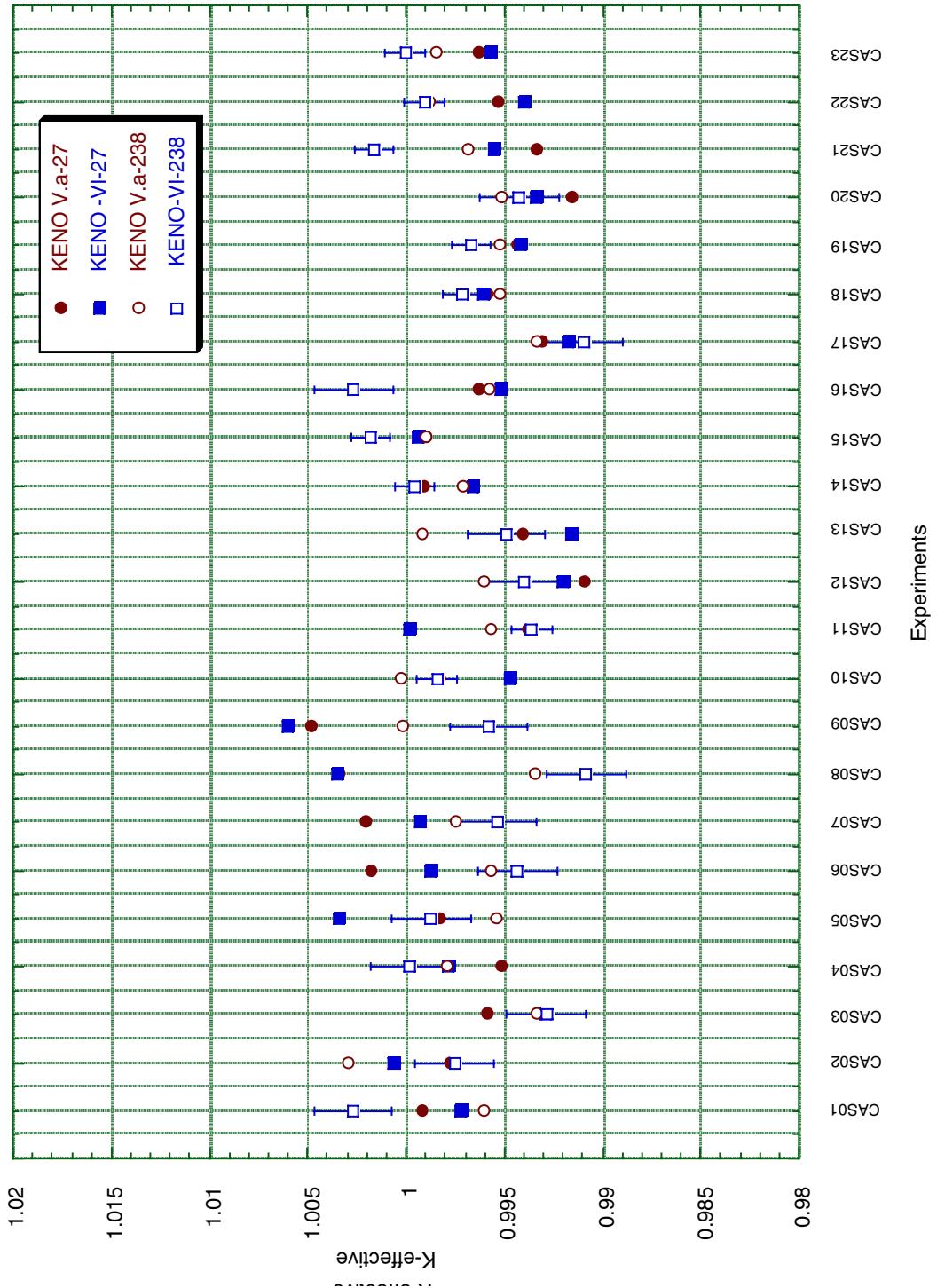


Figure 6. Calculated K-effective values from Table 6.

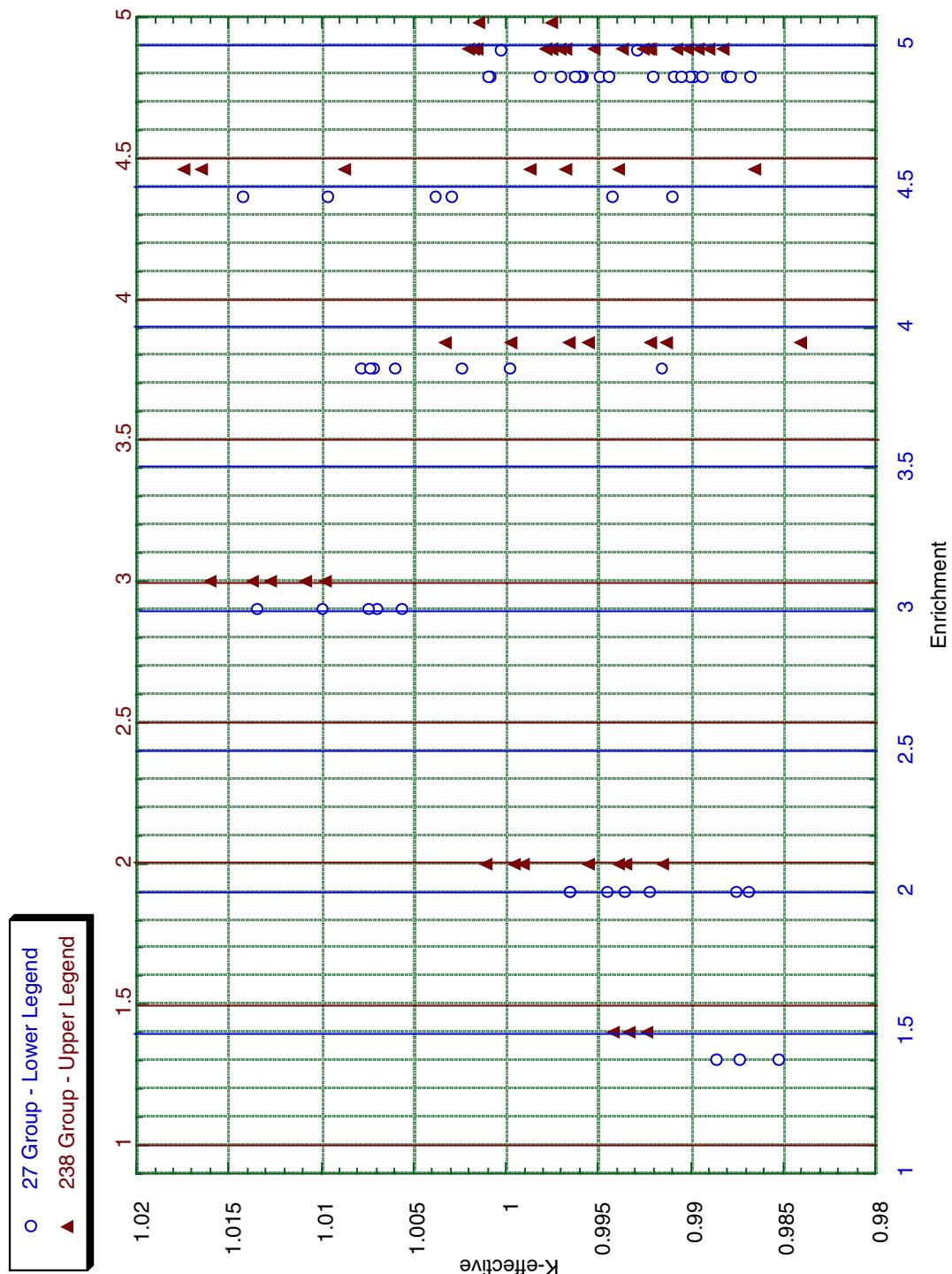


Figure 7. KENO V.a k-effective vs. enrichment level low enrichment experiments.

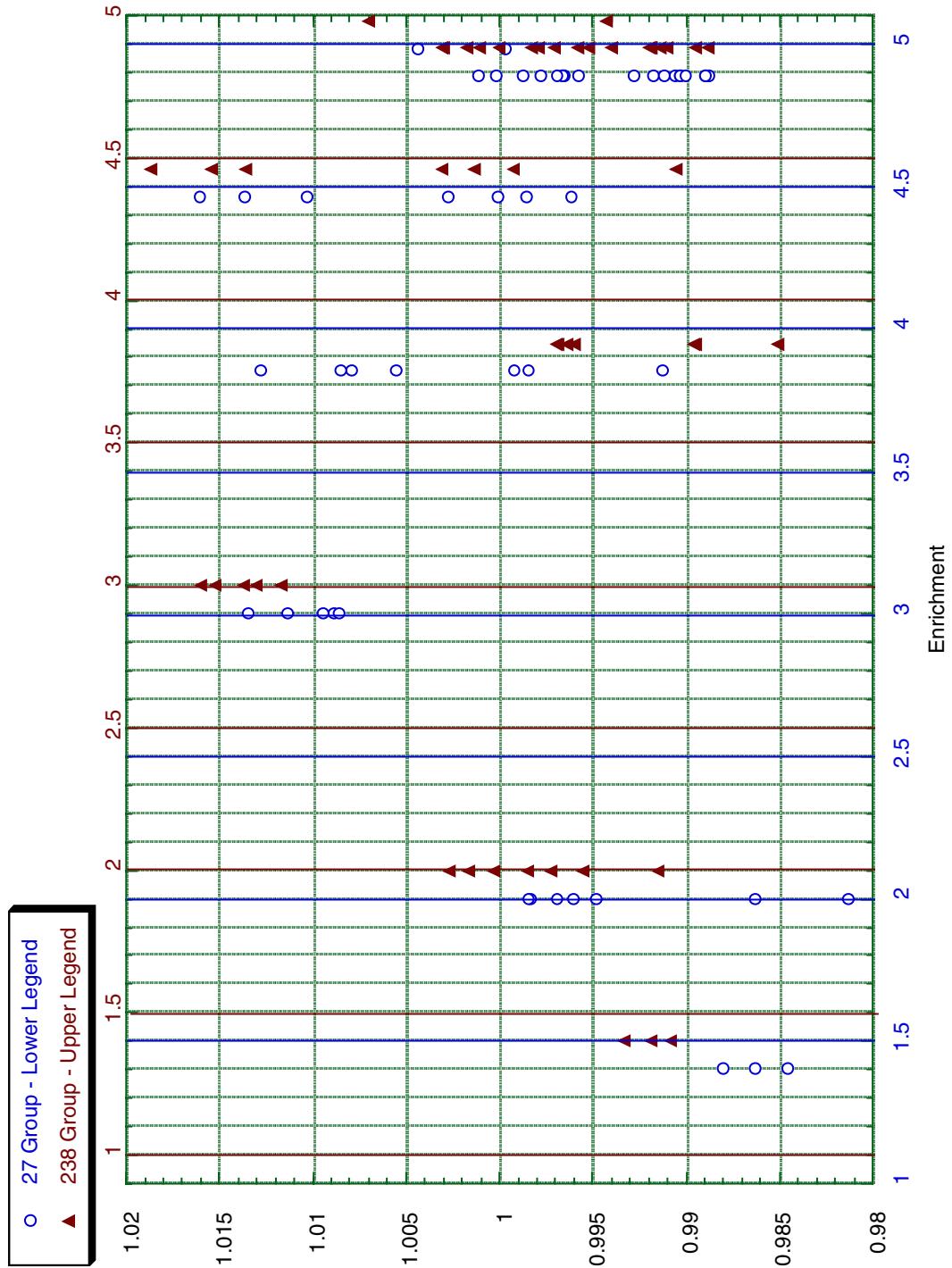


Figure 8. KENO-VI k-effective vs. enrichment level low enrichment experiments.

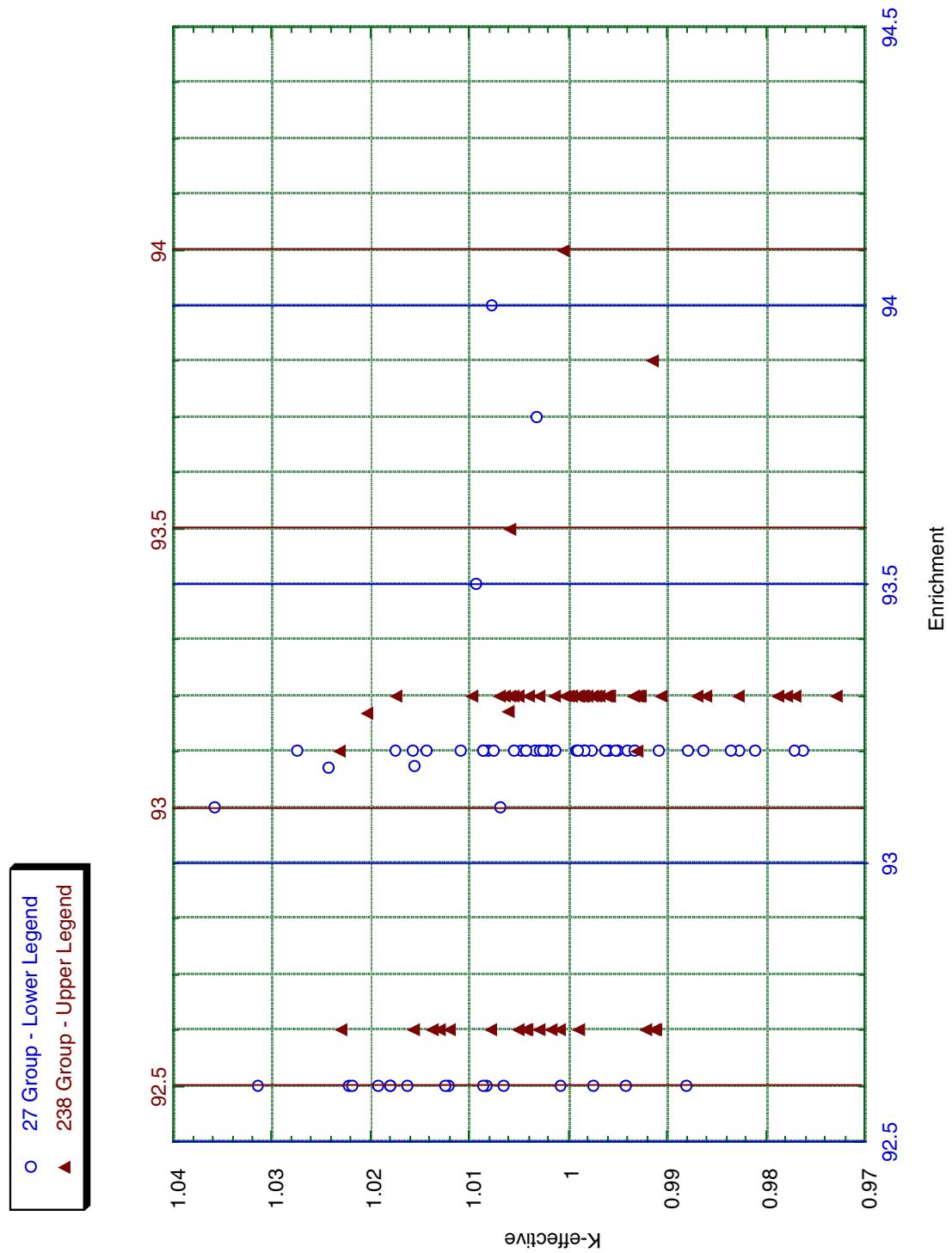


Figure 9. KENO V.a k-effective vs. enrichment level high enrichment experiments.

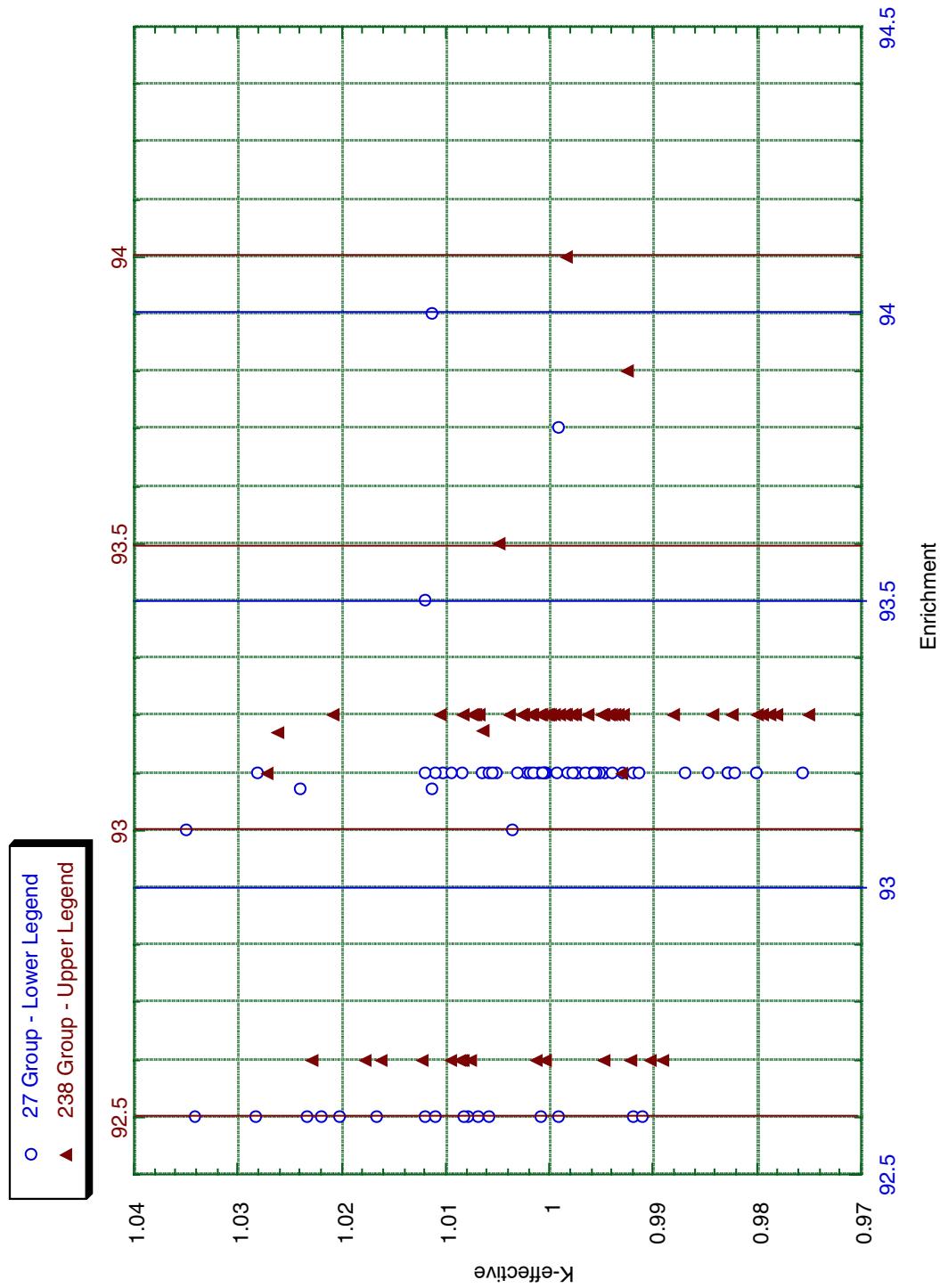


Figure 10. KENO-VI k-effective vs. enrichment level high enrichment experiments.

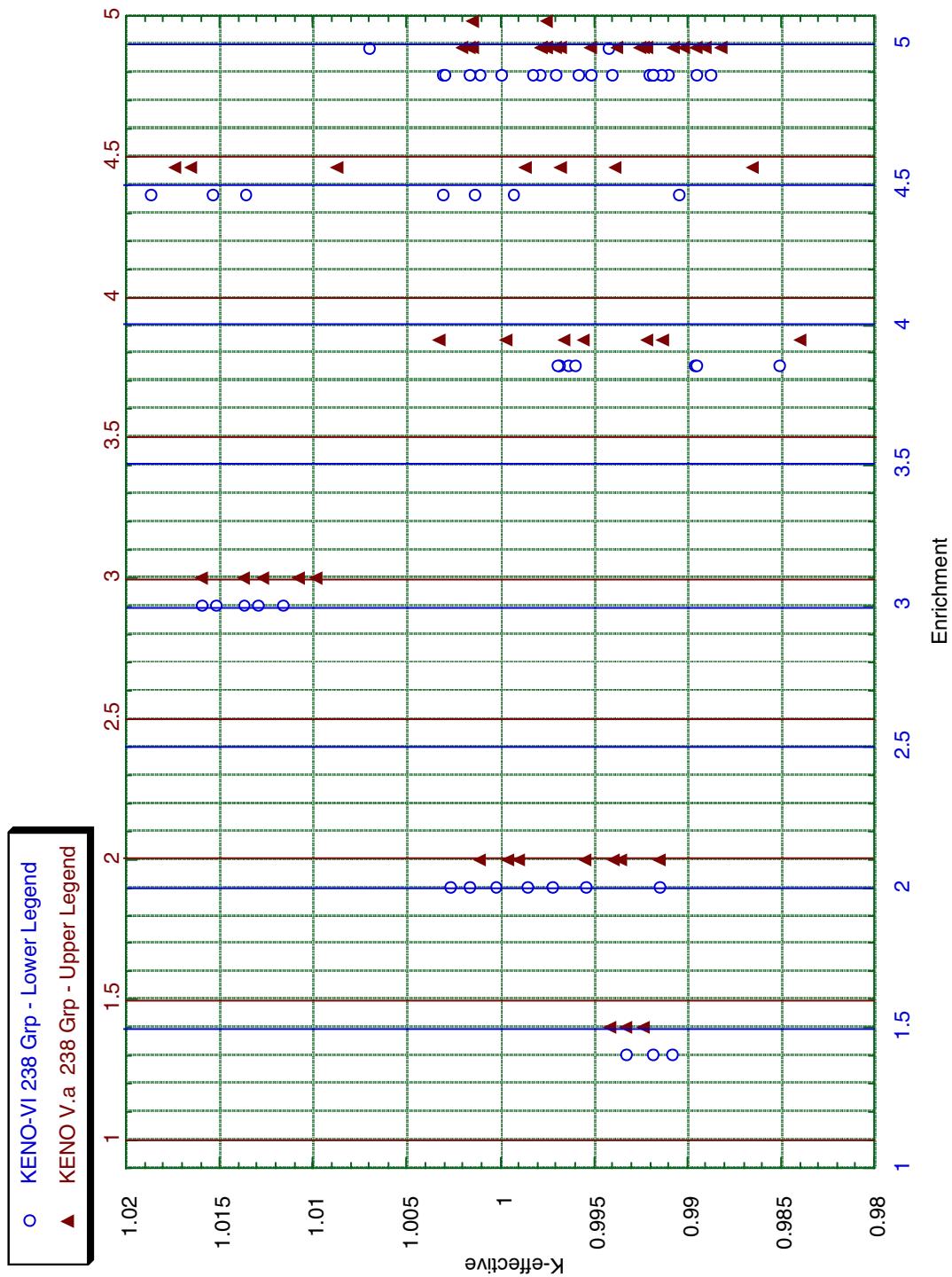


Figure 11. KENO V.a and KENO.VI (238 group) k-effective vs. enrichment level low enrichment experiments.

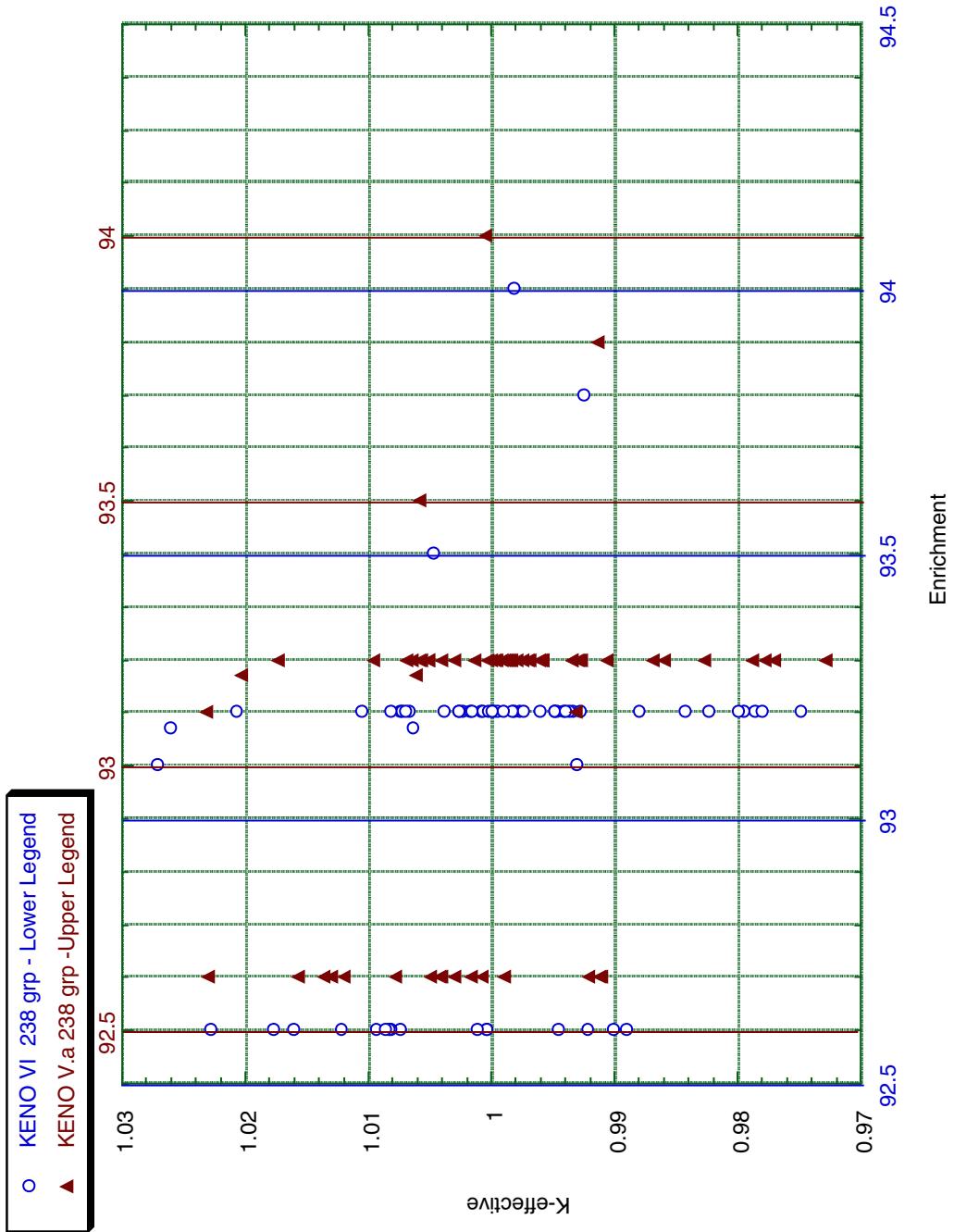


Figure 12. KENO V.a and KENO-VI (238 group) k-effective vs. enrichment level high enrichment experiments.

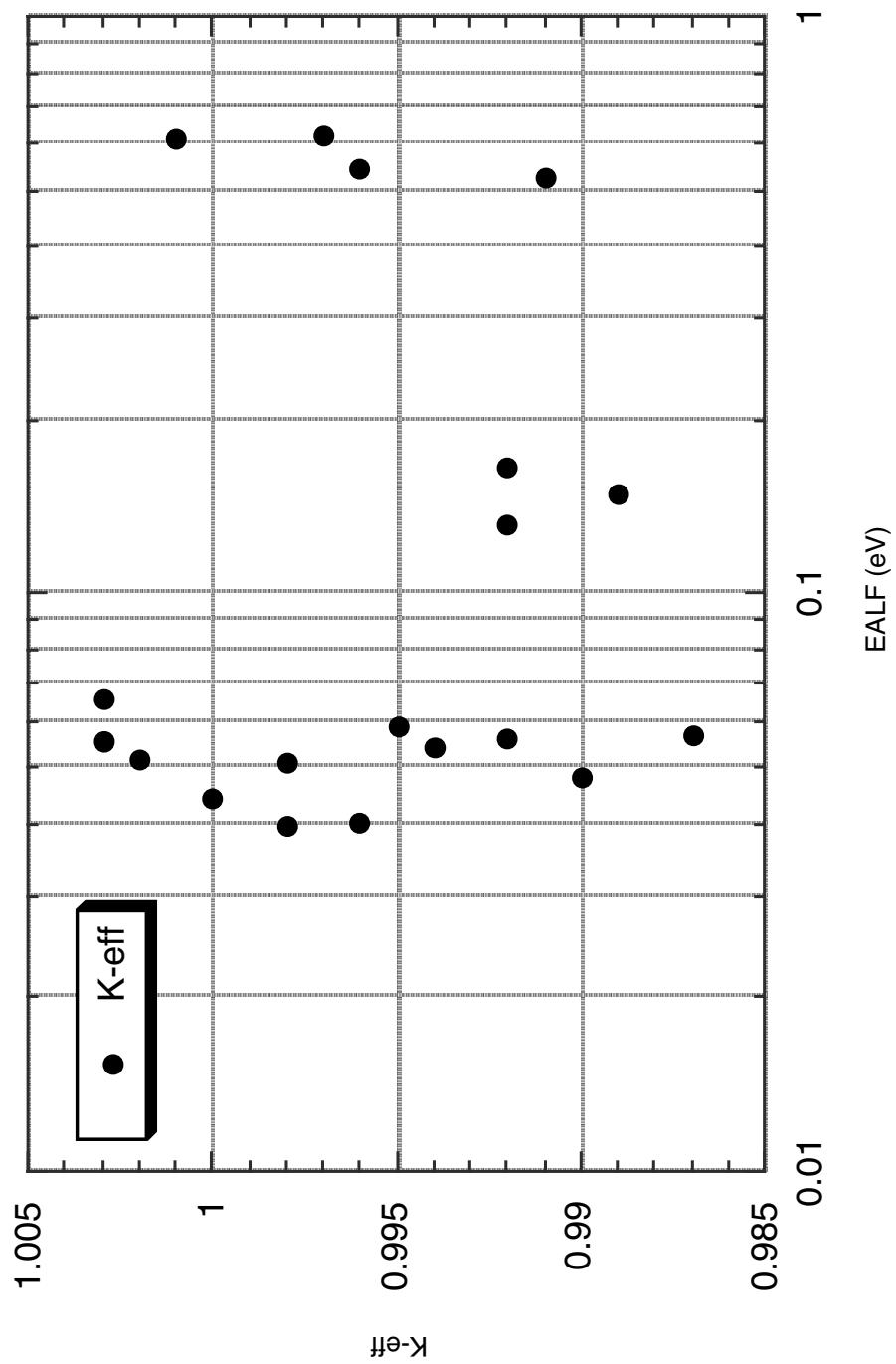


Figure 13. KENO-VI 238-group results for low enriched homogeneous and heterogeneous systems (Table 1).

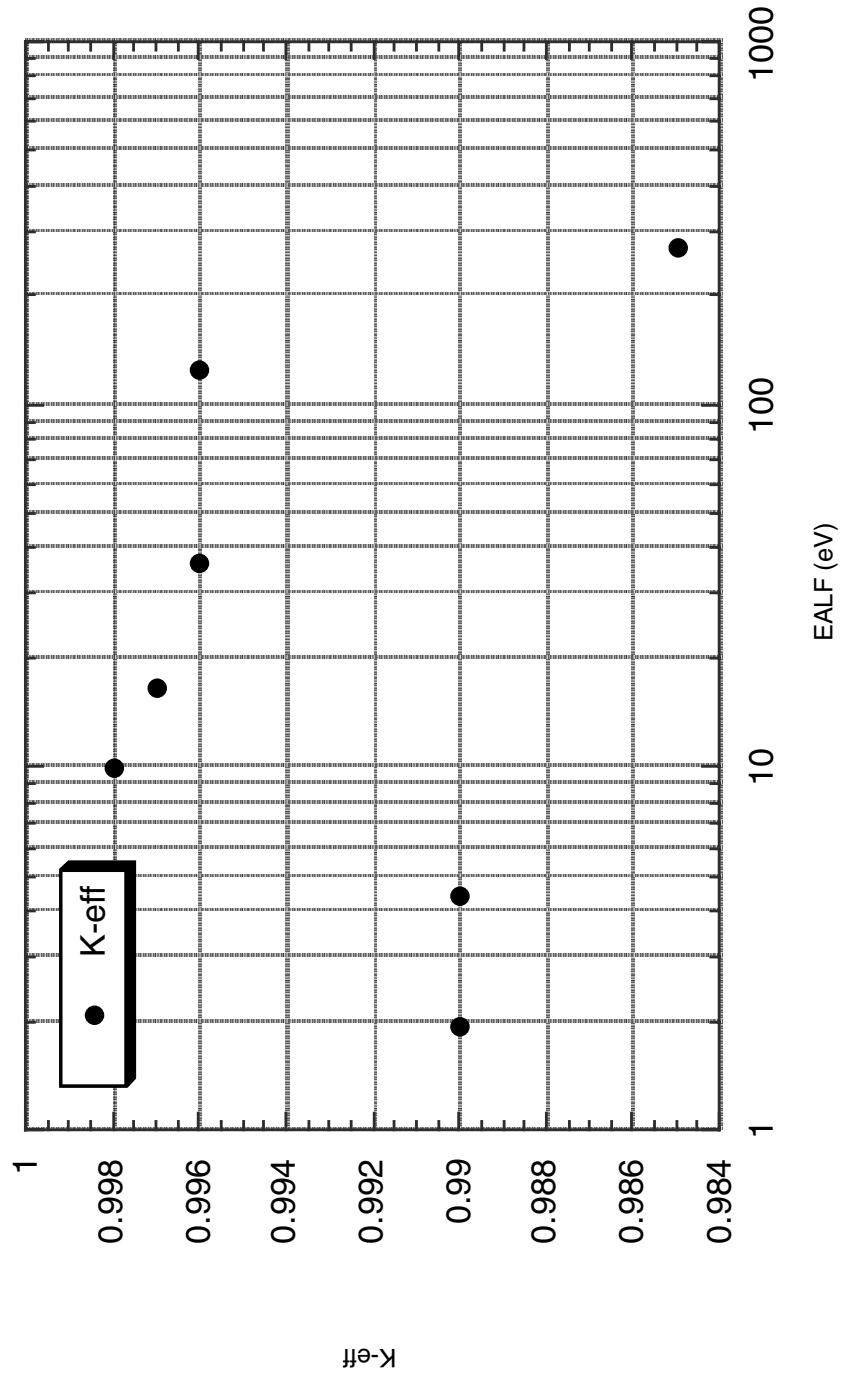


Figure 14. KENO-VI 238-group results for large diameter low enriched uranium cylinders in various lattice arrangements (Table 2).

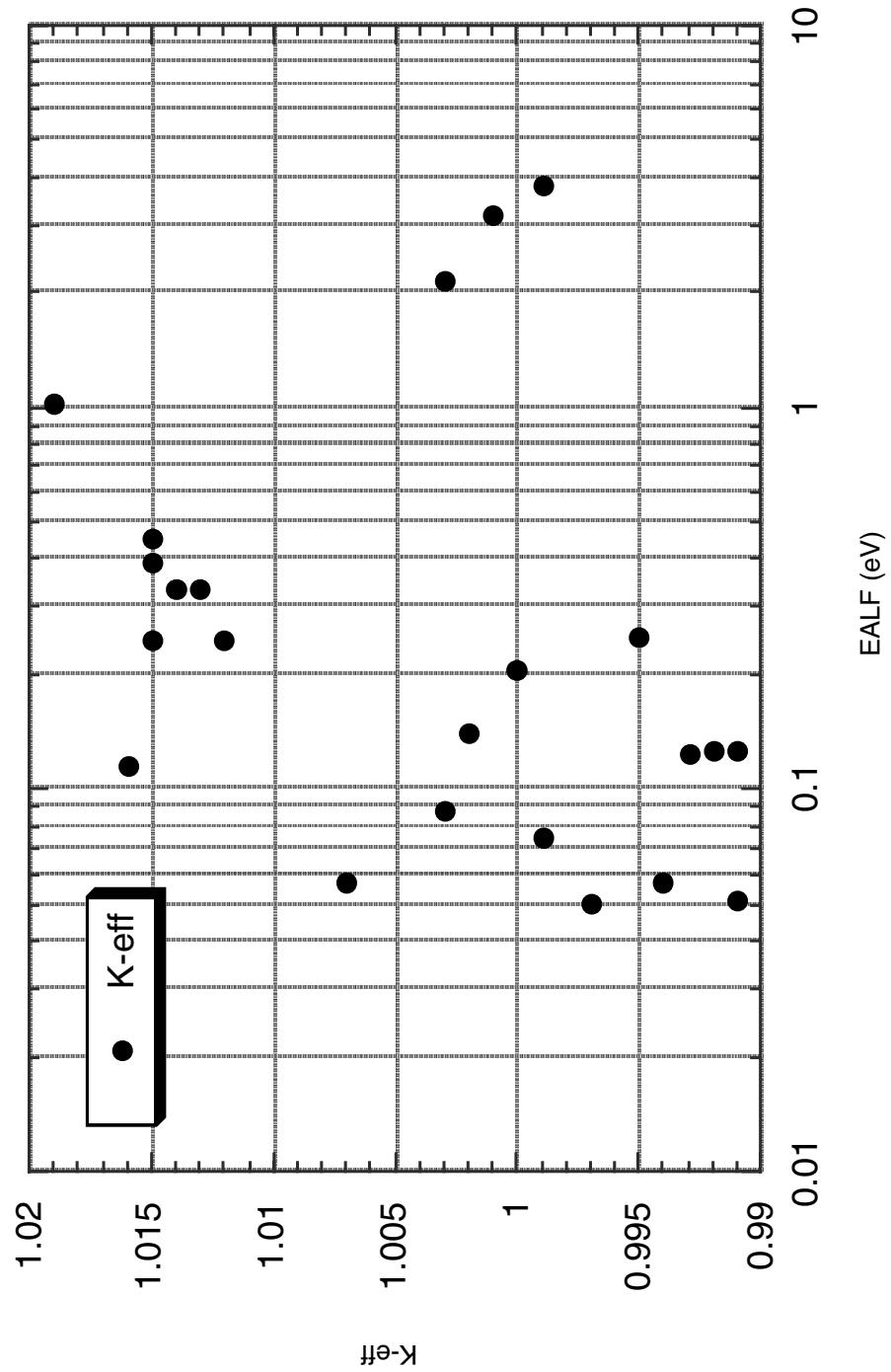


Figure 15. KENO-VI 238-group results for low enriched homogeneous uranium systems (Table 3).

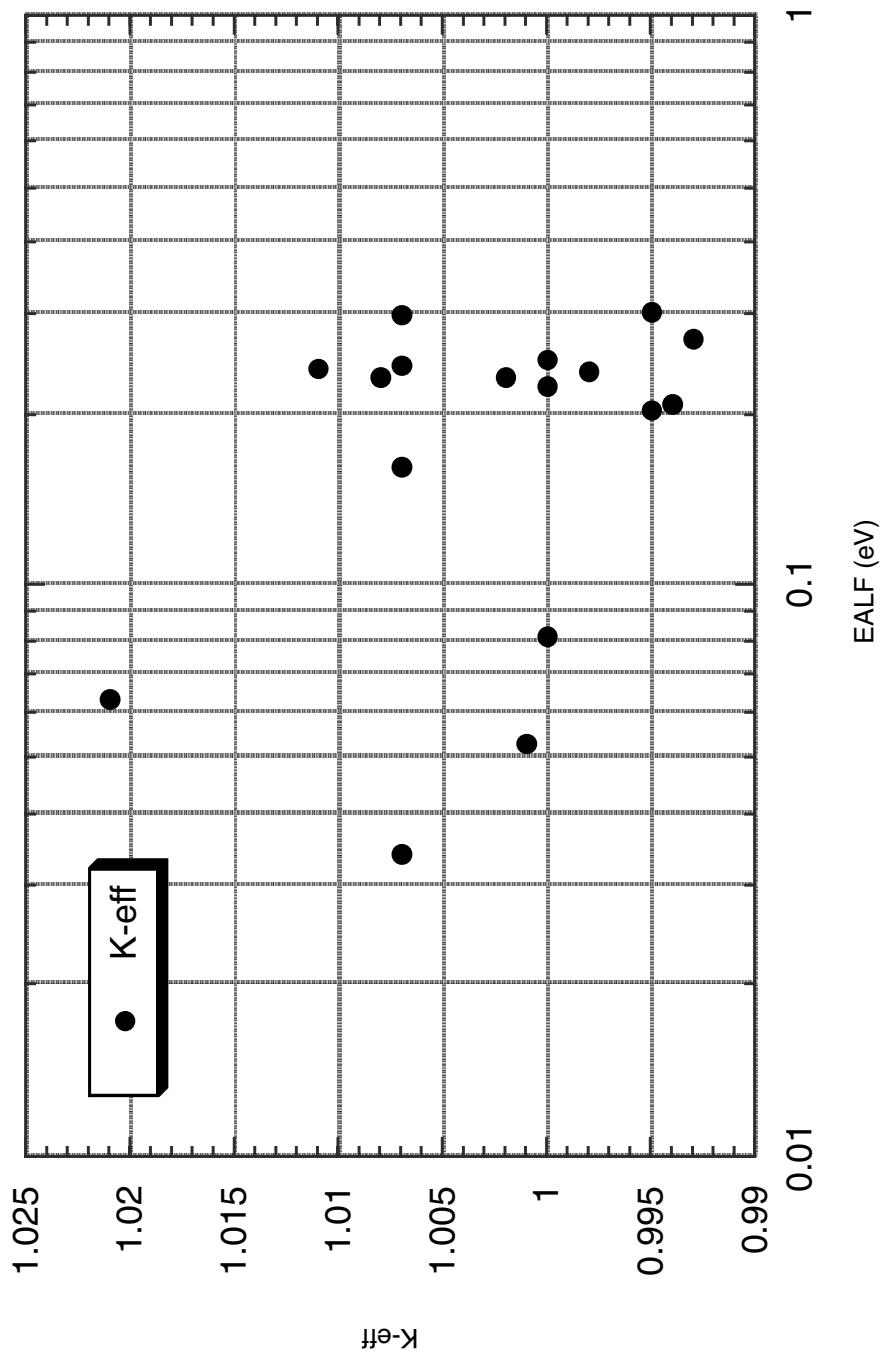


Figure 16. KENO-VI 238-group results for highly enriched uranium solutions (Table 4).

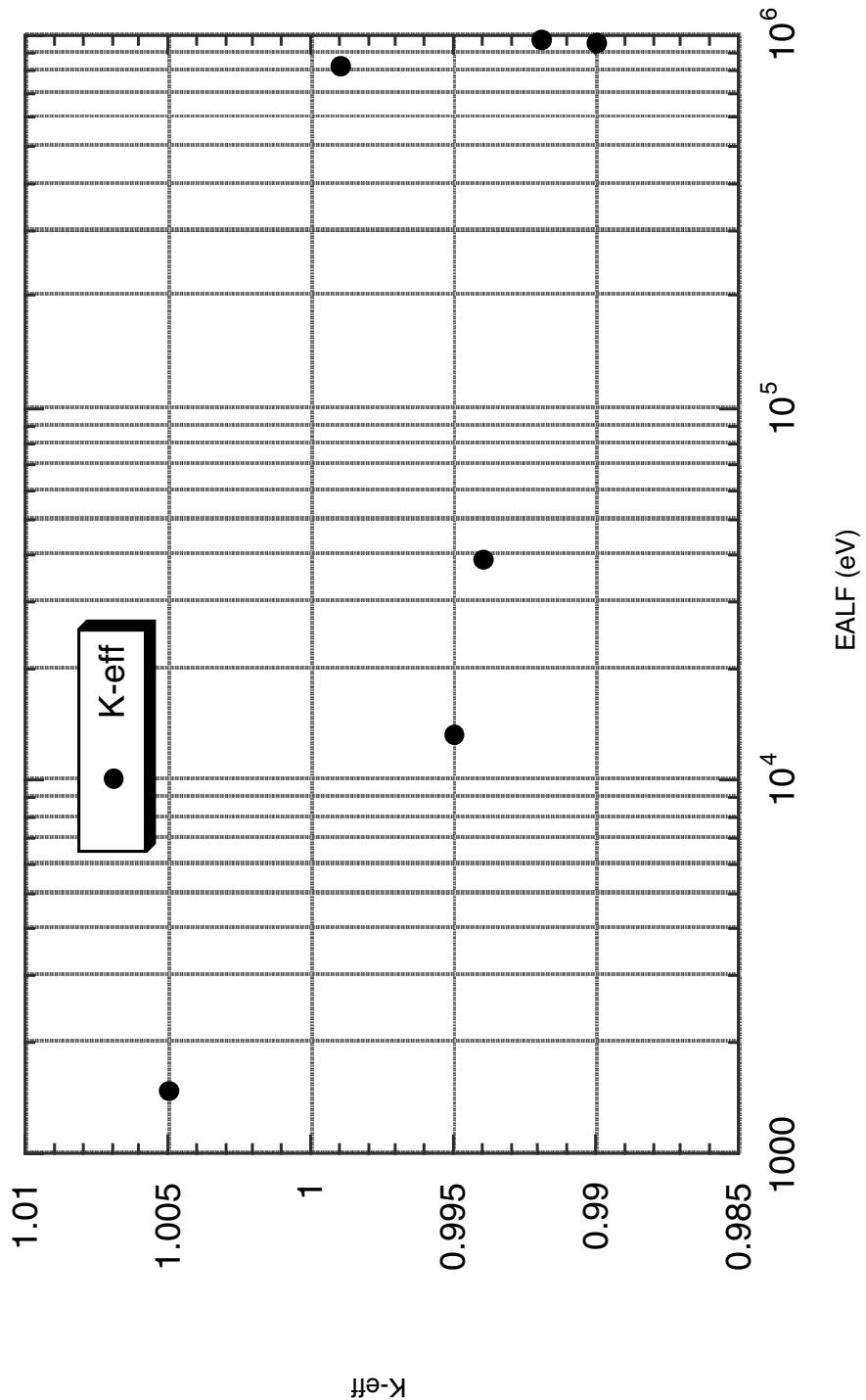


Figure 17. KENO-VI 238-group results for highly enriched uranium metal systems (Table 5).

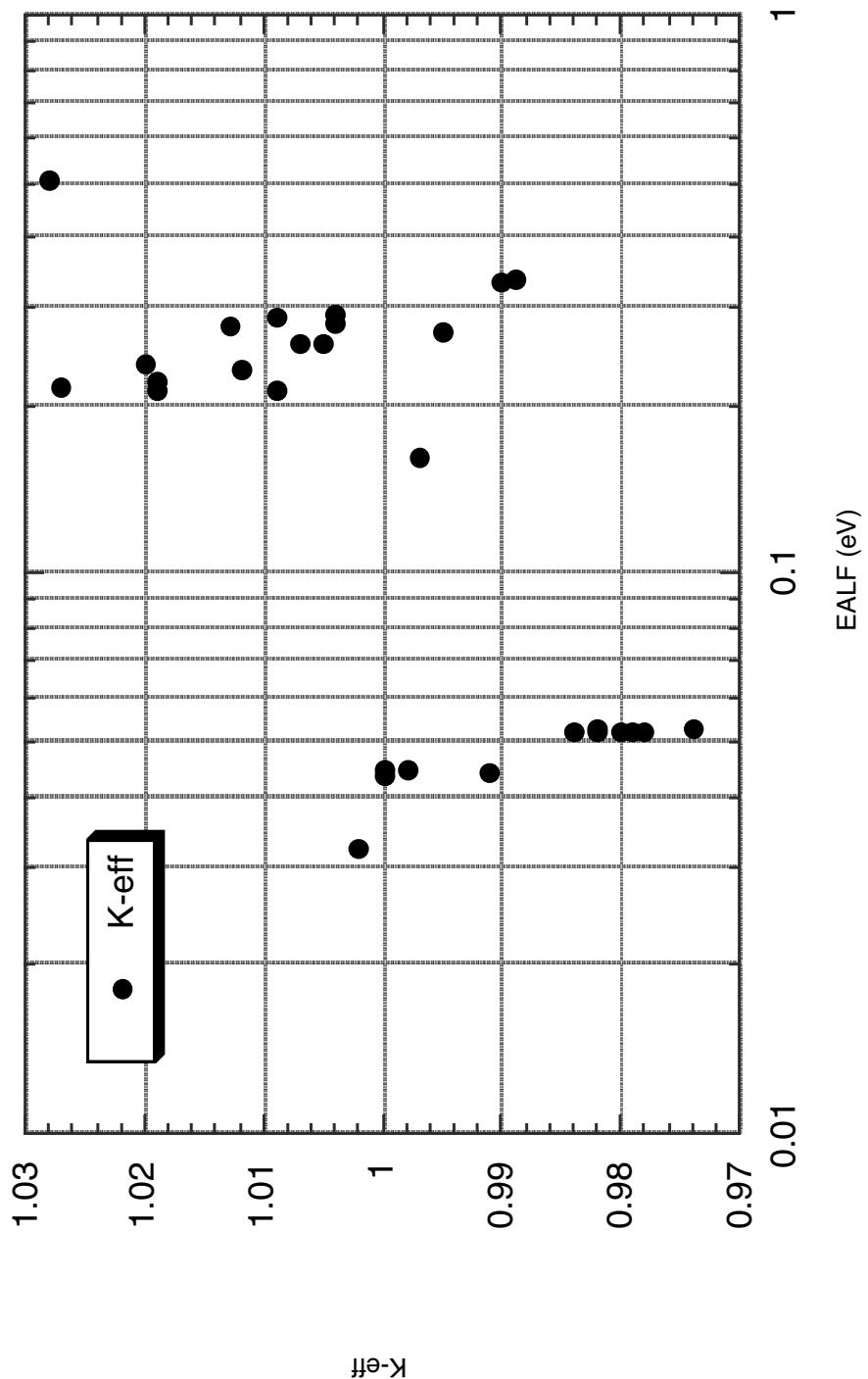
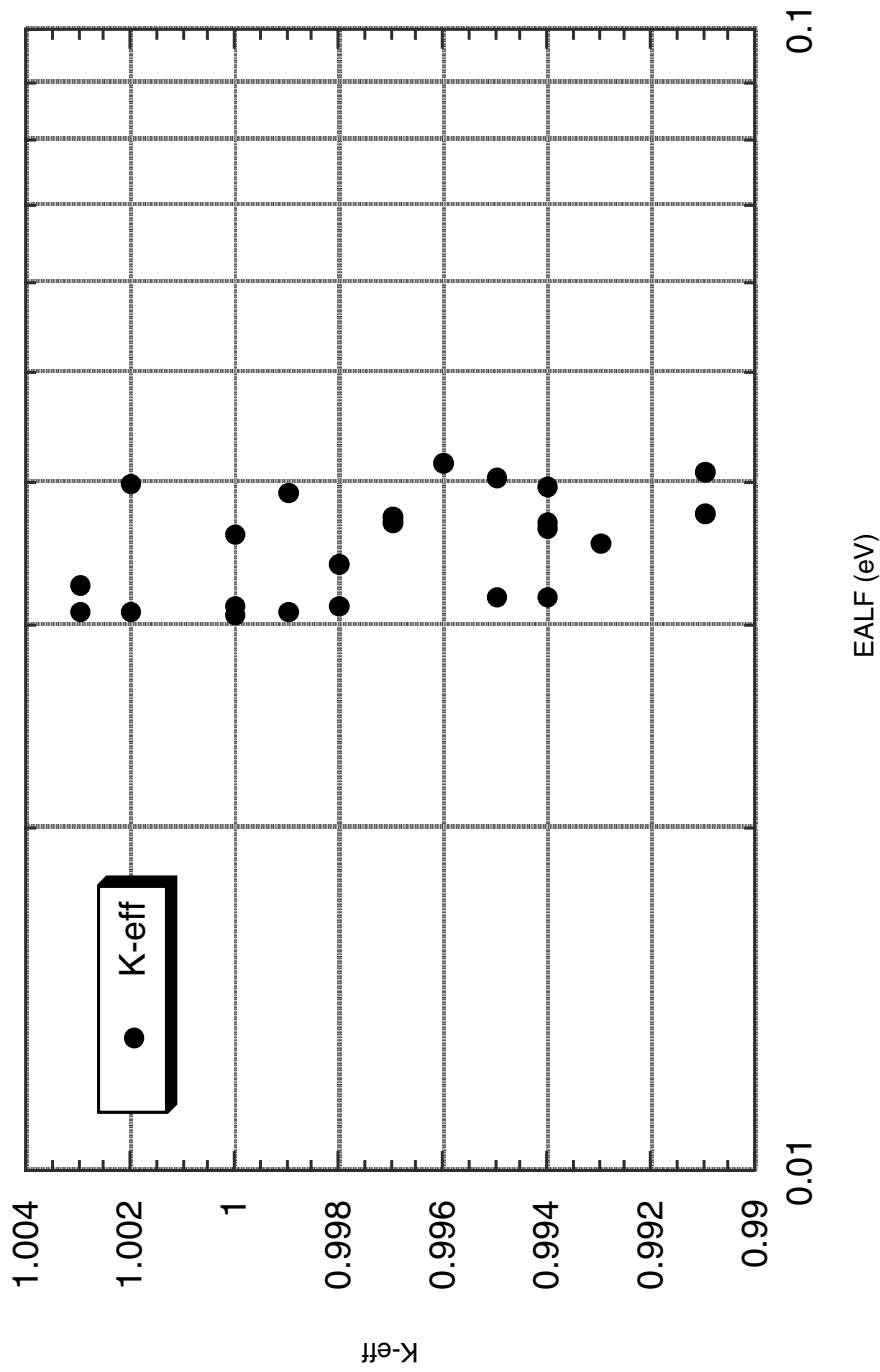


Figure 18. KENO-VI 238 group results for highly enriched uranium solution systems (Table 5).



6. CONCLUSIONS

The KENO V.a and KENO-VI criticality codes accurately calculate a broad range of critical experiments. All KENO V.a and KENO-VI results using the same cross-section library agree within statistical uncertainties. In review, a number of the calculations show a positive or negative bias in excess of 1½% in k_{eff} . Classes of criticals that show a bias include 3% enriched green blocks, highly-enriched uranyl fluoride slab arrays, and highly enriched uranyl nitrate arrays. The consistency of the results for two different Monte Carlo codes using two different cross-section libraries is the basis for a high level of confidence in the analytical methods. The implication is that these biases are due to poor performance of the cross sections and/or inadequate descriptions of the experiments. If these biases are properly taken into account, the KENO V.a and KENO-VI codes can be used with great confidence for the design and criticality safety analysis of uranium-containing systems. Note that only a fraction of the available options and geometry types have been exercised. It must be emphasized that the calculated k_{eff} value from KENO V.a and KENO-VI is an estimate of the eigenvalue of the system and has an associated degree of uncertainty due to the statistical nature of the code. Several suggestions are offered to the users of these codes.

1. Never base the design or safety of a system on a single calculation. Make at least two calculations in which the random sequence is somehow changed (starting random number, slight change in starting distribution, geometry or materials, etc.) to ensure that the calculated k_{eff} is a reasonable estimate of the calculational mean for the system.
2. Substantial efforts may be required to ensure that the problem has converged to a reasonable estimate of the true k_{eff} of the system. Undersampling (insufficient neutrons per generation) or problems with convergence of the source distribution (insufficient generations or a very poor initial starting distribution) commonly occur.
3. Only validated options, geometry types, and materials should be used for the criticality safety design of a system. Biases should be based upon validation calculations of critical experiments with similar characteristics (e.g., geometry, materials, spectrum) to the systems being analyzed.

7. REFERENCES

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APPENDIX A

**KENO V.a INPUT DATA USED FOR VALIDATION CASES
LISTED IN TABLES 1–6 (238 group)**

APPENDIX A

KENO V.A INPUT DATA USED FOR VALIDATION CASES LISTED IN TABLES 1–6 (238 GROUP)

Input data for the validation appears in the same order as listed in Tables 1–6 of Section 1 of this report.

Table A.1. Table 1 input data	64
Table A.2. Table 2 input data	76
Table A.3. Table 3 input data	94
Table A.4. Table 4 input data	142
Table A.5. Table 5 input data	150
Table A.6. Table 6 input data	167

Table A.1. Table 1 input data

```

=csas25
libby exp. 4.89% rods 30 cm long, .762 cm diam, 1.3 cm pitch
238groupndf5 latticecell
uranium    1 .9995 293 92235 4.89 92238 95.11 end
h2o        2 1 end
plexiglass 3 1 end
end comp
squarepitch 1.3 .762 1 2 end
libby exp. 4.89% rods 30 cm long, .762cm diam, 1.3cm pitch
read param npg=2000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 1 1 .381 5.08 0
cuboid    2 1 4p.65 5.08 0
unit 2
cylinder 1 1 .381 1.27 0
cuboid    3 1 4p.65 1.27 0
unit 3
cylinder 1 1 .381 17.935 0
cuboid    2 1 4p.65 17.935 0
unit 4
cylinder 1 1 .381 .635 0
cuboid    3 1 4p.65 .635 0
unit 5
cuboid    2 1 4p.65 5.08 0
unit 6
cylinder 2 1 .381 1.27 0
cuboid    3 1 4p.65 1.27 0
unit 7
cuboid    2 1 4p.65 17.935 0
unit 8
cylinder 2 1 .381 .635 0
cuboid    3 1 4p.65 .635 0
core      0 1 3r0
reflector 3 1 5r0 3.81 1
reflector 2 2 5r3 0 1
reflector 2 3 5r3 2.19 1
reflector 2 4 4r3 3.2 3 1
reflector 2 5 4r3 0 3 2
end geom
read array nux=20 nuy=21 nuz=5 fill
19r5 401r1 19r6 401r2 19r7 401r3 19r8 401r4 19r5 401r1
end fill end array
read bias id=500 2 6 end bias
end data
end

=csas25
libby exp. 4.89 rods 30 cm long, .762 cm diam, 2.05 cm pitch
238groupndf5 latticecell
uranium    1 .9995 293 92235 4.89 92238 95.11 end
h2o        2 1 end
plexiglass 3 1 end
end comp
squarepitch 2.05 .762 1 2 end
libby h2o refl. case 6a
read param npg=2000 nub=yes fdn=yes end param
read geom

```

```

unit 1
cylinder 1 1 .381 30 0
cuboid 2 1 4p1.025 30 0
unit 2
cuboid 2 1 4p1.025 30 0
core 0 1 3r0
reflector 2 2 6r3 3
reflector 2 5 4r3 .3 3 1
reflector 2 6 4r3 0 3 1
end geom
read array nux=14 nuy=15 nuz=1 fill
7r1 7r2 f1
end fill end array
read bias id=500 2 6 end bias
end data
end

=csas25
libby exp. 4.89% rods 30 cm long, .762 cm diam, 1.3 cm pitch
238groupndf5 latticecell
uranium 1 .9995 293 92235 4.89 92238 95.11 end
h2o 2 1 end
plexiglass 3 1 end
pb 4 1 end
end comp
squarepitch 1.3 .762 1 2 end
libby h2o refl. case 14a pb 1 face
read param npg=2000 nub=yes plt=no fdn=yes end param
read geom
unit 1
cylinder 1 1 .381 30 0
cuboid 2 1 4p.65 30 0
unit 2
cuboid 2 1 4p.65 30 0
unit 3
array 1 3r0
reflector 2 2 2r3 0 3 2r0 2
reflector 2 4 2r1.32 0 1.32 2r0 1
unit 4
cuboid 4 1 2p20.32 2p10.16 25.4 0
reflector 2 2 4r0 1.425 0 1
reflector 3 2 5r0 3.175 1
array 2 3r0
reflector 2 4 2r1.68 0 1.68 2r0 1
reflector 2 5 2r3 0 3 2r0 2
reflector 2 2 4r0 3 0 1
reflector 2 3 4r0 2.1 0 1
reflector 3 2 5r0 3 4
reflector 3 6 5r0 1.97 1
end geom
read array ara=1 nux=20 nuy=20 nuz=1 fill
18r1 2r2 f1
end fill
ara=2 nux=1 nuy=2 nuz=1 fill 3 4
end fill end array
read bias id=500 2 6 end bias
read plot ttl='14a x-y' pic=mix
xul=-7.8 yul=53.8 zul=15 xlr=48.8 ylr=-7.8 zlr=15
uax=1 vdn=-1 nax=125 end
ttl='14a x-y' pic=wts end
ttl='14a y-z' pic=mix
xul=20 yul=-7.8 zul=35.5 xlr=20 ylr=53.8 zlr=-14.1

```

```

vax=1 wdn=-1 uax=0 vdn=0 nax=125 end
ttl='14a y-z' pic=wts end
end plot
end data
end

=csas25
libby exp. 4.89% rods 30 cm long, .762 cm diam, 1.3 cm pitch
238groupndf5 latticecell
uranium 1 .9995 293 92235 4.89 92238 95.11 end
h2o 2 1 end
plexiglass 3 1 end
pb 4 1 end
end comp
squarepitch 1.3 .762 1 2 end
libby h2o refl. case 26a pb 4 faces
read param npg=2000 nub=yes plt=no fdn=yes end param
read geom
unit 1
cylinder 1 1 .381 30 0
cuboid 2 1 4p.65 30 0
unit 2
cuboid 2 1 4p.65 30 0
unit 3
array 1 3r0
reflector 2 1 .62 .62 .62 4.52 2r0 1
unit 4
cuboid 4 1 2p10.16 2p15.57 25.4 0
reflector 2 2 4r0 1.425 0 1
reflector 3 2 5r0 3.175 1
unit 5
array 2 3r0
unit 6
cuboid 4 1 2p35.89 2p10.16 25.4 0
reflector 2 2 4r0 1.425 0 1
reflector 3 2 5r0 3.175 1
array 3 3r0
reflector 2 2 4r0 3 0 2
reflector 2 4 4r0 1.95 0 1
reflector 3 2 5r0 3 4
reflector 3 6 5r0 1.97 1
end geom
read array ara=1 nux=23 nuy=20 nuz=1 fill
3r2 2r1 2 5q3 2r1 q23 23r2 q69 2 1 2 2r1 2 5q3 2r1
2r1 2 6q3 2r1 23r2 2r1 2 6q3 2r1 q23 23r2 2q69
2r1 2 6q3 2r1 q23
end fill
ara=2 nux=3 nuy=1 nuz=1 fill 4 3 4 end fill
ara=3 nux=1 nuy=3 nuz=1 fill 6 5 6
end fill end array
read bias id=500 2 6 end bias
read plot ttl=' x-y' pic=mix
xul=0 yul=72 zul=15 xlr=72 ylr=0 zlr=15
uax=1 vdn=-1 nax=125 end
ttl=' x-y' pic=wts end
ttl=' y-z' pic=mix
xul=33 yul=0 zul=40 xlr=33 ylr=72 zlr=-14.1
vax=1 wdn=-1 uax=0 vdn=0 nax=125 end
ttl=' y-z' pic=wts end
end plot
end data
end

```

```

=csas25
libby exp. 4.89% rods 30 cm long, .762 cm diam, 1.3 cm pitch
238groupndf5 latticecell
uranium 1 .9995 293 92235 4.89 92238 95.11 end
h2o 2 1 end
plexiglass 3 1 end
pb 4 1 end
b-10 5 0 4.617-3 end
b-11 5 0 1.872-2 end
c 5 0 5.750-3 end
al 5 0 4.765-2 end
end comp
squarepitch 1.3 .762 1 2 end
libby h2o refl. case 30c pb 4 faces, boral plate 6th row
read param npg=2000 nub=yes pgm=yes plt=no fdn=yes end param
read geom
unit 1
cylinder 1 1 .381 30 0
cuboid 2 1 4p.65 30 0
unit 2
cuboid 2 1 4p.65 30 0
unit 3
array 1 3r0
reflector 2 1 2r.62 0 .62 2r0 1
unit 7
array 4 3r0
reflector 2 1 3r.62 0 2r0 1
unit 8
cuboid 5 1 2p15.57 2p.3175 25.4 0
reflector 2 1 2r0 2r.3325 1.425 3.175 1
unit 4
cuboid 4 1 2p10.16 2p15.57 25.4 0
reflector 2 2 4r0 1.425 0 1
reflector 3 2 5r0 3.175 1
unit 9
array 5 3r0
unit 5
array 2 3r0
unit 6
cuboid 4 1 2p35.89 2p10.16 25.4 0
reflector 2 2 4r0 1.425 0 1
reflector 3 2 5r0 3.175 1
array 3 3r0
reflector 2 2 4r0 3 0 1
reflector 2 3 4r0 1.8 0 1
reflector 3 2 5r0 3 4
reflector 3 6 5r0 1.97 1
end geom
read array ara=1 nux=23 nuy=17 nuz=1 fill
2r2 19r1 2r2 2 21r1 2 f1
end fill
ara=4 nux=23 nuy=5 nuz=1 fill
69r1 2 21r1 2 2r2 19r1 2r2
end fill
ara=5 nux=1 nuy=3 nuz=1 fill 3 8 7 end fill
ara=2 nux=3 nuy=1 nuz=1 fill 4 9 4 end fill
ara=3 nux=1 nuy=3 nuz=1 fill 6 5 6
end fill end array
read bias id=500 2 6 end bias
read plot ttl=' x-y' pic=mix
xul=0 yul=72 zul=15 xlr=72 ylr=0 zlr=15

```

```

uax=1 vdn=-1 nax=125 end
ttl=' x-y' pic=wts end
ttl=' y-z' pic=mix
xul=33 yul=0 zul=40 xlr=33 ylr=72 zlr=-14.1
'following card left out'
vax=1 wdn=-1 uax=0 vdn=0 nax=125 end
ttl=' y-z' pic=wts end
end plot
end data
end

=csas25
libby exp. 4.89% rods 30 cm long, .762 cm diam, 1.3 cm pitch
238groupndf5 latticecell
uranium    1 .9995 293 92235 4.89 92238 95.11 end
h2o        2 1 end
plexiglass 3 1 end
pb        4 1 end
cd        5 1 end
end comp
squarepitch 1.3 .762 1 2 end
libby h2o refl. case 31c pb 4 faces, cd plate 6th row
read param npg=2000  nub=yes plt=no fdn=yes end param
read geom
unit 1
cylinder 1 1 .381 30 0
cuboid   2 1 4p.65 30 0
unit 2
cuboid   2 1 4p.65 30 0
unit 3
array 1 3r0
reflector 2 1 2r.62 0 .62 2r0 1
unit 7
array 4 3r0
reflector 2 1 3r.62 0 2r0 1
unit 8
cuboid   5 1 2p15.57 2p.04445 25.4 0
reflector 2 1 2r0 2r.60555 1.425 3.175 1
unit 4
cuboid   4 1 2p10.16 2p15.57 25.4 0
reflector 2 2 4r0 1.425 0 1
reflector 3 2 5r0 3.175 1
unit 9
array 5 3r0
unit 5
array 2 3r0
unit 6
cuboid   4 1 2p35.89 2p10.16 25.4 0
reflector 2 2 4r0 1.425 0 1
reflector 3 2 5r0 3.175 1
array 3 3r0
reflector 2 2 4r0 .5 0 1
reflector 3 2 5r0 3 4
reflector 3 6 5r0 1.97 1
end geom
read array ara=1 nux=23 nuy=17 nuz=1 fill
11r1 12r2   f1
end fill
ara=4 nux=23 nuy=5 nuz=1 fill
f1
end fill
ara=5 nux=1 nuy=3 nuz=1 fill 3 8 7 end fill

```

```

ara=2 nux=3 nuy=1 nuz=1 fill 4 9 4 end fill
ara=3 nux=1 nuy=3 nuz=1 fill 6 5 6
end fill end array
read bias id=500 2 6 end bias
read plot ttl=' x-y' pic=mix
xul=0 yul=72 zul=15 xlr=72 ylr=0 zlr=15
uax=1 vdn=-1 nax=125 end
ttl=' x-y' pic=wts end
ttl=' y-z' pic=mix
xul=33 yul=0 zul=40 xlr=33 ylr=72 zlr=-14.1
vax=1 wdn=-1 uax=0 vdn=0 nax=125 end
ttl=' y-z' pic=wts end
end plot
end data
end
1

=csas25
libby exp. 4.89% rods 30 cm long, .762 cm diam, 3.25 cm pitch in uo2f2 soln
238groupndf5 latticecell
uranium 1 .9995 293 92235 4.89 92238 95.11 end
solnuo2f2 2 301.16 0 1 293 92235 4.89 92238 95.11 end
plexiglass 3 1 end
al 4 1 end
solnuo2f2 5 301.16 0 1 293 92235 4.89 92238 95.11 end
end comp
squarepitch 3.25 .762 1 2 end
libby rods in uo2f2 soln case 36s
read param npg=2000 far=yes nub=yes fdn=yes end param
read geom
unit 1
cylinder 1 1 .381 5.08 0
cuboid 5 1 4p1.625 5.08 0
unit 2
cylinder 1 1 .381 1.27 0
cuboid 3 1 4p1.625 1.27 0
unit 3
cylinder 1 1 .381 17.935 0
cuboid 5 1 4p1.625 17.935 0
unit 4
cylinder 1 1 .381 .635 0
cuboid 3 1 4p1.625 .635 0
unit 5
cuboid 2 1 4p1.625 5.08 0
unit 6
cylinder 2 1 .381 1.27 0
cuboid 3 1 4p1.625 1.27 0
unit 7
cuboid 2 1 4p1.625 17.935 0
unit 8
cylinder 2 1 .381 .635 0
cuboid 3 1 4p1.625 .635 0
core 0 1 -14.625 -16.25 0
reflector 3 1 5r0 3.81 1
cylinder 5 1 47.94 38.52 -10.16
cylinder 4 1 48.26 38.52 -10.48
end geom
read array nux=9 nuy=10 nuz=5 fill
90r1 90r2 90r3 90r4 90r1
end fill end array
end data
end

```

```

=csas25
libby exp. 4.89% rods 30 cm long, 1.31 cm diam, 3.40 cm pitch in uo2f2 soln
238groupndf5 latticecell
uranium 1 .9995 293 92235 4.89 92238 95.11 end
solnuo2f2 2 300.24 0 1 293 92235 4.89 92238 95.11 end
plexiglass 3 1 end
al 4 1 end
solnuo2f2 5 300.24 0 1 293 92235 4.89 92238 95.11 end
end comp
squarepitch 3.40 1.31 1 2 end
libby rods in uo2f2 soln case 42s
read param npg=2000 far=yes nub=yes fdn=yes end param
read geom
unit 1
cylinder 1 1 .655 5.08 0
cuboid 5 1 4p1.70 5.08 0
unit 2
cylinder 1 1 .655 1.27 0
cuboid 3 1 4p1.70 1.27 0
unit 3
cylinder 1 1 .655 17.935 0
cuboid 5 1 4p1.70 17.935 0
unit 4
cylinder 1 1 .655 .635 0
cuboid 3 1 4p1.70 .635 0
unit 5
cuboid 2 1 4p1.70 5.08 0
unit 6
cylinder 2 1 .655 1.27 0
cuboid 3 1 4p1.70 1.27 0
unit 7
cuboid 2 1 4p1.70 17.935 0
unit 8
cylinder 2 1 .655 .635 0
cuboid 3 1 4p1.70 .635 0
core 0 1 -10.2 -11.9 0
reflector 3 1 5r0 3.81 1
cylinder 5 1 47.94 39.1 -10.16
cylinder 4 1 48.26 39.1 -10.48
end geom
read array nux=6 nuy=7 nuz=5 fill
42r1 42r2 42r3 42r4 42r1
end fill end array
end data
end

```

```

=csas25
libby exp. 4.89% rods 30 cm long, 1.31 cm diam, 3.940 cm pitch in uo2f2 soln
238groupndf5 latticecell
uranium 1 .9995 293 92235 4.89 92238 95.11 end
solnuo2f2 2 300.24 0 1 293 92235 4.89 92238 95.11 end
plexiglass 3 1 end
al 4 1 end
solnuo2f2 5 300.24 0 1 293 92235 4.89 92238 95.11 end
end comp
squarepitch 3.94 1.31 1 2 end
libby rods in uo2f2 soln case 44s
read param npg=2000 far=yes nub=yes fdn=yes end param
read geom
unit 1
cylinder 1 1 .655 5.08 0

```

```

cuboid    5 1 4p1.97 5.08 0
unit 2
cylinder  1 1 .655 1.27 0
cuboid    3 1 4p1.97 1.27 0
unit 3
cylinder  1 1 .655 17.935 0
cuboid    5 1 4p1.97 17.935 0
unit 4
cylinder  1 1 .655 .635 0
cuboid    3 1 4p1.97 .635 0
unit 5
cuboid    2 1 4p1.97 5.08 0
unit 6
cylinder  2 1 .655 1.27 0
cuboid    3 1 4p1.97 1.27 0
unit 7
cuboid    2 1 4p1.97 17.935 0
unit 8
cylinder  2 1 .655 .635 0
cuboid    3 1 4p1.97 .635 0
core      0 1 -11.82 -13.79 0
reflector 3 1 5r0 3.81 1
cylinder  5 1 47.94 39.25 -10.16
cylinder  4 1 48.26 39.25 -10.48
end geom
read array nux=6 nuy=7 nuz=5 fill
42r1 42r2 42r3 42r4 42r1
end fill end array
end data
end

=csas25
4.89% green blocks h/u-235=395.0 40.6 g u-235/l
238groupndf5 multiregion
u-234 1 0 4.3000-7 end
u-235 1 0 1.0402-4 end
u-238 1 0 1.9972-3 end
h     1 0 4.1088-2 end
c     1 0 2.1291-2 end
o     1 0 7.8456-3 end
al   2 1 end
end comp
spherical end
1 28 noextermod end zone
4.89% green blocks unreflected case 2
read param npg=2000 nub=yes fdn=yes end param
read geom
cuboid 1 1 50.8 0 60.96 0 60.452 0
end geom
end data
end

=csas25
4.89% green blocks h/u-235=503.5 33.3 g u-235/l
238groupndf5 multiregion
u-234 1 0 3.5000-7 end
u-235 1 0 8.5320-5 end
u-238 1 0 1.6381-3 end
h     1 0 4.2959-2 end
c     1 0 2.2261-2 end
o     1 0 6.9399-3 end

```

```

al      2 1 end
end comp
spherical end
1 36 noextermod end zone
4.89% green blocks unreflected case 4
read param npg=2000  nub=yes fdn=yes end param
read geom
cuboid 1 1 60.96 0 60.96 0 52.832 0
end geom
end data
end

=csas25
4.89% green blocks h/u-235=199.3 64.9 g u-235/l
238groupndf5 multiregion
u-234 1 0 6.8000-7 end
u-235 1 0 1.6628-4 end
u-238 1 0 3.1926-3 end
h      1 0 3.3140-2 end
c      1 0 1.7173-2 end
o      1 0 1.0766-2 end
al     2 1 end
h2o    3 1 end
para(h2o) 4 1 end
end comp
spherical end
1 22 oneextermod 3 40 noextermod end zone
4.89% green blocks reflected case 1
read param npg=2000  nub=yes fdn=yes end param
read geom
unit 1
cube  1 1 2p10.16
unit 2
cuboid 1 1 4p10.16 2p8.763
core   0 1 3r0.
reflector 4 8 4r0 3.048 0 5
reflector 3 2 4r3 0 3 6
end geom
read array nux=2 nuy=2 nuz=3 fill 8r1 4r2 end fill end array
read bias id=500 2 7 id=400 8 12 end bias
end data
end

=csas25
4.89 green blocks h/u-235=396.7 40.6 g u-235/l
238groupndf5 multiregion
u-234 1 0 4.3000-7 end
u-235 1 0 1.0402-4 end
u-238 1 0 1.9972-3 end
h      1 0 4.1265-2 end
c      1 0 2.1383-2 end
o      1 0 7.8552-3 end
al     2 1 end
h2o    3 1 end
para(h2o) 4 1 end
end comp
spherical end
1 20 oneextermod 3 38 noextermod end zone
4.89% green blocks reflected case 3
read param npg=2000  nub=yes fdn=yes end param
read geom

```

```

cuboid 1 1 40.64 0 40.64 0 57.658 0
reflector 4 8 4r0 3.048 0 5
reflector 3 2 4r3 0 3 6
end geom
read bias id=500 2 7 id=400 8 12 end bias
end data
end

=csas25
4.89% green blocks h/u-235=146.8 81.1 g u-235/l
238groupndf5 multiregion
u-234 1 0 8.5000-7 end
u-235 1 0 2.0779-4 end
u-238 1 0 3.9896-3 end
h 1 0 3.0504-2 end
c 1 0 1.5807-2 end
o 1 0 1.2859-2 end
al 2 1 end
h2o 3 1 end
para(h2o) 4 1 end
end comp
spherical end
1 22 oneextermod 3 40 noextermod end zone
4.89% green blocks reflected case 5
read param npg=2000 nub=yes fdn=yes end param
read geom
cuboid 1 1 50.8 0 50.8 0 42.164 0
reflector 4 8 4r0 3.048 0 5
reflector 3 2 4r3 0 3 6
end geom
read bias id=500 2 7 id=400 8 12 end bias
end data
end

=csas25
4.89% green blocks h/u-235=504.1 33.3 g u-235/l
238groupndf5 multiregion
u-234 1 0 3.5000-7 end
u-235 1 0 8.5320-5 end
u-238 1 0 1.6381-3 end
h 1 0 4.3010-2 end
c 1 0 2.2287-2 end
o 1 0 6.9427-3 end
al 2 1 end
h2o 3 1 end
para(h2o) 4 1 end
end comp
spherical end
1 29 oneextermod 3 47 noextermod end zone
4.89% green blocks reflected case 7
read param npg=2000 nub=yes fdn=yes end param
read geom
cuboid 1 1 50.8 0 50.8 0 41.148 0
reflector 4 8 4r0 3.048 0 5
reflector 3 2 4r3 0 3 6
end geom
read bias id=500 2 7 id=400 8 12 end bias
end data
end

```

```

=csas25
4.89% uo2f2 h/u-235=524
238groupndf5 multiregion
solnuo2f2 1 869.9 0 1 293 92234 .02 92235 4.89
92238 95.09 end
ss304 2 1 end
end comp
cylindrical end
1 25.4 noextermod 2 25.56 noextermod end zone
4.89% uo2f2 20 in diam ss cyl bare 1
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 25.4 38.66 0
cylinder 2 1 25.559 38.66 -.159
end geom
end data
end

=csas25
4.89% uo2f2 h/u-235=1002
238groupndf5 multiregion
solnuo2f2 1 491.6 0 1 293 92234 .02 92235 4.89
92238 95.09 end
al 2 1 end
end comp
spherical end
1 34.6 noextermod 2 34.76 noextermod end zone
4.89% uo2f2 27.3 in diam al sphere bare 4
read param npg=2000 nub=yes fdn=yes end param
read geom
hemisphe-z 1 1 34.6 chord 30.
sphere 0 1 34.6
sphere 2 1 34.759
end geom
end data
end

=csas25
4.89% uo2f2 h/u-235=524
238groupndf5 multiregion
solnuo2f2 1 869.9 0 1 293 92234 .02 92235 4.89
92238 95.09 end
ss304 2 1 end
h2o 3 1 end
end comp
cylindrical end
1 19 oneextermod 2 19.2 noextermod 3 37.2 noextermod end zone
4.89% uo2f2 15 in diam ss cyl refl 1
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 19.05 50.37 0
cylinder 2 1 19.209 50.529 -.159
reflector 3 2 3r3 6
end geom
read bias id=500 2 7 end bias
end data
end

```

```

=csas25
4.89% uo2f2 h/u-235=735
238groupndf5 multiregion
solnuo2f2 1 650.1 0 1 293 92234 .02 92235 4.89
92238 95.09 end
ss304 2 1 end
h2o 3 1 end
end comp
cylindrical end
1 19 oneextermod 2 19.2 noextermod 3 37.2 noextermod end zone
4.89% uo2f2 15 in diam ss cyl refl 3
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 19.05 153.01 0
cylinder 2 1 19.209 153.169 -.159
reflector 3 2 3r3 6
end geom
read bias id=500 2 7 end bias
end data
end

```

```

=csas25
4.89% uo2f2 h/u-235=994
238groupndf5 multiregion
solnuo2f2 1 495.3 0 1 293 92234 .02 92235 4.89
92238 95.09 end
ss304 2 1 end
h2o 3 1 end
end comp
cylindrical end
1 25.4 oneextermod 2 25.56 noextermod 3 43.56 noextermod end zone
4.89% uo2f2 20 in diam ss cyl refl 5
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 25.4 85.72 0
cylinder 2 1 25.559 85.879 -.159
reflector 3 2 3r3 6
end geom
read bias id=500 2 7 end bias
end data
end

```

Table A.2. Table 2 input data

```

=csas25
case ebj.1 u(3.85) 15 @ 7.2"/0"/0"/77.8cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o         2 1.0          end
' fir timber model
c           3 0.  1.06802e-2 end
h           3 0.  2.21713e-2 end
o           3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304       5 1.0          end
end comp
case ebj.1 u(3.85) 15 @ 7.2"/0"/0"/77.8cm, square
read parm
npg=2000 plt=no fdn=yes nub=yes tme=90 tba=2
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 3 1 182.88 0. 18.415 0. 18.415 0.
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 2 1 182.88 0. 8.89 0. 18.415 0.
unit 3
com=* array of timbers 72" x 72" x 7.25" *
array 1 3*0.0
replicate 2 1 2r0. 2r0.3175 2r0. 1
unit 4
com=* section of steel grating *
cuboid 4 1 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 2 1 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 4 1 3.01625 0. 4.524375 -4.524375 3.175 0.
unit 5
com=* array of steel grating *
array 2 3*0.0
replicate 2 1 4r0.9525 2r0.0 1
unit 6
com=* u(3.85) annulus with insert *
cylinder 1 1 3.175 76.2 0.
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p9.144 76.2 0.
unit 7
com=* water cuboid to complete annuli array *
cuboid 2 1 4p9.144 76.2 0.
unit 8
com=* array of 15 annuli with u(3.85) inserts *
array 3 3*0.0
replicate 2 1 4r54.864 1.6 0. 1
core 4 1 -91.44 -91.44 0.
replicate 2 1 4r30.48 2r0. 1
replicate 5 1 5r0.0 0.1905 1
replicate 4 1 5r0.0 2.54 1
end geom

```

```

read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=4 nuy=4 nuz=1
loop 6 1 4 1 1 4 1 1 1 1
    7 4 4 1 1 1 1 1 1 end loop
gbl=4
ara=4 nux=1 nuy=1 nuz=3
fill 3 5 8 end fill
end array
read start
xsm=-36.576 xsp=36.576 ysm=-36.576 ysp=36.576 zsm=21.59 zsp=97.79
end start
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"
xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-121.92 yul=121.92 zul=59.69
xlr=121.92 ylr=-121.92 zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgsc* end
ttl="plan view 2x scale of single u unit, z=midlevel of unit"
xul=0. yul=18.288 zul=59.69
xlr=18.288 ylr=0. zlr=59.69
uax=1. vdn=-1. dlx=0.127 nch=* u.wgsc* end
ttl="cross section of core 1/6 scale,y=9.144"
xul=-91.44 yul=9.144 zul=102.
xlr=91.44 ylr=9.144 zlr=0.
uax=1. wdn=-1. dlx=1.524 nch=* u.wgsc* end
ttl="cross section of mockup 1/10 scale,y=9.144"
xul=-121.92 yul=9.144 zul=105.
xlr=121.92 ylr=9.144 zlr=-65.
uax=1. wdn=-1. dlx=2.54 nch=* u.wgsc* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgsc* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193
uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025
xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
end plot
end data
end

```

```

=csas25
case ebj.4 u(3.85) 16 @ 7.2"/0"/0.25"/79.3cm, triangular
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o        2 1.0          end
' fir timber model
c          3 0.  1.06802e-2 end
h          3 0.  2.21713e-2 end
o          3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304      5 1.0          end
end comp
case ebj.4 u(3.85) 16 @ 7.2"/0"/0.25"/79.3cm, triangular
read parm
tba=3 npg=2000 nub=yes plt=no fdn=yes tme=90
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 3 1 182.88 0. 18.415 0. 18.415 0.
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 2 1 182.88 0. 8.89 0. 18.415 0.
unit 3
com=* array of timbers 72" x 72" x 7.25" *
array 1 3*0.0
replicate 2 1 2r0. 2r0.3175 2r0. 1
unit 4
com=* section of steel grating *
cuboid 4 1 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 2 1 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 4 1 3.01625 0. 4.524375 -4.524375 3.175 0.
unit 5
com=* array of steel grating *
array 2 3*0.0
replicate 2 1 4r0.9525 2r0.0 1
unit 6
com=* u(3.85) annulus with insert *
cylinder 1 1 3.175 76.2 0.
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
unit 7
com=* array of 16 annuli with u(3.85) inserts *
cuboid 2 1 4p91.44 79.3 0.
hole 6   0.0    0.0    0.0
hole 6  -18.923  0.0    0.0
hole 6  -9.4615 16.3878 0.0
hole 6   9.4615 16.3878 0.0
hole 6   18.923  0.0    0.0
hole 6   9.4615 -16.3878 0.0
hole 6  -9.4615 -16.3878 0.0
hole 6  -28.3845 16.3878 0.0
hole 6  -18.923   32.7756 0.0
hole 6   0.0    32.7756 0.0
hole 6  28.3845 16.3878 0.0
hole 6  37.846   0.0    0.0

```

```

hole 6 28.3845 -16.3878 0.0
hole 6 0.0 -32.7756 0.0
hole 6 -18.923 -32.7756 0.0
hole 6 -28.3845 -16.3878 0.0
core 3 1 -91.44 -91.44 0.
replicate 2 1 4r30.48 2r0. 1
replicate 5 1 5r0.0 0.1905 1
replicate 4 1 5r0.0 2.54 1
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
gbl=3
ara=3 nux=1 nuy=1 nuz=3
fill 3 5 7 end fill
end array
read start
nst=1
xsm=-37.5285 xsp=46.99
ysm=-41.9196 ysp=41.9196
zsm= 21.59 zsp=97.79
end start
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"
xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-121.92 yul=121.92 zul=59.69
xlr=121.92 ylr=-121.92 zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgsc* end
ttl="plan view full scale of single u unit, z=midlevel of unit"
xul=-16.75 yul=16.75 zul=59.69
xlr=16.75 ylr=-16.75 zlr=59.69
uax=1. vdn=-1. dlx=0.254 nch=* u.wgsc* end
ttl="cross section of core 1/6 scale,y=0.0"
xul=-91.44 yul=0.0 zul=102.
xlr=91.44 ylr=0.0 zlr=0.
uax=1. wdn=-1. dlx=1.524 nch=* u.wgsc* end
ttl="cross section of mockup 1/10 scale,y=0.0"
xul=-121.92 yul=0.0 zul=105.
xlr=121.92 ylr=0.0 zlr=-65.
uax=1. wdn=-1. dlx=2.54 nch=* u.wgsc* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgsc* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193
uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025

```

```

xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
end plot
end data
end

=csas25
case ebj.8 u(3.85) 6 @ 7.2"/2.6"/0.75"/91.4cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o         2 1.0          end
' fir timber model
c            3 0.  1.06802e-2 end
h            3 0.  2.21713e-2 end
o            3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304       5 1.0          end
end comp
case ebj.8 u(3.85) 6 @ 7.2"/2.6"/0.75"/91.4cm, square
read parm
npg=2000  nub=yes plt=no fdn=yes tme=90 tba=2
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 3 1 182.88 0. 18.415 0. 18.415 0.
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 2 1 182.88 0. 8.89 0. 18.415 0.
unit 3
com=* array of timbers 72" x 72" x 7.25" *
array 1 3*0.0
replicate 2 1 2r0. 2r0.3175 2r0. 1
replicate 2 1 4r30.48 2r0. 1
unit 4
com=* section of steel grating *
cuboid 4 1 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 2 1 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 4 1 3.01625 0. 4.524375 -4.524375 3.175 0.
unit 5
com=* array of steel grating *
array 2 3*0.0
replicate 2 1 4r0.9525 2r0.0 1
replicate 2 1 4r30.48 2r0. 1
unit 6
com=* u(3.85) annulus, h=76.2, submerged, on corner *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 4.614139 76.2 0.
cylinder 1 1 5.628264 76.2 0.
cylinder 1 1 6.485710 76.2 0.
cylinder 1 1 7.242341 76.2 0.
cylinder 1 1 7.927079 76.2 0.
cylinder 1 1 8.557199 76.2 0.

```

```

cylinder 1 1 9.144000 76.2 0.
cuboid 2 1 4p10.0965 91.4 0.
unit 7
com=* u(3.85) annulus, h=76.2, submerged, on side *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 4.614139 76.2 0.
cylinder 1 1 5.628264 76.2 0.
cylinder 1 1 6.485710 76.2 0.
cylinder 1 1 7.242341 76.2 0.
cylinder 1 1 7.927079 76.2 0.
cylinder 1 1 8.557199 76.2 0.
cylinder 1 1 9.144000 76.2 0.
cuboid 2 1 4p10.0965 91.4 0.
unit 8
com=* array of 6 annuli, h=76.2, submerged *
array 3 3*0.0
replicate 2 1 2r61.1505 2r71.247 2r0. 1
replicate 2 1 4r30.48 2r0. 1
core 4 1 -121.92 -121.92 0.
replicate 5 1 5r0.0 0.1905 1
replicate 4 1 5r0.0 2.54 1
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=3 nuy=2 nuz=1
fill 6 7 6 6 7 6 end fill
gbl=4
ara=4 nux=1 nuy=1 nuz=3
fill 3 5 8 end fill
end array
read start
nst=1
xsm=-30.2895 xsp=30.2895
ysm=-20.193 ysp=20.193
zsm=21.59 zsp=97.79
end start
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"
xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-135. yul=135. zul=59.69
xlr=135. ylr=-135. zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="plan view 2x scale of single u unit, z=midlevel of unit"
xul=0.0 yul=20.193 zul=59.69
xlr=20.193 ylr=0.0 zlr=59.69
uax=1. vdn=-1. dlx=0.127 nch=* u.wgs* end
ttl="cross section of core 1/6 scale,y=10.0965"
xul=-91.44 yul=10.0965 zul=125.
xlr=91.44 ylr=10.0965 zlr=-10.

```

```

uax=1. wdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="cross section of mockup 1/10 scale,y=10.0965"
xul=-135. yul=10.0965 zul=125.
xlr=135. ylr=10.0965 zlr=-10.
uax=1. wdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025
xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="cross section of central unit, full scale,y=10.0965"
xul=-10.0965 yul=10.0965 zul=125.
xlr=10.0965 ylr=10.0965 zlr=-10.
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
end plot
end data
end

```

```

=csas25
case ejb.10 u(3.85) 20 @ 7.2"/2.6"/1.87"/79.0cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o         2 1.0          end
' fir timber model
c           3 0.  1.06802e-2 end
h           3 0.  2.21713e-2 end
o           3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304       5 1.0          end
end comp
case ejb.10 u(3.85) 20 @ 7.2"/2.6"/1.87"/79.0cm, square
read parm
npg=2000  nub=yes plt=no fdn=yes tme=90 tba=2
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 3 1 182.88 0. 18.415 0. 18.415 0.
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 2 1 182.88 0. 8.89 0. 18.415 0.
unit 3
com=* array of timbers 72" x 72" x 7.25" *
array 1 3*0.0
replicate 2 1 2r0. 2r0.3175 2r0. 1
replicate 2 1 4r30.48 2r0. 1

```

```

unit 4
com=* section of steel grating *
cuboid 4 1 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 2 1 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 4 1 3.01625 0. 4.524375 -4.524375 3.175 0.
unit 5
com=* array of steel grating *
array 2 3*0.0
replicate 2 1 4r0.9525 2r0.0 1
replicate 2 1 4r30.48 2r0. 1
unit 6
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 7
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 8
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 9
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 10
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 11
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 12
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 13
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 14
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 15
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 16
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.

```

```

unit 17
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 18
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 19
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 20
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 21
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 22
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 23
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 24
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 25
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 2 1 3.302 76.2 0.
cylinder 1 1 9.144 76.2 0.
cuboid 2 1 4p11.5189 79.0 0.
unit 26
com=* water cuboid to complete array *
cuboid 2 1 4p11.5189 79.0 0.
unit 27
com=* array of 20 annuli, h=76.2, submerged *
array 3 3*0.0
replicate 2 1 4r33.8455 2r0. 1
replicate 2 1 4r30.48 2r0. 1
core 4 1 -121.92 -121.92 0.
replicate 5 1 5r0.0 0.1905 1
replicate 4 1 5r0.0 2.54 1
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=5 nuy=5 nuz=1

```

```

fill 26 26 6 7 26 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
26 23 24 25 26 end fill
gbl=4
ara=4 nux=1 nuy=1 nuz=3
fill 3 5 27 end fill
end array
read start
nst=1
xsm=-57.5945 xsp=57.5945
ysm=-57.5945 ysp=57.5945
zsm=21.59 zsp=97.79
end start
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"
xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-135. yul=135. zul=59.69
xlr=135. ylr=-135. zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="cross section of core 1/6 scale,y=0.0"
xul=-91.44 yul=0.0 zul=110.
xlr=91.44 ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="cross section of mockup 1/10 scale,y=0.0"
xul=-135. yul=0.0 zul=125.
xlr=135. ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025
xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="cross section of central unit, full scale,y=0.0"
xul=-11.5189 yul=0.0 zul=110.
xlr=11.5189 ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
end plot
end data

```

```

end

=csas25
case ebj.11 u(3.85) 8 @ 7.2"/2.6"/0.0"/72.5cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o        2 1.0          end
' fir timber model
c          3 0.  1.06802e-2 end
h          3 0.  2.21713e-2 end
o          3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304      5 1.0          end
end comp
case ebj.11 u(3.85) 8 @ 7.2"/2.6"/0.0"/72.5cm, square
read parm
npg=2000 nub=yes plt=no fdn=yes tme=90 tba=2
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 3 1 182.88 0. 18.415 0. 18.415 0.
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 2 1 182.88 0. 8.89 0. 18.415 0.
unit 3
com=* array of timbers 72" x 72" x 7.25" *
array 1 3*0.0
replicate 2 1 2r0. 2r0.3175 2r0. 1
replicate 2 1 4r30.48 2r0. 1
unit 4
com=* section of steel grating *
cuboid 4 1 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 2 1 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 4 1 3.01625 0. 4.524375 -4.524375 3.175 0.
unit 5
com=* array of steel grating *
array 2 3*0.0
replicate 2 1 4r0.9525 2r0.0 1
replicate 2 1 4r30.48 2r0. 1
unit 6
com=* u(3.85) annulus, h=72.5, submerged, on corner *
cylinder 2 1 3.302 72.5 0.
cylinder 1 1 4.614139 72.5 0.
cylinder 1 1 5.628264 72.5 0.
cylinder 1 1 6.485710 72.5 0.
cylinder 1 1 7.242341 72.5 0.
cylinder 1 1 7.927079 72.5 0.
cylinder 1 1 8.557199 72.5 0.
cylinder 1 1 9.144000 72.5 0.
cuboid 2 1 4p9.144 72.5 0.
unit 7
com=* u(3.85) annulus, h=72.5, submerged, on side *
cylinder 2 1 3.302 72.5 0.
cylinder 1 1 4.614139 72.5 0.
cylinder 1 1 5.628264 72.5 0.
cylinder 1 1 6.485710 72.5 0.

```

```

cylinder 1 1 7.242341 72.5 0.
cylinder 1 1 7.927079 72.5 0.
cylinder 1 1 8.557199 72.5 0.
cylinder 1 1 9.144000 72.5 0.
cuboid 2 1 4p9.144 72.5 0.
unit 8
com=* u(3.85) annulus, h=3.7, dry, on corner *
cylinder 0 1 3.302 3.7 0.
cylinder 1 1 4.614139 3.7 0.
cylinder 1 1 5.628264 3.7 0.
cylinder 1 1 6.485710 3.7 0.
cylinder 1 1 7.242341 3.7 0.
cylinder 1 1 7.927079 3.7 0.
cylinder 1 1 8.557199 3.7 0.
cylinder 1 1 9.144000 3.7 0.
cuboid 0 1 4p9.144 3.7 0.
unit 9
com=* u(3.85) annulus, h=3.7, dry, on side *
cylinder 0 1 3.302 3.7 0.
cylinder 1 1 4.614139 3.7 0.
cylinder 1 1 5.628264 3.7 0.
cylinder 1 1 6.485710 3.7 0.
cylinder 1 1 7.242341 3.7 0.
cylinder 1 1 7.927079 3.7 0.
cylinder 1 1 8.557199 3.7 0.
cylinder 1 1 9.144000 3.7 0.
cuboid 0 1 4p9.144 3.7 0.
unit 10
com=* array of 8 annuli, h=72.5, submerged *
array 3 3*0.0
replicate 2 1 2r54.864 2r73.152 2r0. 1
replicate 2 1 4r30.48 2r0. 1
unit 11
com=* array of 8 annuli, h=3.7, dry *
array 4 3*0.0
replicate 0 1 2r54.864 2r73.152 2r0. 1
replicate 0 1 4r30.48 2r0. 1
core 5 1 -121.92 -121.92 0.
replicate 5 1 5r0.0 0.1905 1
replicate 4 1 5r0.0 2.54 1
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=4 nuy=2 nuz=1
fill 6 7 7 6 6 7 7 6 end fill
ara=4 nux=4 nuy=2 nuz=1
fill 8 9 9 8 8 9 9 8 end fill
gbl=5
ara=5 nux=1 nuy=1 nuz=4
fill 3 5 10 11 end fill
end array
'read start
'nst=1
'xsm=-36.576 xsp=36.576
'ysm=-18.288 ysp=18.288
'zsm=21.59 zsp=94.09
'end start
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69

```

```

xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"
xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-135. yul=135. zul=59.69
xlr=135. ylr=-135. zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="plan view 2x scale of single u unit, z=midlevel of unit"
xul=0.0 yul=18.288 zul=59.69
xlr=18.288 ylr=0. zlr=59.69
uax=1. vdn=-1. dlx=0.127 nch=* u.wgs* end
ttl="cross section of core 1/6 scale,y=9.144"
xul=-91.44 yul=9.144 zul=110.
xlr=91.44 ylr=9.144 zlr=-10.
uax=1. wdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="cross section of mockup 1/10 scale,y=9.144"
xul=-135. yul=9.144 zul=125.
xlr=135. ylr=9.144 zlr=-10.
uax=1. wdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025
xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="cross section of central unit, full scale,y=9.144"
xul=0.0 yul=9.144 zul=110.
xlr=18.288 ylr=9.144 zlr=-10.
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
end plot
end data
end

=csas25
case ebj.13 u(3.85) 15 @ 2.5"/0.0"/0.75"/64.8cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o        2 1.0          end
' fir timber model
c          3 0.  1.06802e-2 end
h          3 0.  2.21713e-2 end
o          3 0.  1.10850e-2 end

```

```

' steel for grating, tank walls and floor
carbonsteel 4 1.0           end
' stainless steel lining for tank
ss304      5 1.0           end
end comp
case ebj.13 u(3.85) 15 @ 2.5"/0.0"/0.75"/64.8cm, square
read parm
npg=2000 nub=yes plt=no fdn=yes tme=90 tba=2
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 3 1 182.88 0. 18.415 0. 18.415 0.
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 2 1 182.88 0. 8.89 0. 18.415 0.
unit 3
com=* array of timbers 72" x 72" x 7.25" *
array 1 3*0.0
replicate 2 1 2r0. 2r0.3175 2r0. 1
replicate 2 1 4r30.48 2r0. 1
unit 4
com=* section of steel grating *
cuboid 4 1 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 2 1 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 4 1 3.01625 0. 4.524375 -4.524375 3.175 0.
unit 5
com=* array of steel grating *
array 2 3*0.0
replicate 2 1 4r0.9525 2r0.0 1
replicate 2 1 4r30.48 2r0. 1
unit 6
com=* u(3.85) rod, h=64.8, submerged *
cylinder 1 1 1.419903 64.8 0.
cylinder 1 1 2.008046 64.8 0.
cylinder 1 1 2.459344 64.8 0.
cylinder 1 1 2.839806 64.8 0.
cylinder 1 1 3.175000 64.8 0.
cuboid 2 1 4p4.1275 64.8 0.
unit 7
com=* water cuboid to complete array 3 *
cuboid 2 1 4p4.1275 64.8 0.
unit 8
com=* u(3.85) rod, h=11.4, dry *
cylinder 1 1 1.419903 11.4 0.
cylinder 1 1 2.008046 11.4 0.
cylinder 1 1 2.459344 11.4 0.
cylinder 1 1 2.839806 11.4 0.
cylinder 1 1 3.175000 11.4 0.
cuboid 0 1 4p4.1275 11.4 0.
unit 9
com=* void cuboid to complete array 4 *
cuboid 0 1 4p4.1275 11.4 0.
unit 10
com=* u(3.85) rod array, h=64.8, submerged *
array 3 3*0.0
replicate 2 1 4r74.93 2r0. 1
replicate 2 1 4r30.48 2r0. 1
unit 11
com=* array of 15 rods, h=11.4, dry *
array 4 3*0.0
replicate 0 1 4r74.93 2r0. 1
replicate 0 1 4r30.48 2r0. 1

```

```

core 5 1 -121.92 -121.92 0.
replicate 5 1 5r0.0 0.1905 1
replicate 4 1 5r0.0 2.54 1
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=4 nuy=4 nuz=1
fill 3r6 7 12r6 end fill
ara=4 nux=4 nuy=4 nuz=1
fill 3r8 9 12r8 end fill
gbl=5
ara=5 nux=1 nuy=1 nuz=4
fill 3 5 10 11 end fill
end array
read start
nst=1
xsm=-16.51 xsp=16.51
ysm=-16.51 ysp=16.51
zsm=21.59 zsp=86.39
end start
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view full scale of array, z=midlevel of units"
xul=-16.51 yul=16.51 zul=59.69
xlr=16.51 ylr=-16.51 zlr=59.69
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"
xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-135. yul=135. zul=59.69
xlr=135. ylr=-135. zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="plan view 2x scale of single u unit, z=midlevel of unit"
xul=0.0 yul=8.255 zul=59.69
xlr=8.255 ylr=0.0 zlr=59.69
uax=1. vdn=-1. dlx=0.127 nch=* u.wgs* end
ttl="cross section of core 1/6 scale,y=4.1275"
xul=-91.44 yul=4.1275 zul=110.
xlr=91.44 ylr=4.1275 zlr=-10.
uax=1. wdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="cross section of mockup 1/10 scale,y=4.1275"
xul=-135. yul=4.1275 zul=125.
xlr=135. ylr=4.1275 zlr=-10.
uax=1. wdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193

```

```

uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025
xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="cross section of central unit, 2x scale,y=4.1275"
xul=0.0 yul=4.1275 zul=110.
xlr=8.255 ylr=4.1275 zlr=-10.
uax=1. wdn=-1. dlx=.127 nch=* u.wgs* end
end plot
end data
end

=csas25
case ejb.14 u(3.85) 23 @ 2.5"/0.0"/1.50"/68.9cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o         2 1.0          end
' fir timber model
c            3 0.  1.06802e-2 end
h            3 0.  2.21713e-2 end
o            3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304       5 1.0          end
end comp
case ejb.14 u(3.85) 23 @ 2.5"/0.0"/1.50"/68.9cm, square
read parm
npg=2000  nub=yes plt=no fdn=yes tme=90 tba=2
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 3 1 182.88 0. 18.415 0. 18.415 0.
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 2 1 182.88 0. 8.89 0. 18.415 0.
unit 3
com=* array of timbers 72" x 72" x 7.25" *
array 1 3*0.0
replicate 2 1 2r0. 2r0.3175 2r0. 1
replicate 2 1 4r30.48 2r0. 1
unit 4
com=* section of steel grating *
cuboid 4 1 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 2 1 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 4 1 3.01625 0. 4.524375 -4.524375 3.175 0.
unit 5
com=* array of steel grating *
array 2 3*0.0
replicate 2 1 4r0.9525 2r0.0 1
replicate 2 1 4r30.48 2r0. 1
unit 6
com=* u(3.85) rod, h=68.9, submerged *

```

```

cylinder 1 1 1.419903 68.9 0.
cylinder 1 1 2.008046 68.9 0.
cylinder 1 1 2.459344 68.9 0.
cylinder 1 1 2.839806 68.9 0.
cylinder 1 1 3.175000 68.9 0.
cuboid 2 1 4p5.08 68.9 0.
unit 7
com=* water cuboid to complete array 3 *
cuboid 2 1 4p5.08 68.9 0.
unit 8
com=* u(3.85) rod, h=7.3, dry *
cylinder 1 1 1.419903 7.3 0.
cylinder 1 1 2.008046 7.3 0.
cylinder 1 1 2.459344 7.3 0.
cylinder 1 1 2.839806 7.3 0.
cylinder 1 1 3.175000 7.3 0.
cuboid 0 1 4p5.08 7.3 0.
unit 9
com=* void cuboid to complete array 4 *
cuboid 0 1 4p5.08 7.3 0.
unit 10
com=* u(3.85) rod array, h=68.9, submerged *
array 3 3*0.0
replicate 2 1 4r66.04 2r0. 1
replicate 2 1 4r30.48 2r0. 1
unit 11
com=* array of 22 u(3.85) rods, h=7.3, dry *
array 4 3*0.0
replicate 0 1 4r66.04 2r0. 1
replicate 0 1 4r30.48 2r0. 1
core 5 1 -121.92 -121.92 0.
replicate 5 1 5r0.0 0.1905 1
replicate 4 1 5r0.0 2.54 1
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=5 nuy=5 nuz=1
fill 3r6 2r7 20r6 end fill
ara=4 nux=5 nuy=5 nuz=1
fill 3r8 2r9 20r8 end fill
gbl=5
ara=5 nux=1 nuy=1 nuz=4
fill 3 5 10 11 end fill
end array
read start
nst=1
xsm=-25.4 xsp=25.4
ysm=-25.4 ysp=25.4
zsm=21.59 zsp=90.49
end start
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view of array, full scale"
xul=-25.4 yul=25.4 zul=59.69
xlr=25.4 ylr=-25.4 zlr=59.69
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"

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```

xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-135. yul=135. zul=59.69
xlr=135. ylr=-135. zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="plan view 2x scale of single u unit, z=midlevel of unit"
xul=-5.08 yul=5.08 zul=59.69
xlr=5.08 ylr=-5.08 zlr=59.69
uax=1. vdn=-1. dlx=0.127 nch=* u.wgs* end
ttl="cross section of core 1/6 scale,y=0.0"
xul=-91.44 yul=0.0 zul=110.
xlr=91.44 ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="cross section of mockup 1/10 scale,y=0.0"
xul=-135. yul=0.0 zul=125.
xlr=135. ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025
xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="cross section of central unit, 2x scale,y=0.0"
xul=-5.08 yul=0.0 zul=110.
xlr=5.08 ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=.127 nch=* u.wgs* end
end plot
end data
end

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Table A.3. Table 3 input data

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=CSAS25
ROCKY FLATS CRITICALS NUREG/CR-1071 EXPERIMENT NUMBER 1 (27 GROUP)
' 48 FUEL CANS 2.44 CM MODERATOR GEE.HU77.DATA(OPT1)
238groupndf5 latticecell
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 8.9514e-2 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-al1100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 .88 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
end comp
SPHTRIANGP 19.9462 18.5857 1 3 18.9579 2 END
ROCKY FLATS CRITICALS NUREG/CR-1071 EXPERIMENT NUMBER 1 (27 GROUP)
' 48 FUEL CANS 2.44 CM MODERATOR GEE.HU77.DATA(OPT1)
READ PARM RUN=YES NPG=600
NUB=YES FDN=YES PLT=NO
END PARM
READ GEOM
UNIT 1
COM='FUEL BOX 15.28 CM ON A SIDE WITH .15 CM WALLS .05CM STACKING VOID'
CUBOID 1 1 6P7.49
CUBOID 2 1 6P7.64
CUBOID 0 1 6P7.6650
UNIT 2
COM='X-FACE INTERSTITIAL MODERATOR'
CUBOID 3 1 2P1.2200 4P7.665
UNIT 3
COM='Y-FACE INTERSTITIAL MODERATOR'
CUBOID 3 1 2P7.665 2P1.2200 2P7.665
UNIT 4
COM='Z-FACE INTERSTITIAL MODERATOR'
CUBOID 3 1 4P7.665 2P1.2200
UNIT 5
COM='MORE X-FACE MODERATOR'
CUBOID 3 1 4P1.2200 2P7.665
UNIT 6
COM='MORE Y-FACE MODERATOR'
CUBOID 3 1 2P7.665 4P1.2200
UNIT 7

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COM='MORE Z-FACE MODERATOR'
CUBOID 3 1 2P1.2200 2P7.665 2P1.2200
UNIT 8
COM='LAST OF INTERSTITIAL MODERATOR'
CUBOID 3 1 6P1.2200
UNIT 9
COM='NORTH SPLIT TABLE CORE'
ARRAY 1 3*0.0
UNIT 10
COM='SOUTH SPLIT TABLE CORE'
ARRAY 2 3*0.0
UNIT 11
COM='PLEXIGLASS REFLECTOR SHEET WITHOUT TRIS, NORTH BOTTOM REFLECTOR'
CUBOID 4 1 2P16.5500 2P38.7500 2P0.6150
UNIT 12
COM='PLEXIGLASS REFLECTOR SHEET WITH TRIS, NORTH BOTTOM REFLECTOR'
CUBOID 5 1 2P16.5500 2P38.7500 2P0.6150
UNIT 13
COM='UPPER PORTION NORTH BOTTOM REFLECTOR WITH TRIS'
CUBOID 5 1 2P16.550 2P38.75 2P8.24
UNIT 14
COM='LOWER PORTION NORTH BOTTOM REFLECTOR WITH TRIS'
CUBOID 5 1 2P16.550 2P38.75 2P3.69
UNIT 15
COM='NORTH BOTTOM REFLECTOR INCLUDES REGULAR AND TRIS'
ARRAY 3 3*0.0
UNIT 16
COM='PLEXIGLAS SHEET BOTTOM SOUTH REFLECTOR WITHOUT TRIS'
CUBOID 0 1 2P5.1 2P2.55 2P0.615
CUBOID 4 1 44.3 -5.1 2P38.75 2P0.615
UNIT 17
COM='PLEXIGLAS SHEET BOTTOM SOUTH REFLECTOR WITH TRIS'
CUBOID 0 1 2P5.1 2P2.55 2P0.615
CUBOID 5 1 44.3 -5.1 2P38.75 2P0.6150
UNIT 18
COM='LOWER PORTION SOUTH BOTTOM REFLECTOR WITH TRIS'
CUBOID 0 1 2P5.1 2P2.55 2P8.855
CUBOID 5 1 44.3 -5.1 2P38.75 2P8.855
UNIT 19
COM='SOUTH BOTTOM REFLECTOR WITH REGULAR AND TRIS'
ARRAY 4 3*0.0
UNIT 20
COM='EAST AND WEST REFLECTORS FOR NORTH REFLECTOR WITH TRIS'
CUBOID 5 1 2P16.550 2P12.65 2P54.2825
UNIT 21
COM='ARRAY FOR EAST AND WEST REFLECTORS FOR NORTH REFLECTOR'
ARRAY 5 3*0.0
UNIT 22
COM='EAST AND WEST REFLECTORS FOR SOUTH REFLECTOR WITH TRIS'
CUBOID 5 1 2P24.700 2P12.65 2P54.2825
UNIT 23
COM='ARRAY FOR EAST AND WEST REFLECTORS FOR SOUTH REFLECTOR'
ARRAY 6 3*0.0
UNIT 24
COM='NORTH TOP REFLECTOR WITH TRIS'
CUBOID 5 1 2P29.100 2P64.05 2P12.15
UNIT 25
COM='ARRAY FOR NORTH TOP REFLECTOR'
ARRAY 7 3*0.0
UNIT 26
COM='SOUTH TOP REFLECTOR WITH TRIS'
CUBOID 0 1 2P5.1 2P2.55 2P12.15
CUBOID 5 1 69.4 -5.1 2P64.05 2P12.15

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UNIT 27
COM='ARRAY FOR SOUTH TOP REFLECTOR'
ARRAY 8 3*0.0
UNIT 28
COM='NORTH END REFLECTOR 9.8CM PORTION WITHOUT TRIS'
CUBOID 4 1 2P4.9000 2P64.0500 2P54.2825
UNIT 29
COM='NORTH END RELFECTOR 5.2 CM PORTION WITH TRIS'
CUBOID 5 1 2P2.6 2P64.0500 2P54.2825
UNIT 30
COM='NORTH END RELFECTOR 10.1 CM PORTION WITHOUT TRIS'
CUBOID 4 1 2P5.05 2P64.05 2P54.2825
UNIT 31
COM='ARRAY FOR NORTH END REFLECTOR'
ARRAY 9 3*0.0
UNIT 32
COM='SOUTH END REFLECTOR'
CUBOID 5 1 2P12.55 2P64.05 2P54.2825
UNIT 33
COM='ARRAY FOR SOUTH END REFLECTOR'
ARRAY 10 3*0.0
UNIT 34
COM='BOTTOM MODERATING PLASTIC NORTH CORE'
CUBOID 6 1 2P16.550 2P38.7500 2P13.0500
UNIT 35
COM='TOP MODERATING PLASTIC NORTH CORE'
CUBOID 6 1 2P16.550 2P38.7500 2P3.2525
UNIT 36
ARRAY 11 3*0.0
UNIT 37
ARRAY 12 3*0.0
UNIT 38
COM='NORTH CORE WITH BOTTOM REFLECTOR'
ARRAY 13 3* 0.0
UNIT 39
COM='NORTH CORE WITH EAST AND WEST REFLECTOR'
ARRAY 14 3*0.0
UNIT 40
COM='NORTH CORE WITH END REFLECTOR'
ARRAY 15 3*0.0
UNIT 41
COM='NORTH SPLIT TABLE FACEPLATE'
CUBOID 3 1 2P0.6150 2P64.0500 2P66.4325
UNIT 42
COM='NORTH CORE WITH TOP REFLECTOR'
ARRAY 16 3*0.0
UNIT 43
COM='NORTH CORE WITH FACEPLATE'
ARRAY 17 3*0.0
UNIT 44
COM='12.95 CM THICK MODERATOR SOUTH CORE'
CUBOID 6 1 2P23.924 2P6.475 2P40.183
UNIT 45
COM='2.95 THICK MODERATOR SOUTH CORE'
CUBOID 6 1 2P23.924 2P38.5285 2P1.475
UNIT 46
COM='COMBINATION OF CORE WITH 12.95 THICK MODERATOR'
ARRAY 18 3*0.0
UNIT 47
COM='COMBINATION OF CORE WITH 2.95 THICK MODERATOR'
ARRAY 19 3*0.0
UNIT 48
COM='SOUTH CORE WITH EAST WEST REFLECTORS'

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ARRAY 20 3*0.0
UNIT 49
COM='SOUTH CORE WITH EAST WEST REFLECTORS'
ARRAY 21 3*0.0
UNIT 50
COM='SOUTH CORE END REFLECTOR'
ARRAY 22 3*0.0
UNIT 51
COM='FACEPLATE FOR SOUTH SPLIT TABLE'
CUBOID 3 1 2P0.4620 2P64.0500 2P66.4325
UNIT 52
COM='SOUTH CORE WITH TOP REFLECTOR'
ARRAY 23 3*0.0
UNIT 53
COM='SOUTH CORE WITH FACEPLATE'
ARRAY 24 3*0.0
UNIT 54
COM='AIR GAP'
CUBOID 0 1 2P0.1550 2P64.0500 2P66.4325
GLOBAL
UNIT 55
COM='TOTAL'
ARRAY 25 3*0.0
UNIT 56
COM='EMPTY FUEL LOCATION'
CUBOID 0 1 6P7.6650
UNIT 57
COM='SIDE MODERATOR'
CUBOID 6 1 2P16.550 2P4.4300 2P25.4350
UNIT 58
COM='END MODERATOR'
CUBOID 6 1 2P8.1500 2P38.7500 2P25.4350
UNIT 59
COM='SOUTH CORE BOTTOM MODERATING PLASTIC'
CUBOID 6 1 2P24.7000 2P38.7500 2P13.0500
UNIT 60
COM='SOUTH CORE TOP MODERATING PLASTIC'
CUBOID 6 1 2P24.7000 2P38.7500 2P3.2525
UNIT 61
COM='Y-FACE MODERATOR VOID'
CUBOID 0 1 2P7.665 2P1.2200 2P7.665
END GEOMETRY
READ ARRAY
ARA=1 NUX=3 NUY=7 NUZ=5
COM='NORTH SPLIT TABLE CORE'
FILL 1 2 1 3 5 3 2Q6 1 2 1
      4 7 4 6 8 6 2Q6 4 7 4
      1Q42
      56 2 1 3 5 3 1 2 1 3 5 3 1Q6 56 2 1   END FILL
ARA=2 NUX=3 NUY=7 NUZ=5
COM='SOUTH SPLIT TABLE CORE'
FILL 1 2 1 3 5 3 2Q6 1 2 1
      4 7 4 6 8 6 2Q6 4 7 4
      1Q42
      1 2 56 3 5 61 2Q6 1 2 56 END FILL
ARA=3 NUX=1 NUY=1 NUZ=3
COM='NORTH BOTTOM REFLECTOR'
FILL 14 11 13 END FILL
ARA=4 NUX=1 NUY=1 NUZ=7
COM='SOUTH BOTTOM REFLECTOR'
FILL 18 16 17 16 16 17 17 END FILL
ARA=5 NUX=1 NUY=1 NUZ=1
COM='EAST AND WEST WALLS OF NORTH REFLECTOR'

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FILL 20 END FILL
ARA=6 NUX=1 NUY=1 NUZ=1
COM='EAST AND WEST WALLS OF SOUTH REFLECTOR'
FILL 22 END FILL
ARA=7 NUX=1 NUY=1 NUZ=1
COM='ARRAY FOR NORTH TOP REFLECTOR'
FILL 24 END FILL
ARA=8 NUX=1 NUY=1 NUZ=1
COM='ARRAY FOR SOUTH TOP REFLECTOR'
FILL 26 END FILL
ARA=9 NUX=3 NUY=1 NUZ=1
COM='ARRAY FOR NORTH END REFLECTOR'
FILL 28 29 30 END FILL
ARA=10 NUX=1 NUY=1 NUZ=1
COM='ARRAY FOR SOUTH END REFLECTOR'
FILL 32 END FILL
ARA=11 NUX=1 NUY=2 NUZ=1
COM='COMBINARION OF CORE WITH SIDE MODERATOR'
FILL 9 57 END FILL
ARA=12 NUX=1 NUY=1 NUZ=3
COM='COMBINATION OF PREVIOUS ARRAY WITH TOP AND BOTTOM MODERATOR'
FILL 34 36 35 END FILL
ARA=13 NUX=1 NUY=1 NUZ=2
COM='COMBINATION OF NORTH CORE WITH BOTTOM REFLECTOR'
FILL 15 37 END FILL
ARA=14 NUX=1 NUY=3 NUZ=1
COM='NORTH CORE WITH SIDE REFLECTORS'
FILL 21 38 21 END FILL
ARA=15 NUX=2 NUY=1 NUZ=1
COM='NORTH CORE WITH END REFLECTOR'
FILL 31 39 END FILL
ARA=16 NUX=1 NUY=1 NUZ=2
COM='NORTH CORE WITH TOP REFLECTOR'
FILL 40 25 END FILL
ARA=17 NUX=2 NUY=1 NUZ=1
COM='NORTH CORE WITH FACEPLATE'
FILL 42 41 END FILL
ARA=18 NUX=1 NUY=2 NUZ=1
COM='COMBINATION OF S. CORE WITH SIDE MODERATOR'
FILL 10 57 END FILL
ARA=19 NUX=2 NUY=1 NUZ=1
COM='COMBINATION OF CORE WITH END MODERATOR'
FILL 46 58 END FILL
ARA=20 NUX=1 NUY=1 NUZ=4
COM='SOUTH CORE WITH BOTTOM MODERATOR AND REFLECTOR'
FILL 19 59 47 60 END FILL
ARA=21 NUX=1 NUY=3 NUZ=1
COM='SOUTH CORE WITH EAST WEST REFLECTORS'
FILL 23 48 23 END FILL
ARA=22 NUX=2 NUY=1 NUZ=1
COM='SOUTH CORE WITH END REFLECTOR'
FILL 49 33 END FILL
ARA=23 NUX=1 NUY=1 NUZ=2
COM='COMBINATION OF CORE WITH TOP REFLECTOR'
FILL 50 27 END FILL
ARA=24 NUX=2 NUY=1 NUZ=1
COM='SOUTH CORE WITH FACEPLATE'
FILL 51 52 END FILL
ARA=25 NUX=3 NUY=1 NUZ=1
COM='TOTAL'
FILL 43 54 53 END FILL
END ARRAY
READ PLOT TTL='XZ SLICE OF RFP1 SHOWING MATERIAL REGIONS'

```

```

XUL=-2 YUL=64.05 ZUL=136
XLR=137 YLR=64.05 ZLR=-2
UAX=1 WDN=-1 NAX=130 NCH='0123456' END
TTL='YZ SLICE OF NORTH CORE SECOND ROW'
XUL=28 YUL=-2 ZUL=136
XLR=28 YLR=136 ZLR=-2
VAX=1 WDN=-1 NAX=130 NCH='0123456' END
TTL='YZ SLICE OF SOUTH CORE SECOND ROW'
XUL=80 YUL=-2 ZUL=136
XLR=80 YLR=136 ZLR=-2
VAX=1 WDN=-1 NAX=130 NCH='0123456'
END PLOT
END DATA
END

=csas25
rocky flats criticals nureg/cr-1071 experiment number 15 (27 group)
238groupndf5 latticecell
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 8.9514e-2 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
h2o 4.0 1.0-15 end
rfconcrete 5 1.0 end
end comp
sphtriangp 19.0000 18.5857 1 3 18.9579 2 end
rocky flats criticals nureg/cr-1071 experiment number 15 (27 group)
read parm run=yes npg=2000 plt=no
fdn=yes nub=yes
end parm
read geom
unit 1
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 1 1 6p7.49
cuboid 2 1 6p7.64
cuboid 0 1 6p7.6650
unit 2
com='x-face interstitial moderator'
cuboid 3 1 2p0.4645 4p7.665
unit 3
com='y-face interstitial moderator'
cuboid 3 1 2p7.665 2p0.4645 2p7.665
unit 4
com='z-face interstitial moderator'
cuboid 3 1 4p7.665 2p0.4645
unit 5
com='more x-face moderator'
cuboid 3 1 4p0.4645 2p7.665
unit 6
com='more y-face moderator'
cuboid 3 1 2p7.665 4p0.4645
unit 7
com='more z-face moderator'
cuboid 3 1 2p0.4645 2p7.665 2p0.4645
unit 8

```

```

com='last of interstitial moderator'
cuboid 3 1 6p0.4645
unit 9
com='north split table core'
array 1 -31.589 2*0.0
cuboid 5 1 0.0 -31.589 76.207 0.0 80.366 -25.5
cuboid 0 1 0.0 -32.3 77.5 0.0 83.2 -25.5
cuboid 5 1 0.0 -57.8 103.0 -25.5 108.7 -25.5
unit 10
com='south split table core'
array 2 3*0.0
cuboid 5 1 47.848 0.0 76.207 0.0 80.366 -25.5
hole 11 0.0 38.75 -25.5
cuboid 0 1 47.848 0.0 77.5 0.0 83.2 -25.5
cuboid 5 1 47.848 0.0 103.0 -25.5 108.7 -25.5
hole 11 0.0 38.75 83.2
cuboid 0 1 48.848 0.0 103.0 -25.5 108.7 -25.5
cuboid 5 1 74.348 0.0 103.0 -25.5 108.7 -25.5
unit 11
cuboid 0 1 10.2 0.0 2p2.55 25.5 0.0
unit 12
com='north split table faceplate'
cuboid 3 1 2p0.0001 2p64.2500 2p67.1
unit 13
com='faceplate for south split table'
cuboid 3 1 2p0.4620 2p64.2500 2p67.1
unit 14
com='air gap'
cuboid 0 1 2p0.2850 2p64.2500 2p67.1
global
unit 15
com='total'
array 3 3*0.0
unit 56
com='empty fuel location'
cuboid 0 1 6p7.6650
unit 61
com='y-face moderator void'
cuboid 0 1 2p7.665 2p0.4645 2p7.665
end geometry
read array
ara=1 nux=3 nuy=7 nuz=9
com='north split table core'
fill 1 2 1 3 5 3 2q6 1 2 1
4 7 4 6 8 6 2q6 4 7 4
3q42
1 2 1 3 5 3 2q6 1 2 1 end fill
ara=2 nux=5 nuy=7 nuz=9
com='south split table core'
fill 1 2 1 2 1 3 5 3 5 3 2q10 1 2 1 2 1
4 7 4 7 4 6 8 6 8 6 2q10 4 7 4 7 4
3q70
1 2 1 2 1 3 5 3 5 3
56 2 1 2 1 61 5 3 5 3
56 2 1 2 1 3 5 3 5 3
1 2 1 2 1 end fill
ara=3 nux=5 nuy=1 nuz=1
com='total'
fill 9 12 14 13 10 end fill
end array
read plot ttl='xz slice of rfp1 showing material regions'
xul=-2 yul=64.05 zul=136
xlr=137 ylr=64.05 zlr=-2

```

```

uax=1 wdn=-1 nax=130 nch='0123456'end
ttl='yz slice of north core second row'
xul=28 yul=-2 zul=136
xlr=28 ylr=136 zlr=-2
vax=1 wdn=-1 nax=130 nch='0123456'end
ttl='yz slice of south core second row'
xul=80 yul=-2 zul=136
xlr=80 ylr=136 zlr=-2
vax=1 wdn=-1 nax=130 nch='0123456'
end plot
read start nst=1
xsm=15 xsp=122 ysm=15 ysp=122 zsm=30 zsp=122 end start
end data
end

=csas25
rocky flats criticals nureg/cr-0674 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=0.77, hi enriched sphere driven
238groupndf5 infhommedium
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 8.9514e-2 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-al1100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 0.7 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
arbm-al1100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 7 2.715 end
uranium 8 0.9516 293.0 92234 1.0 92235 93.19 92236 0.4 92238 5.41 end
arbm-pj 0.816 2 0 0 0 1001 85.1 6012 14.9 8 0.0041 end
ss304 9 1.0 end
end comp
rocky flats criticals nureg/cr-0674 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=0.77, hi enriched sphere driven
read parm npg=2000 nub=yes fdn=yes plt=no end parm
read geom
unit 1
com='fuel box with void and part of al box'
cuboid 0 1 9.80 0.0 3.75 0.0 14.98 0.0
cuboid 2 1 9.95 0.0 3.90 -0.15 14.98 0.0
cuboid 1 1 14.98 0.0 9.365 -5.615 14.98 0.0
unit 2
com='front of fuel box'
cuboid 2 1 0.15 0.0 5.615 0.0 14.98 0.0

```

```

cuboid 0 1 0.15 0.0 9.365 0.0 14.98 0.0
cuboid 2 1 0.15 0.0 14.98 0.0 14.98 0.0
unit 3
com='rear of fuel box'
cuboid 2 1 0.15 0.0 14.98 0.0 14.98 0.0
unit 4
com='array to assemble part of box'
array 26 3*0
unit 5
com='top and bottom of box'
cuboid 0 1 9.80 0.0 3.750 0.0 0.15 0.0
cuboid 2 1 15.28 0.0 9.365 -5.615 0.15 0.0
global
unit 6
com='array to assemble top and bottom'
array 27 3*0
cuboid 2 1 15.28 0.0 15.13 -0.15 15.28 0.0
cuboid 0 1 15.305 -0.025 15.155 -0.175 15.305 -0.025
unit 7
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 1 1 6p7.49
cuboid 2 1 6p7.64
cuboid 0 1 6p7.6650
unit 8
com='box for driver'
cylinder 9 1 0.3175 2p7.32
hemisphe+x 8 1 7.334 chord 6.818
cuboid 0 1 8.512 -6.818 2p7.665 2p7.665
hole 37 0.0 0.0 -7.665
unit 34
com='aluminum weight distribution plate for special box'
cuboid 0 1 9.80 0.0 3.750 0.0 0.16 0.0
cuboid 7 1 15.33 0.0 9.54 -5.79 0.16 0.0
unit 35
com='aluminum weight distribution plate for boxes'
cuboid 7 1 4p7.665 0.16 0.0
unit 37
com='driver mount'
cylinder 9 1 1.56 0.33099 0.0
unit 9
com='north split table core'
array 1 3*0.0
cuboid 0 1 30.66 -0.94 77.5 0.0 83.475 0.0
unit 10
com='south split table core'
array 2 3*0.0
cuboid 0 1 49.4 0.0 77.5 0.0 83.475 0.0
unit 11
com='plexiglass reflector sheet without tris, north bottom reflector'
cuboid 4 1 2p15.8000 2p38.7500 2p0.6150
unit 12
com='plexiglass reflector sheet with tris, north bottom reflector'
cuboid 5 1 2p15.8000 2p38.7500 2p0.6150
unit 13
com='upper portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p8.24
unit 14
com='lower portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p3.69
unit 15
com='north bottom reflector includes regular and tris'
array 3 3*0.0
unit 16

```

```

com='plexiglas sheet bottom south reflector without tris'
cuboid 0 1 2p5.1 2p2.5 2p0.6150
cuboid 4 1 44.3 -5.1 2p38.75 2p0.6150
unit 17
com='plexiglas sheet bottom south reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p0.6150
cuboid 5 1 44.3 -5.1 2p38.75 2p0.6150
unit 18
com='lower portion south bottom reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p8.855
cuboid 5 1 44.3 -5.1 2p38.75 2p8.855
unit 19
com='south bottom reflector with regular and tris'
array 4 3*0.0
unit 20
com='east and west reflectors for north reflector with tris'
cuboid 5 1 2p15.8 2p12.65 2p54.2825
unit 21
com='array for east and west reflectors for north reflector'
array 5 3*0.0
unit 22
com='east and west reflectors for south reflector with tris'
cuboid 5 1 2p24.700 2p12.65 2p54.2825
unit 23
com='array for east and west reflectors for south reflector'
array 6 3*0.0
unit 24
com='north top reflector with tris'
cuboid 5 1 2p28.35 2p64.05 2p12.15
unit 25
com='array for north top reflector'
array 7 3*0.0
unit 26
com='south top reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p12.15
cuboid 5 1 69.4 -5.1 2p64.05 2p12.15
unit 27
com='array for south top reflector'
array 8 3*0.0
unit 28
com='north end reflector 9.8cm portion without tris'
cuboid 4 1 2p4.9000 2p64.0500 2p54.2825
unit 29
com='north end reflector 5.2 cm portion with tris'
cuboid 5 1 2p2.6 2p64.0500 2p54.2825
unit 30
com='north end reflector 10.1 cm portion without tris'
cuboid 4 1 2p5.05 2p64.05 2p54.2825
unit 31
com='array for north end reflector'
array 9 3*0.0
unit 32
com='south end reflector'
cuboid 5 1 2p12.55 2p64.05 2p54.2825
unit 33
com='array for south end reflector'
array 10 3*0.0
unit 38
com='north core with bottom reflector'
array 13 3* 0.0
unit 39
com='north core with east and west reflector'
array 14 3*0.0

```

```

unit 40
com='north core with end reflector'
array 15 3*0.0
unit 42
com='north core with top reflector'
array 16 3*0.0
unit 48
com='south core with bottom reflectors'
array 20 3*0.0
unit 49
com='south core with east west reflectors'
array 21 3*0.0
unit 50
com='south core end reflector'
array 22 3*0.0
unit 52
com='south core with top reflector'
array 23 3*0.0
unit 54
com='air gap'
hemisphe-x 8 1 7.334 chord -6.818
cuboid 0 1 -6.818 -7.619 64.475 -63.625 69.13 -63.735
global
unit 55
com='total'
array 25 3*0.0
end geometry
read array
ara=1 nux=2 nuy=5 nuz=9
com='north split table core'
fill 10r7
    10r35
    10r7
    10r35
    10r7
    10r35
    10r7
    10r35
    10r7    end fill
ara=2 nux=3 nuy=5 nuz=9
com='south split table core'
fill 6r7 6 8r7
    6r35 34 8r35
    6r7 6 8r7
    6r35 34 8r35
    6r7 8 8r7
    6r35 34 8r35
    6r7 6 8r7
    6r35 34 8r35
    6r7 6 8r7    end fill
ara=3 nux=1 nuy=1 nuz=3
com='north bottom reflector'
fill 14 11 13 end fill
ara=4 nux=1 nuy=1 nuz=7
com='south bottom reflector'
fill 18 16 17 16 16 17 17 end fill
ara=5 nux=1 nuy=1 nuz=1
com='east and west walls of north reflector'
fill 20 end fill
ara=6 nux=1 nuy=1 nuz=1
com='east and west walls of south reflector'
fill 22 end fill
ara=7 nux=1 nuy=1 nuz=1

```

```

com='array for north top reflector'
fill 24 end fill
ara=8 nux=1 nuy=1 nuz=1
com='array for south top reflector'
fill 26 end fill
ara=9 nux=3 nuy=1 nuz=1
com='array for north end reflector'
fill 28 29 30 end fill
ara=10 nux=1 nuy=1 nuz=1
com='array for south end reflector'
fill 32 end fill
ara=13 nux=1 nuy=1 nuz=2
com='combination of north core with bottom reflector'
fill 15 9 end fill
ara=14 nux=1 nuy=3 nuz=1
com='north core with side reflectors'
fill 21 38 21 end fill
ara=15 nux=2 nuy=1 nuz=1
com='north core with end reflector'
fill 31 39 end fill
ara=16 nux=1 nuy=1 nuz=2
com='north core with top reflector'
fill 40 25 end fill
ara=20 nux=1 nuy=1 nuz=2
com='south core with bottom reflector'
fill 19 10 end fill
ara=21 nux=1 nuy=3 nuz=1
com='south core with east west reflectors'
fill 23 48 23 end fill
ara=22 nux=2 nuy=1 nuz=1
com='south core with end reflector'
fill 49 33 end fill
ara=23 nux=1 nuy=1 nuz=2
com='combination of core with top reflector'
fill 50 27 end fill
ara=25 nux=3 nuy=1 nuz=1
com='total'
fill 42 54 52 end fill
ara=26 nux=3 nuy=1 nuz=1
com='assembly of fuel box front and rear'
fill 2 1 3 end fill
ara=27 nux=1 nuy=1 nuz=3
com='assembly of fuel box top and bottom'
fill 5 4 5 end fill
end array
read plot ttl='yz slice of south core first row'
xul=64.319 yul=55.625 zul=71.735
xlr=64.319 ylr=71.625 zlr=55.735
vax=1 wdn=-1 nax=130 nch='012345678' end
ttl='xz slice of sphere cuboid'
xul=56.0 yul=63.625 zul=71.735
xlr=72.0 ylr=63.625 zlr=55.735
uax=1 wdn=-1 nax=130 nch='012345678'
end plot
' read start nst=6 tfx=65 tfy=63.625 tfz=63.735 lnu=300 end start
read start nst=1 xsm=56.981 xsp=71.649 ysm=56.219 ysp=70.959
zsm=56.401 zsp=71.069 end start
end data
end

```

```

=csas25
rocky flats criticals nureg/cr-0674 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=0.77, low conc. solution driven
238groupndf5 infhommedium
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 8.9514e-2 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-al1100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 0.7 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
arbm-al1100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 7 2.715 end
solnuo2(no3)2 8 86.42 0.149 1.0 293.0 92234 1.022 92235 93.172
92236 0.434 92238 5.372 end
ss304 9 1.0 end
end comp
rocky flats criticals nureg/cr-0674 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=0.77, low conc. solution driven
read parm npg=2000 nub=yes fdn=yes plt=no end parm
read geom
unit 1
com='fuel box with void and part of al box'
cuboid 0 1 9.80 0.0 3.75 0.0 14.98 0.0
cuboid 2 1 9.95 0.0 3.90 -0.15 14.98 0.0
cuboid 1 1 14.98 0.0 9.365 -5.615 14.98 0.0
unit 2
com='front of fuel box'
cuboid 2 1 0.15 0.0 5.615 0.0 14.98 0.0
cuboid 0 1 0.15 0.0 9.365 0.0 14.98 0.0
cuboid 2 1 0.15 0.0 14.98 0.0 14.98 0.0
unit 3
com='rear of fuel box'
cuboid 2 1 0.15 0.0 14.98 0.0 14.98 0.0
unit 4
com='array to assemble part of box'
array 26 3*0
unit 5
com='top and bottom of box'
cuboid 0 1 9.80 0.0 3.750 0.0 0.15 0.0
cuboid 2 1 15.28 0.0 9.365 -5.615 0.15 0.0
global
unit 6
com='array to assemble top and bottom'
array 27 3*0

```

```

cuboid 2 1 15.28 0.0 15.13 -0.15 15.28 0.0
cuboid 0 1 15.305 -0.025 15.155 -0.175 15.305 -0.025
unit 7
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 1 1 6p7.49
cuboid 2 1 6p7.64
cuboid 0 1 6p7.6650
unit 34
com='aluminum weight distribution plate for special box'
cuboid 0 1 9.80 0.0 3.750 0.0 0.16 0.0
cuboid 7 1 15.33 0.0 9.54 -5.79 0.16 0.0
unit 35
com='aluminum weight distribution plate for boxes'
cuboid 7 1 4p7.665 0.16 0.0
unit 9
com='north split table core'
array 1 3*0.0
cuboid 0 1 30.66 -0.94 77.5 0.0 83.475 0.0
unit 10
com='south split table core'
array 2 3*0.0
cuboid 0 1 49.4 0.0 77.5 0.0 83.475 0.0
unit 11
com='plexiglass reflector sheet without tris, north bottom reflector'
cuboid 4 1 2p15.8000 2p38.7500 2p0.6150
unit 12
com='plexiglass reflector sheet with tris, north bottom reflector'
cuboid 5 1 2p15.8000 2p38.7500 2p0.6150
unit 13
com='upper portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p8.24
unit 14
com='lower portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p3.69
unit 15
com='north bottom reflector includes regular and tris'
array 3 3*0.0
unit 16
com='plexiglas sheet bottom south reflector without tris'
cuboid 0 1 2p5.1 2p2.5 2p0.6150
cuboid 4 1 44.3 -5.1 2p38.75 2p0.615
unit 17
com='plexiglas sheet bottom south reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p0.6150
cuboid 5 1 44.3 -5.1 2p38.75 2p0.6150
unit 18
com='lower portion south bottom reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p8.855
cuboid 5 1 44.3 -5.1 2p38.75 2p8.855
unit 19
com='south bottom reflector with regular and tris'
array 4 3*0.0
unit 20
com='east and west reflectors for north reflector with tris'
cuboid 5 1 2p15.8 2p12.65 2p54.2825
unit 21
com='array for east and west reflectors for north reflector'
array 5 3*0.0
unit 22
com='east and west reflectors for south reflector with tris'
cuboid 5 1 2p24.700 2p12.65 2p54.2825
unit 23
com='array for east and west reflectors for south reflector'

```

```

array 6 3*0.0
unit 24
com='north top reflector with tris'
cuboid 5 1 2p28.35 2p64.05 2p12.15
unit 25
com='array for north top reflector'
array 7 3*0.0
unit 26
com='south top reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p12.15
cuboid 5 1 69.4 -5.1 2p64.05 2p12.15
unit 27
com='array for south top reflector'
array 8 3*0.0
unit 28
com='north end reflector 9.8cm portion without tris'
cuboid 4 1 2p4.9000 2p64.0500 2p54.2825
unit 29
com='north end reflector 5.2 cm portion with tris'
cuboid 5 1 2p2.6 2p64.0500 2p54.2825
unit 30
com='north end reflector 10.1 cm portion without tris'
cuboid 4 1 2p5.05 2p64.05 2p54.2825
unit 31
com='array for north end reflector'
array 9 3*0.0
unit 32
com='south end reflector'
cuboid 5 1 2p12.55 2p64.05 2p54.2825
unit 33
com='array for south end reflector'
array 10 3*0.0
unit 38
com='north core with bottom reflector'
array 13 3* 0.0
unit 39
com='north core with east and west reflector'
array 14 3*0.0
unit 40
com='north core with end reflector'
array 15 3*0.0
unit 42
com='north core with top reflector'
array 16 3*0.0
unit 48
com='south core with bottom reflectors'
array 20 3*0.0
unit 49
com='south core with east west reflectors'
array 21 3*0.0
unit 50
com='south core end reflector'
array 22 3*0.0
unit 52
com='south core with top reflector'
array 23 3*0.0
unit 54
com='air gap'
cuboid 0 1 0.912 0.0 64.475 -63.625 69.13 -63.735
global
unit 55
com='total'
array 25 3*0.0

```

```

unit 56
com='combination of two regular fuel boxes'
array 28 3*0.0
unit 57
com='combination of regular fuel box and special fuel box'
array 29 3*0.0
unit 58
com='combination of two regular weight distribution plates'
array 30 3*0.0
unit 59
com='combination of regular and special weight distribution plates'
array 31 3*0.0
unit 60
com='north core solution driver'
cuboid 8 1 2p7.5 2p14.9 5.374 -7.5
cuboid 0 1 2p7.5 2p14.9 2p7.5
cuboid 9 1 2p7.65 2p15.05 2p7.65
cuboid 0 1 2p7.665 2p15.33 2p7.665
unit 61
com='north core solution driver'
cuboid 8 1 2p7.5 2p14.9 5.328 -7.5
cuboid 0 1 2p7.5 2p14.9 2p7.5
cuboid 9 1 2p7.65 2p15.05 2p7.65
cuboid 0 1 2p7.665 2p15.33 2p7.665
end geometry
read array
ara=1 nux=2 nuy=4 nuz=9
com='north split table core'
fill 2r7 2r56 4r7
    2r35 2r58 4r35
    2r7 2r56 4r7
    2r35 2r58 4r35
    2r7 56 60 4r7
    2r35 2r58 4r35
    2r7 2r56 4r7
    2r35 2r58 4r35
    2r7 2r56 4r7
end fill
ara=2 nux=3 nuy=4 nuz=9
com='south split table core'
fill 3r7 3r56 6r7
    3r35 3r58 6r35
    3r7 3r56 6r7
    3r35 3r58 6r35
    3r7 61 56 56 6r7
    3r35 3r58 6r35
    3r7 57 56 56 6r7
    3r35 59 58 58 6r35
    3r7 57 56 56 6r7
end fill
ara=3 nux=1 nuy=1 nuz=3
com='north bottom reflector'
fill 14 11 13 end fill
ara=4 nux=1 nuy=1 nuz=7
com='south bottom reflector'
fill 18 16 17 16 16 17 17 end fill
ara=5 nux=1 nuy=1 nuz=1
com='east and west walls of north reflector'
fill 20 end fill
ara=6 nux=1 nuy=1 nuz=1
com='east and west walls of south reflector'
fill 22 end fill
ara=7 nux=1 nuy=1 nuz=1

```

```

com='array for north top reflector'
fill 24 end fill
ara=8 nux=1 nuy=1 nuz=1
com='array for south top reflector'
fill 26 end fill
ara=9 nux=3 nuy=1 nuz=1
com='array for north end reflector'
fill 28 29 30 end fill
ara=10 nux=1 nuy=1 nuz=1
com='array for south end reflector'
fill 32 end fill
ara=13 nux=1 nuy=1 nuz=2
com='combination of north core with bottom reflector'
fill 15 9 end fill
ara=14 nux=1 nuy=3 nuz=1
com='north core with side reflectors'
fill 21 38 21 end fill
ara=15 nux=2 nuy=1 nuz=1
com='north core with end reflector'
fill 31 39 end fill
ara=16 nux=1 nuy=1 nuz=2
com='north core with top reflector'
fill 40 25 end fill
ara=20 nux=1 nuy=1 nuz=2
com='south core with bottom reflector'
fill 19 10 end fill
ara=21 nux=1 nuy=3 nuz=1
com='south core with east west reflectors'
fill 23 48 23 end fill
ara=22 nux=2 nuy=1 nuz=1
com='south core with end reflector'
fill 49 33 end fill
ara=23 nux=1 nuy=1 nuz=2
com='combination of core with top reflector'
fill 50 27 end fill
ara=25 nux=3 nuy=1 nuz=1
com='total'
fill 42 54 52 end fill
ara=26 nux=3 nuy=1 nuz=1
com='assembly of fuel box front and rear'
fill 2 1 3 end fill
ara=27 nux=1 nuy=1 nuz=3
com='assembly of fuel box top and bottom'
fill 5 4 5 end fill
ara=28 nux=1 nuy=2 nuz=1
com='combination of two fuel boxes'
fill 7 7 end fill
ara=29 nux=1 nuy=2 nuz=1
com='combination of special and regular fuel boxes'
fill 7 6 end fill
ara=30 nux=1 nuy=2 nuz=1
com='combination of two weight distribution plates'
fill 35 35 end fill
ara=31 nux=1 nuy=2 nuz=1
com='combination of special and regular weight distribution plates'
fill 35 34 end fill
end array
read plot ttl='yz slice of south core first row'
xul=64.319 yul=40.000 zul=72.000
xlr=64.319 ylr=72.000 zlr=56.000
vax=1 wdn=-1 nax=130 nch='012345678'end
ttl='xz slice of sphere cuboid'
xul=56.0 yul=63.625 zul=71.735

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```

xlr=72.0 ylr=63.625 zlr=55.735
uax=1 wdn=-1 nax=130 nch='012345678'
end plot
read start nst=1 xsm=41.37 xsp=72.894 ysm=40.63 ysp=71.29
zsm=56.071 zsp=71.4 end start
end data
end

=csas25      parm=size=500000
rocky flats criticals nureg/cr-1653 experiment a (27 group)
' 48 fuel cans 2.44 cm moderator gee.hu125.data(opt)
238groupndf5 latticecell
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 1.5627e-1 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.9 8016 1.20 1 1.9134e-2
end
arbm-al1100 1.0 3 0 0 1 13027 99.18 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 45.91 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 65.50 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.49 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.59 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 49.5 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 86.29 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.03 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 49.5 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 86.29 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.49 8016 32.48 6 .888 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
end comp
sphtriangp 19.9462 18.5857 1 3 18.9579 2 end
rocky flats criticals nureg/cr-1653 experiment a (27 group)
' 48 fuel cans 2.44 cm moderator gee.hu125.data(opt)
read parm run=yes npg=2000 fdn=yes nub=yes plt=no end parm
read geom
unit 1
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 1 1 6p7.49
cuboid 2 1 6p7.64
cuboid 0 1 6p7.6650
unit 2
com='x-face interstitial moderator'
cuboid 3 1 2p1.2200 4p7.665
unit 3
com='y-face interstitial moderator'
cuboid 3 1 2p7.665 2p1.2200 2p7.665
unit 4
com='z-face interstitial moderator'
cuboid 3 1 4p7.665 2p1.2200
unit 5
com='more x-face moderator'
cuboid 3 1 4p1.2200 2p7.665
unit 6

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com='more y-face moderator'
cuboid 3 1 2p7.665 4p1.2200
unit 7
com='more z-face moderator'
cuboid 3 1 2p1.2200 2p7.665 2p1.2200
unit 8
com='last of interstitial moderator'
cuboid 3 1 6p1.2200
unit 9
com='north split table core'
array 1 3*0.0
unit 10
com='south split table core'
array 2 3*0.0
unit 11
com='plexiglass reflector sheet without tris, north bottom reflector'
cuboid 4 1 2p16.5500 2p38.7500 2p0.6150
unit 12
com='plexiglass reflector sheet with tris, north bottom reflector'
cuboid 5 1 2p16.5500 2p38.7500 2p0.6150
unit 13
com='upper portion north bottom reflector with tris'
cuboid 5 1 2p16.550 2p38.75 2p8.24
unit 14
com='lower portion north bottom reflector with tris'
cuboid 5 1 2p16.550 2p38.75 2p3.69
unit 15
com='north bottom reflector includes regular and tris'
array 3 3*0.0
unit 16
com='plexiglas sheet bottom south reflector without tris'
cuboid 0 1 2p5.1 2p2.55 2p0.615
cuboid 4 1 44.3 -5.1 2p38.75 2p0.615
unit 17
com='plexiglas sheet bottom south reflector with tris'
cuboid 0 1 2p5.1 2p2.55 2p0.615
cuboid 5 1 44.3 -5.1 2p38.75 2p0.6150
unit 18
com='lower portion south bottom reflector with tris'
cuboid 0 1 2p5.1 2p2.55 2p8.855
cuboid 5 1 44.3 -5.1 2p38.75 2p8.855
unit 19
com='south bottom reflector with regular and tris'
array 4 3*0.0
unit 20
com='east and west reflectors for north reflector with tris'
cuboid 5 1 2p16.550 2p12.65 2p54.2825
unit 21
com='array for east and west reflectors for north reflector'
array 5 3*0.0
unit 22
com='east and west reflectors for south reflector with tris'
cuboid 5 1 2p24.700 2p12.65 2p54.2825
unit 23
com='array for east and west reflectors for south reflector'
array 6 3*0.0
unit 24
com='north top reflector with tris'
cuboid 5 1 2p29.100 2p64.05 2p12.15
unit 25
com='array for north top reflector'
array 7 3*0.0
unit 26

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```

com='south top reflector with tris'
cuboid 0 1 2p5.1 2p2.55 2p12.15
cuboid 5 1 69.4 -5.1 2p64.05 2p12.15
unit 27
com='array for south top reflector'
array 8 3*0.0
unit 28
com='north end reflector 9.8cm portion without tris'
cuboid 4 1 2p4.9000 2p64.0500 2p54.2825
unit 29
com='north end reflector 5.2 cm portion with tris'
cuboid 5 1 2p2.6 2p64.0500 2p54.2825
unit 30
com='north end reflector 10.1 cm portion without tris'
cuboid 4 1 2p5.05 2p64.05 2p54.2825
unit 31
com='array for north end reflector'
array 9 3*0.0
unit 32
com='south end reflector'
cuboid 5 1 2p12.55 2p64.05 2p54.2825
unit 33
com='array for south end reflector'
array 10 3*0.0
unit 34
com='bottom moderating plastic north core'
cuboid 6 1 2p16.550 2p38.7500 2p13.0500
unit 35
com='top moderating plastic north core'
cuboid 6 1 2p16.550 2p38.7500 2p3.2525
unit 36
array 11 3*0.0
unit 37
array 12 3*0.0
unit 38
com='north core with bottom reflector'
array 13 3* 0.0
unit 39
com='north core with east and west reflector'
array 14 3*0.0
unit 40
com='north core with end reflector'
array 15 3*0.0
unit 41
com='north split table faceplate'
cuboid 3 1 2p0.6150 2p64.0500 2p66.4325
unit 42
com='north core with top reflector'
array 16 3*0.0
unit 43
com='north core with faceplate'
array 17 3*0.0
unit 44
com='12.95 cm thick moderator south core'
cuboid 6 1 2p23.924 2p6.475 2p40.183
unit 45
com='2.95 thick moderator south core'
cuboid 6 1 2p23.924 2p38.5285 2p1.475
unit 46
com='combination of core with 12.95 thick moderator'
array 18 3*0.0
unit 47
com='combination of core with 2.95 thick moderator'

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```

array 19 3*0.0
unit 48
com='south core with east west reflectors'
array 20 3*0.0
unit 49
com='south core with east west reflectors'
array 21 3*0.0
unit 50
com='south core end reflector'
array 22 3*0.0
unit 51
com='faceplate for south split table'
cuboid 3 1 2p0.4620 2p64.0500 2p66.4325
unit 52
com='south core with top reflector'
array 23 3*0.0
unit 53
com='south core with faceplate'
array 24 3*0.0
unit 54
com='air gap'
cuboid 0 1 2p0.1550 2p64.0500 2p66.4325
global
unit 55
com='total'
array 25 3*0.0
unit 56
com='empty fuel location'
cuboid 0 1 6p7.6650
unit 57
com='side moderator'
cuboid 5 1 2p16.550 2p4.4300 2p25.4350
unit 58
com='end moderator'
cuboid 6 1 2p8.1500 2p38.7500 2p25.4350
unit 59
com='south core bottom moderating plastic'
cuboid 6 1 2p24.7000 2p38.7500 2p13.0500
unit 60
com='south core top moderating plastic'
cuboid 6 1 2p24.7000 2p38.7500 2p3.2525
unit 61
com='y-face moderator void'
cuboid 0 1 2p7.665 2p1.2200 2p7.665
unit 62
com='x-face moderator void'
cuboid 0 1 2p1.2200 4p7.665
end geometry
read array
ara=1 nux=3 nuy=7 nuz=5
com='north split table core'
fill 1 2 1 3 5 3 2q6 1 2 1
      4 7 4 6 8 6 2q6 4 7 4
      1q42
      56 2 1 61 5 3 56 2 1 61 5 3 1q6 56 62 56  end fill
ara=2 nux=3 nuy=7 nuz=5
com='south split table core'
fill 1 2 1 3 5 3 2q6 1 2 1
      4 7 4 6 8 6 2q6 4 7 4
      1q42
      1 2 56 3 5 61 2q6 56 62 56  end fill
ara=3 nux=1 nuy=1 nuz=3
com='north bottom reflector'

```

```

fill 14 11 13 end fill
ara=4 nux=1 nuy=1 nuz=7
com='south bottom reflector'
fill 18 16 17 16 16 17 17 end fill
ara=5 nux=1 nuy=1 nuz=1
com='east and west walls of north reflector'
fill 20 end fill
ara=6 nux=1 nuy=1 nuz=1
com='east and west walls of south reflector'
fill 22 end fill
ara=7 nux=1 nuy=1 nuz=1
com='array for north top reflector'
fill 24 end fill
ara=8 nux=1 nuy=1 nuz=1
com='array for south top reflector'
fill 26 end fill
ara=9 nux=3 nuy=1 nuz=1
com='array for north end reflector'
fill 28 29 30 end fill
ara=10 nux=1 nuy=1 nuz=1
com='array for south end reflector'
fill 32 end fill
ara=11 nux=1 nuy=2 nuz=1
com='combinarion of core with side moderator'
fill 9 57 end fill
ara=12 nux=1 nuy=1 nuz=3
com='combination of previous array with top and bottom moderator'
fill 34 36 35 end fill
ara=13 nux=1 nuy=1 nuz=2
com='combination of north core with bottom reflector'
fill 15 37 end fill
ara=14 nux=1 nuy=3 nuz=1
com='north core with side reflectors'
fill 21 38 21 end fill
ara=15 nux=2 nuy=1 nuz=1
com='north core with end reflector'
fill 31 39 end fill
ara=16 nux=1 nuy=1 nuz=2
com='north core with top reflector'
fill 40 25 end fill
ara=17 nux=2 nuy=1 nuz=1
com='north core with faceplate'
fill 42 41 end fill
ara=18 nux=1 nuy=2 nuz=1
com='combination of s. core with side moderator'
fill 10 57 end fill
ara=19 nux=2 nuy=1 nuz=1
com='combination of core with end moderator'
fill 46 58 end fill
ara=20 nux=1 nuy=1 nuz=4
com='south core with bottom moderator and reflector'
fill 19 59 47 60 end fill
ara=21 nux=1 nuy=3 nuz=1
com='south core with east west reflectors'
fill 23 48 23 end fill
ara=22 nux=2 nuy=1 nuz=1
com='south core with end reflector'
fill 49 33 end fill
ara=23 nux=1 nuy=1 nuz=2
com='combination of core with top reflector'
fill 50 27 end fill
ara=24 nux=2 nuy=1 nuz=1
com='south core with faceplate'

```

```

fill 51 52 end fill
ara=25 nux=3 tuy=1 nuz=1
com='total'
fill 43 54 53 end fill
end array
read plot ttl='xz slice of rfp1 showing material regions'
xul=-2 yul=64.05 zul=136
xlr=137 ylr=64.05 zlr=-2
uax=1 wdn=-1 nax=130 nch='0123456'end
ttl='yz slice of north core first row'
xul=48 yul=-2 zul=136
xlr=48 ylr=136 zlr=-2
vax=1 wdn=-1 nax=130 nch='0123456'end
ttl='yz slice of north core second row'
xul=28 yul=-2 zul=136
xlr=28 ylr=136 zlr=-2
vax=1 wdn=-1 nax=130 nch='0123456'end
ttl='yz slice of south core first row'
xul=62 yul=-2 zul=136
xlr=62 ylr=136 zlr=-2
vax=1 wdn=-1 nax=130 nch='0123456'end
ttl='yz slice of south core second row'
xul=80 yul=-2 zul=136
xlr=80 ylr=136 zlr=-2
vax=1 wdn=-1 nax=130 nch='0123456'end
end plot
end data
end

=csas25
rocky flats criticals nureg/cr-1653 experiment c (27 group)
' 80 fuel cans 0.929 cm moderator gee.hu125.data(und2)
238groupndf5 latticecell
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 1.5627e-1 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 .854 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
end comp
sphtriangp 19.00 18.5857 1 3 18.9579 2 end
rocky flats criticals nureg/cr-1653 experiment c (27 group)

```

```

' 80 fuel cans 0.929 cm moderator gee.hu125.data(und2)
read parm run=yes npg=2000 fdn=yes nub=yes plt=no end parm
read geom
unit 1
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 1 1 6p7.49
cuboid 2 1 6p7.64
cuboid 0 1 6p7.6650
unit 2
com='x-face interstitial moderator'
cuboid 3 1 2p0.4645 4p7.665
unit 3
com='y-face interstitial moderator'
cuboid 3 1 2p7.665 2p0.4645 2p7.665
unit 4
com='z-face interstitial moderator'
cuboid 3 1 4p7.665 2p0.4645
unit 5
com='more x-face moderator'
cuboid 3 1 4p0.4645 2p7.665
unit 6
com='more y-face moderator'
cuboid 3 1 2p7.665 4p0.4645
unit 7
com='more z-face moderator'
cuboid 3 1 2p0.4645 2p7.665 2p0.4645
unit 8
com='last of interstitial moderator'
cuboid 3 1 6p0.4645
unit 9
com='north split table core'
array 1 3*0.0
unit 10
com='south split table core'
array 2 3*0.0
unit 11
com='plexiglass reflector sheet without tris, north bottom reflector'
cuboid 4 1 2p15.8000 2p38.7500 2p0.6150
unit 12
com='plexiglass reflector sheet with tris, north bottom reflector'
cuboid 5 1 2p15.8000 2p38.7500 2p0.6150
unit 13
com='upper portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p8.24
unit 14
com='lower portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p3.69
unit 15
com='north bottom reflector includes regular and tris'
array 3 3*0.0
unit 16
com='plexiglas sheet bottom south reflector without tris'
cuboid 0 1 2p5.1 2p2.55 2p0.615
cuboid 4 1 44.3 -5.1 2p38.75 2p0.615
unit 17
com='plexiglas sheet bottom south reflector with tris'
cuboid 0 1 2p5.1 2p2.55 2p0.615
cuboid 5 1 44.3 -5.1 2p38.75 2p0.6150
unit 18
com='lower portion south bottom reflector with tris'
cuboid 0 1 2p5.1 2p2.55 2p8.855
cuboid 5 1 44.3 -5.1 2p38.75 2p8.855
unit 19

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com='south bottom reflector with regular and tris'
array 4 3*0.0
unit 20
com='east and west reflectors for north reflector with tris'
cuboid 5 1 2p15.8 2p12.65 2p54.2825
unit 21
com='array for east and west reflectors for north reflector'
array 5 3*0.0
unit 22
com='east and west reflectors for south reflector with tris'
cuboid 5 1 2p24.700 2p12.65 2p54.2825
unit 23
com='array for east and west reflectors for south reflector'
array 6 3*0.0
unit 24
com='north top reflector with tris'
cuboid 5 1 2p28.35 2p64.05 2p12.15
unit 25
com='array for north top reflector'
array 7 3*0.0
unit 26
com='south top reflector with tris'
cuboid 0 1 2p5.1 2p2.55 2p12.15
cuboid 5 1 69.4 -5.1 2p64.05 2p12.15
unit 27
com='array for south top reflector'
array 8 3*0.0
unit 28
com='north end reflector 9.8cm portion without tris'
cuboid 4 1 2p4.9000 2p64.0500 2p54.2825
unit 29
com='north end reflector 5.2 cm portion with tris'
cuboid 5 1 2p2.6 2p64.0500 2p54.2825
unit 30
com='north end reflector 10.1 cm portion without tris'
cuboid 4 1 2p5.05 2p64.05 2p54.2825
unit 31
com='array for north end reflector'
array 9 3*0.0
unit 32
com='south end reflector'
cuboid 5 1 2p12.55 2p64.05 2p54.2825
unit 33
com='array for south end reflector'
array 10 3*0.0
unit 34
com='12.95 thick moderating plastic north core'
cuboid 6 1 2p15.7945 2p6.4750 2p32.0535
unit 35
com='2.95 thick moderating plastic north core'
cuboid 6 1 2p15.7945 2p38.5285 2p1.475
unit 36
array 11 3*0.0
unit 37
array 12 3*0.0
replicate 0 1 0.0 0.011 0.443 0.0 0.1590 0.0 1
unit 38
com='north core with bottom reflector'
array 13 3*0.0
unit 39
com='north core with east and west reflector'
array 14 3*0.0
unit 40

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com='north core with end reflector'
array 15 3*0.0
unit 41
com='north split table faceplate'
cuboid 3 1 2p0.6150 2p64.0500 2p66.4325
unit 42
com='north core with top reflector'
array 16 3*0.0
unit 43
com='north core with faceplate'
array 17 3*0.0
unit 44
com='12.95 cm thick moderator south core'
cuboid 6 1 2p23.924 2p6.475 2p32.0535
unit 45
com='2.95 thick moderator south core'
cuboid 6 1 2p23.924 2p38.5285 2p1.475
unit 46
com='combination of core with 12.95 thick moderator'
array 18 3*0.0
unit 47
com='combination of core with 2.95 thick moderator'
array 19 3*0.0
replicate 0 1 1.552 0.0 0.4430 0.0 0.159 0.0 1
unit 48
com='south core with east west reflectors'
array 20 3*0.0
unit 49
com='south core with east west reflectors'
array 21 3*0.0
unit 50
com='south core end reflector'
array 22 3*0.0
unit 51
com='faceplate for south split table'
cuboid 3 1 2p0.4620 2p64.0500 2p66.4325
unit 52
com='south core with top reflector'
array 23 3*0.0
unit 53
com='south core with faceplate'
array 24 3*0.0
unit 54
com='air gap'
cuboid 0 1 2p0.7805 2p64.0500 2p66.4325
global
unit 55
com='total'
array 25 3*0.0
unit 56
com='north bottom moderator'
cuboid 6 1 2p15.8000 2p38.7500 2p8.1295
unit 57
com='bottom south moderator'
cuboid 6 1 2p24.700 2p38.75 2p8.1295
'unit 58
'com='south rear moderator'
'cuboid 3 1
end geometry
read array
ara=1 nux=3 nuy=7 nuz=7
com='north split table core'
fill 1 2 1 3 5 3 2q6 1 2 1

```

```

4 7 4 6 8 6 2q6 4 7 4
2q42
1 2 1 3 5 3 2q6 1 2 1 end fill
ara=2 nux=5 nuy=7 nuz=7
com='south split table core'
fill 1 2 1 2 1 3 5 3 5 3 2q10 1 2 1 2 1
4 7 4 7 4 6 8 6 8 6 2q10 4 7 4 7 4
2q70
1 2 1 2 1 3 5 3 5 3 2q10 1 2 1 2 1 end fill
ara=3 nux=1 nuy=1 nuz=4
com='north bottom moderator and reflector'
fill 14 11 13 56 end fill
ara=4 nux=1 nuy=1 nuz=8
com='south bottom moderator and reflector'
fill 18 16 17 16 16 17 17 57 end fill
ara=5 nux=1 nuy=1 nuz=1
com='east and west walls of north reflector'
fill 20 end fill
ara=6 nux=1 nuy=1 nuz=1
com='east and west walls of south reflector'
fill 22 end fill
ara=7 nux=1 nuy=1 nuz=1
com='array for north top reflector'
fill 24 end fill
ara=8 nux=1 nuy=1 nuz=1
com='array for south top reflector'
fill 26 end fill
ara=9 nux=3 nuy=1 nuz=1
com='array for north end reflector'
fill 28 29 30 end fill
ara=10 nux=1 nuy=1 nuz=1
com='array for south end reflector'
fill 32 end fill
ara=11 nux=1 nuy=2 nuz=1
com='combinarion of core with 12.95cm thick moderator'
fill 9 34 end fill
ara=12 nux=1 nuy=1 nuz=2
com='combination of previous array with 2.95cm thick moderator'
fill 36 35 end fill
ara=13 nux=1 nuy=1 nuz=2
com='combination of north core with bottom reflector'
fill 15 37 end fill
ara=14 nux=1 nuy=3 nuz=1
com='north core with side reflectors'
fill 21 38 21 end fill
ara=15 nux=2 nuy=1 nuz=1
com='north core with end reflector'
fill 31 39 end fill
ara=16 nux=1 nuy=1 nuz=2
com='north core with top reflector'
fill 40 25 end fill
ara=17 nux=2 nuy=1 nuz=1
com='north core with faceplate'
fill 42 41 end fill
ara=18 nux=1 nuy=2 nuz=1
com='combination of s. core with 12.95 cm thick moderator'
fill 10 44 end fill
ara=19 nux=1 nuy=1 nuz=2
com='combination of core with 2.95 cm thick moderator'
fill 46 45 end fill
ara=20 nux=1 nuy=1 nuz=2
com='south core with bottom reflector'
fill 19 47 end fill

```

```

ara=21 nux=1 nuy=3 nuz=1
com='south core with east west reflectors'
fill 23 48 23 end fill
ara=22 nux=2 nuy=1 nuz=1
com='south core with end reflector'
fill 49 33 end fill
ara=23 nux=1 nuy=1 nuz=2
com='combination of core with top reflector'
fill 50 27 end fill
ara=24 nux=2 nuy=1 nuz=1
com='south core with faceplate'
fill 51 52 end fill
ara=25 nux=3 nuy=1 nuz=1
com='total'
fill 43 54 53 end fill
end array
read plot ttl='xz slice of rfp3 showing material regions'
xul=-1 yul=64.05 zul=135
xlr=136 ylr=64.05 zlr=-2
uax=1 wdn=-1 nax=130 nch='0123456'end
ttl='yz slice of north core second row'
xul=28 yul=-2 zul=136
xlr=28 ylr=136 zlr=-2
vax=1 wdn=-1 nax=130 nch='0123456'end
ttl='yz slice of south core second row'
xul=80 yul=-2 zul=136
xlr=80 ylr=136 zlr=-2
vax=1 wdn=-1 nax=130 nch='0123456'
end plot
end data
end

=csas25
rocky flats criticals nureg/cr-1653 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=1.25, hi conc. solution driven
238groupndf5 infhommedium
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 1.5627e-1 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-120
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 0.7 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.

```

```

arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 7 2.715 end
solnuo2(no3)2 8 351.18 0.549 1.0 293.0 92234 1.022 92235 93.172
92236 0.434 92238 5.372 end
ss304 9 1.0 end
end comp
rocky flats criticals nureg/cr-1653 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=1.25, hi conc. solution driven
read parm npg=2000 nub=yes fdn=yes plt=no end parm
read geom
unit 1
com='fuel box with void and part of al box'
cuboid 0 1 9.80 0.0 3.75 0.0 14.98 0.0
cuboid 2 1 9.95 0.0 3.90 -0.15 14.98 0.0
cuboid 1 1 14.98 0.0 9.365 -5.615 14.98 0.0
unit 2
com='front of fuel box'
cuboid 2 1 0.15 0.0 5.615 0.0 14.98 0.0
cuboid 0 1 0.15 0.0 9.365 0.0 14.98 0.0
cuboid 2 1 0.15 0.0 14.98 0.0 14.98 0.0
unit 3
com='rear of fuel box'
cuboid 2 1 0.15 0.0 14.98 0.0 14.98 0.0
unit 4
com='array to assemble part of box'
array 26 3*0
unit 5
com='top and bottom of box'
cuboid 0 1 9.80 0.0 3.750 0.0 0.15 0.0
cuboid 2 1 15.28 0.0 9.365 -5.615 0.15 0.0
global
unit 6
com='array to assemble top and bottom'
array 27 3*0
cuboid 2 1 15.28 0.0 15.13 -0.15 15.28 0.0
cuboid 0 1 15.305 -0.025 15.155 -0.175 15.305 -0.025
unit 7
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 1 1 6p7.49
cuboid 2 1 6p7.64
cuboid 0 1 6p7.6650
unit 34
com='aluminum weight distribution plate for special box'
cuboid 0 1 9.80 0.0 3.750 0.0 0.16 0.0
cuboid 7 1 15.33 0.0 9.54 -5.79 0.16 0.0
unit 35
com='aluminum weight distribution plate for boxes'
cuboid 7 1 4p7.665 0.16 0.0
unit 9
com='north split table core'
array 1 3*0.0
cuboid 0 1 30.66 -0.94 77.5 0.0 83.475 0.0
unit 10
com='south split table core'
array 2 3*0.0
cuboid 0 1 49.4 0.0 77.5 0.0 83.475 0.0
unit 11
com='plexiglass reflector sheet without tris, north bottom reflector'
cuboid 4 1 2p15.8000 2p38.7500 2p0.6150
unit 12
com='plexiglass reflector sheet with tris, north bottom reflector'
cuboid 5 1 2p15.8000 2p38.7500 2p0.6150
unit 13
com='upper portion north bottom reflector with tris'

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cuboid 5 1 2p15.8 2p38.75 2p8.24
unit 14
com='lower portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p3.69
unit 15
com='north bottom reflector includes regular and tris'
array 3 3*0.0
unit 16
com='plexiglas sheet bottom south reflector without tris'
cuboid 0 1 2p5.1 2p2.5 2p0.6150
cuboid 4 1 44.3 -5.1 2p38.75 2p0.615
unit 17
com='plexiglas sheet bottom south reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p0.6150
cuboid 5 1 44.3 -5.1 2p38.75 2p0.6150
unit 18
com='lower portion south bottom reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p8.855
cuboid 5 1 44.3 -5.1 2p38.75 2p8.855
unit 19
com='south bottom reflector with regular and tris'
array 4 3*0.0
unit 20
com='east and west reflectors for north reflector with tris'
cuboid 5 1 2p15.8 2p12.65 2p54.2825
unit 21
com='array for east and west reflectors for north reflector'
array 5 3*0.0
unit 22
com='east and west reflectors for south reflector with tris'
cuboid 5 1 2p24.700 2p12.65 2p54.2825
unit 23
com='array for east and west reflectors for south reflector'
array 6 3*0.0
unit 24
com='north top reflector with tris'
cuboid 5 1 2p28.35 2p64.05 2p12.15
unit 25
com='array for north top reflector'
array 7 3*0.0
unit 26
com='south top reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p12.15
cuboid 5 1 69.4 -5.1 2p64.05 2p12.15
unit 27
com='array for south top reflector'
array 8 3*0.0
unit 28
com='north end reflector 9.8cm portion without tris'
cuboid 4 1 2p4.9000 2p64.0500 2p54.2825
unit 29
com='north end reflector 5.2 cm portion with tris'
cuboid 5 1 2p2.6 2p64.0500 2p54.2825
unit 30
com='north end reflector 10.1 cm portion without tris'
cuboid 4 1 2p5.05 2p64.05 2p54.2825
unit 31
com='array for north end reflector'
array 9 3*0.0
unit 32
com='south end reflector'
cuboid 5 1 2p12.55 2p64.05 2p54.2825

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```

unit 33
com='array for south end reflector'
array 10 3*0.0
unit 38
com='north core with bottom reflector'
array 13 3* 0.0
unit 39
com='north core with east and west reflector'
array 14 3*0.0
unit 40
com='north core with end reflector'
array 15 3*0.0
unit 42
com='north core with top reflector'
array 16 3*0.0
unit 48
com='south core with bottom reflectors'
array 20 3*0.0
unit 49
com='south core with east west reflectors'
array 21 3*0.0
unit 50
com='south core end reflector'
array 22 3*0.0
unit 52
com='south core with top reflector'
array 23 3*0.0
unit 54
com='air gap'
cuboid 0 1 0.732 0.0 64.475 -63.625 69.13 -63.735
global
unit 55
com='total'
array 25 3*0.0
unit 56
com='combination of two regular fuel boxes'
array 28 3*0.0
unit 57
com='combination of regular fuel box and special fuel box'
array 29 3*0.0
unit 58
com='combination of two regular weight distribution plates'
array 30 3*0.0
unit 59
com='combination of regular and special weight distribution plates'
array 31 3*0.0
unit 60
com='north core solution driver'
cuboid 8 1 2p7.5 2p14.9 1.863 -7.5
cuboid 0 1 2p7.5 2p14.9 2p7.5
cuboid 9 1 2p7.65 2p15.05 2p7.65
cuboid 0 1 2p7.665 2p15.33 2p7.665
unit 61
com='south core solution driver'
cuboid 8 1 2p7.5 2p14.9 1.794 -7.5
cuboid 0 1 2p7.5 2p14.9 2p7.5
cuboid 9 1 2p7.65 2p15.05 2p7.65
cuboid 0 1 2p7.665 2p15.33 2p7.665
end geometry
read array
ara=1 nux=2 nuy=4 nuz=9
com='north split table core'
fill 2r7 2r56 4r7

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```

2r35 2r58 4r35
2r7 2r56 4r7
2r35 2r58 4r35
2r7 56 60 4r7
2r35 2r58 4r35
2r7 2r56 4r7
2r35 2r58 4r35
2r7 2r56 4r7
end fill
ara=2 nux=3 nuy=4 nuz=9
com='south split table core'
fill 3r7 3r56 6r7
3r35 3r58 6r35
3r7 3r56 6r7
3r35 3r58 6r35
3r7 61 56 56 6r7
3r35 3r58 6r35
3r7 57 56 56 6r7
3r35 59 58 58 6r35
3r7 57 56 56 6r7
end fill
ara=3 nux=1 nuy=1 nuz=3
com='north bottom reflector'
fill 14 11 13 end fill
ara=4 nux=1 nuy=1 nuz=7
com='south bottom reflector'
fill 18 16 17 16 16 17 17 end fill
ara=5 nux=1 nuy=1 nuz=1
com='east and west walls of north reflector'
fill 20 end fill
ara=6 nux=1 nuy=1 nuz=1
com='east and west walls of south reflector'
fill 22 end fill
ara=7 nux=1 nuy=1 nuz=1
com='array for north top reflector'
fill 24 end fill
ara=8 nux=1 nuy=1 nuz=1
com='array for south top reflector'
fill 26 end fill
ara=9 nux=3 nuy=1 nuz=1
com='array for north end reflector'
fill 28 29 30 end fill
ara=10 nux=1 nuy=1 nuz=1
com='array for south end reflector'
fill 32 end fill
ara=13 nux=1 nuy=1 nuz=2
com='combination of north core with bottom reflector'
fill 15 9 end fill
ara=14 nux=1 nuy=3 nuz=1
com='north core with side reflectors'
fill 21 38 21 end fill
ara=15 nux=2 nuy=1 nuz=1
com='north core with end reflector'
fill 31 39 end fill
ara=16 nux=1 nuy=1 nuz=2
com='north core with top reflector'
fill 40 25 end fill
ara=20 nux=1 nuy=1 nuz=2
com='south core with bottom reflector'
fill 19 10 end fill
ara=21 nux=1 nuy=3 nuz=1
com='south core with east west reflectors'
fill 23 48 23 end fill

```

```

ara=22 nux=2 nuy=1 nuz=1
com='south core with end reflector'
fill 49 33 end fill
ara=23 nux=1 nuy=1 nuz=2
com='combination of core with top reflector'
fill 50 27 end fill
ara=25 nux=3 nuy=1 nuz=1
com='total'
fill 42 54 52 end fill
ara=26 nux=3 nuy=1 nuz=1
com='assembly of fuel box front and rear'
fill 2 1 3 end fill
ara=27 nux=1 nuy=1 nuz=3
com='assembly of fuel box top and bottom'
fill 5 4 5 end fill
ara=28 nux=1 nuy=2 nuz=1
com='combination of two fuel boxes'
fill 7 7 end fill
ara=29 nux=1 nuy=2 nuz=1
com='combination of special and regular fuel boxes'
fill 7 6 end fill
ara=30 nux=1 nuy=2 nuz=1
com='combination of two weight distribution plates'
fill 35 35 end fill
ara=31 nux=1 nuy=2 nuz=1
com='combination of special and regular weight distribution plates'
fill 35 34 end fill
end array
read plot ttl='yz slice of south core first row'
xul=64.319 yul=40.000 zul=72.000
xlr=64.319 ylr=72.000 zlr=56.000
vax=1 wdn=-1 nax=130 nch='012345678' end
ttl='xz slice of sphere cuboid'
xul=56.0 yul=63.625 zul=71.735
xlr=72.0 ylr=63.625 zlr=55.735
uax=1 wdn=-1 nax=130 nch='012345678'
end plot
' read start nst=1 xsm=41.37 xsp=72.894 ysm=40.63 ysp=71.29
' zsm=56.071 zsp=71.4 end start
read start nst=1 end start
end data
end

=csas25
rocky flats criticals nureg/cr-2500 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=2.03, hi enriched sphere driven
238groupndf5 infhommedium
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 2.6356e-1 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-al1100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end

```

```

arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
  1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
  15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
  3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
  1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 0.7 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
arbm-al1100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 7 2.715 end
uranium 8 0.9483 293.0 92234 1.0 92235 93.19 92236 0.4 92238 5.41 end
arbm-pj 0.816 2 0 0 0 1001 85.1 6012 14.9 8 0.0089 end
ss304 9 1.0 end
end comp
rocky flats criticals nureg/cr-2500 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=2.03, hi enriched sphere driven
read parm npg=2000 nub=yes fdn=yes plt=no end parm
read geom
unit 1
com='fuel box with void and part of al box'
cuboid 0 1 9.80 0.0 3.75 0.0 14.98 0.0
cuboid 2 1 9.95 0.0 3.90 -0.15 14.98 0.0
cuboid 1 1 14.98 0.0 9.365 -5.615 14.98 0.0
unit 2
com='front of fuel box'
cuboid 2 1 0.15 0.0 5.615 0.0 14.98 0.0
cuboid 0 1 0.15 0.0 9.365 0.0 14.98 0.0
cuboid 2 1 0.15 0.0 14.98 0.0 14.98 0.0
unit 3
com='rear of fuel box'
cuboid 2 1 0.15 0.0 14.98 0.0 14.98 0.0
unit 4
com='array to assemble part of box'
array 26 3*0
unit 5
com='top and bottom of box'
cuboid 0 1 9.80 0.0 3.750 0.0 0.15 0.0
cuboid 2 1 15.28 0.0 9.365 -5.615 0.15 0.0
global
unit 6
com='array to assemble top and bottom'
array 27 3*0
cuboid 2 1 15.28 0.0 15.13 -0.15 15.28 0.0
cuboid 0 1 15.305 -0.025 15.155 -0.175 15.305 -0.025
unit 7
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 1 1 6p7.49
cuboid 2 1 6p7.64
cuboid 0 1 6p7.6650
unit 8
com='box for driver'
cylinder 9 1 0.3175 2p2.318
sphere 0 1 2.34
sphere 8 1 5.67
hole 36 0.0 0.0 2.3401
hole 100 0.0 0.0 -2.3401
cuboid 0 1 8.71 -6.62 2p7.665 7.365 -7.965
hole 37 0.0 0.0 -7.965
unit 34
com='aluminum weight distribution plate for special box'
cuboid 0 1 9.80 0.0 3.750 0.0 0.16 0.0

```

```

cuboid 7 1 15.33 0.0 9.54 -5.79 0.16 0.0
unit 35
com='aluminum weight distribution plate for boxes'
cuboid 7 1 4p7.665 0.16 0.0
unit 36
com='driver support'
cylinder 9 1 0.3175 3.32 0.0
unit 100
com='driver support'
cylinder 9 1 0.3175 0.0 -3.32
unit 37
com='driver mount'
cylinder 9 1 1.56 2.2 0.0
unit 9
com='north split table core'
array 1 3*0.0
cuboid 0 1 30.66 -0.94 77.5 0.0 83.475 0.0
unit 10
com='south split table core'
array 2 3*0.0
cuboid 0 1 49.4 0.0 77.5 0.0 83.475 0.0
unit 11
com='plexiglass reflector sheet without tris, north bottom reflector'
cuboid 4 1 2p15.8000 2p38.7500 2p0.6150
unit 12
com='plexiglass reflector sheet with tris, north bottom reflector'
cuboid 5 1 2p15.8000 2p38.7500 2p0.6150
unit 13
com='upper portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p8.24
unit 14
com='lower portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p3.69
unit 15
com='north bottom reflector includes regular and tris'
array 3 3*0.0
unit 16
com='plexiglas sheet bottom south reflector without tris'
cuboid 0 1 2p5.1 2p2.5 2p0.6150
cuboid 4 1 44.3 -5.1 2p38.75 2p0.615
unit 17
com='plexiglas sheet bottom south reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p0.6150
cuboid 5 1 44.3 -5.1 2p38.75 2p0.6150
unit 18
com='lower portion south bottom reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p8.855
cuboid 5 1 44.3 -5.1 2p38.75 2p8.855
unit 19
com='south bottom reflector with regular and tris'
array 4 3*0.0
unit 20
com='east and west reflectors for north reflector with tris'
cuboid 5 1 2p15.8 2p12.65 2p54.2825
unit 21
com='array for east and west reflectors for north reflector'
array 5 3*0.0
unit 22
com='east and west reflectors for south reflector with tris'
cuboid 5 1 2p24.700 2p12.65 2p54.2825
unit 23
com='array for east and west reflectors for south reflector'
array 6 3*0.0

```

```

unit 24
com='north top reflector with tris'
cuboid 5 1 2p28.35 2p64.05 2p12.15
unit 25
com='array for north top reflector'
array 7 3*0.0
unit 26
com='south top reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p12.15
cuboid 5 1 69.4 -5.1 2p64.05 2p12.15
unit 27
com='array for south top reflector'
array 8 3*0.0
unit 28
com='north end reflector 9.8cm portion without tris'
cuboid 4 1 2p4.9000 2p64.0500 2p54.2825
unit 29
com='north end reflector 5.2 cm portion with tris'
cuboid 5 1 2p2.6 2p64.0500 2p54.2825
unit 30
com='north end reflector 10.1 cm portion without tris'
cuboid 4 1 2p5.05 2p64.05 2p54.2825
unit 31
com='array for north end reflector'
array 9 3*0.0
unit 32
com='south end reflector'
cuboid 5 1 2p12.55 2p64.05 2p54.2825
unit 33
com='array for south end reflector'
array 10 3*0.0
unit 38
com='north core with bottom reflector'
array 13 3* 0.0
unit 39
com='north core with east and west reflector'
array 14 3*0.0
unit 40
com='north core with end reflector'
array 15 3*0.0
unit 42
com='north core with top reflector'
array 16 3*0.0
unit 48
com='south core with bottom reflectors'
array 20 3*0.0
unit 49
com='south core with east west reflectors'
array 21 3*0.0
unit 50
com='south core end reflector'
array 22 3*0.0
unit 52
com='south core with top reflector'
array 23 3*0.0
unit 54
com='air gap'
cuboid 0 1 1.49 0.0 64.475 -63.625 69.13 -63.735
global
unit 55
com='total'
array 25 3*0.0
end geometry

```

```

read array
ara=1 nux=2 nuy=5 nuz=9
com='north split table core'
fill 10r7
  10r35
  10r7
  10r35
  10r7
  10r35
  10r7
  10r35
  10r7   end fill
ara=2 nux=3 nuy=5 nuz=9
com='south split table core'
fill 6r7 6 8r7
  6r35 34 8r35
  6r7 6 8r7
  6r35 34 8r35
  6r7 8 8r7
  6r35 34 8r35
  6r7 6 8r7
  6r35 34 8r35
  6r7 6 8r7   end fill
ara=3 nux=1 nuy=1 nuz=3
com='north bottom reflector'
fill 14 11 13 end fill
ara=4 nux=1 nuy=1 nuz=7
com='south bottom reflector'
fill 18 16 17 16 16 17 17 end fill
ara=5 nux=1 nuy=1 nuz=1
com='east and west walls of north reflector'
fill 20 end fill
ara=6 nux=1 nuy=1 nuz=1
com='east and west walls of south reflector'
fill 22 end fill
ara=7 nux=1 nuy=1 nuz=1
com='array for north top reflector'
fill 24 end fill
ara=8 nux=1 nuy=1 nuz=1
com='array for south top reflector'
fill 26 end fill
ara=9 nux=3 nuy=1 nuz=1
com='array for north end reflector'
fill 28 29 30 end fill
ara=10 nux=1 nuy=1 nuz=1
com='array for south end reflector'
fill 32 end fill
ara=13 nux=1 nuy=1 nuz=2
com='combination of north core with bottom reflector'
fill 15 9 end fill
ara=14 nux=1 nuy=3 nuz=1
com='north core with side reflectors'
fill 21 38 21 end fill
ara=15 nux=2 nuy=1 nuz=1
com='north core with end reflector'
fill 31 39 end fill
ara=16 nux=1 nuy=1 nuz=2
com='north core with top reflector'
fill 40 25 end fill
ara=20 nux=1 nuy=1 nuz=2
com='south core with bottom reflector'
fill 19 10 end fill
ara=21 nux=1 nuy=3 nuz=1

```

```

com='south core with east west reflectors'
fill 23 48 23 end fill
ara=22 nux=2 nuy=1 nuz=1
com='south core with end reflector'
fill 49 33 end fill
ara=23 nux=1 nuy=1 nuz=2
com='combination of core with top reflector'
fill 50 27 end fill
ara=25 nux=3 nuy=1 nuz=1
com='total'
fill 42 54 52 end fill
ara=26 nux=3 nuy=1 nuz=1
com='assembly of fuel box front and rear'
fill 2 1 3 end fill
ara=27 nux=1 nuy=1 nuz=3
com='assembly of fuel box top and bottom'
fill 5 4 5 end fill
end array
read plot ttl='yz slice of south core first row'
xul=64.319 yul=55.625 zul=71.735
xlr=64.319 ylr=71.625 zlr=55.735
vax=1 wdn=-1 nax=130 nch='012345678'end
ttl='xz slice of sphere cuboid'
xul=56.0 yul=63.625 zul=71.735
xlr=72.0 ylr=63.625 zlr=55.735
uax=1 wdn=-1 nax=130 nch='012345678'
end plot
' read start nst=6 tfx=65 tfy=63.625 tfz=63.735 lnu=300 end start
read start nst=1 xsm=56.981 xsp=71.649 ysm=56.219 ysp=70.959
zsm=56.401 zsp=71.069 end start
end data
end

=csas25
british handbook of criticality safety u(1.42)f4 & paraffin (case 04)
238groupndf5 infhommedium
uf4 1 0.4903 293 92235 1.4023 92238 98.5977 end
' note: the enrichment given in the refrence is not weight percent
para(h2o) 1 0.4572 end
end comp
british handbook of criticality safety u(1.42)f4 & paraffin (case 04)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 2p46.55 2p46.50 2p61.9
end geom
end data
end

=csas25
british handbook of criticality safety u(1.42)f4 & paraffin (case 05)
238groupndf5 infhommedium
uf4 1 0.4903 293 92235 1.4023 92238 98.5977 end
' note: the enrichment given in the refrence is not weight percent
para(h2o) 1 0.4572 end
end comp
british handbook of criticality safety u(1.42)f4 & paraffin (case 05)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 2p50.00 2p49.95 2p51.55
end geom
end data

```

```

end

=csas25
british handbook of criticality safety u(1.42)f4 & paraffin (case 06)
238groupndf5 infhommedium
uf4      1 0.4903 293 92235 1.4023 92238 98.5977 end
' note: the enrichment given in the refrence is not weight percent
para(h2o) 1 0.4572 end
end comp
british handbook of criticality safety u(1.42)f4 & paraffin (case 06)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 2p65.35 2p65.3 2p37.1
end geom
end data
end
=csas25
british handbook of criticality safety u(1.42)f4 & paraffin (case 06)
hansen-roach infhommedium
uf4      1 0.4903 293 92235 1.4023 92238 98.5977 end
' note: the enrichment given in the refrence is not weight percent
para(h2o) 1 0.4572 end
end comp
british handbook of criticality safety u(1.42)f4 & paraffin (case 06)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 2p65.35 2p65.3 2p37.1
end geom
end data
end

=csas25
raffety and milhalczko u(2)f4-1 reflected (case 11)
238groupndf5 infhommedium
u-235 1 0 1.5811e-4 end
u-238 1 0 7.6467e-3 end
h      1 0 3.0864e-2 end
c      1 0 1.4839e-2 end
f      1 0 3.1219e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al      3 0.062 end
end comp
raffety and malhalczko u(2)f4-1 reflected (case 11)
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 1 1 4p28.110 2p56.44
replicate 2 2 5*3.048 0.0 5
unit 2
cuboid 3 1 4p28.110 2p0.0001
replicate 3 2 4*3.048 0.0 3.048 5
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
read bias id=400 2 6 end bias
end data
end

```

```

=csas25
raffety and milhalcz u(2)f4-1 reflected (case 11)
hansen-roach infhommedium
u-235 1 0 1.5811e-4 end
u-238 1 0 7.6467e-3 end
h 1 0 3.0864e-2 end
c 1 0 1.4839e-2 end
f 1 0 3.1219e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
raffety and malhalcz u(2)f4-1 reflected (case 11)
read parm run=yes plt=no npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 1 1 4p28.110 2p56.44
replicate 2 2 5*3.048 0.0 5
unit 2
cuboid 3 1 4p28.110 2*0.0001
replicate 3 2 4*3.048 0.0 3.048 5
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
read bias id=400 2 6 end bias
read plot ttl='xz slice of case 11 showing biasing regions'
xul=-1 yul=20 zul=146
xlr=88 ylr=20 zlr=-3
uax=1 wdn=-1 nax=130 nch='0123456'
pic=wts
end plot
end data
end

=csas25
raffety and milhalcz u(2)f4-1 unreflected (case 12)
238groupndf5 infhommedium
u-235 1 0 1.5811e-4 end
u-238 1 0 7.6467e-3 end
h 1 0 3.0864e-2 end
c 1 0 1.4839e-2 end
f 1 0 3.1219e-2 end
end comp
raffety and malhalcz u(2)f4-1 unreflected (case12)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 35.735 -35.735 35.735 -35.735 47.07 -47.07
end geom
end data
end
=csas25
raffety and milhalcz u(2)f4-1 unreflected (case 12)
hansen-roach infhommedium
u-235 1 0 1.5811e-4 end
u-238 1 0 7.6467e-3 end
h 1 0 3.0864e-2 end
c 1 0 1.4839e-2 end
f 1 0 3.1219e-2 end
end comp
raffety and malhalcz u(2)f4-1 unreflected (case12)

```

```

read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 35.735 -35.735 35.735 -35.735 47.07 -47.07
end geom
end data
end

=csas25
raffety and milhalcz u(2)f4-2 unreflected (case 14)
238groupndf5 infhommedium
u-235 1 0 1.3303e-4 end
u-238 1 0 6.4370e-3 end
h 1 0 3.9097e-2 end
c 1 0 1.8797e-2 end
f 1 0 2.6280e-2 end
end comp
raffety and malhalcz u(2)f4-2 unreflected (case 14)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 28.11 -28.11 28.11 -28.11 61.235 -61.235
end geom
end data
end
=csas25
raffety and milhalcz u(2)f4-2 unreflected (case 14)
hansen-roach infhommedium
u-235 1 0 1.3303e-4 end
u-238 1 0 6.4370e-3 end
h 1 0 3.9097e-2 end
c 1 0 1.8797e-2 end
f 1 0 2.6280e-2 end
end comp
raffety and malhalcz u(2)f4-2 unreflected (case 14)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 28.11 -28.11 28.11 -28.11 61.235 -61.235
end geom
end data
end

=csas25
raffety and malhalcz u(2)f4-3 reflected (case 15)
238groupndf5 infhommedium
u-235 1 0 1.1191e-4 end
u-238 1 0 5.4152e-3 end
h 1 0 4.5472e-2 end
c 1 0 2.1861e-2 end
f 1 0 2.2109e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
raffety and malhalcz u(2)f4-3 reflected (case 15)
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 1 1 4p26.835 2p27.145
replicate 2 2 5*3.048 0.0 5
unit 2
cuboid 3 1 4p26.835 2p0.0001
replicate 3 2 4*3.048 0.0 3.048 5

```

```

end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
read bias id=400 2 6 end bias
end data
end

=csas25
raffety and milhalcz u(2)f4-4 reflected (case 16)
238groupndf5 infhommedium
u-235 1 0 0.9924e-4 end
u-238 1 0 4.7998e-3 end
h 1 0 4.9212e-2 end
c 1 0 2.3660e-2 end
f 1 0 1.9596e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
raffety and malhalcz u(2)f4-4 reflected (case 16)
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 1 1 4p23.000 2p48.285
replicate 2 2 5*3.048 0.0 5
unit 2
cuboid 3 1 4p23.000 2p0.0001
replicate 3 2 4*3.048 0.0 3.048 5
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
read bias id=400 2 6 end bias
end data
end

=csas25
raffety and milhalcz u(2)f4-6 reflected (case 19)
238groupndf5 infhommedium
u-235 1 0 0.6232e-4 end
u-238 1 0 3.0100e-3 end
h 1 0 6.0557e-2 end
c 1 0 2.9114e-2 end
f 1 0 1.2309e-2 end
poly(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
raffety and malhalcz u(2)f4-6 reflected (case 19)
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 1 1 2p38.255 2p38.220 2p41.210
replicate 2 2 5*3.048 0.0 5
unit 2
cuboid 3 1 2p38.255 2p38.220 2p0.0001
replicate 3 2 4*3.048 0.0 3.048 5
end geom

```

```

read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
read bias id=400 2 6 end bias
end data
end
=csas25
raffety and milhalcz u(2)f4-6 reflected (case 19)
hansen-roach infhommedium
u-235 1 0 0.6232e-4 end
u-238 1 0 3.0100e-3 end
h 1 0 6.0557e-2 end
c 1 0 2.9114e-2 end
f 1 0 1.2309e-2 end
poly(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
raffety and malhalcz u(2)f4-6 reflected (case 19)
read parm run=yes plt=no npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 1 1 2p38.255 2p38.220 2p41.210
replicate 2 2 5*3.048 0.0 5
unit 2
cuboid 3 1 2p38.255 2p38.220 2*0.0
replicate 3 2 4*3.048 0.0 3.048 5
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
read bias id=400 2 6 end bias
read plot ttl='xz slice of case 19 showing biasing regions'
xul=-1 yul=20 zul=115
xlr=108 ylr=20 zlr=-3
uax=1 wdn=-1 nax=130 nch='0123456'
pic=wts
end plot
end data
end

=csas25
raffety and milhalcz u(2)f4-6 unreflected (case 20)
238groupndf5 infhommedium
u-235 1 0 0.6232e-4 end
u-238 1 0 3.0100e-3 end
h 1 0 6.0557e-2 end
c 1 0 2.9114e-2 end
f 1 0 1.2309e-2 end
end comp
raffety and malhalcz u(2)f4-6 unreflected (case20)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 40.725 -40.725 43.35 -43.35 44.110 -44.110
end geom
end data
end

```

```

=csas25
raffety and milhalcz u(2)f4-6 unreflected (case 20)
hansen-roach infhommedium
u-235 1 0 0.6232e-4 end
u-238 1 0 3.0100e-3 end
h 1 0 6.0557e-2 end
c 1 0 2.9114e-2 end
f 1 0 1.2309e-2 end
end comp
raffety and malhalcz u(2)f4-6 unreflected (case20)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 40.725 -40.725 43.35 -43.35 44.110 -44.110
end geom
end data
end

=csas25
raffety and milhalcz u(3)f4-1 reflected (case 22)
238groupndf5 infhommedium
u-235 1 0 2.3494e-4 end
u-238 1 0 7.4999e-3 end
h 1 0 3.1341e-2 end
c 1 0 1.5067e-2 end
f 1 0 3.0939e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
raffety and malhalcz u(3)f4-1 reflected (case 22)
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 1 1 2p21.735 2p21.735 2p43.1950
replicate 2 2 5*3.048 0.0 5
unit 2
cuboid 3 1 2p21.735 2p21.735 2p0.0001
replicate 3 2 4*3.048 0.0 3.048 5
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
read bias id=400 2 6 end bias
end data
end
=csas25
raffety and milhalcz u(3)f4-1 reflected (case 22)
hansen-roach infhommedium
u-235 1 0 2.3494e-4 end
u-238 1 0 7.4999e-3 end
h 1 0 3.1341e-2 end
c 1 0 1.5067e-2 end
f 1 0 3.0939e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
raffety and malhalcz u(3)f4-1 reflected (case 22)
read parm run=yes plt=no npg=2000 nub=yes fdn=yes end parm
read geom

```

```

unit 1
cuboid 1 1 2p21.735 2p21.735 2p43.1950
replicate 2 2 5*3.048 0.0 5
unit 2
cuboid 3 1 2p21.735 2p21.735 2p0.00001
replicate 3 2 4*3.048 0.0 3.048 5
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
read bias id=400 2 6 end bias
read plot ttl='xz slice of case 22 showing biasing regions'
xul=-1 yul=20 zul=129
xlr=79 ylr=20 zlr=-3
uax=1 wdn=-1 nax=130 nch='0123456'
pic=wts
end plot
end data
end

=csas25
raffety and milhalcz u(3)f4-1 reflected (case 24) no biasing
238groupndf5 infhommedium
u-235 1 0 2.3494e-4 end
u-238 1 0 7.4999e-3 end
h 1 0 3.1341e-2 end
c 1 0 1.5067e-2 end
f 1 0 3.0939e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
raffety and malhalcz u(3)f4-1 reflected (case 24) no biasing
read parm run=yes npg=2000 nub=yes fdn=yes rnd=6361624605E end parm
read geom
unit 1
cuboid 1 1 2p28.125 2p28.125 2p21.705
replicate 2 2 5*3.048 0.0 5
unit 2
cuboid 3 1 2p28.125 2p28.125 2p0.0001
replicate 3 2 4*3.048 0.0 3.048 5
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
' read bias id=400 2 6 end bias
end data
end
=csas25
raffety and milhalcz u(3)f4-1 reflected (case 24) no biasing
hansen-roach infhommedium
u-235 1 0 2.3494e-4 end
u-238 1 0 7.4999e-3 end
h 1 0 3.1341e-2 end
c 1 0 1.5067e-2 end
f 1 0 3.0939e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp

```

```

raffety and malhalczo u(3)f4-1 reflected (case 24) no biasing
read parm run=yes plt=no npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 1 1 2p28.125 2p28.125 2p21.705
replicate 2 2 5*3.048 0.0 5
unit 2
cuboid 3 1 2p28.125 2p28.125 2*0.0
replicate 3 2 4*3.048 0.0 3.048 5
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
' read bias id=400 2 6 end bias
read plot ttl='xz slice of case 24 showing biasing regions'
xul=-1 yul=20 zul=75
xlr=88 ylr=20 zlr=-3
uax=1 wdn=-1 nax=130 nch='0123456'
pic=wts
end plot
end data
end

=csas25
raffety and milhalczo u(3)f4-1 unreflected (case 26)
238groupndf5 infhommedium
u-235 1 0 2.3494e-4 end
u-238 1 0 7.4999e-3 end
h 1 0 3.1341e-2 end
c 1 0 1.5067e-2 end
f 1 0 3.0939e-2 end
end comp
raffety and malhalczo u(3)f4-1 unreflected (case 26)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 28.235 -28.235 28.235 -28.235 43.32 -43.32
end geom
end data
end
=csas25
raffety and milhalczo u(3)f4-1 unreflected (case 26)
hansen-roach infhommedium
u-235 1 0 2.3494e-4 end
u-238 1 0 7.4999e-3 end
h 1 0 3.1341e-2 end
c 1 0 1.5067e-2 end
f 1 0 3.0939e-2 end
end comp
raffety and malhalczo u(3)f4-1 unreflected (case 26)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 28.235 -28.235 28.235 -28.235 43.32 -43.32
end geom
end data
end

=csas25
raffety and milhalczo u(3)f4-1 unreflected (case 28)
238groupndf5 infhommedium
u-235 1 0 2.3494e-4 end

```

```

u-238 1 0 7.4999e-3 end
h      1 0 3.1341e-2 end
c      1 0 1.5067e-2 end
f      1 0 3.0939e-2 end
end comp
raffety and malhalcz u(3)f4-1 unreflected (case 28)
read parm npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 30.7 -30.7 30.7 -30.7 33.00 -33.00
end geom
end data
end

=csas25
raffety and milhalcz u(3)f4-2 unreflected (case 30)
238groupndf5 infhommedium
u-235 1 0 1.6709e-4 end
u-238 1 0 5.3355e-3 end
h      1 0 4.6262e-2 end
c      1 0 2.2241e-2 end
f      1 0 2.2011e-2 end
end comp
raffety and malhalcz u(3)f4-2 unreflected (case 30)
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 2p20.450 2p20.465 2p58.400
end geom
end data
end

=csas25
raffety and milhalcz u(3)f4-2 unreflected (case 30)
hansen-roach infhommedium
u-235 1 0 1.6709e-4 end
u-238 1 0 5.3355e-3 end
h      1 0 4.6262e-2 end
c      1 0 2.2241e-2 end
f      1 0 2.2011e-2 end
end comp
raffety and malhalcz u(3)f4-2 unreflected (case 30)
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
cuboid 1 1 2p20.450 2p20.465 2p58.400
end geom
end data
end

=csas25
critical reflected cylinder of aqueous u(4.98)o2f2 (case 33)
238groupndf5 infhommedium
solnuo2f2 1 910.36 0.0 1 298 92235 4.98 92238 95.02 end
ss304 2 1.0 end
h2o 3 1.0 end
cd 4 1.0 end
end comp
critical reflected cylinder of aqueous u(4.98)o2f2 (case 33)
read parm run=yes npg=2000 nub=yes fdn=yes rnd=6361624605e end parm
read geom
unit 1
cylinder 1 1 19.545 2p27.225
cylinder 0 1 19.545 78.975 -27.225
cylinder 2 1 19.624 79.054 -27.304

```

```

cylinder 4 1 19.705 79.054 -27.304
cylinder 2 1 22.245 79.054 -27.304
cylinder 3 1 45.000 79.054 -27.304
cuboid    0 1 4p45.000 79.054 -27.304
end geom
read plot ttl='xz slice of cylinder case 33'
xul=-45 yul=0.0 zul=81
xlr=45 ylr=0.0 zlr=-29
uax=1 wdn=-1 nax=130 nch='01234'end
ttl='enlargement of lower right hand corner of cylinder'
xul=18 yul=0.0 zul=-25
xlr=23 ylr=0.0 zlr=-28
uax=1 wdn=-1 nax=130 nch='01234'
end plot
end data
end

=csas25
critical cylinder of aqueous u(4.98)o2f2 (case 36)
238groupndf5 infhommedium
solnuo2f2 1 910.36 0.0 1 298 92235 4.98 92238 95.02 end
ss304 2 1.0 end
end comp
critical cylinder of aqueous u(4.98)o2f2 (case 36)
read parm run=yes npg=2000 nub=yes fdm=yes end parm
read geom
unit 1
cylinder 1 1 19.5500 2p50.85
cylinder 0 1 19.5500 74.16 -50.85
cylinder 2 1 19.6287 74.16 -50.9287
cuboid    0 1 4p19.6287 74.16 -50.9287
end geom
read plot ttl='xz slice of cylinder case 36'
xul=-21 yul=0.0 zul=76
xlr=21 ylr=0.0 zlr=-52
uax=1 wdn=-1 nax=130 nch='012'end
ttl='enlargement of lower right corner of cylinder'
xul=18 yul=0.0 zul=-49
xlr=21 ylr=0.0 zlr=-52
uax=1 wdn=-1 nax=130 nch='012'
end plot
end data
end

```

Table A.4. Table 4 input data

```
=csas25
uo2f2 soln h/u-235=1112 bare sphere case 1
238groupndf5 multiregion
u-234 1 0 7.360-7 end
u-235 1 0 5.990-5 end
u-238 1 0 3.592-6 end
h 1 0 6.661-2 end
o 1 0 3.343-2 end
f 1 0 1.285-4 end
al 2 1 end
end comp
spherical end
1 27.9 noextermod 2 28.10 noextermod end zone
uo2f2 soln h/u-235=1112 bare sphere case 1
read param npg=2000 nub=yes fdn=yes end param
read geom
sphere 1 1 27.9
sphere 2 1 28.1
end geom
end data
end

=csas25
uo2f2 soln h/u-235=76.1 h2o refl sphere case 4
238groupndf5 multiregion
u-234 1 0 8.795-6 end
u-235 1 0 8.327-4 end
u-236 1 0 4.449-6 end
u-238 1 0 4.729-5 end
h 1 0 6.337-2 end
o 1 0 3.347-2 end
f 1 0 1.786-3 end
al 2 1 end
h2o 3 1 end
end comp
spherical end
1 11.5 oneextermod 2 11.66 noextermod 3 29.66 noextermod end zone
uo2f2 soln h/u-235=76.1 h2o refl sphere case 4
read param npg=2000 nub=yes fdn=yes end param
read geom
sphere 1 1 11.5
sphere 2 1 11.66
reflector 3 2 3 6
end geom
read bias id=500 2 7 end bias
end data
end

=csas25
uo2f2 soln h/u-235=268.8 h2o refl sphere case 7
238groupndf5 multiregion
u-235 1 0 2.438-4 300 end
u-238 1 0 1.756-5 300 end
h 1 0 6.553-2 300 end
o 1 0 3.329-2 300 end
f 1 0 5.227-4 300 end
al 2 1 300 end
```

```

h2o      3 1 300 end
end comp
spherical end
1 13.2 oneextermod 2 13.33 noextermod 3 31.33 noextermod end zone
uo2f2 soln h/u-235=268.8 h2o refl sphere case 7
read param npg=2000 nub=yes fdn=yes end param
read geom
sphere 1 1 13.2
sphere 2 1 13.33
reflector 3 2 3 6
end geom
read bias id=500 2 7 end bias
end data
end

=csas25
uo2f2 soln h/u-235=239.3 h2o refl sphere case 10
238groupndf5 multiregion
u-235 1 0 2.735-4 359 end
u-238 1 0 1.970-5 359 end
h     1 0 6.545-2 359 end
o     1 0 3.331-2 359 end
f     1 0 5.864-4 359 end
al    2 1 359 end
h2o   3 1 359 end
end comp
spherical end
1 13.2 oneextermod 2 13.33 noextermod 3 31.33 noextermod end zone
uo2f2 soln h/u-235=239.3 h2o refl sphere case 10
read param npg=2000 nub=yes fdn=yes end param
read geom
sphere 1 1 13.2
sphere 2 1 13.33
reflector 3 2 3 6
end geom
read bias id=500 2 7 end bias
end data
end

=csas25
rocky flats uo2(no3)2 soln 357.71 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 357.71 0.549 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al    2 1 end
end comp
cylindrical end
1 14 noextermod 2 14.3 noextermod end zone
rocky flats uo2(no3)2 soln 28.01 cm d1am bare 2
read param npg=5000 nub=yes fdn=yes end param
read geom
cylinder 1 1 14.005 30.91 0
cylinder 2 1 14.325 30.91 -.32
end geom
end data
end

```

```

=csas25
rocky flats uo2(no3)2 soln 357.71 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 357.71 .549 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
end comp
cylindrical end
1 16.5 noextermod 2 16.8 noextermod end zone
rocky flats uo2(no3)2 soln 33.01 cm d1am bare 5
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 16.505 22.53 0
cylinder 2 1 16.825 22.53 -.32
end geom
end data
end

=csas25
rocky flats uo2(no3)2 soln 334.77 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 334.77 .521 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 14 noextermod 2 14.3 noextermod end zone
rocky flats uo2(no3)2 soln 28.01 cm d1am refl 2 conc refl
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 14.005 28.60 0
cylinder 2 1 14.325 28.60 -.32
cuboid 0 1 64.6 -57.2 57.4 -64.8 80.8 -41.1
reflector 3 2 4r5.14 2r0 5
reflector 0 1 4r0 2r0.9 1
reflector 3 2 4r0 2r5.14 5
end geom
read bias id=301 2 6 end bias
end data
end

=csas25
rocky flats uo2(no3)2 soln 334.77 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 334.77 .521 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 16.5 noextermod 2 16.8 noextermod end zone
rocky flats uo2(no3)2 soln 33.01 cm d1am refl 6 conc refl
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 16.505 16.78 0
cylinder 2 1 16.825 16.78 -.32
cuboid 0 1 104.55 -17.25 16.825 -105.375 121.58 -.32
reflector 3 2 4r5.14 2r0 5
reflector 0 1 4r0 2r0.9 1
reflector 3 2 4r0 2r5.14 5

```

```

end geom
read bias id=301 2 6 end bias
end data
end

=csas25
rocky flats uo2(no3)2 soln 147.66 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 147.66 .271 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
plexiglass 3 1 end
h 4 0 5.5169-2 end
c 4 0 3.3967-2 end
o 4 0 1.4231-2 end
p 4 0 3.8500-4 end
cl 4 0 3.5610-4 end
br-79 4 0 3.184-4 end
br-81 4 0 3.116-4 end
end comp
cylindrical end
1 16.5 noextermod 2 16.8 noextermod end zone
rocky flats uo2(no3)2 soln 33.01 cm diam refl 9 plexiglass refl
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 16.505 22.78 0
cylinder 2 1 16.825 22.78 -.32
cuboid 0 1 61.2 -61.7 60.4 -62.5 81.1 -41.8
reflector 3 2 4r2.971 2r0 7
reflector 4 2 5r0 2.971 7
reflector 4 2 4r0 2.886 0 7
end geom
read bias id=500 2 8 end bias
end data
end

=csas25
rocky flats uo2(no3)2 soln 345.33 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 345.33 .534 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
plexiglass 3 1 end
h 4 0 5.5169-2 end
c 4 0 3.3967-2 end
o 4 0 1.4231-2 end
p 4 0 3.8500-4 end
cl 4 0 3.5610-4 end
br-79 4 0 3.184-4 end
br-81 4 0 3.116-4 end
end comp
cylindrical end
1 16.5 noextermod 2 16.8 noextermod end zone
rocky flats uo2(no3)2 soln 33.01 cm diam refl 12 plexiglass refl
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 16.505 17.2 0
cylinder 2 1 16.825 17.2 -.32
cuboid 0 1 105.2 -17.7 17.3 -105.6 122.58 -.32
reflector 3 2 4r2.971 2r0 7
reflector 4 2 5r0 2.971 7

```

```

reflector 4 2 4r0 2.886 0 7
end geom
read bias id=500 2 8 end bias
end data
end

=csas25
rocky flats uo2(no3)2 soln 364.11 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 364.11 .584 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 10.5 noextermod 2 10.9 noextermod end zone
rocky flats uo2(no3)2 soln 21.12 cm dlam 4x4 array conc refl c2
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 10.56 17.13 0
cylinder 2 1 10.96 17.13 -.32
cuboid 0 1 4p15.24 121.58 -.32
core 0 1 2r-60.96 -.32
reflector 3 2 4r5.14 2r0 5
reflector 0 1 4r0 2r1.25 1
reflector 3 2 4r0 2r5.14 5
end geom
read array nux=4 nuy=4 nuz=1 end array
read bias id=301 2 6 end bias
end data
end

=csas25
rocky flats uo2(no3)2 soln 359.55 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 359.55 .578 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 8 noextermod 2 8.3 noextermod end zone
rocky flats uo2(no3)2 soln 16.12 cm dlam 4x4 array conc refl c4
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 8.06 31.82 0
cylinder 2 1 8.38 31.82 -.32
cuboid 0 1 4p15.24 121.58 -.32
core 0 1 2r-60.96 -.32
reflector 3 2 4r5.14 2r0 5
reflector 0 1 4r0 2r1.25 1
reflector 3 2 4r0 2r5.14 5
end geom
read array nux=4 nuy=4 nuz=1 end array
read bias id=301 2 6 end bias
end data
end

```

```

=csas25
rocky flats uo2(no3)2 soln 364.11 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 364.11 .584 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 10.5 noextermod 2 10.9 noextermod end zone
rocky flats uo2(no3)2 soln 21.12 cm d1am 2x2 array conc refl c6
read param npg=2000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 1 1 10.56 31.11 0
cylinder 2 1 10.96 31.11 -.32
cuboid 0 1 4p15.24 121.58 -.32
unit 2
cuboid 0 1 4p15.24 121.58 -.32
core 0 1 2r-60.96 -.32
reflector 3 2 4r5.14 2r0 5
reflector 0 1 4r0 2r1.25 1
reflector 3 2 4r0 2r5.14 5
end geom
read array nux=4 nuy=4 nuz=1
fill 5r2 2r1 2r2 2r1 5r2 end fill
end array
read bias id=301 2 6 end bias
end data
end

=csas25
rocky flats uo2(no3)2 soln 359.55 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 359.55 .578 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 8 noextermod 2 8.3 noextermod end zone
rocky flats uo2(no3)2 soln 16.12 cm d1am 2x4 array conc refl c8
read param npg=2000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 1 1 8.06 51.45 0
cylinder 2 1 8.38 51.45 -.32
cuboid 0 1 4p15.24 121.58 -.32
unit 2
cuboid 0 1 4p15.24 121.58 -.32
core 0 1 2r-60.96 -.32
reflector 3 2 4r5.14 2r0 5
reflector 0 1 4r0 2r1.25 1
reflector 3 2 4r0 2r5.14 5
end geom
read array nux=4 nuy=4 nuz=1
fill 2r1 2r2 3q4 end fill
end array
read bias id=301 2 6 end bias
end data
end

```

```

=csas25
rocky flats uo2(no3)2 soln 355.94 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 355.94 .494 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
plexiglass 3 1 end
h 4 0 5.5169-2 end
c 4 0 3.3967-2 end
o 4 0 1.4231-2 end
p 4 0 3.8500-4 end
cl 4 0 3.5610-4 end
br-79 4 0 3.184-4 end
br-81 4 0 3.116-4 end
end comp
cylindrical end
1 10.5 noextermod 2 10.9 noextermod end zone
rocky flats uo2(no3)2 soln 21.12 cm d1am 4x4 array plexiglass refl p2
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 10.56 18.82 0
cylinder 2 1 10.96 18.82 -.32
cuboid 0 1 4p15.24 122.58 -.32
core 0 1 2r-60.96 -.32
reflector 0 1 4r.49 2r0 1
reflector 3 2 4r2.971 2r0 7
reflector 4 2 5r0 2.971 7
reflector 4 2 4r0 2.886 0 7
end geom
read array nux=4 nuy=4 nuz=1
end array
read bias id=500 2 8 end bias
end data
end

```

```

=csas25
rocky flats uo2(no3)2 soln 355.94 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 355.94 .494 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
plexiglass 3 1 end
h 4 0 5.5169-2 end
c 4 0 3.3967-2 end
o 4 0 1.4231-2 end
p 4 0 3.8500-4 end
cl 4 0 3.5610-4 end
br-79 4 0 3.184-4 end
br-81 4 0 3.116-4 end
end comp
cylindrical end
1 8 noextermod 2 8.3 noextermod end zone
rocky flats uo2(no3)2 soln 16.12 cm d1am 4x4 array plexiglass refl p4
read param npg=2000 nub=yes fdn=yes end param
read geom
cylinder 1 1 8.06 35.56 0
cylinder 2 1 8.38 35.56 -.32
cuboid 0 1 4p15.24 122.58 -.32
core 0 1 2r-60.96 -.32
reflector 0 1 4r.49 2r0 1
reflector 3 2 4r2.971 2r0 7

```

```

reflector 4 2 5r0 2.971      7
reflector 4 2 4r0 2.886 0    7
end geom
read array nux=4 nuy=4 nuz=1
end array
read bias id=500 2 8 end bias
end data
end

=csas25
rocky flats uo2(no3)2 soln 355.94 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 355.94 .494 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al      2 1 end
plexiglass 3 1 end
h      4 0 5.5169-2 end
c      4 0 3.3967-2 end
o      4 0 1.4231-2 end
p      4 0 3.8500-4 end
cl     4 0 3.5610-4 end
br-79  4 0 3.184-4 end
br-81  4 0 3.116-4 end
end comp
cylindrical end
1 10.5 noextermod 2 10.9 noextermod end zone
rocky flats uo2(no3)2 soln 21.12 cm dlam 2x2 array plexiglass refl p6
read param npg=2000  nub=yes fdn=yes end param
read geom
unit 1
cylinder 1 1 10.56 33.20 0
cylinder 2 1 10.96 33.20 -.32
cuboid   0 1 4p15.24 122.58 -.32
unit 2
cuboid   0 1 4p15.24 122.58 -.32
core     0 1 2r-60.96 -.32
reflector 0 1 4r.49 2r0 1
reflector 3 2 4r2.971 2r0 7
reflector 4 2 5r0 2.971      7
reflector 4 2 4r0 2.886 0    7
end geom
read array nux=4 nuy=4 nuz=1
fill 5r2 2r1 2r2 2r1 5r2 end fill
end array
read bias id=500 2 8 end bias
end data
end

```

Table A.5. Table 5 input data

```
=csas25
keno-5 validation case a-1
238groupndf5 multiregion
uranium 1 .9837 293 92235 93.8 92238 6.2 end
end comp
spherical end
1 8.73136 noextermod end zone
keno-5 validation case a-1
read param      npg=2000 fdn=yes nub=yes end param
read geom
sphere    1 1 8.73136
end geom
end data
end

=csas25
keno-5 validation case a-3
238groupndf5 multiregion
solnuo2f2 1 19.992 0 1 293 92235 93.2 92238 6.8 end
al        2 end
end comp
spherical end
1 34.6 oneextermod 2 34.92 noextermod end zone
keno-5 validation case a-3
read param      npg=2000 fdn=yes nub=yes end param
read geom
sphere    1 1 34.6
sphere    2 1 34.92
cube      0 1 35.0 -35.0
end geom
end data
end

=csas25
keno-5 validation case a-5
238groupndf5 multiregion
uranium 1 .9848 283 92235 93.5 92238 6.5 end
h2o      2 end
end comp
spherical end
1 12.7 oneextermod 2 31. noextermod end zone
keno-5 validation case a-5
read param tme=60      npg=2000 fdn=yes nub=yes end param
read geom
hemisphere 2 1 12.7
hemisphere 1 1 15.24
cuboid     2 1 31.00 -31.00 31.00 -31.00 31.00 -16.
end geom
end data
end

=csas25
keno-5 validation case a-7
238groupndf5 multiregion
uranium 1 .9848 293 92235 94 92238 6 end
uranium 2 end
```

```

end comp
slab end
1 7.62 noextermod 2 52.02 noextermod end zone
keno-5 validation case a-7
read param      npg=2000 fdn=yes nub=yes end param
read geom
cuboid    1 1 3.81 -3.81 4.445 -4.445 7.62 -7.62
cuboid    2 1 26.01 -26.01 26.645 -26.645 29.82 -29.82
cube      0 1 30.0 -30.0
end geom
end data
end

=csas25
keno-5 validation case a-9
238groupndf5 multiregion
arbmoil   .88 3 0 0 6012 86.82 1001 13.16 16000 .02 1 end
uranium   2 .9528 293 92235 93.1 92238 6.9 end
arbmpjel   .024 2 0 0 6012 85 1001 15 2 end
carbonsteel 3 end
end comp
spherical end
2 8.2 oneextermod 1 40.5 noextermod end zone
keno-5 validation case a-9
read param
tme=60 npg=2000 fdn=yes nub=yes end param
read geom
hemisphere 3 1 6.012
hemisphere 2 1 10.488
sphere     1 1 40.488
cube       0 1 41.0 -41.0
end geom
end data
end

=csas25
keno-5 validation case a11
238groupndf5 multiregion
solnuo2(no3)2 1 346.73 .542 1 293 92235 93.172 92238 6.828 end
ss304 2 end
end comp
cylindrical end
1 13.96 oneextermod 2 14.28 oneextermod end zone
keno-5 validation case a11
read param      npg=2000 fdn=yes nub=yes end param
read geom
cylinder  1 1 13.96 14.465 -14.465
cylinder  0 1 13.96 27.135 -14.465
cylinder  2 1 14.28 27.135 -15.105
end geom
end data
end

=csas25
keno-5 validation case b-5
238groupndf5 multiregion
uranium  1 .9809 293 92235 93.2 92238 6.8 end
end comp
cylindrical end
1 4.56 noextermod end zone

```

```

keno-5 validation case b-5
read param      npg=2000 fdn=yes nub=yes end param
read geom
box type 1
cylinder 1 1 4.558 2.16 -2.16
cylinder 0 1 5.747 2.16 -2.16
cylinder 1 1 5.747 4.851 -4.851
cuboid    0 1 5.8554 -5.8554 5.8554 -5.8554 4.9771 -4.9771
end geom
read array nux=2 nuy=2 nuz=2 end array
end data
end

=csas25
keno-5 validation case b-9
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
keno-5 validation case b-9
read param      npg=2000 fdn=yes nub=yes end param
read geom
box type 1
cylinder 1 1 9.52 8.7804 -8.7804
cylinder 0 1 9.52 8.9896 -8.7804
cylinder 2 1 10.16 9.6296 -9.4204
cuboid    0 1 13.4 -13.4 13.4 -13.4 12.8696 -12.6604
end geom
read array nux=3 nuy=3 nuz=3 end array
end data
end

=csas25
keno-5 validation case b-10
238groupndf5 multiregion
solnuo2(no3)2 1 63.3 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
keno-5 validation case b-10
read param      npg=2000 fdn=yes nub=yes end param
read geom
box type 1
cylinder 1 1 9.52 8.7804 -8.7804
cylinder 0 1 9.52 8.9895 -8.7804
cylinder 2 1 10.16 9.6295 -9.4204
cuboid    0 1 11.282 -11.282 11.282 -11.282 10.7179 -11.7179
end geom
read array nux=3 nuy=3 nuz=3 end array
read start nst=1 end start
end data
end

=csas25
keno-5 validation case b-12
238groupndf5 multiregion
uranium 1 .9829 293 92235 93.2 92238 6.8 end

```

```

c      2 .8296 end
poly(h2o) 3 1 end
end comp
cylindrical end
1 5.747 oneextermod 2 10.92 noextermod end zone
keno-5 validation case b-12
read param tme=60    npg=2000 fdn=yes nub=yes end param
read geom
box type 1
cylinder 1 1 5.747 3.9699 -4.1071
cylinder 0 1 5.777 4.1071 -4.1071
cuboid   2 1 10.9195 -10.9195 10.9195 -10.9195 7.8755 -7.8755
cuboid   0 1 15.047 -15.047 15.047 -15.047 12.0035 -12.0035
core     0 1 -30.094 -30.094 -24.007
cuboid   3 1 45.344 -45.344 45.344 -45.344 39.247 -39.247
cube     0 1 46.0 -46.0
end geom
read array nux=2 nuy=2 nuz=2 end array
end data
end

=csas25
keno-5 validation case b-14
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
keno-5 validation case b-14
read param tme=60    npg=2000 fdn=yes nub=yes end param
read geom
cylinder 1 1 9.52 8.7804 -8.7804
cylinder 0 1 9.52 8.9896 -8.7804
cylinder 2 1 10.16 9.6296 -9.4204
cuboid   0 1 18.425 -18.425 18.425 -18.425 17.8946 -17.6854
core     0 1 -55.275 -55.275 -53.37
cuboid   3 1 70.515 -70.515 70.515 -70.515 68.61 -68.61
end geom
read array nux=3 nuy=3 nuz=3 end array
end data
end

=csas25
keno-5 validation case b-16
238groupndf5 multiregion
solnuo2(no3)2 1 450.8 .72 1 293 92235 93.1 92238 6.9 end
ss304      2 end
end comp
cylindrical end
1 8.128 noextermod 2 8.4074 noextermod end zone
keno-5 validation case b-16
read param    npg=2000 fdn=yes nub=yes end param
read geom
box type 1
x cylinder 1 1 8.128 68.3006 -68.3006
x cylinder 2 1 8.4074 68.58 -68.58
cuboid   0 1 68.58 -68.58 9.2075 -9.2075 14.999 -110.32
box type 2
y cylinder 1 1 8.128 68.3006 -68.3006

```

```

ycylinder 2 1 8.4074 68.58 -68.58
cuboid    0 1 9.2075 -9.2075 68.58 -68.58 14.999 -110.32
box type  3
xcylinder 1 1 8.128 68.3006 -68.3006
xcylinder 2 1 8.4074 68.58 -68.58
cuboid    0 1 68.58 -68.58 9.2075 -9.2075 125.09 -14.999
box type  4
ycylinder 1 1 8.128 68.3006 -68.3006
ycylinder 2 1 8.4074 68.58 -68.58
cuboid    0 1 9.2075 -9.2075 68.58 -68.58 125.09 -14.999
box type  5
cuboid    1 1 8.89 -8.89 8.89 -8.89 14.999 -110.00
cuboid    2 1 9.2075 -9.2075 9.2075 -9.2075 14.999 -110.32
box type  6
cuboid    1 1 8.89 -8.89 8.89 -8.89 125.09 -14.999
cuboid    2 1 9.2075 -9.2075 9.2075 -9.2075 125.09 -14.999
box type  7
cuboid    0 1 68.58 -68.58 68.58 -68.58 14.999 -110.32
box type  8
cuboid    0 1 68.58 -68.58 68.58 -68.58 125.09 -14.999
end geom
read array nux=3 nuy=3 nuz=2 loop
1 1 3 2 2 2 1 1 1 2 2 2 1 1 3 2 1 1 1 3 1 3 2 2 2 1 2 2 1
4 2 2 1 1 3 2 2 2 1 5 2 2 1 2 2 1 1 1 1 6 2 2 1 2 2 1 2 2 1
7 1 3 2 1 3 2 1 1 1 8 1 3 2 1 3 2 2 2 1
end loop end array
end data
end
member name cas20

```

```

=csas25
keno-5 validation case b-18
238groupndf5 multiregion
solnuo2(no3)2 1 364.11 .584 1 293 92235 93.172 92238 6.828 end
arbmal      2.737 9 0 0 1 12000 1 13027 97.35 14000 .6 22000 .03
24000 .17 25055 .07 26000 .47 29000 .25 14000 .06 2 end
arbmcconc   2.321 13 0 0 1 1001 .75 6012 5.55 7014 .01 8016 49.29
11023 .42 12000 1.48 13027 2.06 14000 15.7 16000 .17 19000 .75 20000 22.95
22000 .05 26000 .82 3 end
end comp
cylindrical end
1 10.56 noextermod 2 10.96 noextermod end zone
keno-5 validation case b-18
read param tme=60 npg=2000 fdn=yes nub=yes end param
read geom
box type 1
cylinder 1 1 10.56 8.565 -8.565
cylinder 0 1 10.56 110.535 -8.565
cylinder 2 1 10.96 110.535 -8.885
cuboid   0 1 15.25 -15.15 15.25 -15.25 115.515 -8.885
box type 2
cylinder 1 1 10.56 8.565 -8.565
cylinder 0 1 10.56 110.535 -8.565
cylinder 2 1 10.96 110.535 -8.885
cuboid   0 1 15.15 -15.25 15.25 -15.25 115.515 -8.885
box type 3
cylinder 1 1 10.56 8.565 -8.565
cylinder 0 1 10.56 110.535 -8.565
cylinder 2 1 10.96 110.535 -8.885
cuboid   0 1 15.25 -15.25 15.25 -15.25 115.515 -8.885
core     0 1 -60.9 -61.0 -62.2
reflector 0 1 2z 2r.1 2z 1

```

```

cuboid      3 1 86.6 -86.6 86.8 -86.8 87.9 -87.9
end geom
read array nux=4 nuy=4 loop
1 1 1 1 1 4 1 1 1 1    2 4 4 1 1 4 1 1 1 1    3 2 3 1 1 4 1 1 1 1
end loop end array
end data
end

=csas25
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al          2 1 end
h2o         3 1 end
end comp
slab end
1 3.81 oneextermod 2 4.12 noextermod 3 22.12 noextermod end zone
93.2% uo2f2 3 in al slab 3x1x1 array 1 in sep h2o refl
read param    npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cuboid      1 1 2p3.81 2p60.325 19.13 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p4.128 2p60.643 19.13 -.318
unit 2
cuboid      3 1 2.54 0 2p60.643 19.13 -.318
core        0 1 3r0
reflector   3 2 4r3 0 3 6
end geom
read array nux=5 nuy=1 nuz=1 fill 1 2 1 2 1 end fill end array
read bias id=500 2 7 end bias
end data
end

=csas25
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al          2 1 end
h2o         3 1 end
end comp
slab end
1 3.81 oneextermod 2 4.12 noextermod 3 22.12 noextermod end zone
93.2% uo2f2 3 in al slab 3x1x1 array 5.5 in sep h2o refl
read param    npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cuboid      1 1 2p3.81 2p60.325 111.68 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p4.128 2p60.643 111.68 -.318
unit 2
cuboid      3 1 13.97 0 2p60.643 111.68 -.318
core        0 1 3r0
reflector   3 2 4r3 0 3 6
end geom
read array nux=5 nuy=1 nuz=1 fill 1 2 1 2 1 end fill end array
read bias id=500 2 7 end bias
end data
end

```

```

=csas25
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al 2 1 end
end comp
slab end
1 3.81 noextermod 2 4.12 noextermod end zone
93.2% uo2f2 3, 6 in al slabs 2x1x1 array 15 in sep
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cuboid 1 1 2p3.81 2p60.325 65.81 0
reflector 2 1 4r.318 0 .318 1
cuboid 0 1 2p4.128 2p65. 150. -1.
unit 2
cuboid 1 1 2p7.417 2p60.325 65.81 0
reflector 2 1 4r.318 0 .318 1
cuboid 0 1 2p7.735 2p65. 150. -1.
unit 3
cuboid 0 1 38.1 0 2p65. 150. -1.
end geom
read array nux=3 nuy=1 nuz=1 fill 2 3 1 end fill end array
end data
end

```

```

=csas25
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al 2 1 end
end comp
slab end
1 3.81 noextermod 2 4.12 noextermod end zone
93.2% uo2f2 3, 6, 3 in al slabs 3x1x1 array 0 in sep
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cuboid 1 1 2p3.81 2p60.325 19.63 0
reflector 2 1 4r.318 0 .318 1
cuboid 0 1 2p4.128 2p65. 150. -1.
unit 2
cuboid 1 1 2p7.417 2p60.325 19.63 0
reflector 2 1 4r.318 0 .318 1
cuboid 0 1 2p7.735 2p65. 150. -1.
end geom
read array nux=3 nuy=1 nuz=1 fill 1 2 1 end fill end array
end data
end

```

```

=csas25
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al 2 1 end
end comp

```

```

slab end
1 3.81 noextermod 2 4.12 noextermod end zone
93.2% uo2f2 3, 6, 3 in al slabs 3x1x1 array 20 in sep
read param      npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cuboid      1 1 2p3.81 2p60.325 62.56 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p4.128 2p65. 150. -1.
unit 2
cuboid      1 1 2p7.417 2p60.325 62.56 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p7.735 2p65. 150. -1.
unit 3
cuboid      0 1 50.8 0 2p65. 150. -1.
end geom
read array nux=5 nuy=1 nuz=1 fill 1 3 2 3 1 end fill end array
end data
end

```

```

=csas25
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al          2 1 end
end comp
slab end
1 7.62 noextermod 2 7.94 noextermod end zone
93.2% uo2f2 6 & 3 in al slabs 2x1x1 array 12 in sep
read param      npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cuboid      1 1 2p3.81 2p60.325 58.19 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p4.128 2p65. 150. -1.
unit 2
cuboid      2 1 2p.318 2p60.325 58.19 0
cuboid      1 1 2p7.938 2p60.325 58.19 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p8.574 2p65. 150. -1.
unit 3
cuboid      0 1 30.48 0 2p65. 150. -1.
end geom
read array nux=3 nuy=1 nuz=1 fill 2 3 1 end fill end array
end data
end

```

```

=csas25
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al          2 1 end
end comp
slab end
1 7.62 noextermod 2 7.94 noextermod end zone
93.2% uo2f2 6 & 3 in al slabs 2x1x1 array 30 in sep
read param      npg=2000 fdn=yes nub=yes end param
read geom
unit 1

```

```

cuboid      1 1 2p3.81 2p60.325 83.11 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p4.128 2p65. 150. -1.
unit 2
cuboid      2 1 2p.318 2p60.325 83.11 0
cuboid      1 1 2p7.938 2p60.325 83.11 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p8.574 2p65. 150. -1.
unit 3
cuboid      0 1 76.2 0 2p65. 150. -1.
end geom
read array nux=3 nuy=1 nuz=1 fill 2 3 1 end fill end array
end data
end

```

```

=csas25
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al          2 1 end
end comp
slab end
1 7.62 noextermod 2 7.94 noextermod end zone
93.2% uo2f2 6 in al slab 2x1x1 array 6 in sep
read param    npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cuboid      1 1 2p7.417 2p60.325 32.79 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p15.354 2p65. 150. -1.
unit 2
cuboud      2 1 2p.318 2p60.325 32.79 0
cuboid      1 1 2p7.938 2p60.325 32.79 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p15.875 2p65. 150. -1.
end geom
read array nux=2 nuy=1 nuz=1 fill 1 2 end fill end array
end data
end

```

```

=csas25
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al          2 1 end
end comp
slab end
1 7.62 noextermod 2 7.94 noextermod end zone
93.2% uo2f2 6 in al slab 2x1x1 array 48 in sep
read param    npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cuboid      1 1 2p7.417 2p60.325 73.23 0
reflector   2 1 4r.318 0 .318 1
cuboid      0 1 2p68.694 2p65. 150. -1.
unit 2
cuboud      2 1 2p.318 2p60.325 73.23 0
cuboid      1 1 2p7.938 2p60.325 73.23 0
reflector   2 1 4r.318 0 .318 1

```

```

cuboid      0 1 2p69.215 2p65. 150. -1.
end geom
read array nux=2 nuy=1 nuz=1 fill 1 2 end fill end array
end data
end

=csas25
uo2(no3)2 63.3 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 63.3 0 1 293 92235 92.6 92238 7.4 end
plexiglass    2 1 end
arbmwood .640525 3 0 0 0 6012 44.435 1001 6.2639 8016 49.301 3 end
carbonsteel   4 end
reg-concrete  5 end
end comp
cylindrical  end
1 9.52 oneextermod  2 10.16 noextermod end zone
uo2(no3)2 63.3 g u/l 3x3x3 array unrefl. walls, floor, & tank
read param    npg=2000 fdn=yes nub=yes plt=no end param
read geom
unit 1
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid    0 1 4p11.365 19.615 -1.845
unit 2
array    1 2r-34.095 0.
cuboid   0 1 4p200. 250. -50.
unit 3
cylinder 0 1 142.8 224. -48.
cylinder 4 1 144.8 224. -50.
cuboid   0 1 218.1 -181.9 215. -185. 250. -50.
array    2 3r0.
reflector 0 1 57.4 57. 260. 559.2 400. 0. 1
reflector 2 1 5r0 .32 1
reflector 3 1 5r0 1.27 1
reflector 4 1 5r0 .64 1
reflector 0 1 5r0 365 1
reflector 5 2 6r3 10
reflector 5 12 0 3 4r0 10
end geom
read start xsm=165 xsp=234 ysm=165 ysp=234 zsm=50 zsp=115 end start
read bias id=301 2 21 end bias
read array ara=1 nux=3 nuy=3 nuz=3 fill f1 end fill
ara=2 nux=2 nuy=1 nuz=1 fill 2 3 end fill end array
read plot
xul=113.2 yul=286.8 zul=60. xlr=286.8 ylr=113.2 zlr=60.
uax=1 vdn=-1 nax=125 end
xul=437.1 yul=329.8 zul=60. xlr=726.7 ylr=40.2 zlr=60. end
end plot
end data
end

=csas25
uo2(no3)2 279 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 279 0 1 293 92235 92.6 92238 7.4 end
plexiglass    2 1 end
arbmwood .640525 3 0 0 0 6012 44.435 1001 6.2639 8016 49.301 3 end
carbonsteel   4 end
reg-concrete  5 end

```

```

end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
uo2(no3)2 279 g u/l 2x2x2 array unrefl. walls, tank, & floor
read param plt=no npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid 0 1 4p10.875 19.125 -1.355
unit 2
array 1 2r-21.75 0.
cuboid 0 1 4p200. 250. -50.
unit 3
cylinder 0 1 142.8 224. -48.
cylinder 4 1 144.8 224. -50.
cuboid 0 1 218.1 -181.9 215. -185. 250. -50.
array 2 3r0.
reflector 0 1 57.4 57. 260. 559.2 400. 0. 1
reflector 2 1 5r0 .32 1
reflector 3 1 5r0 1.27 1
reflector 4 1 5r0 .64 1
reflector 0 1 5r0 365 1
reflector 5 2 6r3 10
reflector 5 12 0 3 4r0 10
end geom
read start xsm=178 xsp=222 ysm=178 ysp=222 zsm=50 zsp=91 end start
read bias id=301 2 21 end bias
read array ara=1 nux=2 nuy=2 nuz=2 fill f1 end fill
ara=2 nux=2 nuy=1 nuz=1 fill 2 3 end fill end array
read plot
xul=113.2 yul=286.8 zul=60. xlr=286.8 ylr=113.2 zlr=60.
uax=1 vdn=-1 nax=125 end
xul=437.1 yul=329.8 zul=60. xlr=726.7 ylr=40.2 zlr=60. end
end plot
end data
end

```

```

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
arbmwood .640525 3 0 0 0 6012 44.435 1001 6.2639 8016 49.301 3 end
carbonsteel 4 end
reg-concrete 5 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
uo2(no3)2 415 g u/l 3x3x3 array unrefl. walls, tank, & floor
read param plt=no npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid 0 1 4p13.40 21.65 -3.88
unit 2
array 1 2r-40.2 0.
cuboid 0 1 4p200. 250. -50.
unit 3

```

```

cylinder 0 1 142.8 224. -48.
cylinder 4 1 144.8 224. -50.
cuboid 0 1 218.1 -181.9 215. -185. 250. -50.
array 2 3r0.
reflector 0 1 57.4 57. 260. 559.2 400. 0. 1
reflector 2 1 5r0 .32 1
reflector 3 1 5r0 1.27 1
reflector 4 1 5r0 .64 1
reflector 0 1 5r0 365 1
reflector 5 2 6r3 10
reflector 5 12 0 3 4r0 10
end geom
read start xsm=160 xsp=240 ysm=160 ysp=240 zsm=50 zsp=127 end start
read bias id=301 2 21 end bias
read array ara=1 nux=3 nuy=3 nuz=3 fill f1 end fill
ara=2 nux=2 nuy=1 nuz=1 fill 2 3 end fill end array
read plot
xul=113.2 yul=286.8 zul=60. xlr=286.8 ylr=113.2 zlr=60.
uax=1 vdn=-1 nax=125 end
xul=437.1 yul=329.8 zul=60. xlr=726.7 ylr=40.2 zlr=60. end
end plot
end data
end

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
arbmwood .640525 3 0 0 0 6012 44.435 1001 6.2639 8016 49.301 3 end
carbonsteel 4 end
reg-concrete 5 end
solnuo2(no3)2 6 279 0 1 293 92235 92.6 92238 7.4 end
end comp
cylindrical end
1 9.52 oneextermmod 2 10.16 noextermmod end zone
uo2(no3)2 415 g u/l 3x3x3 array unrefl. 279 g u/l 5 cent. units walls, floor, &
read param plt=no npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid 0 1 4p13.365 21.615 -3.845
unit 4
cylinder 6 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid 0 1 4p13.365 21.615 -3.845
unit 2
array 1 2r-40.095 0.
cuboid 0 1 4p200. 250. -50.
unit 3
cylinder 0 1 142.8 224. -48.
cylinder 4 1 144.8 224. -50.
cuboid 0 1 218.1 -181.9 215. -185. 250. -50.
array 2 3r0.
reflector 0 1 57.4 57. 260. 559.2 400. 0. 1
reflector 2 1 5r0 .32 1
reflector 3 1 5r0 1.27 1
reflector 4 1 5r0 .64 1
reflector 0 1 5r0 365 1

```

```

reflector 5 2 6r3 10
reflector 5 12 0 3 4r0 10
end geom
read start xsm=138 xsp=262 ysm=138 ysp=262 zsm=50 zsp=169 end start
read bias id=301 2 21 end bias
read array ara=1 nux=3 nuy=3 nuz=3 fill 10r1 4 1 3r4 1 4 10r1 end fill
ara=2 nux=2 nuy=1 nuz=1 fill 2 3 end fill end array
read plot
xul=113.2 yul=286.8 zul=60. xlr=286.8 ylr=113.2 zlr=60.
uax=1 vdn=-1 nax=125 end
xul=437.1 yul=329.8 zul=60. xlr=726.7 ylr=40.2 zlr=60. end
end plot
end data
end

```

```

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
uo2(no3)2 415 g u/l 3x3x3 array 15.24 cm par. bot., 2.54 cm plex.
read param npg=2000 fdn=yes nub=yes end param
read geom
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid 0 1 4p16.13 24.38 -6.61
core 0 1 3r0.
reflector 2 2 5r2.54 0 1
reflector 3 2 5r0 3 4
reflector 3 6 5r0 3.24 1
end geom
read bias id=400 2 6 end bias
read array nux=3 nuy=3 nuz=3 end array
end data
end

```

```

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
uo2(no3)2 415 g u/l 3x3x3 array 15.24 cm par. bot., 7.62 cm par.
read param npg=2000 fdn=yes nub=yes end param
read geom
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid 0 1 4p18.085 26.335 -8.565
core 0 1 3r0.
reflector 3 2 5r3 0 2
reflector 3 4 5r1.62 0 1
reflector 3 2 5r0 3 4

```

```

reflector 3 6 5r0 3.24 1
end geom
read bias id=400 2 6 end bias
read array nux=3 nuy=3 nuz=3 end array
end data
end

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
uo2(no3)2 415 g u/l 3x3x3 array 1.27 cm paraffin refl.
read param npg=2000 fdn=yes nub=yes end param
read geom
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid 0 1 4p14.67 22.92 -5.15
core 0 1 3r0.
reflector 3 2 6r1.27 1
end geom
read bias id=400 2 6 end bias
read array nux=3 nuy=3 nuz=3 end array
end data
end

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
uo2(no3)2 415 g u/l 2x2x2 array 15.24 cm par. bot., 1.27 cm plex.
read param npg=2000 fdn=yes nub=yes end param
read geom
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid 0 1 4p11.965 20.215 -2.445
core 0 1 3r0.
reflector 2 2 5r1.27 0 1
reflector 3 2 5r0 3 4
reflector 3 6 5r0 3.24 1
end geom
read bias id=400 2 6 end bias
read array nux=2 nuy=2 nuz=2 end array
end data
end

```

```

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass      2 1 end
para(h2o)       3 1 end
end comp
cylindrical end
1 9.52 oneextermmod 2 10.16 noextermmod end zone
uo2(no3)2 415 g u/l 2x2x2 array 15.24 cm par. bot., 2.54 cm plex.
read param      npg=2000 fdn=yes nub=yes end param
read geom
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid    0 1 4p12.865 21.115 -3.345
core     0 1 3r0.
reflector 2 2 5r2.54 0 1
reflector 3 2 5r0 3 4
reflector 3 6 5r0 3.24 1
end geom
read bias id=400 2 6 end bias
read array nux=2 nuy=2 nuz=2 end array
end data
end

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass      2 1 end
para(h2o)       3 1 end
end comp
cylindrical end
1 9.52 oneextermmod 2 10.16 noextermmod end zone
uo2(no3)2 415 g u/l 2x2x2 array 15.24 cm par. bot., 6.35 cm plex.
read param      npg=2000 fdn=yes nub=yes end param
read geom
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid    0 1 4p14.48 22.73 -4.96
core     0 1 3r0.
'reflector 2 2 5r3.0 0 1
'reflector 2 3 5r3.35 0 1
'reflector 3 2 5r0 3 4
'reflector 3 6 5r0 3.24 1
reflector 2 1 5r3.0 0 1
reflector 2 1 5r3.35 0 1
reflector 3 1 5r0 3 4
reflector 3 1 5r0 3.24 1
end geom
'read bias id=400 2 6 end bias
read array nux=2 nuy=2 nuz=2 end array
end data
end

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end

```

```

plexiglass      2 1 end
para(h2o)       3 1 end
end comp
cylindrical end
1 9.52 oneextermod  2 10.16 noextermod end zone
uo2(no3)2 415 g u/l 2x2x2 array 15.24 cm par. bot., 7.62 cm par.
read param      npg=2000 fdn=yes nub=yes end param
read geom
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid    0 1 4p14.515 22.765 -4.995
core    0 1 3r0.
reflector 3 2 5r3 0 2
reflector 3 4 5r1.62 0 1
reflector 3 2 5r0 3 4
reflector 3 6 5r0 3.24 1
end geom
read bias id=400 2 6 end bias
read array nux=2 nuy=2 nuz=2 end array
end data
end

```

```

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass      2 1 end
para(h2o)       3 1 end
end comp
cylindrical end
1 9.52 oneextermod  2 10.16 noextermod end zone
uo2(no3)2 415 g u/l 2x2x2 array 1.27 cm paraffin refl.
read param      npg=2000 fdn=yes nub=yes end param
read geom
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.
cylinder 2 1 10.16 18.41 -.64
cuboid    0 1 4p11.80 20.05 -2.28
core    0 1 3r0.
reflector 3 2 6r1.27 1
end geom
read bias id=400 2 6 end bias
read array nux=2 nuy=2 nuz=2 end array
end data
end

```

```

=csas25
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass      2 1 end
para(h2o)       3 1 end
end comp
cylindrical end
1 9.52 oneextermod  2 10.16 noextermod end zone
uo2(no3)2 415 g u/l 2x2x2 array 3.81 cm paraffin refl.
read param      npg=2000 fdn=yes nub=yes end param
read geom
cylinder 1 1 9.52 17.5609 0.
cylinder 0 1 9.52 17.77 0.

```

```
cylinder 2 1 10.16 18.41 -.64
cuboid   0 1 4p13.615 21.865 -4.095
core    0 1 3r0.
reflector 3 2 6r3.81 1
end geom
read bias id=400 2 6 end bias
read array nux=2 nuy=2 nuz=2 end array
end data
end
```

Table A.6. Table 6 input data

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1  0  0.0      end
u-234      1  0  0.00538-4  end
u-235      1  0  0.48006-4  end
u-236      1  0  0.00138-4  end
u-238      1  0  0.02807-4  end
n          1  0  1.869-4    end
h          1  0  0.066228   end
o          1  0  0.033736   end
b-10       1  0  0.0      end
b-11       1  0  0.0      end
th-232     1  0  0.0      end
al         2  1           end
ss316      3  1           end
carbonsteel 4  1           end
end comp
eta experiments
read param npg=2000 fdn=yes  nub=yes  tme=59  end param
read geom
sphere 1 1 34.5948
sphere 2 1 34.9148
cuboid 0 1 6p34.9148
end geom  read start nst=1 end start
end data
end

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1  0  0.0      end
u-234      1  0  0.00631-4  end
u-235      1  0  0.56206-4  end
u-236      1  0  0.00163-4  end
u-238      1  0  0.03281-4  end
n          1  0  2.129-4    end
h          1  0  0.066148   end
o          1  0  0.033800   end
b-10       1  0  0.01029-4  end
b-11       1  0  0.04166-4  end
th-232     1  0  0.0      end
al         2  1           end
ss316      3  1           end
carbonsteel 4  1           end
end comp
eta experiments
read param npg=2000 fdn=yes  nub=yes  tme=59  end param
read geom
sphere 1 1 34.5948  sphere 2 1 34.9148  cuboid 0 1 6p34.9148
end geom  read start nst=1 end start
end data
end

```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.0      end
u-234      1 0 0.00716-4 end
u-235      1 0 0.63944-4 end
u-236      1 0 0.00184-4 end
u-238      1 0 0.03734-4 end
n          1 0 2.392-4   end
h          1 0 0.066070  end
o          1 0 0.033865  end
b-10       1 0 0.02057-4 end
b-11       1 0 0.08332-4 end
th-232     1 0 0.0      end
al         2 1           end
ss316      3 1           end
carbonsteel 4 1           end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
sphere 1 1 34.5948    sphere 2 1 34.9148    cuboid 0 1 6p34.9148
end geom read start nst=1 end start
end data
end
```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.0      end
u-234      1 0 0.00762-4 end
u-235      1 0 0.67959-4 end
u-236      1 0 0.00197-4 end
u-238      1 0 0.03967-4 end
n          1 0 2.548-4   end
h          1 0 0.066028  end
o          1 0 0.034028  end
b-10       1 0 0.02532-4 end
b-11       1 0 0.10255-4 end
th-232     1 0 0.0      end
al         2 1           end
ss316      3 1           end
carbonsteel 4 1           end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
sphere 1 1 34.5948    sphere 2 1 34.9148    cuboid 0 1 6p34.9148
end geom read start nst=1 end start
end data
end
```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.43284-4 end
u-234      1 0 0.00716-4 end
u-235      1 0 0.00018-4 end
u-236      1 0 0.0      end
u-238      1 0 0.00281-4 end
n          1 0 1.178-4   end
```

```

h          1  0  0.066360  end
o          1  0  0.033608  end
b-10      1  0  0.0          end
b-11      1  0  0.0          end
th-232    1  0  0.000196-3 end
a1         2  1          end
ss316     3  1          end
carbonsteel 4  1          end
end comp
eta experiments
read param npg=2000 fdn=yes  nub=yes  tme=59  end param
read geom
sphere 1 1 34.5948   sphere 2 1 34.9148   cuboid 0 1 6p34.9148
end geom  read start nst=1 end start
end data
end

=csas25
eta experiments  exp
238groupndf5  infhommedium
u-233      1  0  0.45120-4  end
u-234      1  0  0.00744-4  end
u-235      1  0  0.00018-4  end
u-236      1  0  0.0          end
u-238      1  0  0.00291-4  end
n          1  0  1.224-4    end
h          1  0  0.066345  end
o          1  0  0.033621  end
b-10      1  0  0.00263-4  end
b-11      1  0  0.01066-4  end
th-232    1  0  0.000205-3 end
a1         2  1          end
ss316     3  1          end
carbonsteel 4  1          end
end comp
eta experiments
read param npg=2000 fdn=yes  nub=yes  tme=59  end param
read geom
sphere 1 1 34.5948   sphere 2 1 34.9148   cuboid 0 1 6p34.9148
end geom  read start nst=1 end start
end data
end

=csas25
eta experiments  exp
238groupndf5  infhommedium
u-233      1  0  0.46798-4  end
u-234      1  0  0.00772-4  end
u-235      1  0  0.00018-4  end
u-236      1  0  0.0          end
u-238      1  0  0.00301-4  end
n          1  0  1.274-4    end
h          1  0  0.066329  end
o          1  0  0.033634  end
b-10      1  0  0.00512-4  end
b-11      1  0  0.02075-4  end
th-232    1  0  0.000213-3 end
a1         2  1          end
ss316     3  1          end
carbonsteel 4  1          end
end comp

```

```

eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
sphere 1 1 34.5948 sphere 2 1 34.9148 cuboid 0 1 6p34.9148
end geom read start nst=1 end start
end data
end

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.48455-4 end
u-234      1 0 0.00801-4 end
u-235      1 0 0.00021-4 end
u-236      1 0 0.0 end
u-238      1 0 0.00311-4 end
n          1 0 1.319-4 end
h          1 0 0.066315 end
o          1 0 0.033646 end
b-10       1 0 0.00758-4 end
b-11       1 0 0.03069-4 end
th-232     1 0 0.000221-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
sphere 1 1 34.5948 sphere 2 1 34.9148 cuboid 0 1 6p34.9148
end geom read start nst=1 end start
end data
end

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.5066-4 end
u-234      1 0 0.00827-4 end
u-235      1 0 0.00021-4 end
u-236      1 0 0.0 end
u-238      1 0 0.00327-4 end
n          1 0 1.363-4 end
h          1 0 0.0663 end
o          1 0 0.033659 end
b-10       1 0 0.01005-4 end
b-11       1 0 0.04070-4 end
th-232     1 0 0.000227-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
sphere 1 1 34.5948 sphere 2 1 34.9148 cuboid 0 1 6p34.9148
end geom read start nst=1 end start
end data
end

```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.0          end
u-234      1 0 0.00409-4   end
u-235      1 0 0.36185-4   end
u-236      1 0 0.00220-4   end
u-238      1 0 0.01985-4   end
n          1 0 1.116-4     end
h          1 0 0.066394    end
o          1 0 0.033592    end
b-10       1 0 0.0          end
b-11       1 0 0.0          end
th-232     1 0 0.0          end
al         2 1              end
ss316      3 1              end
carbonsteel 4 1             end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
sphere 1 1 61.0108 sphere 2 1 61.7808 cuboid 0 1 6p61.7808
end geom read start nst=1 end start
end data
end

```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.33460-4   end
u-234      1 0 0.00525-4   end
u-235      1 0 0.00010-4   end
u-236      1 0 0.0          end
u-238      1 0 0.00256-4   end
n          1 0 0.753-4     end
h          1 0 0.066467    end
o          1 0 0.033525    end
b-10       1 0 0.0          end
b-11       1 0 0.0          end
th-232     1 0 0.000148-3  end
al         2 1              end
ss316      3 1              end
carbonsteel 4 1             end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
sphere 1 1 61.0108 sphere 2 1 61.7808 cuboid 0 1 6p61.7808
end geom read start nst=1 end start
end data
end

```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.00000-4  end
u-234      1 0 0.00469-4   end
u-235      1 0 0.41364-4   end
u-236      1 0 0.00243-4   end
u-238      1 0 0.02271-4   end
n          1 0 1.27200-4   end

```

```

h          1  0  0.066345  end
o          1  0  0.033624  end
b-10      1  0  0.0       end
b-11      1  0  0.0       end
th-232    1  0  0.000000-3 end
al         2  1           end
ss316     3  1           end
carbonsteel 4  1           end
end comp
eta experiments
read param npg=2000 fdn=yes  nub=yes  tme=59  end param
read geom cylinder 1 1  77.3684   45.1358   0.0
cylinder  0 1  77.3684   264.0     0.0
cylinder  3 1  77.4984   264.13   -0.13
cuboid    0 1  4p77.4984  264.13   -0.13
end geom
read start nst=1 end start
end data
end

```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1  0  0.00000-4  end
u-234      1  0  0.00451-4  end
u-235      1  0  0.40595-4  end
u-236      1  0  0.00222-4  end
u-238      1  0  0.02339-4  end
n          1  0  1.40900-4  end
h          1  0  0.066343   end
o          1  0  0.033655   end
b-10      1  0  0.0       end
b-11      1  0  0.0       end
th-232    1  0  0.000000-3 end
al         2  1           end
ss316     3  1           end
carbonsteel 4  1           end
end comp
eta experiments
read param npg=2000 fdn=yes  nub=yes  tme=59  end param
read geom cylinder 1 1  77.3684   47.4472   0.0
cylinder  0 1  77.3684   264.0     0.0
cylinder  3 1  77.4984   264.13   -0.13
cuboid    0 1  4p77.4984  264.13   -0.13
end geom
read start nst=1 end start
end data
end

```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1  0  0.00000-4  end
u-234      1  0  0.00409-4  end
u-235      1  0  0.36452-4  end
u-236      1  0  0.00209-4  end
u-238      1  0  0.02048-4  end
n          1  0  1.18500-4  end
h          1  0  0.066383   end
o          1  0  0.033605   end
b-10      1  0  0.0       end

```

```

b-11      1  0  0.0      end
th-232    1  0  0.000000-3 end
al       2  1      end
ss316    3  1      end
carbonsteel 4  1      end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom cylinder 1 1 77.3684    72.7456  0.0
cylinder 0 1 77.3684   264.0    0.0
cylinder 3 1 77.4984   264.13   -0.13
cuboid   0 1 4p77.4984  264.13   -0.13
end geom
read start nst=1 end start
end data
end

```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1  0  0.00000-4 end
u-234      1  0  0.00397-4 end
u-235      1  0  0.34845-4 end
u-236      1  0  0.00194-4 end
u-238      1  0  0.01962-4 end
n          1  0  1.20800-4 end
h          1  0  0.066389 end
o          1  0  0.033609 end
b-10       1  0  0.0      end
b-11       1  0  0.0      end
th-232    1  0  0.000000-3 end
al       2  1      end
ss316    3  1      end
carbonsteel 4  1      end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom cylinder 1 1 77.3684    105.2068  0.0
cylinder 0 1 77.3684   264.0    0.0
cylinder 3 1 77.4984   264.13   -0.13
cuboid   0 1 4p77.4984  264.13   -0.13
end geom
read start nst=1 end start
end data
end

```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1  0  0.00000-4 end
u-234      1  0  0.00384-4 end
u-235      1  0  0.33519-4 end
u-236      1  0  0.00186-4 end
u-238      1  0  0.01924-4 end
n          1  0  1.24400-4 end
h          1  0  0.066391 end
o          1  0  0.033615 end
b-10       1  0  0.0      end
b-11       1  0  0.0      end
th-232    1  0  0.000000-3 end
al       2  1      end

```

```

ss316      3 1          end
carbonsteel 4 1          end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom cylinder 1 1 77.3684    203.2762  0.0
cylinder 0 1 77.3684    264.0     0.0
cylinder 3 1 77.4984    264.13   -0.13
cuboid   0 1 4p77.4984  264.13   -0.13
end geom
read start nst=1 end start
end data
end

```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.36517-4 end
u-234      1 0 0.00556-4 end
u-235      1 0 0.00000-4 end
u-236      1 0 0.00000-4 end
u-238      1 0 0.00410-4 end
n          1 0 0.82600-4 end
h          1 0 0.066439 end
o          1 0 0.033539 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000037-3 end
a1         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom cylinder 1 1 77.3684    49.5046  0.0
cylinder 0 1 77.3684    264.0     0.0
cylinder 3 1 77.4984    264.13   -0.13
cuboid   0 1 4p77.4984  264.13   -0.13
end geom
read start nst=1 end start
end data
end

```

```

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.34978-4 end
u-234      1 0 0.00525-4 end
u-235      1 0 0.00000-4 end
u-236      1 0 0.00000-4 end
u-238      1 0 0.00395-4 end
n          1 0 0.84900-4 end
h          1 0 0.066444 end
o          1 0 0.033542 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000032-3 end
a1         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp

```

```

eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom cylinder 1 1 77.3684 59.2074 0.0
cylinder 0 1 77.3684 264.0 0.0
cylinder 3 1 77.4984 264.13 -0.13
cuboid 0 1 4p77.4984 264.13 -0.13
end geom
read start nst=1 end start
end data
end

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233 1 0 0.33292-4 end
u-234 1 0 0.00507-4 end
u-235 1 0 0.00000-4 end
u-236 1 0 0.00000-4 end
u-238 1 0 0.00375-4 end
n 1 0 0.80200-4 end
h 1 0 0.066459 end
o 1 0 0.033533 end
b-10 1 0 0.0 end
b-11 1 0 0.0 end
th-232 1 0 0.000037-3 end
al 2 1 end
ss316 3 1 end
carbonsteel 4 1 end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom cylinder 1 1 77.3684 77.6732 0.0
cylinder 0 1 77.3684 264.0 0.0
cylinder 3 1 77.4984 264.13 -0.13
cuboid 0 1 4p77.4984 264.13 -0.13
end geom
read start nst=1 end start
end data
end

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233 1 0 0.31567-4 end
u-234 1 0 0.00481-4 end
u-235 1 0 0.00000-4 end
u-236 1 0 0.00000-4 end
u-238 1 0 0.00354-4 end
n 1 0 0.79500-4 end
h 1 0 0.066470 end
o 1 0 0.033531 end
b-10 1 0 0.0 end
b-11 1 0 0.0 end
th-232 1 0 0.000258-3 end
al 2 1 end
ss316 3 1 end
carbonsteel 4 1 end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom cylinder 1 1 77.3684 138.9126 0.0

```

```

cylinder 0 1 77.3684    264.0    0.0
cylinder 3 1 77.4984    264.13   -0.13
cuboid   0 1 4p77.4984  264.13   -0.13
end geom
read start nst=1 end start
end data
end

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.00000-4 end
u-234      1 0 0.00397-4 end
u-235      1 0 0.33940-4 end
u-236      1 0 0.00240-4 end
u-238      1 0 0.01975-4 end
n          1 0 1.40700-4 end
h          1 0 0.066367 end
o          1 0 0.033645 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000000-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom cylinder 1 1 136.7790    90.8812   0.0
cylinder 0 1 136.7790    274.0    0.0
cylinder 4 1 138.6840    275.905   -1.905
cuboid   0 1 4p138.6840  275.905   -1.905
end geom
read start nst=1 end start
end data
end

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.00000-4 end
u-234      1 0 0.00381-4 end
u-235      1 0 0.33124-4 end
u-236      1 0 0.00232-4 end
u-238      1 0 0.01942-4 end
n          1 0 1.36700-4 end
h          1 0 0.066374 end
o          1 0 0.033634 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000000-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom cylinder 1 1 136.7790    122.4280   0.0
cylinder 0 1 136.7790    274.0    0.0
cylinder 4 1 138.6840    275.905   -1.905
cuboid   0 1 4p138.6840  275.905   -1.905

```

```

end geom
read start nst=1 end start
end data
end

=csas25
eta experiments exp
238groupndf5 infhommedium
u-233      1 0 0.00000-4 end
u-234      1 0 0.00368-4 end
u-235      1 0 0.32347-4 end
u-236      1 0 0.00220-4 end
u-238      1 0 0.01894-4 end
n          1 0 1.33800-4 end
h          1 0 0.066385 end
o          1 0 0.033631 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000000-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
eta experiments
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom cylinder 1 1 136.7790    241.1222   0.0
cylinder 0 1 136.7790 274.0 0.0
cylinder 4 1 138.6840 275.905 -1.905
cuboid    0 1 4p138.6840 275.905 -1.905
end geom
read start nst=1 end start
end data
end

```


APPENDIX B

KENO-VI INPUT DATA USED FOR VALIDATION CASES LISTED IN TABLES 1–6 (238 group)

APPENDIX B

KENO-VI INPUT DATA USED FOR VALIDATION CASES LISTED IN TABLES 1–6 (238 GROUP)

Input data for the validation appears in the same order as listed in Tables 1–6 of Section 1 of this report.

Table B.1. Table 1 input data	182
Table B.2. Table 2 input data	199
Table B.3. Table 3 input data	218
Table B.4. Table 4 input data	252
Table B.5. Table 5 input data	256
Table B.6. Table 6 input data	279

Table B.1. Table 1 input data

```

=csas26      parm=size=5000000
libby exp. 4.89% rods 30 cm long, .762 cm diam, 1.3 cm pitch
238groupndf5 latticecell
uranium    1 .9995 293 92235 4.89 92238 95.11 end
h2o        2 1 end
plexiglass 3 1 end
end comp
squarepitch 1.3 .762 1 2 end
read param npg=2000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 .381 5.08 0
cuboid   20 4p.65 5.08 0
media    1 1 10
media    2 1 20 -10
boundary  20
unit 2
cylinder 10 .381 1.27 0
cuboid   20 4p.65 1.27 0
media    1 1 10
media    3 1 20 -10
boundary  20
unit 3
cylinder 10 .381 17.935 0
cuboid   20 4p.65 17.935 0
media    1 1 10
media    2 1 20 -10
boundary  20
unit 4
cylinder 10 .381 .635 0
cuboid   20 4p.65 .635 0
media    1 1 10
media    3 1 20 -10
boundary  20
unit 5
cuboid   10 4p.65 5.08 0
media    2 1 10
boundary 10
unit 6
cylinder 10 .381 1.27 0
cuboid   20 4p.65 1.27 0
media    2 1 10
media    3 1 20 -10
boundary  20
unit 7
cuboid   10 4p.65 17.935 0
media    2 1 10
boundary 10
unit 8
cylinder 10 .381 .635 0
cuboid   20 4p.65 .635 0
media    2 1 10
media    3 1 20 -10
boundary  20
global unit 10
cuboid   10 26.0  0.0  27.3  0.0  30.0  0.0
cuboid   20 26.0  0.0  27.3  0.0  30.0  -3.81
cuboid   30 41.0  -15.0 42.3  -15.0 39.2  -15.0
array    1 10 place 1 1 1 .65 .65 0.0

```

```

media 3 1 20 -10
media 2 1 30 -20 -10
boundary 30
end geom
read array nux=20 nuy=21 nuz=5 fill
19r5 401r1 19r6 401r2 19r7 401r3 19r8 401r4 19r5 401r1
end fill end array
end data
end

=csas26      parm=size=5000000
libby exp. 4.89 rods 30 cm long, .762 cm diam, 2.05 cm pitch
238groupndf5 latticecell
uranium    1 .9995 293 92235 4.89 92238 95.11 end
h2o        2 1 end
plexiglass 3 1 end
end comp
squarepitch 2.05 .762 1 2 end
read param npg=2000  nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 .381 30 0
cuboid   20 4p1.025 30 0
media 1 1 10
media 2 1 20 -10
boundary 20
unit 2
cuboid   10 4p1.025 30 0
media 2 1 10
boundary 10
global
unit 3
cuboid 10 28.7 0.0 30.75 0.0 30.0 0.0
cuboid 20 31.7 -3.0 33.75 -3.0 33.0 -3.0
cuboid 30 34.7 -6.0 36.75 -6.0 36.0 -6.0
cuboid 40 37.7 -9.0 39.75 -9.0 39.0 -9.0
cuboid 50 40.7 -12.0 42.75 -12.0 39.3 -12.0
cuboid 60 43.7 -15.0 45.75 -15.0 39.3 -15.0
array 1 10 place 1 1 1 1.025 1.025 0.0
media 2 2 20 -10
media 2 3 30 -20 -10
media 2 4 40 -30 -20 -10
media 2 5 50 -40 -30 -20 -10
media 2 6 60 -50 -40 -30 -20 -10
boundary 60
end geom
read array nux=14 nuy=15 nuz=1 fill
7r1 7r2 f1
end fill end array
read bias id=500 2 6 end bias
end data
end

=csas26      parm=size=5000000
libby exp. 4.89% rods 30 cm long, .762 cm diam, 1.3 cm pitch
238groupndf5 latticecell
uranium    1 .9995 293 92235 4.89 92238 95.11 end
h2o        2 1 end
plexiglass 3 1 end
pb        4 1 end
end comp

```

```

squarepitch 1.3 .762 1 2 end
read param npg=2000 nub=yes plt=no fdn=yes end param
read geom
unit 1
cylinder 10 .381 30 0
cuboid 20 4p.65 30 0
media 1 1 10
media 2 1 20 -10
boundary 20
unit 2
cuboid 10 4p.65 30 0
media 2 1 10
boundary 10
unit 3
cuboid 10 26.0 0.0 26.0 0.0 30.0 0.0
cuboid 20 33.32 -7.32 26.0 -7.32 30.0 0.0
array 1 10 place 1 1 1 .65 .65 0.0
media 2 1 20 -10
boundary 20
unit 4
cuboid 10 2p20.32 2p10.16 25.4 0
cuboid 20 20.32 -20.32 10.16 -10.16 26.825 0.0
cuboid 30 20.32 -20.32 10.16 -10.16 26.825 -3.175
media 4 1 10
media 2 1 20 -10
media 3 1 30 -20 -10
boundary 30
global
unit 5
cuboid 10 40.64 0.0 53.64 0.0 30.0 0.0
cuboid 20 48.32 -7.68 53.64 -7.68 35.1 0.0
cuboid 30 48.32 -7.68 53.64 -7.68 35.1 -13.97
array 2 10 place 1 1 1 7.32 7.32 0.0
media 2 1 20 -10
media 3 1 30 -20 -10
boundary 30
end geom
read array ara=1 nux=20 nuy=20 nuz=1 fill
18r1 2r2 f1
end fill
ara=2 nux=1 nuy=2 nuz=1 fill 3 4
end fill end array
read plot ttl='14a x-y' pic=mix
xul=-7.8 yul=53.8 zul=15 xlr=48.8 ylr=-7.8 zlr=15
uax=1 vdn=-1 nax=125 end
ttl='14a x-y' pic=wts end
ttl='14a y-z' pic=mix
xul=20 yul=-7.8 zul=35.5 xlr=20 ylr=53.8 zlr=-14.1
vax=1 wdn=-1 uax=0 vdn=0 nax=125 end
ttl='14a y-z' pic=wts end
end plot
end data
end

=csas26
libby exp. 4.89% rods 30 cm long, .762 cm diam, 1.3 cm pitch
238groupndf5 latticecell
uranium 1 .9995 293 92235 4.89 92238 95.11 end
h2o 2 1 end
plexiglass 3 1 end
pb 4 1 end
end comp

```

```

squarepitch 1.3 .762 1 2 end
read param npg=2000 nub=yes plt=no fdn=yes end param
read geom
unit 1
cylinder 10 .381 30 0
cuboid 20 4p.65 30 0
media 1 1 10
media 2 1 20 -10
boundary 20
unit 2
cuboid 10 4p.65 30 0
media 2 1 10
boundary 10
unit 3
cuboid 10 29.9 0.0 26.0 0.0 30.0 0.0
cuboid 20 30.52 -0.62 26.62 -4.52 30.0 0.0
array 1 10 place 1 1 1 .65 .65 0.0
media 2 1 20 -10
boundary 20
unit 4
cuboid 10 2p10.16 2p15.57 25.4 0
cuboid 20 2p10.16 2p15.57 26.825 0
cuboid 30 2p10.16 2p15.57 26.825 -3.175
media 4 1 10
media 2 2 20 -10
media 3 2 30 -20 -10
boundary 30
unit 5
cuboid 10 71.78 0.0 31.14 0.0 30.0 0.0
array 2 10 place 1 1 1 10.16 15.57 3.175
boundary 10
unit 6
cuboid 10 2p35.89 2p10.16 25.4 0
cuboid 20 2p35.89 2p10.16 26.825 0
cuboid 30 2p35.89 2p10.16 26.825 -3.175
media 4 1 10
media 2 2 20 -10
media 3 2 30 -20 -10
boundary 30
global unit 7
cuboid 10 71.78 0.0 71.78 0.0 30.0 0.0
cuboid 20 71.78 0.0 71.78 0.0 33.0 0.0
cuboid 30 71.78 0.0 71.78 0.0 36.0 0.0
cuboid 40 71.78 0.0 71.78 0.0 37.95 0.0
cuboid 50 71.78 0.0 71.78 0.0 37.95 -3.0
cuboid 60 71.78 0.0 71.78 0.0 37.95 -6.0
cuboid 70 71.78 0.0 71.78 0.0 37.95 -9.0
cuboid 80 71.78 0.0 71.78 0.0 37.95 -12.0
cuboid 90 71.78 0.0 71.78 0.0 37.95 -13.97
array 3 10 place 1 1 1 35.89 10.16 3.175
media 2 2 20 -10
media 2 3 30 -20 -10
media 2 4 40 -30 -20 -10
media 3 5 50 -40 -30 -20 -10
media 3 6 60 -50 -40 -30 -20 -10
media 3 7 70 -60 -50 -40 -30 -20 -10
media 3 8 80 -70 -60 -50 -40 -30 -20 -10
media 3 9 90 -80 -70 -60 -50 -40 -30 -20 -10
boundary 90
end geom
read array ara=1 nux=23 nuy=20 nuz=1 fill
3r2 2r1 2 5q3 2r1 q23 23r2 q69 2 1 2 2r1 2 5q3 2r1
2r1 2 6q3 2r1 23r2 2r1 2 6q3 2r1 q23 23r2 2q69

```

```

2r1 2 6q3 2r1 q23
end fill
ara=2 nux=3 nuy=1 nuz=1 fill 4 3 4 end fill
ara=3 nux=1 nuy=3 nuz=1 fill 6 5 6
end fill end array
read bias id=500 2 9 end bias
read plot ttl=' x-y' pic=mix
xul=0 yul=72 zul=15 xlr=72 ylr=0 zlr=15
uax=1 vdn=-1 nax=125 end
ttl=' x-y' pic=wts end
ttl=' y-z' pic=mix
xul=33 yul=0 zul=40 xlr=33 ylr=72 zlr=-14.1
vax=1 wdn=-1 uax=0 vdn=0 nax=125 end
ttl=' y-z' pic=wts end
end plot
end data
end

=csas26      parm=size=5000000
libby exp. 4.89% rods 30 cm long, .762 cm diam, 1.3 cm pitch
238groupndf5 latticecell
uranium    1 .9995 293 92235 4.89 92238 95.11 end
h2o        2 1 end
plexiglass 3 1 end
pb         4 1 end
b-10       5 0 4.617-3 end
b-11       5 0 1.872-2 end
c          5 0 5.750-3 end
al         5 0 4.765-2 end
end comp
squarepitch 1.3 .762 1 2 end
read param npg=2000  nub=yes plt=no fdn=yes end param
read geom
unit 1
cylinder 10 .381 30 0
cuboid   20 4p.65 30 0
media    1 1 10
media    2 1 20 -10
boundary  20
unit 2
cuboid   10 4p.65 30 0
media    2 1 10
boundary  10
unit 3
cuboid   10 29.9 0.0 22.1 0.0 30.0 0.0
cuboid   20 30.52 -.62 22.1 -.62 30.0 0.0
array    1 10 place 1 1 1 .65 .65 0.0
media    2 1 20 -10
boundary  20
unit 7
cuboid   10 29.9 0.0 6.5 0.0 30.0 0.0
cuboid   20 30.52 -.62 7.12 0.0 30.0 0.0
array    4 10 place 1 1 1 .65 .65 0.0
media    2 1 20 -10
boundary  20
unit 8
cuboid   10 2p15.57 2p.3175 25.4 0
cuboid   20 2p15.57 2p.65 26.825 -3.175
media    5 1 10
media    2 1 20 -10
boundary  20
unit 4

```

```

cuboid 10 2p10.16 2p15.57 25.4 0
cuboid 20 2p10.16 2p15.57 26.825 0.0
cuboid 30 2p10.16 2p15.57 26.825 -3.175
media 4 1 10
media 2 1 20 -10
media 3 1 30 -20 -10
boundary 30
unit 9
cuboid 10 31.14 0.0 31.14 0.0 30.0 0.0
array 5 10 place 1 1 1 .62 .62 0.0
boundary 10
unit 5
cuboid 10 71.78 0.0 31.14 0.0 30.0 0.0
array 2 10 place 1 1 1 10.16 15.57 3.175
boundary 10
unit 6
cuboid 10 2p35.89 2p10.16 25.4 0
cuboid 20 2p35.89 2p10.16 26.825 0.0
cuboid 30 2p35.89 2p10.16 26.825 -3.175
media 4 1 10
media 2 1 20 -10
media 3 1 30 -20 -10
boundary 30
global
unit 10
cuboid 10 71.78 0.0 71.78 0.0 30.0 0.0
cuboid 20 71.78 0.0 71.78 0.0 34.8 0.0
cuboid 30 71.78 0.0 71.78 0.0 34.8 -13.97
array 3 10 place 1 1 1 35.89 10.16 3.175
media 2 1 20 -10
media 3 1 30 -20 -10
boundary 30
end geom
read array ara=1 nux=23 nuy=17 nuz=1 fill
2r2 19r1 2r2 2 21r1 2 f1
end fill
ara=4 nux=23 nuy=5 nuz=1 fill
69r1 2 21r1 2 2r2 19r1 2r2
end fill
ara=5 nux=1 nuy=3 nuz=1 fill 3 8 7 end fill
ara=2 nux=3 nuy=1 nuz=1 fill 4 9 4 end fill
ara=3 nux=1 nuy=3 nuz=1 fill 6 5 6
end fill end array
read plot ttl=' x-y' pic=mix
xul=0 yul=72 zul=15 xlr=72 ylr=0 zlr=15
uax=1 vdn=-1 nax=125 end
ttl=' x-y' pic=wts end
ttl=' y-z' pic=mix
xul=33 yul=0 zul=40 xlr=33 ylr=72 zlr=-14.1
ttl=' y-z' pic=wts end
end plot
end data
end

=csas26 parm=size=5000000
libby exp. 4.89% rods 30 cm long, .762 cm diam, 1.3 cm pitch
238groupndf5 latticecell
uranium 1 .9995 293 92235 4.89 92238 95.11 end
h2o 2 1 end
plexiglass 3 1 end
pb 4 1 end
cd 5 1 end

```

```

end comp
squarepitch 1.3 .762 1 2 end
read param npg=2000 nub=yes plt=no fdn=yes end param
read geom
unit 1
cylinder 10 .381 30 0
cuboid 20 4p.65 30 0
media 1 1 10
media 2 1 20 -10
boundary 20
unit 2
cuboid 10 4p.65 30 0
media 2 1 10
boundary 10
unit 3
cuboid 10 29.9 0.0 22.1 0.0 30.0 0.0
cuboid 20 30.52 -.62 22.1 -.62 30.0 0.0
array 1 10 place 1 1 1 .65 .65 0.0
media 2 1 20 -10
boundary 20
unit 7
cuboid 10 29.9 0.0 6.5 0.0 30.0 0.0
cuboid 20 30.52 -.62 7.12 0.0 30.0 0.0
array 4 10 place 1 1 1 .65 .65 0.0
media 2 1 20 -10
boundary 20
unit 8
cuboid 10 2p15.57 2p.04445 25.4 0
cuboid 20 15.57 -15.57 .65 -.65 26.825 -3.175
media 5 1 10
media 2 1 20 -10
boundary 20
unit 4
cuboid 10 2p10.16 2p15.57 25.4 0
cuboid 20 2p10.16 2p15.57 26.825 0.0
cuboid 30 2p10.16 2p15.57 26.825 -3.175
media 4 1 10
media 2 2 20 -10
media 3 2 30 -20 -10
boundary 30
unit 9
cuboid 10 31.14 0.0 31.14 0.0 30.0 0.0
array 5 10 place 1 1 1 .62 .62 0.0
boundary 10
unit 5
cuboid 10 71.78 0.0 31.14 0.0 30.0 0.0
array 2 10 place 1 1 1 10.16 15.57 3.175
boundary 10
unit 6
cuboid 10 2p35.89 2p10.16 25.4 0
cuboid 20 35.89 -35.89 10.16 -10.16 26.825 0.0
cuboid 30 35.89 -35.89 10.16 -10.16 26.825 -3.175
media 4 1 10
media 2 2 20 -10
media 3 2 30 -20 -10
boundary 30
global
unit 10
cuboid 10 71.78 0.0 71.78 0.0 30.0 0.0
cuboid 20 71.78 0.0 71.78 0.0 30.5 0.0
cuboid 30 71.78 0.0 71.78 0.0 30.5 -3.0
cuboid 40 71.78 0.0 71.78 0.0 30.5 -6.0
cuboid 50 71.78 0.0 71.78 0.0 30.5 -9.0

```

```

cuboid 60 71.78 0.0 71.78 0.0 30.5 -12.0
cuboid 70 71.78 0.0 71.78 0.0 30.5 -13.97
array 3 10 place 1 1 1 35.89 10.16 3.175
media 2 2 20 -10
media 3 2 30 -20 -10
media 3 3 40 -30 -20 -10
media 3 4 50 -40 -30 -20 -10
media 3 5 60 -50 -40 -30 -20 -10
media 3 6 70 -60 -50 -40 -30 -20 -10
boundary 70
end geom
read array ara=1 nux=23 nuy=17 nuz=1 fill
11r1 12r2 f1
end fill
ara=4 nux=23 nuy=5 nuz=1 fill
f1
end fill
ara=5 nux=1 nuy=3 nuz=1 fill 3 8 7 end fill
ara=2 nux=3 nuy=1 nuz=1 fill 4 9 4 end fill
ara=3 nux=1 nuy=3 nuz=1 fill 6 5 6
end fill end array
read bias id=500 2 6 end bias
read plot ttl=' x-y' pic=mix
xul=0 yul=72 zul=15 xlr=72 ylr=0 zlr=15
uax=1 vdn=-1 nax=125 end
ttl=' x-y' pic=wts end
ttl=' y-z' pic=mix
xul=33 yul=0 zul=40 xlr=33 ylr=72 zlr=-14.1
vax=1 wdn=-1 uax=0 vdn=0 nax=125 end
ttl=' y-z' pic=wts end
end plot
end data
end
1

=csas26  parm=size=5000000
libby exp. 4.89% rods 30 cm long, .762 cm diam, 3.25 cm pitch in uo2f2 soln
238groupndf5 latticecell
uranium 1 .9995 293 92235 4.89 92238 95.11 end
solnuo2f2 2 301.16 0 1 293 92235 4.89 92238 95.11 end
plexiglass 3 1 end
al 4 1 end
solnuo2f2 5 301.16 0 1 293 92235 4.89 92238 95.11 end
end comp
squarepitch 3.25 .762 1 2 end
read param npg=2000 far=yes nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 .381 5.08 0
cuboid 20 4p1.625 5.08 0
media 1 1 10
media 5 1 20 -10
boundary 20
unit 2
cylinder 10 .381 1.27 0
cuboid 20 4p1.625 1.27 0
media 1 1 10
media 3 1 20 -10
boundary 20
unit 3
cylinder 10 .381 17.935 0
cuboid 20 4p1.625 17.935 0

```

```

media 1 1 10
media 5 1 20 -10
boundary 20
unit 4
cylinder 10 .381 .635 0
cuboid 20 4p1.625 .635 0
media 1 1 10
media 3 1 20 -10
boundary 20
unit 5
cuboid 10 4p1.625 5.08 0
media 2 1 10
boundary 10
unit 6
cylinder 10 .381 1.27 0
cuboid 20 4p1.625 1.27 0
media 2 1 10
media 3 1 20 -10
boundary 20
unit 7
cuboid 10 4p1.625 17.935 0
media 2 1 10
boundary 10
unit 8
cylinder 10 .381 .635 0
cuboid 20 4p1.625 .635 0
media 2 1 10
media 3 1 20 -10
boundary 20
global
unit 9
cuboid 10 2p14.625 2p16.25 30.0 0.0
cuboid 20 2p14.625 2p16.25 30.0 -3.81
cylinder 30 47.94 38.52 -10.16
cylinder 40 48.26 38.52 -10.48
array 1 10 place 1 1 1 -13.0 -14.625 0.0
media 3 1 20 -10
media 5 1 30 -20 -10
media 4 1 40 -30
boundary 40
end geom
read array nux=9 nuy=10 nuz=5 fill
90r1 90r2 90r3 90r4 90r1
end fill end array
end data
end

=csas26      parm=size=5000000
libby exp. 4.89% rods 30 cm long, 1.31 cm diam, 3.40 cm pitch in uo2f2 soln
238groupndf5  latticecell
uranium 1 .9995 293 92235 4.89 92238 95.11 end
solnuo2f2 2 300.24 0 1 293 92235 4.89 92238 95.11 end
plexiglass 3 1 end
al 4 1 end
solnuo2f2 5 300.24 0 1 293 92235 4.89 92238 95.11 end
end comp
squarepitch 3.40 1.31 1 2 end
read param npg=2000 far=yes nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 .655 5.08 0
cuboid 20 4p1.70 5.08 0

```

```

media 1 1 10
media 5 1 20 -10
boundary 20
unit 2
cylinder 10 .655 1.27 0
cuboid 20 4p1.70 1.27 0
media 1 1 10
media 3 1 20 -10
boundary 20
unit 3
cylinder 10 .655 17.935 0
cuboid 20 4p1.70 17.935 0
media 1 1 10
media 5 1 20 -10
boundary 20
unit 4
cylinder 10 .655 .635 0
cuboid 20 4p1.70 .635 0
media 1 1 10
media 3 1 20 -10
boundary 20
unit 5
cuboid 10 4p1.70 5.08 0
media 2 1 10
boundary 10
unit 6
cylinder 10 .655 1.27 0
cuboid 20 4p1.70 1.27 0
media 2 1 10
media 3 1 20 -10
boundary 20
unit 7
cuboid 10 4p1.70 17.935 0
media 2 1 10
boundary 10
unit 8
cylinder 10 .655 .635 0
cuboid 20 4p1.70 .635 0
media 2 1 10
media 3 1 20 -10
boundary 20
global
unit 9
cuboid 10 2p10.2 2p11.9 30.0 0.0
cuboid 20 2p10.2 2p11.9 30.0 -3.81
cylinder 30 47.94 39.1 -10.16
cylinder 40 48.26 39.1 -10.48
array 1 10 place 1 1 1 -8.5 -10.2 0.0
media 3 1 20 -10
media 5 1 30 -20 -10
media 4 1 40 -30 -20 -10
boundary 40
end geom
read array nux=6 nuy=7 nuz=5 fill
42r1 42r2 42r3 42r4 42r1
end fill end array
end data
end

```

```

=csas26  parm=size=5000000
libby exp. 4.89% rods 30 cm long, 1.31 cm diam, 3.940 cm pitch in uo2f2 soln
238groupndf5  latticecell
uranium   1 .9995 293 92235 4.89 92238 95.11 end
solnuo2f2  2 300.24 0 1 293 92235 4.89 92238 95.11 end
plexiglass 3 1 end
al 4 1 end
solnuo2f2  5 300.24 0 1 293 92235 4.89 92238 95.11 end
end comp
squarepitch 3.94 1.31 1 2 end
read param npg=2000  far=yes  nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 .655 5.08 0
cuboid   20 4p1.97 5.08 0
media   1 1 10
media   5 1 20 -10
boundary  20
unit 2
cylinder 10 .655 1.27 0
cuboid   20 4p1.97 1.27 0
media   1 1 10
media   3 1 20 -10
boundary  20
unit 3
cylinder 10 .655 17.935 0
cuboid   20 4p1.97 17.935 0
media   1 1 10
media   5 1 20 -10
boundary  20
unit 4
cylinder 10 .655 .635 0
cuboid   20 4p1.97 .635 0
media   1 1 10
media   3 1 20 -10
boundary  20
unit 5
cuboid   10 4p1.97 5.08 0
media   2 1 10
boundary  10
unit 6
cylinder 10 .655 1.27 0
cuboid   20 4p1.97 1.27 0
media   2 1 10
media   3 1 20 -10
boundary  20
unit 7
cuboid   10 4p1.97 17.935 0
media   2 1 10
boundary  10
unit 8
cylinder 10 .655 .635 0
cuboid   20 4p1.97 .635 0
media   2 1 10
media   3 1 20 -10
boundary  20
global
unit 9
cuboid 10 2p11.82 2p13.79 30.0 0.0
cuboid 20 2p11.82 2p13.79 30.0 -3.81
cylinder 30 47.94 39.25 -10.16
cylinder 40 48.26 39.25 -10.48
array 1 10 place 1 1 1 -9.85 -11.82 0.0

```

```

media 3 1 20 -10
media 5 1 30 -20 -10
media 4 1 40 -30 -20 -10
boundary 40
end geom
read array nux=6 nuy=7 nuz=5 fill
42r1 42r2 42r3 42r4 42r1
end fill end array
end data
end

=csas26  parm=zsize=5000000
4.89% green blocks  unreflected h/u-235=395.0 40.6 g u-235/l
238groupndf5 multiregion
u-234 1 0 4.3000-7 end
u-235 1 0 1.0402-4 end
u-238 1 0 1.9972-3 end
h 1 0 4.1088-2 end
c 1 0 2.1291-2 end
o 1 0 7.8456-3 end
al 2 1 end
end comp
spherical end
1 28 noextermod end zone
read param npg=2000  nub=yes fdn=yes end param
read geom
global unit 1
cuboid 10 50.8 0 60.96 0 60.452 0
media 1 1 10
boundary 10
end geom
end data
end

=csas26  parm=size=5000000
4.89% green blocks h/u-235=503.5 33.3 g u-235/l
238groupndf5 multiregion
u-234 1 0 3.5000-7 end
u-235 1 0 8.5320-5 end
u-238 1 0 1.6381-3 end
h 1 0 4.2959-2 end
c 1 0 2.2261-2 end
o 1 0 6.9399-3 end
al 2 1 end
end comp
spherical end
1 36 noextermod end zone
read param npg=2000  nub=yes fdn=yes end param
read geom
global
unit 1
cuboid 10 60.96 0 60.96 0 52.832 0
media 1 1 10
boundary 10
end geom
end data
end

```

```

=csas26  parm=size=5000000
4.89% green blocks h/u-235=199.3 64.9 g u-235/l
238groupndf5  multiregion
u-234  1 0 6.8000-7 end
u-235  1 0 1.6628-4 end
u-238  1 0 3.1926-3 end
h      1 0 3.3140-2 end
c      1 0 1.7173-2 end
o      1 0 1.0766-2 end
al     2 1 end
h2o    3 1 end
para(h2o) 4 1 end
end comp
spherical end
1 22 oneextermod 3 40 noextermod end zone
read param npg=2000  nub=yes fdn=yes      rnd=6b4f695d171d  plt=yes  end param
read geom
unit 1
cuboid 10 6p10.16
media 1 1 10
boundary 10
unit 2
cuboid 10 4p10.16 2p8.763
media 1 1 10
boundary 10
global
unit 3
cuboid 10 40.64 0.0 40.64 0.0 58.166 0.0
cuboid 20 40.64 0.0 40.64 0.0 73.406 0.0
cuboid 30 58.64 -18.0 58.64 -18.0 73.406 -18.0
array 1 10 place 1 1 1 10.16 10.16 10.16
media 4 1 20 -10
media 3 1 30 -20 -10
boundary 30
end geom
read array nux=2 nuy=2 nuz=3 fill 8r1 4r2 end fill end array
read plot scr=yes
ttl='xz slice'
xul=-18.0 yul=20 zul=73.4
xlr=58.64 ylr=20 zlr=-18.0
uax=1 wdn=-1 nax=640 nch='0123'
end plot
end data
end

```

```

=csas26  parm=size=5000000
4.89 green blocks h/u-235=396.7 40.6 g u-235/l
238groupndf5  multiregion
u-234  1 0 4.3000-7 end
u-235  1 0 1.0402-4 end
u-238  1 0 1.9972-3 end
h      1 0 4.1265-2 end
c      1 0 2.1383-2 end
o      1 0 7.8552-3 end
al     2 1 end
h2o    3 1 end
para(h2o) 4 1 end
end comp
spherical end
1 20 oneextermod 3 38 noextermod end zone
read param npg=2000  nub=yes fdn=yes end param
read geom

```

```

global unit 1
cuboid 10 40.64 0 40.64 0 57.658 0
cuboid 20 40.64 0.0 40.64 0.0 72.898 0.0
cuboid 30 58.64 -18.0 58.64 -18.0 72.898 -18.0
media 1 1 10
media 4 8 20 -10
media 3 2 30 -20 -10
boundary 30
end geom
read bias id=500 2 7 id=400 8 12 end bias
end data
end

=csas26 parm=size=5000000
4.89% green blocks h/u-235=146.8 81.1 g u-235/l
238groupndf5 multiregion
u-234 1 0 8.5000-7 end
u-235 1 0 2.0779-4 end
u-238 1 0 3.9896-3 end
h 1 0 3.0504-2 end
c 1 0 1.5807-2 end
o 1 0 1.2859-2 end
al 2 1 end
h2o 3 1 end
para(h2o) 4 1 end
end comp
spherical end
1 22 oneextermod 3 40 noextermod end zone
read param npg=2000 nub=yes fdn=yes end param
read geom
global
unit 1
cuboid 10 50.8 0 50.8 0 42.164 0
cuboid 20 50.8 0.0 50.8 0.0 57.404 0.0
cuboid 30 68.8 -18.0 68.8 -18.0 57.404 -18.0
media 1 1 10
media 4 8 20 -10
media 3 2 30 -20 -10
boundary 30
end geom
end data
end

=csas26 parm=size=5000000
4.89% green blocks h/u-235=504.1 33.3 g u-235/l
238groupndf5 multiregion
u-234 1 0 3.5000-7 end
u-235 1 0 8.5320-5 end
u-238 1 0 1.6381-3 end
h 1 0 4.3010-2 end
c 1 0 2.2287-2 end
o 1 0 6.9427-3 end
al 2 1 end
h2o 3 1 end
para(h2o) 4 1 end
end comp
spherical end
1 29 oneextermod 3 47 noextermod end zone
read param npg=2000 nub=yes fdn=yes end param
read geom
global

```

```

unit 1
cuboid 10 50.8 0 50.8 0 41.148 0
cuboid 20 50.8 0.0 50.8 0.0 56.388 0.0
cuboid 30 68.8 -18.0 68.8 -18.0 56.388 -18.0
media 1 1 10
media 4 1 20 -10
media 3 1 30 -20 -10
boundary 30
end geom
end data
end

```

```

=csas26      parm=size=5000000
4.89% uo2f2 h/u-235=524
238groupndf5 multiregion
solnuo2f2 1 869.9 0 1 293 92234 .02 92235 4.89
92238 95.09 end
ss304      2 1 end
end comp
cylindrical end
1 25.4 noextermod 2 25.56 noextermod end zone
read param npg=2000 nub=yes fdn=yes end param
read geom
global unit 1
cylinder 10 25.4 38.66 0
cylinder 20 25.559 38.66 -.159
media 1 1 10
media 2 1 20 -10
boundary 20
end geom
end data
end

```

```

=csas26      parm=size=5000000
4.89% uo2f2 h/u-235=1002
238groupndf5 multiregion
solnuo2f2 1 491.6 0 1 293 92234 .02 92235 4.89
92238 95.09 end
al      2 1 end
end comp
spherical end
1 34.6 noextermod 2 34.76 noextermod end zone
read param npg=2000 nub=yes fdn=yes end param
read geom
global unit 1
sphere 10 34.6
plane 20 zpl=1.0 con=-30
sphere 30 34.759
media 1 1 10 -20
media 0 1 20 10
media 2 1 30 -10
boundary 30
end geom
end data
end

```

```

=csas26      parm=size=5000000
4.89% uo2f2 h/u-235=524
238groupndf5 multiregion
solnuo2f2 1 869.9 0 1 293 92234 .02 92235 4.89

```

```

92238 95.09 end
ss304      2 1 end
h2o        3 1 end
end comp
cylindrical end
1 19 oneextermod 2 19.2 noextermod 3 37.2 noextermod end zone
read param npg=2000  nub=yes fdn=yes end param
read geom
global unit 1
cylinder 10 19.05 50.37 0
cylinder 20 19.209 50.529 -.159
cylinder 30 37.209 68.529 -18.159
media 1 1 10
media 2 1 20 -10
media 3 2 30 -20
boundary 30
end geom
read bias id=500 2 7 end bias
end data
end

```

```

=csas26      parm=size=500000
4.89% uo2f2 h/u-235=735
238groupndf5 multiregion
solnuo2f2 1 650.1 0 1 293 92234 .02 92235 4.89
92238 95.09 end
ss304      2 1 end
h2o        3 1 end
end comp
cylindrical end
1 19 oneextermod 2 19.2 noextermod 3 37.2 noextermod end zone
read param npg=2000  nub=yes fdn=yes end param
read geom
global unit 1
cylinder 10 19.05 153.01 0.0
cylinder 20 19.209 153.169 -.159
cylinder 30 37.209 171.17 -18.159
media 1 1 10
media 2 1 20 -10
media 3 1 30 -20
boundary 30
end geom
end data
end

```

```

=csas26      parm=size=5000000
4.89% uo2f2 h/u-235=994
238groupndf5 multiregion
solnuo2f2 1 495.3 0 1 293 92234 .02 92235 4.89
92238 95.09 end
ss304      2 1 end
h2o        3 1 end
end comp
cylindrical end
1 25.4 oneextermod 2 25.56 noextermod 3 43.56 noextermod end zone
read param npg=2000  nub=yes fdn=yes end param
read geom
global unit 1
cylinder 10 25.4 85.72 0
cylinder 20 25.559 85.879 -.159
cylinder 30 43.559 103.88 -18.159

```

```
media 1 1 10
media 2 1 20 -10
media 3 1 30 -20
boundary 30
end geom
end data
end
```

Table B.2. Table 2 input data

```

=csas26    parm=size=500000
case ebj.1 u(3.85) 15 @ 7.2"/0"/0"/77.8cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o        2 1.0          end
' fir timber model
c          3 0.  1.06802e-2 end
h          3 0.  2.21713e-2 end
o          3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304      5 1.0          end
end comp
read parm
npg=2000  plt=yes fdn=yes nub=yes tme=90 tba=2
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 10 182.88 0. 18.415 0. 18.415 0.
media 3 1 10
boundary 10
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 10 182.88 0. 8.89 0. 18.415 0.
media 2 1 10
boundary 10
unit 3
com=* array of timbers 72" x 72" x 7.25" *
cuboid 10 182.88 0.0 182.245 0.0 18.415 0.0
cuboid 20 182.88 0.0 182.5625 -.3175 18.415 0.0
array 1 10 place 1 1 1 0.0 0.0 0.0
media 2 1 20 -10
boundary 20
unit 4
com=* section of steel grating *
cuboid 10 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 20 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 30 3.01625 0. 4.524375 -4.524375 3.175 0.
media 4 1 10
media 2 1 20 -10
media 4 2 30 -20 -10
boundary 30
unit 5
com=* array of steel grating *
cuboid 10 180.975 0.0 180.975 0.0 3.175 0.0
cuboid 20 181.9275 -.9525 181.9275 -.9525 3.175 0.0
array 2 10 place 1 1 1 0.0 4.524375 0.0
media 2 1 20 -10
boundary 20
unit 6
com=* u(3.85) annulus with insert *
cylinder 10 3.175 76.2 0.
cylinder 20 3.302 76.2 0.
cylinder 30 9.144 76.2 0.
cuboid 40 4p9.144 76.2 0.

```

```

media 1 1 10
media 2 1 20 -10
media 1 1 30 -20 -10
media 2 1 40 -30 -20 -10
boundary 40
unit 7
com=/* water cuboid to complete annuli array */
cuboid 10 4p9.144 76.2 0.
media 2 1 10
boundary 10
unit 8
com=/* array of 15 annuli with u(3.85) inserts */
cuboid 10 73.152 0.0 73.152 0.0 76.2 0.0
cuboid 20 128.016 -54.864 128.016 -54.864 77.8 0.0
array 3 10 place 1 1 1 9.144 9.144 0.0
media 2 1 20 -10
boundary 20
global unit 9
cuboid 10 91.44 -91.44 91.44 -91.44 99.39 0.0
cuboid 20 121.92 -121.92 121.92 -121.92 99.39 0.0
cuboid 30 121.92 -121.92 121.92 -121.92 99.39 -.19050
cuboid 40 121.92 -121.92 121.92 -121.92 99.39 -2.7305
array 4 10 place 1 1 1 -91.44 -91.1225 0.0
media 2 1 20 -10
media 5 1 30 -20 -10
media 4 1 40 -30 -20 -10
boundary 40
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=4 nuy=4 nuz=1
loop 6 1 4 1 1 4 1 1 1 1
    7 4 4 1 1 1 1 1 1 end loop
gbl=4
ara=4 nux=1 nuy=1 nuz=3
fill 3 5 8 end fill
end array
read start
xsm=-36.576 xsp=36.576 ysm=-36.576 ysp=36.576 zsm=21.59 zsp=97.79
end start
read plot scr=yes
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
nax=640 uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
'ttl="plan view 1/6 scale of core, z=midlevel of grating"
'xul=-91.44 yul=91.44 zul=20.0025
'xlr=91.44 ylr=-91.44 zlr=20.0025
'uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
'ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
'xul=-91.44 yul=91.44 zul=9.2075
'xlr=91.44 ylr=-91.44 zlr=9.2075
'uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-121.92 yul=121.92 zul=59.69
xlr=121.92 ylr=-121.92 zlr=59.69
nax=640 uax=1. vdn=-1. dlx=2.54 nch=* u.wgsc* end
'ttl="plan view 2x scale of single u unit, z=midlevel of unit"
'xul=0. yul=18.288 zul=59.69
'xlr=18.288 ylr=0. zlr=59.69

```

```

'uax=1. vdn=-1. dlx=0.127 nch=* u.wgsc* end
'ttl="cross section of core 1/6 scale,y=9.144"
'xul=-91.44 yul=9.144 zul=102.
'xlr=91.44 ylr=9.144 zlr=0.
'uax=1. wdn=-1. dlx=1.524 nch=* u.wgsc* end
'ttl="cross section of mockup 1/10 scale,y=9.144"
'xul=-121.92 yul=9.144 zul=105.
'xlr=121.92 ylr=9.144 zlr=-65.
'uax=1. wdn=-1. dlx=2.54 nch=* u.wgsc* end
'ttl="cross section of grating/fir timbers, full scale"
'xul=0. yul=0. zul=24.13
'xlr=25.4 ylr=0. zlr=-3.0
'uax=1. wdn=-1. dlx=.254 nch=* u.wgsc* end
'ttl="plan view of grating thru tiebars, full scale"
'xul=0. yul=25.4 zul=21.193
'xlr=25.4 ylr=0. zlr=21.193
'uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
'ttl="plan view of grating @ grating midlevel, full scale"
'xul=0. yul=25.4 zul=20.0025
'xlr=25.4 ylr=0. zlr=20.0025
'uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
'ttl="plan view of timbers @ timber midlevel, full scale"
'xlr=25.4 ylr=-25.4 zlr=9.2075
'uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
end plot
end data
end
```

```

=csas26      parm=size=500000
case ebj.4 u(3.85) 16 @ 7.2"/0"/0.25"/79.3cm, triangular
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o         2 1.0          end
' fir timber model
c            3 0.  1.06802e-2 end
h            3 0.  2.21713e-2 end
o            3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304       5 1.0          end
end comp
read parm
tba=3 npg=2000  nub=yes plt=yes fdn=yes tme=90
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 10 182.88 0. 18.415 0. 18.415 0.
media 3 1 10
boundary 10
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 10 182.88 0. 8.89 0. 18.415 0.
media 2 1 10
boundary 10
unit 3
com=* array of timbers 72" x 72" x 7.25" *
cuboid 10 182.88 0.0 182.245 0.0 18.415 0.0
```

```

cuboid 20 182.88 0.0 182.5625 -.3175 18.415 0.0
array 1 10 place 1 1 1 0.0 0.0 0.0
media 2 1 20 -10
boundary 20
unit 4
com=/* section of steel grating */
cuboid 10 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 20 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 30 3.01625 0. 4.524375 -4.524375 3.175 0.
media 4 1 10
media 2 1 20 -10
media 4 1 30 -20 -10
boundary 30
unit 5
com=/* array of steel grating */
cuboid 10 180.975 0.0 180.975 0.0 3.175 0.0
cuboid 20 181.9275 -.9525 181.9275 -.9525 3.175 0.0
array 2 10 place 1 1 1 0.0 4.524375 0.0
media 2 1 20 -10
boundary 20
unit 6
com=/* u(3.85) annulus with insert */
cylinder 10 3.175 76.2 0.
cylinder 20 3.302 76.2 0.
cylinder 30 9.144 76.2 0.
media 1 1 10
media 2 1 20 -10
media 1 1 30 -20 -10
boundary 30
unit 7
com=/* array of 16 annuli with u(3.85) inserts */
cylinder 10 9.144 76.2 0.0
hole 6 10
cylinder 20 9.144 76.2 0.0 origin x=-18.923
hole 6 20
origin x=-18.923
cylinder 30 9.144 76.2 0.0 origin x=-9.4615 y=16.3878
hole 6 30
origin x=-9.4615 y=16.3878
cylinder 40 9.144 76.2 0.0 origin x=9.4615 y=16.3878
hole 6 40
origin x=9.4615 y=16.3878
cylinder 50 9.144 76.2 0.0 origin x=18.923
hole 6 50
origin x=18.923
cylinder 60 9.144 76.2 0.0 origin x=9.4615 y=-16.3878
hole 6 60
origin x=9.4615 y=-16.3878
cylinder 70 9.144 76.2 0.0 origin x=-9.4615 y=-16.3878
hole 6 70
origin x=-9.4615 y=-16.3878
cylinder 80 9.144 76.2 0.0 origin x=-28.3845 y=16.3878
hole 6 80
origin x=-28.3845 y=16.3878
cylinder 90 9.144 76.2 0.0 origin x=-18.923 y=32.7756
hole 6 90
origin x=-18.923 y=32.7756
cylinder 100 9.144 76.2 0.0 origin y=32.7756
hole 6 100
origin y=32.7756
cylinder 110 9.144 76.2 0.0 origin x=28.3845 y=16.3878
hole 6 110
origin x=28.3845 y=16.3878

```

```

cylinder 120 9.144 76.2 0.0 origin x=37.846
hole 6 120
origin x=37.846
cylinder 130 9.144 76.2 0.0 origin x=28.3845 y=-16.3878
hole 6 130
origin x=28.3845 y=-16.3878
cylinder 140 9.144 76.2 0.0 origin x=0.0 y=-32.7756
hole 6 140
origin x=0.0 y=-32.7756
cylinder 150 9.144 76.2 0.0 origin x=-18.923 y=-32.7756
hole 6 150
origin x=-18.923 y=-32.7756
cylinder 160 9.144 76.2 0.0 origin x=-28.3845 y=-16.3878
hole 6 160
origin x=-28.3845 y=-16.3878
cuboid 170 91.44 -91.44 91.44 -91.44 79.3 0.0
media 2 1 170 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120
-130 -140 -150 -160
boundary 170
global
unit 8
cuboid 10 91.44 -91.44 91.44 -91.44 100.89 0.0
cuboid 20 121.92 -121.92 121.92 -121.92 100.89 0.0
cuboid 30 121.92 -121.92 121.92 -121.92 100.89 -.19050
cuboid 40 121.92 -121.92 121.92 -121.92 100.89 -2.7305
array 3 10 place 1 1 1 -91.44 -91.1225 0.0
media 2 1 20 -10
media 5 1 30 -20 -10
media 4 1 40 -30 -20 -10
boundary 40
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
gbl=3
ara=3 nux=1 nuy=1 nuz=3
fill 3 5 7 end fill
end array
read start
nst=1
xsm=-37.5285 xsp=46.99
ysm=-41.9196 ysp=41.9196
zsm= 21.59 zsp=97.79
end start
read plot scr=yes
'ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
'xul=-91.44 yul=91.44 zul=59.69
'xlr=91.44 ylr=-91.44 zlr=59.69
'uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
'ttl="plan view 1/6 scale of core, z=midlevel of grating"
'xul=-91.44 yul=91.44 zul=20.0025
'xlr=91.44 ylr=-91.44 zlr=20.0025
'uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
'ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
'xul=-91.44 yul=91.44 zul=9.2075
'xlr=91.44 ylr=-91.44 zlr=9.2075
'uax=1. vdn=-1. dlx=1.524 nch=* u.wgsc* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-121.92 yul=121.92 zul=59.69
xlr=121.92 ylr=-121.92 zlr=59.69
nax=640 uax=1. vdn=-1. dlx=2.54 nch=* u.wgsc* end

```

```

'ttl="plan view full scale of single u unit, z=midlevel of unit"
'xul=-16.75 yul=16.75 zul=59.69
'xlr=16.75 ylr=-16.75 zlr=59.69
'uax=1. vdn=-1. dlx=0.254 nch=* u.wgsc* end
'ttl="cross section of core 1/6 scale,y=0.0"
'xul=-91.44 yul=0.0 zul=102.
'xlr=91.44 ylr=0.0 zlr=0.
'uax=1. wdn=-1. dlx=1.524 nch=* u.wgsc* end
'ttl="cross section of mockup 1/10 scale,y=0.0"
'xul=-121.92 yul=0.0 zul=105.
'xlr=121.92 ylr=0.0 zlr=-65.
'uax=1. wdn=-1. dlx=2.54 nch=* u.wgsc* end
'ttl="cross section of grating/fir timbers, full scale"
'xul=0. yul=0. zul=24.13
'xlr=25.4 ylr=0. zlr=-3.0
'uax=1. wdn=-1. dlx=.254 nch=* u.wgsc* end
'ttl="plan view of grating thru tiebars, full scale"
'xul=0. yul=25.4 zul=21.193
'xlr=25.4 ylr=0. zlr=21.193
'uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
'ttl="plan view of grating @ grating midlevel, full scale"
'xul=0. yul=25.4 zul=20.0025
'xlr=25.4 ylr=0. zlr=20.0025
'uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
'ttl="plan view of timbers @ timber midlevel, full scale"
'xul=0. yul=25.4 zul=9.2075
'xlr=25.4 ylr=-25.4 zlr=9.2075
'uax=1. vdn=-1. dlx=.254 nch=* u.wgsc* end
end plot
end data
end
```

```

=csas26      parm=size=500000
case ebj.8 u(3.85) 6 @ 7.2"/2.6"/0.75"/91.4cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o         2 1.0          end
' fir timber model
c           3 0.  1.06802e-2 end
h           3 0.  2.21713e-2 end
o           3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304       5 1.0          end
end comp
read parm
npg=2000  nub=yes plt=no fdn=yes tme=90 tba=2
end parm
read geom
unit 1
com=/* fir timber 7.25" x 72" x 7.25" *
cuboid 10 182.88 0. 18.415 0. 18.415 0.
media 3 1 10
boundary 10
unit 2
com=/* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 10 182.88 0. 8.89 0. 18.415 0.
media 2 1 10
```

```

boundary 10
unit 3
com=* array of timbers 72" x 72" x 7.25" *
cuboid 10 182.88 0.0 182.245 0.0 18.415 0.0
cuboid 20 213.362 -30.48 213.04 -30.8 18.415 0.0
array 1 10 place 1 1 1 0.0 0.0 0.0
media 2 1 20 -10
boundary 20
unit 4
com=* section of steel grating *
cuboid 10 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 20 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 30 3.01625 0. 4.524375 -4.524375 3.175 0.
media 4 1 10
media 2 1 20 -10
media 4 1 30 -20 -10
boundary 30
unit 5
com=* array of steel grating *
cuboid 10 180.975 0.0 180.975 0.0 3.175 0.0
cuboid 20 212.41 -31.432 212.41 -31.43 3.175 0.0
array 2 10 place 1 1 1 0.0 4.524375 0.0
media 2 1 20 -10
boundary 20
unit 6
com=* u(3.85) annulus, h=76.2, submerged, on corner *
cylinder 10 3.302 76.2 0.
cylinder 20 9.144000 76.2 0.
cuboid 30 4p10.0965 91.4 0.
media 2 1 10
media 1 1 20 -10
media 2 1 30 -20 -10
boundary 30
unit 7
com=* u(3.85) annulus, h=76.2, submerged, on side *
cylinder 10 3.302 76.2 0.
cylinder 20 9.144000 76.2 0.
cuboid 30 4p10.0965 91.4 0.
media 2 1 10
media 1 1 20 -10
media 2 1 30 -20 -10
boundary 30
unit 8
com=* array of 6 annuli, h=76.2, submerged *
cuboid 10 60.579 0.0 40.386 0.0 91.4 0.0
cuboid 20 152.211 -91.631 142.11 -101.73 91.44 0.0
array 3 10 place 1 1 1 10.0965 10.0965 0.0
media 2 1 20 -10
boundary 20
global unit 9
cuboid 10 121.921 -121.921 121.92 -121.92 112.99 0.0
cuboid 20 121.921 -121.921 121.92 -121.92 112.99 -0.19050
cuboid 30 121.921 -121.921 121.92 -121.92 112.99 -2.7305
array 4 10 place 1 1 1 -91.441 -91.12 0.0
media 5 1 20 -10
media 4 1 30 -20 -10
boundary 30
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill

```

```

ara=3 nux=3 nuy=2 nuz=1
fill 6 7 6 6 7 6 end fill
gbl=4
ara=4 nux=1 nuy=1 nuz=3
fill 3 5 8 end fill
end array
read start
nst=1
xsm=-30.2895 xsp=30.2895
ysm=-20.193 ysp=20.193
zsm=21.59 zsp=97.79
end start
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"
xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-135. yul=135. zul=59.69
xlr=135. ylr=-135. zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="plan view 2x scale of single u unit, z=midlevel of unit"
xul=0.0 yul=20.193 zul=59.69
xlr=20.193 ylr=0.0 zlr=59.69
uax=1. vdn=-1. dlx=0.127 nch=* u.wgs* end
ttl="cross section of core 1/6 scale,y=10.0965"
xul=-91.44 yul=10.0965 zul=125.
xlr=91.44 ylr=10.0965 zlr=-10.
uax=1. wdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="cross section of mockup 1/10 scale,y=10.0965"
xul=-135. yul=10.0965 zul=125.
xlr=135. ylr=10.0965 zlr=-10.
uax=1. wdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025
xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="cross section of central unit, full scale,y=10.0965"
xul=-10.0965 yul=10.0965 zul=125.
xlr=10.0965 ylr=10.0965 zlr=-10.
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
end plot
end data

```

```

end

=csas26  parm=size=500000
case ebj.10 u(3.85) 20 @ 7.2"/2.6"/1.87"/79.0cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o        2 1.0          end
' fir timber model
c          3 0.  1.06802e-2 end
h          3 0.  2.21713e-2 end
o          3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304      5 1.0          end
end comp
read parm
npg=2000  nub=yes plt=no fdn=yes tme=90 tba=2
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 10 182.88 0. 18.415 0. 18.415 0.
media 3 1 10
boundary 10
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 10 182.88 0. 8.89 0. 18.415 0.
media 2 1 10
boundary 10
unit 3
com=* array of timbers 72" x 72" x 7.25" *
cuboid 10 182.88 0.0 182.245 0.0 18.415 0.0
cuboid 20 213.36 -30.48 213.0425 -30.7975 18.415 0.0
array 1 10 place 1 1 1 3*0.0
media 2 1 20 -10
boundary 20
unit 4
com=* section of steel grating *
cuboid 10 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 20 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 30 3.01625 0. 4.524375 -4.524375 3.175 0.
media 4 1 10
media 2 1 20 -10
media 4 1 30 -20 -10
boundary 30
unit 5
com=* array of steel grating *
cuboid 10 180.975 0.0 180.975 0.0 3.175 0.0
cuboid 20 212.4075 -31.4325 212.4075 -31.4325 3.175 0.0
array 2 10 place 1 1 1 0.0 4.524375 0.0
media 2 1 20 -10
boundary 20
unit 6
com=* u(3.85) annulus, h=76.2, submerged *
cylinder 10 3.302 76.2 0.
cylinder 20 9.144 76.2 0.
cuboid 30 4p11.5189 79.0 0.
media 2 1 10

```

```

media 1 1 20 -10
media 2 1 30 -20 -10
boundary 30
unit 26
com=* water cuboid to complete array *
cuboid 10 4p11.5189 79.0 0.
media 2 1 10
boundary 10
unit 27
com=* array of 20 annuli, h=76.2, submerged *
cuboid 10 115.189 0.0 115.189 0.0 79.0 0.0
cuboid 20 179.5145 -64.3255 179.5145 -64.3255 79.0 0.0
array 3 10 place 1 1 1 11.5189 11.5189 0.0
media 2 1 20 -10
boundary 20
global unit 28
cuboid 10 213.36 -30.48 213.0425 -30.7975 97.79 0.0
cuboid 20 213.36 -30.48 213.0425 -30.7975 97.79 -.1905
cuboid 30 213.36 -30.48 213.0425 -30.7975 97.79 -2.7305
array 4 10 place 1 1 1 0.0 0.0 0.0
media 5 1 20 -10
media 4 2 30 -20 -10
boundary 30
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=5 nuy=5 nuz=1
fill 26 26 6 6 26 15r6
26 3r6 26 end fill
gbl=4
ara=4 nux=1 nuy=1 nuz=3
fill 3 5 27 end fill
end array
'read start
'nst=1
'xsm=-57.5945 xsp=57.5945
'ysm=-57.5945 ysp=57.5945
'zsm=21.59 zsp=97.79
'end start
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"
xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-135. yul=135. zul=59.69
xlr=135. ylr=-135. zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="plan view 2x scale of single u unit, z=midlevel of unit"
xul=-11.5189 yul=11.5189 zul=59.69
xlr=11.5189 ylr=-11.5189 zlr=59.69
uax=1. vdn=-1. dlx=0.127 nch=* u.wgs* end

```

```

ttl="cross section of core 1/6 scale,y=0.0"
xul=-91.44 yul=0.0 zul=110.
xlr=91.44 ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="cross section of mockup 1/10 scale,y=0.0"
xul=-135. yul=0.0 zul=125.
xlr=135. ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025
xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="cross section of central unit, full scale,y=0.0"
xul=-11.5189 yul=0.0 zul=110.
xlr=11.5189 ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
end plot
end data
end

```

```

=csas26      parm=size=500000
case ebj.11 u(3.85) 8 @ 7.2"/2.6"/0.0"/72.5cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235          1 0.  1.8643e-3 end
u-238          1 0.  4.5971e-2   end
' full density water moderator/reflector
h2o            2 1.0           end
' fir timber model
c              3 0.  1.06802e-2 end
h              3 0.  2.21713e-2 end
o              3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel    4 1.0           end
' stainless steel lining for tank
ss304         5 1.0           end
end comp
read parm
npg=2000  nub=yes plt=yes fdn=yes tme=90 tba=2
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 10 182.88 0. 18.415 0. 18.415 0.
media 3 1 10
boundary 10
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 10 182.88 0. 8.89 0. 18.415 0.
media 2 1 10

```

```

boundary 10
unit 3
com=* array of timbers 72" x 72" x 7.25" *
cuboid 10 182.88 0.0 182.245 0.0 18.415 0.0
cuboid 20 213.36 -30.48 213.0425 -30.7975 18.415 0.0
array 1 10 place 1 1 1 3*0.0
media 2 1 20 -10
boundary 20
unit 4
com=* section of steel grating *
cuboid 10 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 20 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 30 3.01625 0. 4.524375 -4.524375 3.175 0.
media 4 1 10
media 2 1 20 -10
media 4 1 30 -20 -10
boundary 30
unit 5
com=* array of steel grating *
cuboid 10 180.975 0.0 180.975 0.0 3.175 0.0
cuboid 20 212.4075 -31.4325 212.4075 -31.4325 3.175 0.0
array 2 10 place 1 1 1 0.0 4.524375 0.0
media 2 1 20 -10
boundary 20
unit 6
com=* u(3.85) annulus, h=72.5, submerged, on corner *
cylinder 10 3.302 72.5 0.
cylinder 20 9.144000 72.5 0.
cuboid 30 4p9.144 72.5 0.
media 2 1 10
media 1 1 20 -10
media 2 1 30 -20 -10
boundary 30
unit 7
com=* u(3.85) annulus, h=72.5, submerged, on side *
cylinder 10 3.302 72.5 0.
cylinder 20 9.144000 72.5 0.
cuboid 30 4p9.144 72.5 0.
media 2 1 10
media 1 1 20 -10
media 2 1 30 -20 -10
boundary 30
unit 8
com=* u(3.85) annulus, h=3.7, dry, on corner *
cylinder 10 3.302 3.7 0.
cylinder 20 9.144000 3.7 0.
cuboid 30 4p9.144 3.7 0.
media 0 1 10
media 1 1 20 -10
media 0 1 30 -20 -10
boundary 30
unit 9
com=* u(3.85) annulus, h=3.7, dry, on side *
cylinder 10 3.302 3.7 0.
cylinder 20 9.144000 3.7 0.
cuboid 30 4p9.144 3.7 0.
media 0 1 10
media 1 1 20 -10
media 0 1 30 -20 -10
boundary 30
unit 10
com=* array of 8 annuli, h=72.5, submerged *
cuboid 10 73.152 0.0 36.576 0.0 72.5 0.0

```

```

cuboid 20 158.496 -85.344 140.208 -103.632 72.5 0.0
array 3 10 place 1 1 1 9.144 9.144 0.0
media 2 1 20 -10
boundary 20
unit 11
com=* array of 8 annuli, h=3.7, dry *
cuboid 10 73.152 0.0 36.576 0.0 3.7 0.0
cuboid 20 158.496 -85.344 140.208 -103.632 3.7 0.0
array 4 10 place 1 1 1 9.144 9.144 0.0
media 0 1 20 -10
boundary 20
global unit 12
cuboid 10 213.36 -30.48 213.0425 -30.7975 97.79 0.0
cuboid 20 213.36 -30.48 213.0425 -30.7975 97.79 -.1905
cuboid 30 213.36 -30.48 213.0425 -30.7975 97.79 -2.7305
array 5 10 place 1 1 1 0.0 0.0 0.0
media 5 1 20 -10
media 4 2 30 -20 -10
boundary 30
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=4 nuy=2 nuz=1
fill 6 7 7 6 6 7 7 6 end fill
ara=4 nux=4 nuy=2 nuz=1
fill 8 9 9 8 8 9 9 8 end fill
gbl=5
ara=5 nux=1 nuy=1 nuz=4
fill 3 5 10 11 end fill
end array
read plot scr=yes
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=0.0 yul=125 zul=30.0
xlr=182 ylr=62 zlr=30.0
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* nax=640 end
end plot
end data
end

=csas26 parm=size=500000
case ejb.13 u(3.85) 15 @ 2.5"/0.0"/0.75"/64.8cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o        2 1.0          end
' fir timber model
c          3 0.  1.06802e-2 end
h          3 0.  2.21713e-2 end
o          3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304      5 1.0          end
end comp
read parm
npg=2000 nub=yes plt=no fdn=yes tme=90 tba=2
end parm

```

```

read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 10 182.88 0. 18.415 0. 18.415 0.
media 3 1 10
boundary 10
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 10 182.88 0. 8.89 0. 18.415 0.
media 2 1 10
boundary 10
unit 3
com=* array of timbers 72" x 72" x 7.25" *
cuboid 10 182.88 0.0 182.245 0.0 18.415 0.0
cuboid 20 213.36 -30.48 213.0425 -30.7975 18.415 0.0
array 1 10 place 1 1 1 3*0.0
media 2 1 20 -10
boundary 20
unit 4
com=* section of steel grating *
cuboid 10 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 20 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 30 3.01625 0. 4.524375 -4.524375 3.175 0.
media 4 1 10
media 2 1 20 -10
media 4 1 30 -20 -10
boundary 30
unit 5
com=* array of steel grating *
cuboid 10 180.975 0.0 180.975 0.0 3.175 0.0
cuboid 20 212.41 -31.43 212.4075 -31.4325 3.175 0.0
array 2 10 place 1 1 1 0.0 4.524375 0.0
media 2 1 20 -10
boundary 20
unit 6
com=* u(3.85) rod, h=64.8, submerged *
cylinder 10 3.175000 64.8 0.
cuboid 20 4p4.1275 64.8 0.
media 1 1 10
media 2 1 20 -10
boundary 20
unit 7
com=* water cuboid to complete array 3 *
cuboid 10 4p4.1275 64.8 0.
media 2 1 10
boundary 10
unit 8
com=* u(3.85) rod, h=11.4, dry *
cylinder 10 3.175000 11.4 0.
cuboid 20 4p4.1275 11.4 0.
media 1 1 10
media 0 1 20 -10
boundary 20
unit 9
com=* void cuboid to complete array 4 *
cuboid 10 4p4.1275 11.4 0.
media 0 1 10
boundary 10
unit 10
com=* u(3.85) rod array, h=64.8, submerged *
cuboid 10 33.02 0.0 33.02 0.0 64.8 0.0
cuboid 20 138.43 -105.41 138.43 -105.41 64.8 0.0
array 3 10 place 1 1 1 4.1275 4.1275 0.0

```

```

media 2 1 20 -10
boundary 20
unit 11
com=* array of 15 rods, h=11.4, dry *
cuboid 10 33.02 0.0 33.02 0.0 11.4 0.0
cuboid 20 138.43 -105.41 138.43 -105.41 11.4 0.0
array 4 10 place 1 1 1 4.1275 4.1275 0.0
media 0 1 20 -10
boundary 20
global unit 12
cuboid 10 213.36 -30.48 213.0425 -30.7975 97.79 0.0
cuboid 20 213.36 -30.48 213.0425 -30.7975 97.79 -.19050
cuboid 30 213.36 -30.48 213.0425 -30.7975 97.79 -2.7305
array 5 10 place 1 1 1 3*0.0
media 5 1 20 -10
media 4 1 30 -20 -10
boundary 30
end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=4 nuy=4 nuz=1
fill 3r6 7 12r6 end fill
ara=4 nux=4 nuy=4 nuz=1
fill 3r8 9 12r8 end fill
gbl=5
ara=5 nux=1 nuy=1 nuz=4
fill 3 5 10 11 end fill
end array
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view full scale of array, z=midlevel of units"
xul=-16.51 yul=16.51 zul=59.69
xlr=16.51 ylr=-16.51 zlr=59.69
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"
xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-135. yul=135. zul=59.69
xlr=135. ylr=-135. zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="plan view 2x scale of single u unit, z=midlevel of unit"
xul=0.0 yul=8.255 zul=59.69
xlr=8.255 ylr=0.0 zlr=59.69
uax=1. vdn=-1. dlx=0.127 nch=* u.wgs* end
ttl="cross section of core 1/6 scale,y=4.1275"
xul=-91.44 yul=4.1275 zul=110.
xlr=91.44 ylr=4.1275 zlr=-10.
uax=1. wdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="cross section of mockup 1/10 scale,y=4.1275"
xul=-135. yul=4.1275 zul=125.
xlr=135. ylr=4.1275 zlr=-10.

```

```

uax=1. wdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025
xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="cross section of central unit, 2x scale,y=4.1275"
xul=0.0 yul=4.1275 zul=110.
xlr=8.255 ylr=4.1275 zlr=-10.
uax=1. wdn=-1. dlx=.127 nch=* u.wgs* end
end plot
end data
end

=csas26      parm=size=500000
case ejb.14 u(3.85) 23 @ 2.5"/0.0"/1.50"/68.9cm, square
238groupndf5 infhommedium
' u(3.85) metal
u-235      1 0.  1.8643e-3 end
u-238      1 0.  4.5971e-2 end
' full density water moderator/reflector
h2o         2 1.0          end
' fir timber model
c            3 0.  1.06802e-2 end
h            3 0.  2.21713e-2 end
o            3 0.  1.10850e-2 end
' steel for grating, tank walls and floor
carbonsteel 4 1.0          end
' stainless steel lining for tank
ss304       5 1.0          end
end comp
read parm
npg=2000  nub=yes plt=no fdn=yes tme=90 tba=2
end parm
read geom
unit 1
com=* fir timber 7.25" x 72" x 7.25" *
cuboid 10 182.88 0. 18.415 0. 18.415 0.
media 3 1 10
boundary 10
unit 2
com=* water gap 3.5" x 72" x 7.25" between timbers *
cuboid 10 182.88 0. 8.89 0. 18.415 0.
media 2 1 10
boundary 10
unit 3
com=* array of timbers 72" x 72" x 7.25" *
cuboid 10 182.88 0.0 182.245 0.0 18.415 0.0
cuboid 20 213.36 -30.48 213.0425 -30.7975 18.415 0.0
array 1 10 place 1 1 1 3*0.0
media 2 1 20 -10

```

```

boundary 20
unit 4
com=/* section of steel grating */
cuboid 10 2.778125 .238125 .396875 -.396875 3.175 2.38125
cuboid 20 2.778125 .238125 4.524375 -4.524375 3.175 0.
cuboid 30 3.01625 0. 4.524375 -4.524375 3.175 0.
media 4 2 10
media 2 1 20 -10
media 4 1 30 -20 -10
boundary 30
unit 5
com=/* array of steel grating */
cuboid 10 180.975 0.0 180.975 0.0 3.175 0.0
cuboid 20 212.41 -31.43 212.4075 -31.4325 3.175 0.0
array 2 10 place 1 1 1 0.0 4.524375 0.0
media 2 1 20 -10
boundary 20
unit 6
com=/* u(3.85) rod, h=68.9, submerged */
cylinder 10 3.175000 68.9 0.
cuboid 20 4p5.08 68.9 0.
media 1 1 10
media 2 1 20 -10
boundary 20
unit 7
com=/* water cuboid to complete array 3 */
cuboid 10 4p5.08 68.9 0.
media 2 1 10
boundary 10
unit 8
com=/* u(3.85) rod, h=7.3, dry */
cylinder 10 3.175000 7.3 0.
cuboid 20 4p5.08 7.3 0.
media 1 1 10
media 0 1 20 -10
boundary 20
unit 9
com=/* void cuboid to complete array 4 */
cuboid 10 4p5.08 7.3 0.
media 0 1 10
boundary 10
unit 10
com=/* u(3.85) rod array, h=68.9, submerged */
cuboid 10 50.8 0.0 50.8 0.0 68.9 0.0
cuboid 20 147.32 -96.52 147.32 -96.52 68.9 0.0
array 3 10 place 1 1 1 5.08 5.08 0.0
media 2 1 20 -10
boundary 20
unit 11
com=/* array of 22 u(3.85) rods, h=7.3, dry */
cuboid 10 50.8 0.0 50.8 0.0 7.3 0.0
cuboid 20 147.32 -96.52 147.32 -96.52 7.3 0.0
array 4 10 place 1 1 1 5.08 5.08 0.0
media 2 1 20 -10
boundary 20
global unit 12
cuboid 10 213.36 -30.48 213.0425 -30.7975 97.79 0.0
cuboid 20 213.36 -30.48 213.0425 -30.7975 97.79 -.19050
cuboid 30 213.36 -30.48 213.0425 -30.7975 97.79 -2.7305
array 5 10 place 1 1 1 3*0.0
media 5 1 20 -10
media 4 1 30 -20 -10
boundary 30

```

```

end geom
read array
ara=1 nux=1 nuy=13 nuz=1
fill 1 2 5q2 1 end fill
ara=2 nux=60 nuy=20 nuz=1
fill f4 end fill
ara=3 nux=5 nuy=5 nuz=1
fill 3r6 2r7 20r6 end fill
ara=4 nux=5 nuy=5 nuz=1
fill 3r8 2r9 20r8 end fill
gbl=5
ara=5 nux=1 nuy=1 nuz=4
fill 3 5 10 11 end fill
end array
'read start
'nst=1
'xsm=-25.4 xsp=25.4
'ysm=-25.4 ysp=25.4
'zsm=21.59 zsp=90.49
'end start
read plot
ttl="plan view 1/6 scale of core, z=midlevel of annuli/inserts"
xul=-91.44 yul=91.44 zul=59.69
xlr=91.44 ylr=-91.44 zlr=59.69
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view of array, full scale"
xul=-25.4 yul=25.4 zul=59.69
xlr=25.4 ylr=-25.4 zlr=59.69
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of grating"
xul=-91.44 yul=91.44 zul=20.0025
xlr=91.44 ylr=-91.44 zlr=20.0025
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/6 scale of core, z=midlevel of fir timbers"
xul=-91.44 yul=91.44 zul=9.2075
xlr=91.44 ylr=-91.44 zlr=9.2075
uax=1. vdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="plan view 1/10 scale of mockup, z=midlevel of u units"
xul=-135. yul=135. zul=59.69
xlr=135. ylr=-135. zlr=59.69
uax=1. vdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="plan view 2x scale of single u unit, z=midlevel of unit"
xul=-5.08 yul=5.08 zul=59.69
xlr=5.08 ylr=-5.08 zlr=59.69
uax=1. vdn=-1. dlx=0.127 nch=* u.wgs* end
ttl="cross section of core 1/6 scale,y=0.0"
xul=-91.44 yul=0.0 zul=110.
xlr=91.44 ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=1.524 nch=* u.wgs* end
ttl="cross section of mockup 1/10 scale,y=0.0"
xul=-135. yul=0.0 zul=125.
xlr=135. ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=2.54 nch=* u.wgs* end
ttl="cross section of grating/fir timbers, full scale"
xul=0. yul=0. zul=24.13
xlr=25.4 ylr=0. zlr=-3.0
uax=1. wdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating thru tiebars, full scale"
xul=0. yul=25.4 zul=21.193
xlr=25.4 ylr=0. zlr=21.193
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of grating @ grating midlevel, full scale"
xul=0. yul=25.4 zul=20.0025

```

```
xlr=25.4 ylr=0. zlr=20.0025
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="plan view of timbers @ timber midlevel, full scale"
xul=0. yul=25.4 zul=9.2075
xlr=25.4 ylr=-25.4 zlr=9.2075
uax=1. vdn=-1. dlx=.254 nch=* u.wgs* end
ttl="cross section of central unit, 2x scale,y=0.0"
xul=-5.08 yul=0.0 zul=110.
xlr=5.08 ylr=0.0 zlr=-10.
uax=1. wdn=-1. dlx=.127 nch=* u.wgs* end
end plot
end data
end
```

Table B.3. Table 3 input data

```

=csas26      parm=size=500000
  rocky flats criticals nureg/cr-1071 experiment number 1 (27 group)
' 48 fuel cans 2.44 cm moderator gee.hu77.data(opt1)
238groupndf5  latticecell
u3o8  1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o   1 8.9514e-2 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 .88 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
end comp
sphtriangp 19.9462 18.5857 1 3 18.9579 2 end
' 48 fuel cans 2.44 cm moderator gee.hu77.data(opt1)
read parm run=yes npg=2000
nub=yes fdn=yes plt=yes run=yes
end parm
read geom
unit 1
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 10 6p7.49
cuboid 20 6p7.64
cuboid 30 6p7.6650
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 2
com='x-face interstitial moderator'
cuboid 10 2p1.2200 4p7.665
media 3 1 10
boundary 10
unit 3
com='y-face interstitial moderator'
cuboid 10 2p7.665 2p1.2200 2p7.665
media 3 1 10
boundary 10
unit 4
com='z-face interstitial moderator'
cuboid 10 4p7.665 2p1.2200

```

```

media 3 1 10
boundary 10
unit 5
com='more x-face moderator'
cuboid 10 4p1.2200 2p7.665
media 3 1 10
boundary 10
unit 6
com='more y-face moderator'
cuboid 10 2p7.665 4p1.2200
media 3 1 10
boundary 10
unit 7
com='more z-face moderator'
cuboid 10 2p1.2200 2p7.665 2p1.2200
media 3 1 10
boundary 10
unit 8
com='last of interstitial moderator'
cuboid 10 6p1.2200
media 3 1 10
boundary 10
unit 56
com='empty fuel location'
cuboid 10 6p7.6650
media 0 1 10
boundary 10
unit 61
com='y-face moderator void'
cuboid 10 2p7.665 2p1.22 2p7.665
media 0 1 10
boundary 10
unit 9
com='north split table core'
cuboid 10 33.1 0.0 68.64 0.0 50.87 0.0
cuboid 20 33.1 0.0 72.75 -4.75 57.375 -26.1
cuboid 30 33.1 0.0 98.05 -30.05 81.675 -42.58
cuboid 40 33.1 0.0 98.05 -30.05 81.675 -43.81
cuboid 50 33.1 0.0 98.05 -30.85 81.675 -51.19
cuboid 60 42.9 0.0 98.05 -30.05 81.675 -51.19
cuboid 70 48.1 0.0 98.05 -30.05 81.675 -51.19
cuboid 80 57.7 0.0 98.05 -30.05 81.675 -51.19
cuboid 90 57.7 -1.23 98.05 -30.05 81.675 -51.19
array 1 10 place 1 1 1 7.6650 7.6650 7.6650
media 6 1 20 -10
media 5 1 30 -20 -10
media 4 1 40 -30 -20 -10
media 5 1 50 -40 -30 -20 -10
media 4 1 60 -50 -40 -30 -20 -10
media 5 1 70 -60 -50 -40 -30 -20 -10
media 4 1 80 -70 -60 -50 -40 -30 -20 -10
media 3 1 90 -80 -70 -60 -50 -40 -30 -20 -10
boundary 90
unit 10
com='south split table core'
cuboid 10 33.1 0.0 68.64 0.0 50.87 0.0
cuboid 20 33.1 -16.3 72.75 -4.75 57.375 -26.1
cuboid 30 33.1 -16.3 72.75 -4.75 57.375 -27.33
cuboid 40 33.1 -16.3 72.75 -4.75 57.375 -28.56
cuboid 50 33.1 -16.3 72.75 -4.75 57.375 -29.79
cuboid 60 33.1 -16.3 72.75 -4.75 57.375 -31.02
cuboid 70 33.1 -16.3 72.75 -4.75 57.375 -32.25
cuboid 80 33.1 -16.3 72.75 -4.75 57.375 -33.48

```

```

cuboid   90   33.1 -41.4   98.05 -30.05  81.675 -51.19
cuboid  100  34.33 -41.4   98.05 -30.05  81.675 -51.19
array   2 10 place 1 1 1      7.6650  7.6650  7.6650
media   6 1 20 -10
media   5 1 30 -20 -10
media   5 1 40 -30 -20 -10
media   4 1 50 -40 -30 -20 -10
media   4 1 60 -50 -40 -30 -20 -10
media   5 1 70 -60 -50 -40 -30 -20 -10
media   4 1 80 -70 -60 -50 -40 -30 -20 -10
media   5 1 90 -80 -70 -60 -50 -40 -30 -20 -10
media   3 1 100 -90 -80 -70 -60 -50 -40 -30 -20 -10
hole    12          origin x=28.  y=34.  z=-38.645
hole    13          origin x=28.  y=34.  z=69.525
boundary 100
global unit 11
cuboid 10 93.26 -41.4 98.05 -30.05 81.675 -51.19
array  3 10 place 1 1 1  0.0  0.0  0.0
boundary 10
unit 12
cuboid 10 5.1 -5.1  2.5 -2.5  12.545 -12.545
media  0 1 10
boundary 10
unit 13
cuboid 10 5.1 -5.1  2.5 -2.5  12.15 -12.15
media  0 1 10
boundary 10
end geometry
read array
ara=1 nux=3 nuy=7 nuz=5
com='north split table core'
fill  1 2 1 3 5 3 2q6 1 2 1
      4 7 4 6 8 6 2q6 4 7 4
      1q42
      1 2 56 3 5 3 1 2 1 3 5 3 1q6 1 2 56  end fill
ara=2 nux=3 nuy=7 nuz=5
com='south split table core'
fill  1 2 1 3 5 3 2q6 1 2 1
      4 7 4 6 8 6 2q6 4 7 4
      1q42
      56 2 1 61 5 3 2q6 56 2 1 end fill
ara=3 nux=2 nuy=1 nuz=1
fill 10 9 end fill
end array
'read plot scr=yes
read plot
ttl='xy slice '
xul=-50.0 yul=98.0 zul=45.0
xlr=93.0 ylr=-30.0 zlr=45.0
uax=1 vdn=-1 nax=640 nch='0123456' end
ttl='xz slice '
xul=-50.0 yul=0.0 zul=81.0
xlr=93.0 ylr=0.0 zlr=-51.0
uax=1 wdn=-1 nax=640 nch='0123456' end
end plot
end data
end

=csas26
rocky flats criticals nureg/cr-1071 experiment number 15 (27 group)
238groupndf5 latticecell
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end

```

```

h2o    1 8.9514e-2 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
    end
arbm-al1100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
    end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
    25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
    1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
h2o    4.0 1.0-15 end
rfconcrete   5 1.0 end
end comp
sphtriangp 19.0000 18.5857 1 3 18.9579 2 end
read parm run=yes npg=2000 plt=yes
fdn=yes nub=yes
end parm
read geom
unit 1
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 10 6p7.49
cuboid 20 6p7.64
cuboid 30 6p7.6650
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 2
com='x-face interstitial moderator'
cuboid 10 2p0.4645 4p7.665
media 3 1 10
boundary 10
unit 3
com='y-face interstitial moderator'
cuboid 10 2p7.665 2p0.4645 2p7.665
media 3 1 10
boundary 10
unit 4
com='z-face interstitial moderator'
cuboid 10 4p7.665 2p0.4645
media 3 1 10
boundary 10
unit 5
com='more x-face moderator'
cuboid 10 4p0.4645 2p7.665
media 3 1 10
boundary 10
unit 6
com='more y-face moderator'
cuboid 10 2p7.665 4p0.4645
media 3 1 10
boundary 10
unit 7
com='more z-face moderator'
cuboid 10 2p0.4645 2p7.665 2p0.4645
media 3 1 10
boundary 10
unit 8
com='last of interstitial moderator'
cuboid 10 6p0.4645
media 3 1 10
boundary 10
global unit 9

```

```

com='north split table core'
cuboid 10 31.589 0.0 64.107 0.0 80.366 0.0
cuboid 20 31.589 0.0 76.207 0.0 80.366 -25.5
cuboid 30 31.589 -.711 77.5 0.0 83.2 -25.5
cuboid 40 31.589 -26.211 103.0 -25.5 108.7 -25.5
array 1 10 place 1 1 1 7.6650 7.6650 7.6650
media 5 1 20 -10
media 0 1 30 -20 -10
media 5 1 40 -30 -20 -10
boundary 40
unit 10
com='south split table core'
cuboid 10 47.848 0.0 64.107 0.0 80.366 0.0
cuboid 20 47.848 0.0 76.207 0.0 80.366 -25.5
cuboid 30 47.848 0.0 77.5 0.0 83.2 -25.5
cuboid 40 47.848 0.0 103.0 -25.5 108.7 -25.5
cuboid 50 48.848 0.0 103.0 -25.5 108.7 -25.5
cuboid 60 74.348 0.0 103.0 -25.5 108.7 -25.5
array 2 10 place 1 1 1 7.6650 7.6650 7.6650
media 5 1 20 -10
media 0 1 30 -20 -10
media 5 1 40 -30 -20 -10
media 0 1 50 -40 -30 -20 -10
media 5 1 60 -50 -40 -30 -20 -10
hole 11 origin x=42.748 y=32.0535 z=-12.751
hole 11 origin x=42.748 y=32.0535 z=95.95
boundary 60
unit 11
cuboid 10 5.1 -5.1 2.55 -2.55 12.75 -12.75
media 0 1 10
boundary 10
unit 12
com='north split table faceplate'
cuboid 10 2p0.0001 2p64.2500 2p67.1
media 3 1 10
boundary 10
unit 13
com='faceplate for south split table'
cuboid 10 2p0.4620 2p64.2500 2p67.1
media 3 1 10
boundary 10
unit 14
com='air gap'
cuboid 10 2p0.2850 2p64.2500 2p67.1
media 0 1 10
boundary 10
global unit 15
com='total'
cuboid 10 133.64 0.0 128.50 0.0 134.20 0.0
array 3 10 place 1 1 1 26.211 25.5 25.5
boundary 10
unit 56
com='empty fuel location'
cuboid 10 6p7.6650
media 0 1 10
boundary 10
unit 61
com='y-face moderator void'
cuboid 10 2p7.665 2p0.4645 2p7.665
media 0 1 10
boundary 10
end geometry
read array

```

```

ara=1 nux=3 nuy=7 nuz=9
com='north split table core'
fill 1 2 1 3 5 3 2q6 1 2 1
      4 7 4 6 8 6 2q6 4 7 4
      3q42
      1 2 1 3 5 3 2q6 1 2 1 end fill
ara=2 nux=5 nuy=7 nuz=9
com='south split table core'
fill 1 2 1 2 1 3 5 3 5 3 2q10 1 2 1 2 1
      4 7 4 7 4 6 8 6 8 6 2q10 4 7 4 7 4
      3q70
      1 2 1 2 1 3 5 3 5 3
      56 2 1 2 1 61 5 3 5 3
      56 2 1 2 1 3 5 3 5 3
      1 2 1 2 1 end fill
ara=3 nux=5 nuy=1 nuz=1
com='total'
fill 9 12 14 13 10 end fill
end array
read plot scr=yes
ttl='xy slice of rfpl showing material regions'
xul=0.0 yul=128.0 zul=12.5
xlr=134 ylr=0.0 zlr=12.5
uax=1 vdn=-1 nax=640 nch='0123456'end
ttl='xy slice of rfpl showing material regions'
xul=0.0 yul=128.0 zul=121.45
xlr=134 ylr=0.0 zlr=121.45
uax=1 vdn=-1 nax=640 nch='0123456'end
'ttl='yz slice of north core second row'
'xul=28 yul=-2 zul=136
'xlr=28 ylr=136 zlr=-2
'vex=1 wdn=-1 nax=640 nch='0123456'end
'ttl='yz slice of south core second row'
'xul=80 yul=-2 zul=136
'xlr=80 ylr=136 zlr=-2
'vex=1 wdn=-1 nax=640 nch='0123456'
'ttl='xz slice of rfpl showing material regions'
'xul=-2 yul=32. zul=136
'xlr=137 ylr=32.0 zlr=-2
'uax=1 wdn=-1 nax=640 nch='0123456'end
end plot
read start nst=1
xsm=15 xsp=122 ysm=15 ysp=122 zsm=30 zsp=122 end start
end data
end

=csas26
rocky flats criticals nureg/cr-0674 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=0.77, hi enriched sphere driven
238groupndf5 infhommedium
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 8.9514e-2 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-al1100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4

```

```

    1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
    3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
    1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
    15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
    3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
    1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 0.7 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 7 2.715 end
uranium 8 0.9516 293.0 92234 1.0 92235 93.19 92236 0.4 92238 5.41 end
arbm-pj 0.816 2 0 0 0 1001 85.1 6012 14.9 8 0.0041 end
ss304 9 1.0 end
end comp
read parm npg=2000 nub=yes fdn=yes plt=yes      run=yes end parm
read geom
unit 1
'com='slotted fuel box'
cuboid 10 9.95 0.0 3.75 0.0 14.98 0.0
cuboid 20 10.1 0.0 3.9 -.15 14.98 0.0
cuboid 30 15.13 .15 9.365 -5.615 14.98 0.0
cuboid 40 15.28 0.0 9.515 -5.765 15.13 -.15
cuboid 50 15.305 -.025 9.54 -5.79 15.155 -.175
media 0 1 10
media 2 1 20 -10
media 1 1 30 -20 -10
media 2 1 40 -30 -20 -10
media 0 1 50 -40 -30 -20 -10
boundary 50
unit 2
'com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 10 6p7.49
cuboid 20 6p7.64
cuboid 30 6p7.6650
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10
boundary 30
unit 3
'com='aluminum weight distribution plate for boxes'
cuboid 10 4p7.665 0.16 0.0
media 7 1 10
boundary 10
unit 4
'com='aluminum weight distribution plate for special box'
cuboid 10 9.80 0.0 3.75 0.0 .16 0.0
cuboid 20 15.33 0.0 9.54 -5.79 .16 0.0
media 0 1 10
media 7 1 20 -10
boundary 20
unit 5
cylinder 10 .3175 2p7.32
sphere 20 7.334
cylinder 30 1.56 .33099 0.0          origin z= -7.6649
cuboid 40 8.512 -6.818 2p7.665 2p7.665
media 9 1 10 20
media 8 1 20 -10
media 9 1 30 -20 -10

```

```

media 0 1 40 -10 -20 -30
boundary 40
unit 9
com='north split table core'
cuboid 10 30.66 0.0 76.65 0.0 77.29 0.0
cuboid 20 30.66 -0.94 77.5 0.0 83.475 0.0
cuboid 30 30.66 -0.94 77.5 0.0 83.475 -16.48
cuboid 40 30.66 -0.94 77.5 0.0 83.475 -17.71
cuboid 50 30.66 -0.94 77.5 0.0 83.475 -25.09
cuboid 60 30.66 -12.544 77.5 0.0 83.475 -25.09
cuboid 70 30.66 -17.744 77.5 0.0 83.475 -25.09
cuboid 80 30.66 -27.544 77.5 0.0 83.475 -25.09
cuboid 90 30.66 -27.544 102.8 -25.3 107.775 -25.09
array 1 10 place 1 1 1 7.665 7.665 7.665
media 0 1 20 -10
media 5 1 30 -20 -10
media 4 1 40 -30 -20 -10
media 5 1 50 -40 -30 -20 -10
media 4 1 60 -50 -40 -30 -20 -10
media 5 1 70 -60 -50 -40 -30 -20 -10
media 4 1 80 -70 -60 -50 -40 -30 -20 -10
media 5 1 90 -80 -70 -60 -50 -40 -30 -20 -10
boundary 90
unit 10
com='south split table core'
cuboid 10 45.99 0.0 76.65 0.0 77.29 0.0
cuboid 20 49.4 0.0 77.5 0.0 83.475 0.0
cuboid 30 49.4 0.0 77.5 0.0 83.475 -1.23
cuboid 40 49.4 0.0 77.5 0.0 83.475 -2.46
cuboid 50 49.4 0.0 77.5 0.0 83.475 -3.69
cuboid 60 49.4 0.0 77.5 0.0 83.475 -4.92
cuboid 70 49.4 0.0 77.5 0.0 83.475 -6.15
cuboid 80 49.4 0.0 77.5 0.0 83.475 -7.38
cuboid 90 74.5 0.0 102.8 -25.3 107.775 -25.09
array 2 10 place 1 1 1 7.665 7.665 7.665
media 0 1 20 -10
media 5 1 30 -20 -10
media 5 1 40 -30 -20 -10
media 4 1 50 -40 -30 -20 -10
media 4 1 60 -50 -40 -30 -20 -10
media 5 1 70 -60 -50 -40 -30 -20 -10
media 4 1 80 -70 -60 -50 -40 -30 -20 -10
media 5 1 90 -80 -70 -60 -50 -40 -30 -20 -10
hole 13 origin x=0.0 y=36.425 z=-25.09
hole 14 origin x=0.0 y=36.425 z=83.475
boundary 90
unit 11
com='air gap'
sphere 10 7.334
cuboid 20 -6.818 -7.619 64.475 -63.625 69.13 -63.735
media 8 1 10
media 0 1 20 -10
boundary 20
global unit 12
com='total'
cuboid 10 133.505 0.0 128.1 0.0 132.865 0.0
array 3 10 place 1 1 1 27.544 25.3 25.09
boundary 10
unit 13
'com='bottom hole'
cuboid 10 9.95 0.0 3.75 0.0 25.09 0.0
media 0 1 10
boundary 10

```

```

unit 14
'com='top hole'
cuboid 10 9.95 0.0 3.75 0.0 24.3 0.0
media 0 1 10
boundary 10
end geometry
read array
ara=1 nux=2 nuy=5 nuz=9
com='north split table core'
fill 10r2
10r3
10r2
10r3
10r2
10r3
10r2
10r3
10r2
10r3
10r2 end fill
ara=2 nux=3 nuy=5 nuz=9
com='south split table core'
fill 6r2 1 8r2
6r3 4 8r3
6r2 1 8r2
6r3 4 8r3
6r2 5 8r2
6r3 4 8r3
6r2 1 8r2
6r3 4 8r3
6r2 1 8r2 end fill
ara=3 nux=3 nuy=1 nuz=1
com='total'
fill 9 11 10 end fill
end array
read plot scr=yes
ttl='xy slice '
xul=0.0 yul=128.1 zul=125.0
xlr=133.505 ylr=0.0 zlr=125.0
uax=1 vdn=-1 nax=640 nch='012345678' end
ttl='xz slice of sphere cuboid'
xul=0.0 yul=64.05 zul=132.865
xlr=133.505 ylr=64.05 zlr=0.0
uax=1 wdn=-1 nax=390 nch='012345678'
end plot
' read start nst=6 tfx=65 tfy=63.625 tfz=63.735 lnu=300 end start
read start nst=1 xsm=56.981 xsp=71.649 ysm=56.219 ysp=70.959
zsm=56.401 zsp=71.069 end start
end data
end

=csas26
rocky flats criticals nureg/cr-0674 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=0.77, low conc. solution driven
238groupndf5 infhommedium
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 8.9514e-2 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2

```

```

1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 0.7 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
arbm-al1100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 7 2.715 end
solnuo2(no3)2 8 86.42 0.149 1.0 293.0 92234 1.022 92235 93.172
92236 0.434 92238 5.372 end
ss304 9 1.0 end
end comp
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=0.77, low conc. solution driven
read parm npg=2000 nub=yes fdn=yes plt=no end parm
read geom
unit 1
com='fuel box with void and part of al box'
cuboid 10 9.80 0.0 3.75 0.0 14.98 0.0
cuboid 20 9.95 0.0 3.90 -0.15 14.98 0.0
cuboid 30 14.98 0.0 9.365 -5.615 14.98 0.0
media 0 1 10
media 2 1 20 -10
media 1 1 30 -20
boundary 30
unit 2
com='front of fuel box'
cuboid 10 0.15 0.0 5.615 0.0 14.98 0.0
cuboid 20 1 0.15 0.0 9.365 0.0 14.98 0.0
cuboid 30 1 0.15 0.0 14.98 0.0 14.98 0.0
media 2 1 10
media 0 1 20 -10
media 2 1 30 -20
boundary 30
unit 3
com='rear of fuel box'
cuboid 10 0.15 0.0 14.98 0.0 14.98 0.0
media 2 1 10
boundary 10
unit 4
com='array to assemble part of box'
array 26 3*0
unit 5
com='top and bottom of box'
cuboid 0 1 9.80 0.0 3.750 0.0 0.15 0.0
cuboid 2 1 15.28 0.0 9.365 -5.615 0.15 0.0
global
unit 6
com='array to assemble top and bottom'
array 27 3*0
cuboid 2 1 15.28 0.0 15.13 -0.15 15.28 0.0
cuboid 0 1 15.305 -0.025 15.155 -0.175 15.305 -0.025
unit 7
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'

```

```

cuboid 1 1 6p7.49
cuboid 2 1 6p7.64
cuboid 0 1 6p7.6650
unit 34
com='aluminum weight distribution plate for special box'
cuboid 0 1 9.80 0.0 3.750 0.0 0.16 0.0
cuboid 7 1 15.33 0.0 9.54 -5.79 0.16 0.0
unit 35
com='aluminum weight distribution plate for boxes'
cuboid 7 1 4p7.665 0.16 0.0
unit 9
com='north split table core'
array 1 3*0.0
cuboid 0 1 30.66 -0.94 77.5 0.0 83.475 0.0
unit 10
com='south split table core'
array 2 3*0.0
cuboid 0 1 49.4 0.0 77.5 0.0 83.475 0.0
unit 11
com='plexiglass reflector sheet without tris, north bottom reflector'
cuboid 4 1 2p15.8000 2p38.7500 2p0.6150
unit 12
com='plexiglass reflector sheet with tris, north bottom reflector'
cuboid 5 1 2p15.8000 2p38.7500 2p0.6150
unit 13
com='upper portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p8.24
unit 14
com='lower portion north bottom reflector with tris'
cuboid 5 1 2p15.8 2p38.75 2p3.69
unit 15
com='north bottom reflector includes regular and tris'
array 3 3*0.0
unit 16
com='plexiglas sheet bottom south reflector without tris'
cuboid 0 1 2p5.1 2p2.5 2p0.6150
cuboid 4 1 44.3 -5.1 2p38.75 2p0.615
unit 17
com='plexiglas sheet bottom south reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p0.6150
cuboid 5 1 44.3 -5.1 2p38.75 2p0.6150
unit 18
com='lower portion south bottom reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p8.855
cuboid 5 1 44.3 -5.1 2p38.75 2p8.855
unit 19
com='south bottom reflector with regular and tris'
array 4 3*0.0
unit 20
com='east and west reflectors for north reflector with tris'
cuboid 5 1 2p15.8 2p12.65 2p54.2825
unit 21
com='array for east and west reflectors for north reflector'
array 5 3*0.0
unit 22
com='east and west reflectors for south reflector with tris'
cuboid 5 1 2p24.700 2p12.65 2p54.2825
unit 23
com='array for east and west reflectors for south reflector'
array 6 3*0.0
unit 24
com='north top reflector with tris'
cuboid 5 1 2p28.35 2p64.05 2p12.15

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unit 25
com='array for north top reflector'
array 7 3*0.0
unit 26
com='south top reflector with tris'
cuboid 0 1 2p5.1 2p2.5 2p12.15
cuboid 5 1 69.4 -5.1 2p64.05 2p12.15
unit 27
com='array for south top reflector'
array 8 3*0.0
unit 28
com='north end reflector 9.8cm portion without tris'
cuboid 4 1 2p4.9000 2p64.0500 2p54.2825
unit 29
com='north end reflector 5.2 cm portion with tris'
cuboid 5 1 2p2.6 2p64.0500 2p54.2825
unit 30
com='north end reflector 10.1 cm portion without tris'
cuboid 4 1 2p5.05 2p64.05 2p54.2825
unit 31
com='array for north end reflector'
array 9 3*0.0
unit 32
com='south end reflector'
cuboid 5 1 2p12.55 2p64.05 2p54.2825
unit 33
com='array for south end reflector'
array 10 3*0.0
unit 38
com='north core with bottom reflector'
array 13 3* 0.0
unit 39
com='north core with east and west reflector'
array 14 3*0.0
unit 40
com='north core with end reflector'
array 15 3*0.0
unit 42
com='north core with top reflector'
array 16 3*0.0
unit 48
com='south core with bottom reflectors'
array 20 3*0.0
unit 49
com='south core with east west reflectors'
array 21 3*0.0
unit 50
com='south core end reflector'
array 22 3*0.0
unit 52
com='south core with top reflector'
array 23 3*0.0
unit 54
com='air gap'
cuboid 0 1 0.912 0.0 64.475 -63.625 69.13 -63.735
global
unit 55
com='total'
array 25 3*0.0
unit 56
com='combination of two regular fuel boxes'
array 28 3*0.0

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unit 57
com='combination of regular fuel box and special fuel box'
array 29 3*0.0
unit 58
com='combination of two regular weight distribution plates'
array 30 3*0.0
unit 59
com='combination of regular and special weight distribution plates'
array 31 3*0.0
unit 60
com='north core solution driver'
cuboid 8 1 2p7.5 2p14.9 5.374 -7.5
cuboid 0 1 2p7.5 2p14.9 2p7.5
cuboid 9 1 2p7.65 2p15.05 2p7.65
cuboid 0 1 2p7.665 2p15.33 2p7.665
unit 61
com='north core solution driver'
cuboid 8 1 2p7.5 2p14.9 5.328 -7.5
cuboid 0 1 2p7.5 2p14.9 2p7.5
cuboid 9 1 2p7.65 2p15.05 2p7.65
cuboid 0 1 2p7.665 2p15.33 2p7.665
end geometry
read array
ara=1 nux=2 nuy=4 nuz=9
com='north split table core'
fill 2r7 2r56 4r7
    2r35 2r58 4r35
    2r7 2r56 4r7
    2r35 2r58 4r35
    2r7 56 60 4r7
    2r35 2r58 4r35
    2r7 2r56 4r7
    2r35 2r58 4r35
    2r7 2r56 4r7
end fill
ara=2 nux=3 nuy=4 nuz=9
com='south split table core'
fill 3r7 3r56 6r7
    3r35 3r58 6r35
    3r7 3r56 6r7
    3r35 3r58 6r35
    3r7 61 56 56 6r7
    3r35 3r58 6r35
    3r7 57 56 56 6r7
    3r35 59 58 58 6r35
    3r7 57 56 56 6r7
end fill
ara=3 nux=1 nuy=1 nuz=3
com='north bottom reflector'
fill 14 11 13 end fill
ara=4 nux=1 nuy=1 nuz=7
com='south bottom reflector'
fill 18 16 17 16 16 17 17 end fill
ara=5 nux=1 nuy=1 nuz=1
com='east and west walls of north reflector'
fill 20 end fill
ara=6 nux=1 nuy=1 nuz=1
com='east and west walls of south reflector'
fill 22 end fill
ara=7 nux=1 nuy=1 nuz=1
com='array for north top reflector'
fill 24 end fill
ara=8 nux=1 nuy=1 nuz=1

```

```

com='array for south top reflector'
fill 26 end fill
ara=9 nux=3 nuy=1 nuz=1
com='array for north end reflector'
fill 28 29 30 end fill
ara=10 nux=1 nuy=1 nuz=1
com='array for south end reflector'
fill 32 end fill
ara=13 nux=1 nuy=1 nuz=2
com='combination of north core with bottom reflector'
fill 15 9 end fill
ara=14 nux=1 nuy=3 nuz=1
com='north core with side reflectors'
fill 21 38 21 end fill
ara=15 nux=2 nuy=1 nuz=1
com='north core with end reflector'
fill 31 39 end fill
ara=16 nux=1 nuy=1 nuz=2
com='north core with top reflector'
fill 40 25 end fill
ara=20 nux=1 nuy=1 nuz=2
com='south core with bottom reflector'
fill 19 10 end fill
ara=21 nux=1 nuy=3 nuz=1
com='south core with east west reflectors'
fill 23 48 23 end fill
ara=22 nux=2 nuy=1 nuz=1
com='south core with end reflector'
fill 49 33 end fill
ara=23 nux=1 nuy=1 nuz=2
com='combination of core with top reflector'
fill 50 27 end fill
ara=25 nux=3 nuy=1 nuz=1
com='total'
fill 42 54 52 end fill
ara=26 nux=3 nuy=1 nuz=1
com='assembly of fuel box front and rear'
fill 2 1 3 end fill
ara=27 nux=1 nuy=1 nuz=3
com='assembly of fuel box top and bottom'
fill 5 4 5 end fill
ara=28 nux=1 nuy=2 nuz=1
com='combination of two fuel boxes'
fill 7 7 end fill
ara=29 nux=1 nuy=2 nuz=1
com='combination of special and regular fuel boxes'
fill 7 6 end fill
ara=30 nux=1 nuy=2 nuz=1
com='combination of two weight distribution plates'
fill 35 35 end fill
ara=31 nux=1 nuy=2 nuz=1
com='combination of special and regular weight distribution plates'
fill 35 34 end fill
end array
read plot ttl='yz slice of south core first row'
xul=64.319 yul=40.000 zul=72.000
xlr=64.319 ylr=72.000 zlr=56.000
vax=1 wdn=-1 nax=130 nch='012345678'end
ttl='xz slice of sphere cuboid'
xul=56.0 yul=63.625 zul=71.735
xlr=72.0 ylr=63.625 zlr=55.735
uax=1 wdn=-1 nax=130 nch='012345678'
end plot

```

```

read start nst=1 xsm=41.37 xsp=72.894 ysm=40.63 ysp=71.29
  zsm=56.071 zsp=71.4    end start
end data
end

=csas26
rocky flats criticals nureg/cr-1653 experiment a (27 group)
' 48 fuel cans 2.44 cm moderator gee.hu125.data(opt)
238groupndf5 latticecell
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 1.5627e-1 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
  end
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
  end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
  25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
  1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
  1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
  3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
  1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
  15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
  3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
  1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 .888 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
end comp
sphtriangp 19.9462 18.5857 1 3 18.9579 2 end
' 48 fuel cans 2.44 cm moderator gee.hu77.data(opt1)
read parm run=yes npg=2000
nub=yes fdn=yes plt=yes run=yes
end parm
read geom
unit 1
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 10 6p7.49
cuboid 20 6p7.64
cuboid 30 6p7.6650
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 2
com='x-face interstitial moderator'
cuboid 10 2p1.2200 4p7.665
media 3 1 10
boundary 10
unit 3
com='y-face interstitial moderator'
cuboid 10 2p7.665 2p1.2200 2p7.665
media 3 1 10
boundary 10

```

```

unit 4
com='z-face interstitial moderator'
cuboid 10 4p7.665 2p1.2200
media 3 1 10
boundary 10
unit 5
com='more x-face moderator'
cuboid 10 4p1.2200 2p7.665
media 3 1 10
boundary 10
unit 6
com='more y-face moderator'
cuboid 10 2p7.665 4p1.2200
media 3 1 10
boundary 10
unit 7
com='more z-face moderator'
cuboid 10 2p1.2200 2p7.665 2p1.2200
media 3 1 10
boundary 10
unit 8
com='last of interstitial moderator'
cuboid 10 6p1.2200
media 3 1 10
boundary 10
unit 56
com='empty fuel location'
cuboid 10 6p7.6650
media 0 1 10
boundary 10
unit 61
com='y-face moderator void'
cuboid 10 2p7.665 2p1.22 2p7.665
media 0 1 10
boundary 10
unit 62
com='x-face moderator void'
cuboid 10 2p1.22 4p7.665
media 0 1 10
boundary 10
unit 9
com='north split table core'
cuboid 10 33.1 0.0 68.64 0.0 50.87 0.0
cuboid 20 33.1 0.0 72.75 -4.75 50.87 0.0
cuboid 25 33.1 0.0 72.75 -4.75 57.375 -26.1
cuboid 30 33.1 0.0 98.05 -30.05 81.675 -42.58
cuboid 40 33.1 0.0 98.05 -30.05 81.675 -43.81
cuboid 50 33.1 0.0 98.05 -30.85 81.675 -51.19
cuboid 60 42.9 0.0 98.05 -30.05 81.675 -51.19
cuboid 70 48.1 0.0 98.05 -30.05 81.675 -51.19
cuboid 80 57.7 0.0 98.05 -30.05 81.675 -51.19
cuboid 90 57.7 -1.23 98.05 -30.05 81.675 -51.19
array 1 10 place 1 1 1 7.6650 7.6650 7.6650
media 5 1 20 -10
media 6 1 25 -20 -10
media 5 1 30 -20 -10 -25
media 4 1 40 -30 -20 -10 -25
media 5 1 50 -40 -30 -20 -10 -25
media 4 1 60 -50 -40 -30 -20 -10 -25
media 5 1 70 -60 -50 -40 -30 -20 -10 -25
media 4 1 80 -70 -60 -50 -40 -30 -20 -10 -25
media 3 1 90 -80 -70 -60 -50 -40 -30 -20 -10 -25
boundary 90

```

```

unit 10
com='south split table core'
cuboid 10 33.1 0.0 68.64 0.0 50.87 0.0
cuboid 20 33.1 0.0 72.75 -4.75 50.87 0.0
cuboid 25 33.1 -16.3 72.75 -4.75 57.375 -26.1
cuboid 30 33.1 -16.3 72.75 -4.75 57.375 -27.33
cuboid 40 33.1 -16.3 72.75 -4.75 57.375 -28.56
cuboid 50 33.1 -16.3 72.75 -4.75 57.375 -29.79
cuboid 60 33.1 -16.3 72.75 -4.75 57.375 -31.02
cuboid 70 33.1 -16.3 72.75 -4.75 57.375 -32.25
cuboid 80 33.1 -16.3 72.75 -4.75 57.375 -33.48
cuboid 90 33.1 -41.4 98.05 -30.05 81.675 -51.19
cuboid 100 34.33 -41.4 98.05 -30.05 81.675 -51.19
array 2 10 place 1 1 1 7.6650 7.6650 7.6650
media 5 1 20 -10
media 6 1 25 -20 -10
media 5 1 30 -20 -10 -25
media 5 1 40 -30 -20 -10 -25
media 4 1 50 -40 -30 -20 -10 -25
media 4 1 60 -50 -40 -30 -20 -10 -25
media 5 1 70 -60 -50 -40 -30 -20 -10 -25
media 4 1 80 -70 -60 -50 -40 -30 -20 -10 -25
media 5 1 90 -80 -70 -60 -50 -40 -30 -20 -10 -25
media 3 1 100 -90 -80 -70 -60 -50 -40 -30 -20 -10 -25
hole 12 origin x=28. y=34. z=-38.645
hole 13 origin x=28. y=34. z=69.525
boundary 100
global unit 11
cuboid 10 93.26 -41.4 98.05 -30.05 81.675 -51.19
array 3 10 place 1 1 1 0.0 0.0 0.0
boundary 10
unit 12
cuboid 10 5.1 -5.1 2.5 -2.5 12.545 -12.545
media 0 1 10
boundary 10
unit 13
cuboid 10 5.1 -5.1 2.5 -2.5 12.15 -12.15
media 0 1 10
boundary 10
end geometry
read array
ara=1 nux=3 nuy=7 nuz=5
com='north split table core'
fill 1 2 1 3 5 3 2q6 1 2 1
4 7 4 6 8 6 2q6 4 7 4
1q42
1 2 56 3 5 61 1 2 56 3 5 61 1q6 56 62 56 end fill
ara=2 nux=3 nuy=7 nuz=5
com='south split table core'
fill 1 2 1 3 5 3 2q6 1 2 1
4 7 4 6 8 6 2q6 4 7 4
1q42
56 2 1 61 5 3 2q6 56 62 56 end fill
ara=3 nux=2 nuy=1 nuz=1
fill 10 9 end fill
end array
read plot scr=yes
ttl='xy slice '
xul=-50.0 yul=98.0 zul=50.0
xlr=93.0 ylr=-30.0 zlr=50.0
uax=1 vdn=-1 nax=640 nch='0123456' end
ttl='xz slice '
xul=-50.0 yul=0.0 zul=81.0

```

```

xlr=93.0 ylr=0.0 zlr=-51.0
uax=1 wdn=-1 nax=640 nch='0123456' end
end plot
end data
end

=csas26
rocky flats criticals nureg/cr-1653 experiment c (27 group)
' 80 fuel cans 0.929 cm moderator gee.hu125.data(und2)
238groupndf5 latticecell
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 1.5627e-1 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 .854 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
end comp
sphtriangp 19.00 18.5857 1 3 18.9579 2 end
' 80 fuel cans 0.929 cm moderator gee.hu125.data(und2)
read parm run=yes npg=2000 fdn=yes nub=yes plt=yes end parm
read geom
unit 1
com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 10 6p7.49
cuboid 20 6p7.64
cuboid 30 6p7.6650
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10
boundary 30
unit 2
com='x-face interstitial moderator'
cuboid 10 2p0.4645 4p7.665
media 3 1 10
boundary 10
unit 3
com='y-face interstitial moderator'
cuboid 10 2p7.665 2p0.4645 2p7.665
media 3 1 10
boundary 10

```

```

unit 4
com='z-face interstitial moderator'
cuboid 10 4p7.665 2p0.4645
media 3 1 10
boundary 10
unit 5
com='more x-face moderator'
cuboid 10 4p0.4645 2p7.665
media 3 1 10
boundary 10
unit 6
com='more y-face moderator'
cuboid 10 2p7.665 4p0.4645
media 3 1 10
boundary 10
unit 7
com='more z-face moderator'
cuboid 10 2p0.4645 2p7.665 2p0.4645
media 3 1 10
boundary 10
unit 8
com='last of interstitial moderator'
cuboid 10 6p0.4645
media 3 1 10
boundary 10
unit 9
com='north split table core'
cuboid 10 31.589 0.0 64.107 0.0 64.107 0.0
cuboid 20 31.589 0.0 77.057 0.0 67.057 -16.259
cuboid 30 31.589 0.0 102.357 -25.3 67.057 -32.739
cuboid 40 31.589 0.0 102.357 -25.3 67.057 -33.969
cuboid 50 31.589 0.0 102.357 -25.3 67.057 -41.349
cuboid 60 41.389 0.0 102.357 -25.3 67.057 -41.349
cuboid 70 46.589 0.0 102.357 -25.3 67.057 -41.349
cuboid 80 56.689 0.0 102.357 -25.3 67.057 -41.349
cuboid 90 56.689 0.0 102.357 -25.3 91.357 -41.349
cuboid 100 56.689 -1.23 102.357 -25.3 91.357 -41.349
array 1 10 place 1 1 1 7.665 7.665 7.665
media 6 1 20 -10
media 5 1 30 -20 -10
media 4 1 40 -30 -20 -10
media 5 1 50 -40 -30 -20 -10
media 4 1 60 -50 -40 -30 -20 -10
media 5 1 70 -60 -50 -40 -30 -20 -10
media 4 1 80 -70 -60 -50 -40 -30 -20 -10
media 5 1 90 -80 -70 -60 -50 -40 -30 -20 -10
media 3 1 100 -90 -80 -70 -60 -50 -40 -30 -20 -10
boundary 100
unit 10
com='south split table core'
cuboid 10 47.848 0.0 64.107 0.0 64.107 0.0
cuboid 20 47.848 0.0 77.057 0.0 67.057 0.0
cuboid 30 47.8480 -1.552 77.5 0.0 67.057 0.0
cuboid 40 47.8480 -1.552 77.5 0.0 67.057 -16.259
cuboid 50 47.8480 -1.552 102.357 -25.3 67.057 -16.259
cuboid 60 47.848 -1.552 102.357 -25.3 67.057 -18.719
cuboid 70 47.848 -1.552 102.357 -25.3 67.057 -21.179
cuboid 80 47.848 -1.552 102.357 -25.3 67.057 -22.409
cuboid 90 47.848 -1.552 102.357 -25.3 67.057 -23.639
cuboid 100 47.848 -26.652 102.357 -25.3 91.357 -41.349
cuboid 110 49.078 -26.652 102.357 -25.3 91.357 -41.349
array 2 10 place 1 1 1 7.665 7.665 7.665
media 6 1 20 -10

```

```

media 0 1 30 -20 -10
media 6 1 40 -30 -20 -10
media 5 1 50 -40 -30 -20 -10
media 5 1 60 -50 -40 -30 -20 -10
media 4 1 70 -60 -50 -40 -30 -20 -10
media 5 1 80 -70 -60 -50 -40 -30 -20 -10
media 4 1 90 -80 -70 -60 -50 -40 -30 -20 -10
media 5 1 100 -90 -80 -70 -60 -50 -40 -30 -20 -10
media 3 1 110 -100 -90 -80 -70 -60 -50 -40 -30 -20 -10
hole 11      origin x=42.748   y=32.0535   z=79.207
hole 12      origin x=42.748   y=32.0535   z=-28.804
boundary 110
unit 11
cuboid 10 5.1 -5.1 2.5 -2.5 12.15 -12.15
media 0 1 10
boundary 10
unit 12
cuboid 10 5.1 -5.1 2.5 -2.5 12.545 -12.545
media 0 1 10
boundary 10
unit 54
com='air gap'
cuboid 10 2p0.7805    102.357 -25.3 91.357 -41.349
media 0 1 10
boundary 10
global
unit 55
com='total'
cuboid 10 108.558 -26.652 102.357 -25.3 91.357 -41.349
array 3 10      place 1 1 1      0.0 0.0 0.0
boundary 10
end geometry
read array
ara=1 nux=3 nuy=7 nuz=7
com='north split table core'
fill 1 2 1 3 5 3 2q6 1 2 1
4 7 4 6 8 6 2q6 4 7 4
2q42
1 2 1 3 5 3 2q6 1 2 1 end fill
ara=2 nux=5 nuy=7 nuz=7
com='south split table core'
fill 1 2 1 2 1 3 5 3 5 3 2q10 1 2 1 2 1
4 7 4 7 4 6 8 6 8 6 2q10 4 7 4 7 4
2q70
1 2 1 2 1 3 5 3 5 3 2q10 1 2 1 2 1 end fill
ara=3 nux=3 nuy=1 nuz=1
com='total'
fill 10 54 9      end fill
end array
read plot scr=yes
ttl='xy slice'
xul=-30.0 yul=105.0 zul=-28.8
xlr=110.0 ylr=-30.0 zul=-28.8
uax=1 vdn=-1 nax=640 nch='0123456' end
ttl='xz slice of rfp3 showing material regions'
xul=-27 yul=64.05 zul=92.0
xlr=110 ylr=64.05 zlr=-46.0
uax=1 wdn=-1 nax=640 nch='0123456' end
ttl='yz slice of north core second row'
xul=28 yul=-30 zul=92.0
xlr=28 ylr=136 zlr=-46.0
vax=1 wdn=-1 nax=640 nch='0123456' end
ttl='yz slice of south core second row'

```

```

xul=80 yul=-30 zul=92.0
xlr=80 ylr=136 zlr=-46.0
vax=1 wdn=-1 nax=640 nch='0123456'
end plot
end data
end

=csas26
rocky flats criticals nureg/cr-1653 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=1.25, hi conc. solution driven
238groupndf5 infhommedium
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 1.5627e-1 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-120
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 0.7 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 7 2.715 end
solnuo2(no3)2 8 351.18 0.549 1.0 293.0 92234 1.022 92235 93.172
92236 0.434 92238 5.372 end
ss304 9 1.0 end
end comp
read parm npg=2000 nub=yes fdn=yes plt=yes run=yes end parm
read geom
unit 1
'com='slotted fuel box'
cuboid 10 9.95 0.0 3.75 0.0 14.98 0.0
cuboid 20 10.1 0.0 3.9 -.15 14.98 0.0
cuboid 30 15.13 .15 9.365 -5.615 14.98 0.0
cuboid 40 15.28 0.0 9.515 -5.765 15.13 -.15
cuboid 50 15.305 -.025 9.54 -5.79 15.155 -.175
media 0 1 10
media 2 1 20 -10
media 1 1 30 -20 -10
media 2 1 40 -30 -20 -10
media 0 1 50 -40 -30 -20 -10
boundary 50
unit 2
'com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 10 6p7.49
cuboid 20 6p7.64
cuboid 30 6p7.6650

```

```

media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10
boundary 30
unit 3
'com='aluminum weight distribution plate for boxes'
cuboid 10 4p7.665 0.16 0.0
media 7 1 10
boundary 10
unit 4
'com='aluminum weight distribution plate for special box'
cuboid 10 9.80 0.0 3.75 0.0 .16 0.0
cuboid 20 15.33 0.0 9.54 -5.79 .16 0.0
media 0 1 10
media 7 1 20 -10
boundary 20
unit 5
com='solution driver'
cuboid 10 2p7.5 2p14.9 1.863 -7.5
cuboid 20 2p7.5 2p14.9 2p7.5
cuboid 30 2p7.65 2p15.05 2p7.65
cuboid 40 2p7.665 2p15.33 2p7.665
media 8 1 10
media 0 1 20 -10
media 9 1 30 -20 -10
media 0 1 40 -30 -20 -10
boundary 40
unit 9
com='north split table core'
cuboid 10 30.66 0.0 76.65 0.0 77.29 0.0
cuboid 20 30.66 -0.94 77.5 0.0 83.475 0.0
cuboid 30 30.66 -0.94 77.5 0.0 83.475 -16.48
cuboid 40 30.66 -0.94 77.5 0.0 83.475 -17.71
cuboid 50 30.66 -0.94 77.5 0.0 83.475 -25.09
cuboid 60 30.66 -12.544 77.5 0.0 83.475 -25.09
cuboid 70 30.66 -17.744 77.5 0.0 83.475 -25.09
cuboid 80 30.66 -27.544 77.5 0.0 83.475 -25.09
cuboid 90 30.66 -27.544 102.8 -25.3 107.775 -25.09
array 1 10 place 1 1 1 7.665 7.665 7.665
media 0 1 20 -10
media 5 1 30 -20 -10
media 4 1 40 -30 -20 -10
media 5 1 50 -40 -30 -20 -10
media 4 1 60 -50 -40 -30 -20 -10
media 5 1 70 -60 -50 -40 -30 -20 -10
media 4 1 80 -70 -60 -50 -40 -30 -20 -10
media 5 1 90 -80 -70 -60 -50 -40 -30 -20 -10
hole 5 origin x=22.995 y=46.31 z=38.645
boundary 90
unit 10
com='south split table core'
cuboid 10 45.99 0.0 76.65 0.0 77.29 0.0
cuboid 20 49.4 0.0 77.5 0.0 83.475 0.0
cuboid 30 49.4 0.0 77.5 0.0 83.475 -1.23
cuboid 40 49.4 0.0 77.5 0.0 83.475 -2.46
cuboid 50 49.4 0.0 77.5 0.0 83.475 -3.69
cuboid 60 49.4 0.0 77.5 0.0 83.475 -4.92
cuboid 70 49.4 0.0 77.5 0.0 83.475 -6.15
cuboid 80 49.4 0.0 77.5 0.0 83.475 -7.38
cuboid 90 74.5 0.0 102.8 -25.3 107.775 -25.09
array 2 10 place 1 1 1 7.665 7.665 7.665
media 0 1 20 -10 -
media 5 1 30 -20 -10 -

```

```

media 5 1 40 -30 -20 -10 -
media 4 1 50 -40 -30 -20 -10 -
media 4 1 60 -50 -40 -30 -20 -10
media 5 1 70 -60 -50 -40 -30 -20 -10
media 4 1 80 -70 -60 -50 -40 -30 -20 -10
media 5 1 90 -80 -70 -60 -50 -40 -30 -20 -10
hole 13      origin x=0.0  y=36.425  z=-25.09
hole 14      origin x=0.0  y=36.425  z=83.475
hole 5       origin x=7.665  y=46.31   z=38.645
boundary 90
unit 11
com='air gap'
cuboid 10 -6.818  -7.619  64.475  -63.625  69.13  -63.735
media 0 1 10
boundary 10
global unit 12
com='total'
cuboid 10 133.505  0.0 128.1  0.0 132.865  0.0
array 3 10      place 1 1 1        27.544    25.3    25.09
boundary 10
unit 13
'com='bottom hole'
cuboid 10 9.95    0.0     3.75     0.0     25.09   0.0
media 0 1 10
boundary 10
unit 14
'com='top hole'
cuboid 10 9.95    0.0     3.75     0.0     24.3    0.0
media 0 1 10
boundary 10
end geometry
read array
ara=1 nux=2 nuy=5 nuz=9
com='north split table core'
fill 10r2
  10r3
  10r2
  10r3
  10r2
  10r3
  10r2
  10r3
  10r2   end fill
ara=2 nux=3 nuy=5 nuz=9
com='south split table core'
fill 6r2 2 8r2
  6r3 3 8r3
  6r2 2 8r2
  6r3 3 8r3
  6r2 2 8r2
  6r3 3 8r3
  6r2 1 8r2
  6r3 4 8r3
  6r2 1 8r2   end fill
ara=3 nux=3 nuy=1 nuz=1
com='total'
fill 9 11 10  end fill
end array
read plot scr=yes
ttl='xy slice '
xul=0.0 yul=128.1 zul=63.0
xlr=133.505 ylr=0.0 zlr=63.0
uax=1 vdn=-1 nax=640 nch='012345678'end

```

```

ttl='xz slice of sphere cuboid'
xul=0.0 yul=64.05 zul=132.865
xlr=133.505 ylr=64.05 zlr=0.0
uax=1 wdn=-1 nax=640 nch='012345678'
end plot
' read start nst=6 tfx=65 tfy=63.625 tfz=63.735 lnu=300 end start
read start nst=1 xsm=56.981 xsp=71.649 ysm=56.219 ysp=70.959
zsm=56.401 zsp=71.069 end start
end data
end

=csas26
rocky flats criticals nureg/cr-2500 experiment number ? (27 group model)
' fuel cube 15.28 cm, u(4.46)3o8 @ h/u=2.03, hi enriched sphere driven
238groupndf5 infhommedium
u3o8 1 5.4078e-1 293.0 92234 0.03 92235 4.46 92236 0.08 92238 95.43 end
h2o 1 2.6356e-1 end
arbm-baggie 1.0 3 0 0 0 1001 14.01 6012 84.79 8016 1.20 1 1.9134e-2
end
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 2 9.5390e-1
end
arbm-tape(vinyl) 1.0 7 0 0 0 1001 5.92 6012 47.93 8016 10.82 17000
25.73 20000 6.9 22000 1.6 82000 1.1 2 1.1115e-2 end
arbm-tape(mylar) 1.0 3 0 0 0 1001 6.83 6012 66.15 8016 27.02 2
1.7491e-2 end
arbm-moderator 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 3 end
arbm-plex(reg) 1.0 3 0 0 0 1001 7.84 6012 59.93 8016 32.23 4
1.1773 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 4
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 4
1.1648e-3 end
arbm-plex(tris) 1.0 8 0 0 1 1001 7.16 6012 52.93 7014 0.16 8016 29.82
15031 1.02 17000 1.81 35079 4.260 35081 2.840 5 1.2757 end
arbm-plex(paper) 1.0 3 0 0 0 1001 6.48 6012 42.17 8016 51.35 5
3.7534e-3 end
arbm-plex(glue) 1.0 3 0 0 0 1001 11.67 6012 87.13 8016 1.20 5
1.1648e-3 end
arbm-filler 1.185 3 0 0 0 1001 7.83 6012 59.69 8016 32.48 6 0.7 end
' this material is actually moderator adjusted for the volume
' fraction of the void filled between core and reflector.
arbm-all100 1.0 3 0 0 1 13027 99.3 26000 0.5 29000 0.2 7 2.715 end
uranium 8 0.9483 293.0 92234 1.0 92235 93.19 92236 0.4 92238 5.41 end
arbm-pj 0.816 2 0 0 0 1001 85.1 6012 14.9 8 0.0089 end
ss304 9 1.0 end
end comp
read parm npg=2000 nub=yes fdn=yes plt=yes run=yes end parm
read geom
unit 1
'com='slotted fuel box'
cuboid 10 9.95 0.0 3.75 0.0 14.98 0.0
cuboid 20 10.1 0.0 3.9 -.15 14.98 0.0
cuboid 30 15.13 .15 9.365 -5.615 14.98 0.0
cuboid 40 15.28 0.0 9.515 -5.765 15.13 -.15
cuboid 50 15.305 -.025 9.54 -5.79 15.155 -.175
media 0 1 10
media 2 1 20 -10
media 1 1 30 -20 -10
media 2 1 40 -30 -20 -10
media 0 1 50 -40 -30 -20 -10
boundary 50

```

```

unit 2
'com='fuel box 15.28 cm on a side with .15 cm walls .05cm stacking void'
cuboid 10 6p7.49
cuboid 20 6p7.64
cuboid 30 6p7.6650
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10
boundary 30
unit 3
'com='aluminum weight distribution plate for boxes'
cuboid 10 4p7.665 0.16 0.0
media 7 1 10
boundary 10
unit 4
'com='aluminum weight distribution plate for special box'
cuboid 10 9.80 0.0 3.75 0.0 .16 0.0
cuboid 20 15.33 0.0 9.54 -5.79 .16 0.0
media 0 1 10
media 7 1 20 -10
boundary 20
unit 5
cylinder 10 .3175 2p5.675
sphere 15 2.34
sphere 20 5.67
cylinder 30 1.56 2.2 0.0 origin z= -7.6649
cuboid 40 8.512 -6.818 2p7.665 2p7.665
media 9 1 10
media 0 1 15 -10
media 8 1 20 -15 -10
media 9 1 30 -20 -10 -15
media 0 1 40 -10 -20 -30
boundary 40
unit 9
com='north split table core'
cuboid 10 30.66 0.0 76.65 0.0 77.29 0.0
cuboid 20 30.66 -0.94 77.5 0.0 83.475 0.0
cuboid 30 30.66 -0.94 77.5 0.0 83.475 -16.48
cuboid 40 30.66 -0.94 77.5 0.0 83.475 -17.71
cuboid 50 30.66 -0.94 77.5 0.0 83.475 -25.09
cuboid 60 30.66 -12.544 77.5 0.0 83.475 -25.09
cuboid 70 30.66 -17.744 77.5 0.0 83.475 -25.09
cuboid 80 30.66 -27.544 77.5 0.0 83.475 -25.09
cuboid 90 30.66 -27.544 102.8 -25.3 107.775 -25.09
array 1 10 place 1 1 1 7.665 7.665 7.665
media 0 1 20 -10
media 5 1 30 -20 -10
media 4 1 40 -30 -20 -10
media 5 1 50 -40 -30 -20 -10
media 4 1 60 -50 -40 -30 -20 -10
media 5 1 70 -60 -50 -40 -30 -20 -10
media 4 1 80 -70 -60 -50 -40 -30 -20 -10
media 5 1 90 -80 -70 -60 -50 -40 -30 -20 -10
boundary 90
unit 10
com='south split table core'
cuboid 10 45.99 0.0 76.65 0.0 77.29 0.0
cuboid 20 49.4 0.0 77.5 0.0 83.475 0.0
cuboid 30 49.4 0.0 77.5 0.0 83.475 -1.23
cuboid 40 49.4 0.0 77.5 0.0 83.475 -2.46
cuboid 50 49.4 0.0 77.5 0.0 83.475 -3.69
cuboid 60 49.4 0.0 77.5 0.0 83.475 -4.92
cuboid 70 49.4 0.0 77.5 0.0 83.475 -6.15

```

```

cuboid  80  49.4  0.0  77.5  0.0  83.475  -7.38
cuboid  90  74.5  0.0  102.8 -25.3  107.775 -25.09
array   2 10 place 1 1 1 7.665  7.665  7.665
media   0 1 20 -10
media   5 1 30 -20 -10
media   5 1 40 -30 -20 -10
media   4 1 50 -40 -30 -20 -10
media   4 1 60 -50 -40 -30 -20 -10
media   5 1 70 -60 -50 -40 -30 -20 -10
media   4 1 80 -70 -60 -50 -40 -30 -20 -10
media   5 1 90 -80 -70 -60 -50 -40 -30 -20 -10
hole 13      origin x=0.0  y=36.425  z=-25.09
hole 14      origin x=0.0  y=36.425  z=83.475
boundary 90
unit 11
com='air gap'
cuboid 10 -6.818 -7.619 64.475 -63.625 69.13 -63.735
media 0 1 10
boundary 10
global unit 12
com='total'
cuboid 10 133.505 0.0 128.1 0.0 132.865 0.0
array 3 10     place 1 1 1       27.544    25.3   25.09
boundary 10
unit 13
'com='bottom hole'
cuboid 10 9.95   0.0     3.75     0.0     25.09  0.0
media 0 1 10
boundary 10
unit 14
'com='top hole'
cuboid 10 9.95   0.0     3.75     0.0     24.3   0.0
media 0 1 10
boundary 10
end geometry
read array
ara=1 nux=2 nuy=5 nuz=9
com='north split table core'
fill 10r2
  10r3
  10r2
  10r3
  10r2
  10r3
  10r2
  10r3
  10r2   end fill
ara=2 nux=3 nuy=5 nuz=9
com='south split table core'
fill 6r2 1 8r2
  6r3 4 8r3
  6r2 1 8r2
  6r3 4 8r3
  6r2 5 8r2
  6r3 4 8r3
  6r2 1 8r2
  6r3 4 8r3
  6r2 1 8r2   end fill
ara=3 nux=3 nuy=1 nuz=1
com='total'
fill 9 11 10  end fill
end array

```

```

read plot    scr=yes
ttl='xy slice '
xul=0.0  yul=128.1  zul=125.0
xlr=133.505 ylr=0.0  zlr=125.0
uax=1  vdn=-1 nax=640  nch='012345678'end
ttl='xz slice of sphere cuboid'
xul=0.0  yul=64.05 zul=132.865
xlr=133.505 ylr=64.05 zlr=0.0
uax=1  wdn=-1 nax=640  nch='012345678'
end plot
' read start  nst=6 tfx=65 tfy=63.625 tfz=63.735 lnu=300  end start
read start  nst=1 xsm=56.981 xsp=71.649 ysm=56.219 ysp=70.959
zsm=56.401 zsp=71.069  end start
end data
end

=csas26
british handbook of criticality safety u(1.42)f4 & paraffin (case 04)
238groupndf5  infhommedium
uf4      1 0.4903 293 92235 1.4023 92238 98.5977 end
' note: the enrichment given in the refrence is not weight percent
para(h2o) 1 0.4572 end
end comp
read parm   npg=2000 nub=yes fdn=yes end parm
read geom
global unit 1
cuboid  10 2p46.55 2p46.50 2p61.9
media  1 1 10
boundary 10
end geom
end data
end

=csas26
british handbook of criticality safety u(1.42)f4 & paraffin (case 05)
238groupndf5  infhommedium
uf4      1 0.4903 293 92235 1.4023 92238 98.5977 end
' note: the enrichment given in the refrence is not weight percent
para(h2o) 1 0.4572 end
end comp
read parm   npg=2000 nub=yes fdn=yes end parm
read geom
global
unit 1
cuboid  10 2p50.00 2p49.95 2p51.55
media  1 1 10
boundary 10
end geom
end data
end

=csas26
british handbook of criticality safety u(1.42)f4 & paraffin (case 06)
238groupndf5  infhommedium
uf4      1 0.4903 293 92235 1.4023 92238 98.5977 end
' note: the enrichment given in the refrence is not weight percent
para(h2o) 1 0.4572 end
end comp
read parm   npg=5000 nub=yes fdn=yes end parm
read geom

```

```

global
unit 1
cuboid 10 2p65.35 2p65.3 2p37.1
media 1 1 10
boundary 10
end geom
end data
end

=csas26
raffety and milhalcz u(2)f4-1 reflected (case 11)
238groupndf5 infhommedium
u-235 1 0 1.5811e-4 end
u-238 1 0 7.6467e-3 end
h 1 0 3.0864e-2 end
c 1 0 1.4839e-2 end
f 1 0 3.1219e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 10 4p28.110 2p56.44
cuboid 20 4p43.35 71.68 -56.44
media 1 1 10
media 2 2 20 -10
boundary 20
unit 2
cuboid 10 4p28.110 2p0.0001
cuboid 20 4p43.35 0.0001 -15.24
media 3 1 10
media 3 2 20 -10
boundary 20
global unit 3
cuboid 10 4p43.35 128.1201 -15.24
array 1 10 place 1 1 1 0.0 0.0 0.0
boundary 10
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
read bias id=400 2 6 end bias
read plot ttl='xz slice of case 11 showing biasing regions'
xul=-40 yul=20 zul=130
xlr=40 ylr=20 zlr=-15
uax=1 wdn=-1 nax=130 nch='0123456'
end plot
end data
end

```

```

=csas26
raffety and milhalcz u(2)f4-1 unreflected (case 12)
238groupndf5 infhommedium
u-235 1 0 1.5811e-4 end
u-238 1 0 7.6467e-3 end
h 1 0 3.0864e-2 end
c 1 0 1.4839e-2 end

```

```

f      1 0 3.1219e-2 end
end comp
read parm    npg=2000 nub=yes fdn=yes end parm
read geom
global unit 1
cuboid 10  35.735 -35.735 35.735 -35.735 47.07 -47.07
media 1 1 10
boundary 10
end geom
end data
end

=csas26
raffety and milhalcz u(2)f4-2 unreflected (case 14)
238groupndf5  infhommedium
u-235 1 0 1.3303e-4 end
u-238 1 0 6.4370e-3 end
h      1 0 3.9097e-2 end
c      1 0 1.8797e-2 end
f      1 0 2.6280e-2 end
end comp
read parm    npg=2000 nub=yes fdn=yes end parm
read geom
global unit 1
cuboid 10 28.11 -28.11 28.11 -28.11 61.235 -61.235
media 1 1 10
boundary 10
end geom
end data
end

=csas26
raffety and malhalcz u(2)f4-3 reflected (case 15)
238groupndf5  infhommedium
u-235 1 0 1.1191e-4 end
u-238 1 0 5.4152e-3 end
h      1 0 4.5472e-2 end
c      1 0 2.1861e-2 end
f      1 0 2.2109e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al      3 0.062 end
end comp
read parm  run=yes      npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 10 4p26.835 2p27.145
cuboid 20 4p42.075 42.385 -27.145
media 1 1 10
media 2 1 20 -10
boundary 20
unit 2
cuboid 10 4p42.075 0.0 -15.25
media 3 1 10
boundary 10
global
unit 3
cuboid 10 4p42.075 69.53 -15.25
array 1 10 place 1 1 1 3*0.0
boundary 10
end geom

```

```

read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
end data
end

=csas26
raffety and milhalcz u(2)f4-4 reflected (case 16)
238groupndf5 infhommedium
u-235 1 0 0.9924e-4 end
u-238 1 0 4.7998e-3 end
h 1 0 4.9212e-2 end
c 1 0 2.3660e-2 end
f 1 0 1.9596e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 10 4p23.000 2p48.285
cuboid 20 38.24 -38.24 38.24 -38.24 63.525 -48.285
media 1 1 10
media 2 1 20 -10
boundary 20
unit 2
cuboid 10 4p38.24 0.0 -15.24
media 3 1 10
boundary 10
global unit 3
cuboid 10 4p38.24 111.81 -15.24
array 1 10 place 1 1 1 3*0.0
boundary 10
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
end data
end

=csas26
raffety and milhalcz u(2)f4-6 reflected (case 19)
238groupndf5 infhommedium
u-235 1 0 0.6232e-4 end
u-238 1 0 3.0100e-3 end
h 1 0 6.0557e-2 end
c 1 0 2.9114e-2 end
f 1 0 1.2309e-2 end
poly(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 10 2p38.255 2p38.220 2p41.210
cuboid 20 2p53.495 2p53.46 56.45 -41.21
media 1 1 10

```

```

media 2 2 20 -10
boundary 20
unit 2
cuboid 10 2p38.255 2p38.220 2p0.0001
cuboid 20 2p53.495 2p53.46 .0001 -15.24
media 3 1 10
media 3 2 20 -10
boundary 20
global unit 3
cuboid 10 2p53.495 2p53.46 97.6601 -15.24
array 1 10 place 1 1 1 0.0 0.0 0.0
boundary 10
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
read bias id=400 2 6 end bias
end data
end

=csas26
raffety and milhalcz u(2)f4-6 unreflected (case 20)
238groupndf5 infhommedium
u-235 1 0 0.6232e-4 end
u-238 1 0 3.0100e-3 end
h 1 0 6.0557e-2 end
c 1 0 2.9114e-2 end
f 1 0 1.2309e-2 end
end comp
read parm npg=2000 nub=yes fdn=yes end parm
read geom
global unit 1
cuboid 10 40.725 -40.725 43.35 -43.35 44.110 -44.110
media 1 1 10
boundary 10
end geom
end data
end

=csas26
raffety and milhalcz u(3)f4-1 reflected (case 22)
238groupndf5 infhommedium
u-235 1 0 2.3494e-4 end
u-238 1 0 7.4999e-3 end
h 1 0 3.1341e-2 end
c 1 0 1.5067e-2 end
f 1 0 3.0939e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 10 2p21.735 2p21.735 2p43.1950
cuboid 20 4p36.975 58.435 -43.195
media 1 1 10
media 2 1 20 -10
boundary 20

```

```

unit 2
cuboid 10 4p36.975 .0001 -15.24
media 3 1 10
boundary 10
global unit 3
cuboid 10 4p36.975 101.6301 -15.24
array 1 10 place 1 1 1 3*0.0
boundary 10
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
end data
end

=csas26
raffety and milhalcz u(3)f4-1 reflected (case 24) no biasing
238groupndf5 infhommedium
u-235 1 0 2.3494e-4 end
u-238 1 0 7.4999e-3 end
h 1 0 3.1341e-2 end
c 1 0 1.5067e-2 end
f 1 0 3.0939e-2 end
para(h2o) 2 1.0 end
plexiglass 3 0.918 end
al 3 0.062 end
end comp
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
unit 1
cuboid 10 2p28.125 2p28.125 2p21.705
cuboid 20 4p43.365 36.945 -21.705
media 1 1 10
media 2 2 20 -10
boundary 20
unit 2
cuboid 10 2p28.125 2p28.125 2p0.0001
cuboid 20 4p43.365 .0001 -15.24
media 3 1 10
media 3 2 20 -10
boundary 20
global unit 3
cuboid 10 4p43.365 58.6501 -15.24
array 1 10 place 1 1 1 0.0 0.0 0.0
boundary 10
end geom
read array
nux=1 nuy=1 nuz=2
fill 2 1 end fill
end array
' read bias id=400 2 6 end bias
end data
end

=csas26
raffety and milhalcz u(3)f4-1 unreflected (case 26)
238groupndf5 infhommedium
u-235 1 0 2.3494e-4 end
u-238 1 0 7.4999e-3 end
h 1 0 3.1341e-2 end

```

```

c      1 0 1.5067e-2 end
f      1 0 3.0939e-2 end
end comp
read parm  npg=2000 nub=yes fdn=yes end parm
read geom
global uni 1
cuboid 10 28.235 -28.235 28.235 -28.235 43.32 -43.32
media 1 1 10
boundary 10
end geom
end data
end

=csas26
raffety and milhalcz u(3)f4-1 unreflected (case 28)
238groupndf5 infhommedium
u-235 1 0 2.3494e-4 end
u-238 1 0 7.4999e-3 end
h      1 0 3.1341e-2 end
c      1 0 1.5067e-2 end
f      1 0 3.0939e-2 end
end comp
read geom
global unit 1
cuboid 10 30.7 -30.7 30.7 -30.7 33.00 -33.00
media 1 1 10
boundary 10
end geom
end data
end

=csas26
raffety and milhalcz u(3)f4-2 unreflected (case 30)
238groupndf5 infhommedium
u-235 1 0 1.6709e-4 end
u-238 1 0 5.3355e-3 end
h      1 0 4.6262e-2 end
c      1 0 2.2241e-2 end
f      1 0 2.2011e-2 end
end comp
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
global unit 1
cuboid 10 2p20.450 2p20.465 2p58.400
media 1 1 10
boundary 10
end geom
end data
end

=csas26
critical reflected cylinder of aqueous u(4.98)o2f2 (case 33)
238groupndf5 infhommedium
solnuo2f2 1 910.36 0.0 1 298 92235 4.98 92238 95.02 end
ss304 2 1.0 end
h2o    3 1.0 end
cd     4 1.0 end
end comp
read parm run=yes npg=5000 nub=yes fdn=yes end parm
read geom

```

```

global unit 1
cylinder 10 19.545 2p27.225
cylinder 20 19.545 78.975 -27.225
cylinder 30 19.624 79.054 -27.304
cylinder 40 19.705 79.054 -27.304
cylinder 50 22.245 79.054 -27.304
cylinder 60 45.000 79.054 -27.304
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20 -10
media 4 1 40 -30
media 2 1 50 -40 -30
media 3 1 60 -50 -40 -30
boundary 60
end geom
read plot ttl='xz slice of cylinder case 33'
xul=-45 yul=0.0 zul=81
xlr=45 ylr=0.0 zlr=-29
uax=1 wdn=-1 nax=130 nch='01234'end
ttl='enlargement of lower right hand corner of cylinder'
xul=18 yul=0.0 zul=-25
xlr=23 ylr=0.0 zlr=-28
uax=1 wdn=-1 nax=130 nch='01234'
end plot
end data
end

=csas26
critical cylinder of aqueous u(4.98)o2f2 (case 36)
238groupndf5 infhommedium
solnuo2f2 1 910.36 0.0 1 298 92235 4.98 92238 95.02 end
ss304 2 1.0 end
end comp
read parm run=yes npg=2000 nub=yes fdn=yes end parm
read geom
global unit 1
cylinder 10 19.5500 2p50.85
cylinder 20 19.5500 74.16 -50.85
cylinder 30 19.6287 74.16 -50.9287
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20 -10
boundary 30
end geom
read plot ttl='xz slice of cylinder case 36'
xul=-21 yul=0.0 zul=76
xlr=21 ylr=0.0 zlr=-52
uax=1 wdn=-1 nax=130 nch='012'end
ttl='enlargement of lower right corner of cylinder'
xul=18 yul=0.0 zul=-49
xlr=21 ylr=0.0 zlr=-52
uax=1 wdn=-1 nax=130 nch='012'
end plot
end data
end

```

Table B.4. Table 4 input data

```
=csas26
uo2f2 soln h/u-235=1112 bare sphere case 1
238groupndf5 multiregion
u-234 1 0 7.360-7 end
u-235 1 0 5.990-5 end
u-238 1 0 3.592-6 end
h 1 0 6.661-2 end
o 1 0 3.343-2 end
f 1 0 1.285-4 end
al 2 1 end
end comp
spherical end
1 27.9 noextermod 2 28.10 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
global unit 1
sphere 10 27.9
sphere 20 28.1
media 1 1 10
media 2 1 20 -10
boundary 20
end geom
end data
end

=csas26
uo2f2 soln h/u-235=76.1 h2o refl sphere case 4
238groupndf5 multiregion
u-234 1 0 8.795-6 end
u-235 1 0 8.327-4 end
u-236 1 0 4.449-6 end
u-238 1 0 4.729-5 end
h 1 0 6.337-2 end
o 1 0 3.347-2 end
f 1 0 1.786-3 end
al 2 1 end
h2o 3 1 end
end comp
spherical end
1 11.5 oneextermod 2 11.66 noextermod 3 29.66 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
global
unit 1
sphere 10 11.5
sphere 20 11.66
sphere 30 29.66
media 1 1 10
media 2 1 20 -10
media 3 1 30 -20
boundary 30
end geom
end data
end
```

```

=csas26
uo2f2 soln h/u-235=268.8 h2o refl sphere case 7
238groupndf5 multiregion
u-235 1 0 2.438-4 300 end
u-238 1 0 1.756-5 300 end
h 1 0 6.553-2 300 end
o 1 0 3.329-2 300 end
f 1 0 5.227-4 300 end
al 2 1 300 end
h2o 3 1 300 end
end comp
spherical end
1 13.2 oneextermod 2 13.33 noextermod 3 31.33 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
global
unit 1
sphere 10 13.2
sphere 20 13.33
sphere 30 31.33
media 1 1 10
media 2 1 20 -10
media 3 1 30 -20
boundary 30
end geom
end data
end

=csas26
uo2f2 soln h/u-235=239.3 h2o refl sphere case 10
238groupndf5 multiregion
u-235 1 0 2.735-4 359 end
u-238 1 0 1.970-5 359 end
h 1 0 6.545-2 359 end
o 1 0 3.331-2 359 end
f 1 0 5.864-4 359 end
al 2 1 359 end
h2o 3 1 359 end
end comp
spherical end
1 13.2 oneextermod 2 13.33 noextermod 3 31.33 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
global
unit 1
sphere 10 13.2
sphere 20 13.33
sphere 30 31.33
media 1 1 10
media 2 1 20 -10
media 3 1 30 -20
boundary 30
end geom
end data
end

=csas26
rocky flats uo2(no3)2 soln 357.71 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 357.71 0.549 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end

```

```

al      2 1 end
end comp
cylindrical end
1 14 noextermod 2 14.3 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
global
unit 1
cylinder 10 14.005 30.91 0
cylinder 20 14.325 30.91 -.32
media 1 1 10
media 2 1 20 -10
boundary 20
end geom
end data
end

=csas26
rocky flats uo2(no3)2 soln 357.71 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 357.71 .549 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al      2 1 end
end comp
cylindrical end
1 16.5 noextermod 2 16.8 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
global
unit 1
cylinder 10 16.505 22.53 0
cylinder 20 16.825 22.53 -.32
media 1 1 10
media 2 1 20 -10
boundary 20
end geom
end data
end

=csas26
rocky flats uo2(no3)2 soln 334.77 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 334.77 .521 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al      2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 14 noextermod 2 14.3 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
global
unit 1
cylinder 10 14.005 28.60 0
cylinder 20 14.325 28.60 -.32
cuboid   30  64.6 -57.2 57.4 -64.8 80.8 -41.1
cuboid   40  90.3 -82.9 83.1 -90.5 80.8 -41.1
cuboid   50  90.3 -82.9 83.1 -90.5 81.7 -42.0
cuboid   60  90.3 -82.9 83.1 -90.5 107.4 -67.7
media 1 1 10
media 2 1 20 -10

```

```

media 0 1 30 -20
media 3 1 40 -30
media 0 1 50 -40
media 3 1 60 -50
boundary 60
end geom
end data
end

=csas26
rocky flats uo2(no3)2 soln 334.77 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 334.77 .521 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 16.5 noextermod 2 16.8 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
global
unit 1
cylinder 10 16.505 16.78 0
cylinder 20 16.825 16.78 -.32
cuboid 30 104.55 -17.25 16.825 -105.375 121.58 -.32
cuboid 40 130.25 -42.95 42.525 -131.07 121.58 -.32
cuboid 50 130.25 -42.95 42.525 -131.07 122.48 -1.22
cuboid 60 130.25 -42.95 42.525 -131.07 148.18 -26.92
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
media 3 1 40 -30
media 0 1 50 -40
media 3 1 60 -50
boundary 60
end geom
end data
end

=csas26
rocky flats uo2(no3)2 soln 147.66 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 147.66 .271 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
plexiglass 3 1 end
h 4 0 5.5169-2 end
c 4 0 3.3967-2 end
o 4 0 1.4231-2 end
p 4 0 3.8500-4 end
cl 4 0 3.5610-4 end
br-79 4 0 3.184-4 end
br-81 4 0 3.116-4 end
end comp
cylindrical end
1 16.5 noextermod 2 16.8 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
global

```

```

unit 1
cylinder 10 16.505 22.78 0
cylinder 20 16.825 22.78 -.32
cuboid 30 61.2 -61.7 60.4 -62.5 81.1 -41.8
cuboid 40 81.997 -82.497 81.197 -83.297 81.1 -41.8
cuboid 50 81.997 -82.497 81.197 -83.297 101.30 -62.597
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
media 3 1 40 -30
media 4 1 50 -40
boundary 50
end geom
end data
end

```

```

=csas26
rocky flats uo2(no3)2 soln 345.33 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 345.33 .534 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
plexiglass 3 1 end
h 4 0 5.5169-2 end
c 4 0 3.3967-2 end
o 4 0 1.4231-2 end
p 4 0 3.8500-4 end
cl 4 0 3.5610-4 end
br-79 4 0 3.184-4 end
br-81 4 0 3.116-4 end
end comp
cylindrical end
1 16.5 noextermod 2 16.8 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
global
unit 1
cylinder 10 16.505 17.2 0
cylinder 20 16.825 17.2 -.32
cuboid 30 105.2 -17.7 17.3 -105.6 122.58 -.32
cuboid 40 126.0 -38.497 38.097 -126.40 233.58 -.32
cuboid 50 126.0 -38.497 38.097 -126.40 142.78 -21.117
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
media 3 1 40 -30
media 4 1 50 -40
boundary 50
end geom
end data
end

```

```

=csas26
rocky flats uo2(no3)2 soln 364.11 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 364.11 .584 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end

```

```

1 10.5 noextermod 2 10.9 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 10.56 17.13 0
cylinder 20 10.96 17.13 -.32
cuboid 30 4p15.24 121.58 -.32
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10
boundary 30
global
unit 2
cuboid 10 4p60.96 121.58 -.32
cuboid 20 4p86.66 121.58 -.32
cuboid 30 4p86.66 122.83 -1.57
cuboid 40 4p86.66 148.53 -27.27
array 1 10 place 1 1 1 -45.72 -45.72 0.0
media 3 1 20 -10
media 0 1 30 -20 -10
media 3 1 40 -30 -20 -10
boundary 40
end geom
read array nux=4 nuy=4 nuz=1 fill f1 end fill end array
end data
end

```

```

=csas26
rocky flats uo2(no3)2 soln 359.55 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 359.55 .578 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 8 noextermod 2 8.3 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 8.06 31.82 0
cylinder 20 8.38 31.82 -.32
cuboid 30 4p15.24 121.58 -.32
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
global
unit 2
cuboid 10 4p60.96 121.58 -.32
cuboid 20 4p86.66 121.58 -.32
cuboid 30 4p86.66 122.83 -1.57
cuboid 40 4p86.66 148.53 -27.27
array 1 10 place 1 1 1 -45.72 -45.72 0.0
media 3 1 20 -10
media 0 1 30 -20
media 3 1 40 -30 -20
boundary 40
end geom
read array nux=4 nuy=4 nuz=1 fill f1 end fill end array
end data
end

```

```

=csas26
rocky flats uo2(no3)2 soln 364.11 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 364.11 .584 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 10.5 noextermod 2 10.9 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 10.56 31.11 0
cylinder 20 10.96 31.11 -.32
cuboid 30 4p15.24 121.58 -.32
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10
boundary 30
unit 2
cuboid 10 4p15.24 121.58 -.32
media 0 1 10
boundary 10
global
unit 3
cuboid 10 4p60.96 121.58 -.32
cuboid 20 4p86.66 121.58 -.32
cuboid 30 4p86.66 122.83 -1.57
cuboid 40 4p86.66 248.53 -27.27
array 1 10 place 1 1 1 -45.72 -45.72 0.0
media 3 1 20 -10
media 0 1 30 -20
media 3 1 40 -30 -20
boundary 40
end geom
read array nux=4 nuy=4 nuz=1
fill 5r2 2r1 2r2 2r1 5r2 end fill
end array
end data
end

```

```

=csas26
rocky flats uo2(no3)2 soln 359.55 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 359.55 .578 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
rfconcrete 3 1 end
end comp
cylindrical end
1 8 noextermod 2 8.3 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 8.06 51.45 0
cylinder 20 8.38 51.45 -.32
cuboid 30 4p15.24 121.58 -.32
media 1 1 10
media 2 1 20 -10

```

```

media 0 1 30 -20 -10
boundary 30
unit 2
cuboid 10 4p15.24 121.58 -.32
media 0 1 10
boundary 10
global
unit 3
cuboid 10 4p60.96 121.58 -.32
cuboid 20 4p86.66 121.58 -.32
cuboid 30 4p86.66 122.83 -1.57
cuboid 40 4p86.66 248.53 -27.27
array 1 10 place 1 1 1 -45.72 -45.72 0.0
media 3 1 20 -10
media 0 1 30 -20
media 3 1 40 -30 -20
boundary 40
end geom
read array nux=4 nuy=4 nuz=1
fill 2r1 2r2 3q4 end fill
end array
end data
end

=csas26
rocky flats uo2(no3)2 soln 355.94 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 355.94 .494 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
plexiglass 3 1 end
h 4 0 5.5169-2 end
c 4 0 3.3967-2 end
o 4 0 1.4231-2 end
p 4 0 3.8500-4 end
cl 4 0 3.5610-4 end
br-79 4 0 3.184-4 end
br-81 4 0 3.116-4 end
end comp
cylindrical end
1 10.5 noextermod 2 10.9 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 10.56 18.82 0
cylinder 20 10.96 18.82 -.32
cuboid 30 4p15.24 122.58 -.32
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
global
unit 2
cuboid 10 4p60.96 122.58 -.32
cuboid 20 4p61.45 122.58 -.32
cuboid 30 4p82.247 122.58 -.32
cuboid 40 4p82.247 142.78 -21.117
array 1 10 place 1 1 1 -45.72 -45.72 0.0
media 0 1 20 -10
media 3 1 30 -20 -10
media 4 1 40 -30 -20
boundary 40

```

```

end geom
read array nux=4 nuy=4 nuz=1 fill f1 end fill
end array
end data
end

=csas26
rocky flats uo2(no3)2 soln 355.94 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 355.94 .494 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
plexiglass 3 1 end
h 4 0 5.5169-2 end
c 4 0 3.3967-2 end
o 4 0 1.4231-2 end
p 4 0 3.8500-4 end
cl 4 0 3.5610-4 end
br-79 4 0 3.184-4 end
br-81 4 0 3.116-4 end
end comp
cylindrical end
1 8 noextermod 2 8.3 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 8.06 35.56 0
cylinder 20 8.38 35.56 -.32
cuboid 30 4p15.24 122.58 -.32
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10
boundary 30
global
unit 2
cuboid 10 4p60.96 122.58 -.32
cuboid 20 4p61.45 122.58 -.32
cuboid 30 4p82.247 122.58 -.32
cuboid 40 4p82.247 142.78 -21.117
array 1 10 place 1 1 1 -45.72 -45.72 0.0
media 0 1 20 -10
media 3 1 30 -20 -10
media 4 1 40 -30
boundary 40
end geom
read array nux=4 nuy=4 nuz=1 fill f1 end fill
end array
end data
end

=csas26
rocky flats uo2(no3)2 soln 355.94 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 355.94 .494 1 293 92234 1.022 92235 93.172 92236 .434
92238 5.372 end
al 2 1 end
plexiglass 3 1 end
h 4 0 5.5169-2 end
c 4 0 3.3967-2 end
o 4 0 1.4231-2 end
p 4 0 3.8500-4 end

```

```

cl    4 0 3.5610-4 end
br-79 4 0 3.184-4 end
br-81 4 0 3.116-4 end
end comp
cylindrical end
1 10.5 noextermod 2 10.9 noextermod end zone
read param npg=3000 nub=yes fdn=yes end param
read geom
unit 1
cylinder 10 10.56 33.20 0
cylinder 20 10.96 33.20 -.32
cuboid 30 4p15.24 122.58 -.32
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 2
cuboid 10 4p15.24 122.58 -.32
media 0 1 10
boundary 10
global
unit 3
cuboid 10 4p60.96 122.58 -.32
cuboid 20 4p61.45 122.58 -.32
cuboid 30 4p82.247 122.58 -.32
cuboid 40 4p82.247 142.78 -21.117
array 1 10 place 1 1 1 -45.72 -45.72 0.0
media 0 1 20 -10
media 3 1 30 -20 -10
media 4 1 40 -30 -20
boundary 40
end geom
read array nux=4 nuy=4 nuz=1
fill 5r2 2r1 2r2 2r1 5r2 end fill
end array
end data
end

```

Table B.5. Table 5 input data

```
=csas26
keno-6 validation case a-1
238groupndf5 multiregion
uranium 1 .9837 293 92235 93.8 92238 6.2 end
end comp
spherical end
1 8.73136 noextermod end zone
read param      npg=5000 fdn=yes nub=yes end param
read geom
global unit 1
sphere   10 8.73136
media 1 1 10
boundary 10
end geom
end data
end

=csas26
keno-6 validation case a-3
238groupndf5 multiregion
solnuo2f2 1 19.992 0 1 293 92235 93.2 92238 6.8 end
al      2 end
end comp
spherical end
1 34.6 oneextermod 2 34.92 noextermod end zone
read param      npg=3000 fdn=yes nub=yes end param
read geom
global
unit 1
sphere   10 34.6
sphere   20 34.92
cuboid   30 6p35.0
media  1 1 10
media  2 1 20 -10
media  0 1 30 -20
boundary 30
end geom
end data
end

=csas26
keno-6 validation case a-5
238groupndf5 multiregion
uranium 1 .9848 283 92235 93.5 92238 6.5 end
h2o      2 end
end comp
spherical end
1 12.7 oneextermod 2 31. noextermod end zone
read param tme=60      npg=3000 fdn=yes nub=yes end param
read geom
global
unit 1
sphere 10 12.7 chord +z=0
sphere 20 15.24 chord +z=0
cuboid 30 31.00 -31.00 31.00 -31.00 31.00 -16.
media 2 1 10
media 1 1 20 -10
media 2 1 30 -20
```

```

boundary 30
end geom
end data
end

=csas26
keno-6 validation case a-7
238groupndf5 multiregion
uranium 1 .9848 293 92235 94 92238 6 end
uranium 2 end
end comp
slab end
1 7.62 noextermod 2 52.02 noextermod end zone
read param    npg=3000 fdn=yes nub=yes end param
read geom
global
unit 1
cuboid    10 3.81 -3.81 4.445 -4.445 7.62 -7.62
cuboid    20 26.01 -26.01 26.645 -26.645 29.82 -29.82
cuboid    30 6p30.0
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

=csas26
keno-6 validation case a-9
238groupndf5 multiregion
arbmoil   .88 3 0 0 6012 86.82 1001 13.16 16000 .02 1 end
uranium   2 .9528 293 92235 93.1 92238 6.9 end
arbmpjel  .024 2 0 0 6012 85 1001 15 2 end
carbonsteel 3 end
end comp
spherical end
2 8.2 oneextermod 1 40.5 noextermod end zone
read param
tme=60 npg=3000 fdn=yes nub=yes end param
read geom
global
unit 1
sphere   10 6.012 chord +z=0
sphere   20 10.488 chord +z=0
sphere   30 6p40.488
media 3 1 10
media 2 1 20 -10
media 1 1 30 -20 -10
boundary 30
end geom
end data
end

=csas26
keno-6 validation case a11
238groupndf5 multiregion
solnuo2(no3)2 1 346.73 .542 1 293 92235 93.172 92238 6.828 end
ss304 2 end
end comp

```

```

cylindrical end
1 13.96 oneextermod 2 14.28 oneextermod end zone
read param      npg=5000 fdn=yes nub=yes end param
read geom
global unit 1
cylinder 10 13.96 14.465 -14.465
cylinder 20 13.96 27.135 -14.465
cylinder 30 14.28 27.135 -15.105
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
boundary 30
end geom
end data
end

=csas26
keno-6 validation case b-5
238groupndf5 multiregion
uranium 1 .9809 293 92235 93.2 92238 6.8 end
end comp
cylindrical end
1 4.56 noextermod end zone
read param      npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 4.558 2.16 -2.16
cylinder 20 5.747 2.16 -2.16
cylinder 30 5.747 4.851 -4.851
cuboid 40 5.8554 -5.8554 5.8554 -5.8554 4.9771 -4.9771
media 1 1 10
media 0 1 20 -10
media 1 1 30 -20
media 0 1 40 -30
boundary 40
global unit 2
cuboid 10 4p11.7108 2p9.9542
array 1 10 place 1 1 1 -5.8554 -5.8554 -4.9771
boundary 10
end geom
read array ara=1 nux=2 tuy=2 nuz=2 fill f1 end fill end array
end data
end

=csas26
keno-6 validation case b-9
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param      npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 8.7804 -8.7804
cylinder 20 9.52 8.9896 -8.7804
cylinder 30 10.16 9.6296 -9.4204
cuboid 40 13.4 -13.4 13.4 -13.4 12.8696 -12.6604
media 1 1 10
media 0 1 20 -10

```

```

media 2 1 30 -20
media 0 1 40 -30
boundary 40
global unit 2
cuboid 10 4p40.2 63.9296 -12.6604
array 1 10 place 1 1 1 -26.8 -26.8 0.0
boundary 10
end geom
read array ara=1 nux=3 nuy=3 nuz=3 fill f1 end fill end array
end data
end

=csas26
keno-6 validation case b-10
238groupndf5 multiregion
solnuo2(no3)2 1 63.3 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 8.7804 -8.7804
cylinder 20 9.52 8.9895 -8.7804
cylinder 30 10.16 9.6295 -9.4204
cuboid 40 11.282 -11.282 11.282 -11.282 10.7179 -11.7179
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global unit 2
cuboid 10 4p33.846 55.5895 -11.7179
array 1 10 place 1 1 1 -22.564 -22.564 0.0
boundary 10
end geom
read array nux=3 nuy=3 nuz=3 fill f1 end fill end array
end data
end

=csas26
keno-6 validation case b-12
238groupndf5 multiregion
uranium 1 .9829 293 92235 93.2 92238 6.8 end
c 2 .8296 end
poly(h2o) 3 1 end
end comp
cylindrical end
1 5.747 oneextermod 2 10.92 noextermod end zone
read param tme=60 npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 5.747 3.9699 -4.1071
cylinder 20 5.777 4.1071 -4.1071
cuboid 30 10.9195 -10.9195 10.9195 -10.9195 7.8755 -7.8755
cuboid 40 15.047 -15.047 15.047 -15.047 12.0035 -12.0035
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30

```

```

boundary 40
global unit 2
cuboid 10 4p30.094 22p24.007
cuboid 20 4p45.344 2p39.247
array 1 10 place 1 1 1 -15.047 -15.047 -12.0035
media 3 1 20 -10
boundary 20
end geom
read array nux=2 nuy=2 nuz=2 fill f1 end fill end array
end data
end

=csas26
keno-6 validation case b-14
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param tme=60 npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 8.7804 -8.7804
cylinder 20 9.52 8.9896 -8.7804
cylinder 30 10.16 9.6296 -9.4204
cuboid 40 18.425 -18.425 18.425 -18.425 17.8946 -17.6854
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20 -10
media 0 1 40 -30
boundary 40
global unit 2
cuboid 10 4p55.275 53.4746 -53.1568
cuboid 20 70.515 -70.515 70.515 -70.515 68.61 -68.61
array 1 10 place 1 1 1 -36.85 -36.85 -35.4717
media 3 1 20 -10
boundary 20
end geom
read array nux=3 nuy=3 nuz=3 fill f1 end fill end array
end data
end

=csas26
keno-6 validation case b-16
238groupndf5 multiregion
solnuo2(no3)2 1 450.8 .72 1 293 92235 93.1 92238 6.9 end
ss304 2 end
end comp
cylindrical end
1 8.128 noextermod 2 8.4074 noextermod end zone
read param npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 8.128 68.3006 -68.3006 rotate a1=90 a2=90
cylinder 20 8.4074 68.58 -68.58 rotate a1=90 a2=90
cuboid 30 68.58 -68.58 9.2075 -9.2075 14.999 -110.32
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10

```

```

boundary 30
unit 2
cylinder 10 8.128 68.3006 -68.3006 rotate a2=90
cylinder 20 8.4074 68.58 -68.58 rotate a2=90
cuboid 30 9.2075 -9.2075 68.58 -68.58 14.999 -110.32
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10
boundary 30
unit 3
cylinder 10 8.128 68.3006 -68.3006 rotate a1=90 a2=90
cylinder 20 8.4074 68.58 -68.58 rotate a1=90 a2=90
cuboid 30 68.58 -68.58 9.2075 -9.2075 125.09 -14.999
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10
boundary 30
unit 4
cylinder 10 8.128 68.3006 -68.3006 rotate a2=90
cylinder 20 8.4074 68.58 -68.58 rotate a2=90
cuboid 30 9.2075 -9.2075 68.58 -68.58 125.09 -14.999
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20 -10
boundary 30
unit 5
cuboid 10 8.89 -8.89 8.89 -8.89 14.999 -110.00
cuboid 20 9.2075 -9.2075 9.2075 -9.2075 14.999 -110.32
media 1 1 10
media 2 1 20 -10
boundary 20
unit 6
cuboid 10 8.89 -8.89 8.89 -8.89 125.09 -14.999
cuboid 20 9.2075 -9.2075 9.2075 -9.2075 125.09 -14.999
media 1 1 10
media 2 1 20 -10
boundary 20
unit 7
cuboid 10 68.58 -68.58 68.58 -68.58 14.999 -110.32
media 0 1 10
boundary 10
unit 8
cuboid 10 68.58 -68.58 68.58 -68.58 125.09 -14.999
media 0 1 10
boundary 10
global unit 9
cuboid 10 224.155 -68.58 224.155 -68.58 155.088 -110.32
array 1 10 place 1 1 1 0.0 0.0 0.0
boundary 10
end geom
read array nux=3 nuy=3 nuz=2 loop
1 1 3 2 2 2 1 1 1 1 2 2 2 1 1 3 2 1 1 1 3 1 3 2 2 2 1 2 2 1
4 2 2 1 1 3 2 2 2 1 5 2 2 1 2 2 1 1 1 1 6 2 2 1 2 2 1 2 2 1
7 1 3 2 1 3 2 1 1 1 8 1 3 2 1 3 2 2 2 1
end loop end array
end data
end

```

```

=csas26
keno-6 validation case b-18
238groupndf5 multiregion

```

```

solnuo2(no3)2 1 364.11 .584 1 293 92235 93.172 92238 6.828 end
arbmal 2.737 9 0 0 1 12000 1 13027 97.35 14000 .6 22000 .03
24000 .17 25055 .07 26000 .47 29000 .25 14000 .06 2 end
arbmcconc 2.321 13 0 0 1 1001 .75 6012 5.55 7014 .01 8016 49.29
11023 .42 12000 1.48 13027 2.06 14000 15.7 16000 .17 19000 .75 20000 22.95
22000 .05 26000 .82 3 end
end comp
cylindrical end
1 10.56 noextermod 2 10.96 noextermod end zone
read param tme=60 npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 10.56 8.565 -8.565
cylinder 20 10.56 110.535 -8.565
cylinder 30 10.96 110.535 -8.885
cuboid 40 15.25 -15.15 15.25 -15.25 115.515 -8.885
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20 -10
media 0 1 40 -30
boundary 40
unit 2
cylinder 10 10.56 8.565 -8.565
cylinder 20 10.56 110.535 -8.565
cylinder 30 10.96 110.535 -8.885
cuboid 40 15.15 -15.25 15.25 -15.25 115.515 -8.885
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20 -10
media 0 1 40 -30
boundary 40
unit 3
cylinder 10 10.56 8.565 -8.565
cylinder 20 10.56 110.535 -8.565
cylinder 30 10.96 110.535 -8.885
cuboid 40 15.25 -15.25 15.25 -15.25 115.515 -8.885
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20 -10
media 0 1 40 -30
boundary 40
global unit 4
cuboid 10 2p60.90 2p61.0 115.515 -8.885
cuboid 20 2p60.90 2p61.1 115.515 -8.885
cuboid 30 2p86.6 2p86.8 141.215 -34.585
array 1 10 place 1 1 1 -45.75 -45.75 0.0
media 0 1 20 -10
media 3 1 30 -20
boundary 30
end geom
read array nux=4 nuy=4 loop
1 1 1 1 1 4 1 1 1 1 2 4 4 1 1 4 1 1 1 1 3 2 3 1 1 4 1 1 1 1
end loop end array
end data
end
```

```

=csas26
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end

```

```

al      2 1 end
h2o      3 1 end
end comp
slab end
1 3.81 oneextermod 2 4.12 noextermod 3 22.12 noextermod end zone
read param      npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cuboid 10 2p3.81 2p60.325 19.13 0
cuboid 20 2p4.128 2p60.643 19.13 -.318
cuboid 30 2p4.128 2p60.643 19.13 -.318
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 2
cuboid      10 2.54 0 2p60.643 19.13 -.318
media 3 1 10
boundary 10
global unit 3
cuboid 10 29.848 0.0 2p60.643 19.13 -.318
cuboid 20 47.848 -18.0 2p78.643 19.13 -18.318
array 1 10 place 1 1 1 4.128 0.0 0.0
media 3 1 20 -10
boundary 20
end geom
read array ara=1 nux=5 nuy=1 nuz=1 fill 1 2 1 2 1 end fill end array
end data
end

```

```

=csas26
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al      2 1 end
h2o      3 1 end
end comp
slab end
1 3.81 oneextermod 2 4.12 noextermod 3 22.12 noextermod end zone
read param      npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cuboid      10 2p3.81 2p60.325 111.68 0
cuboid 20      2p4.128 2p60.643 111.68 -.318
cuboid 30 2p4.128 2p60.643 111.68 -.318
media 1 1 10
media 2 1 20 -10
media 3 1 30 -20 -10
boundary 30
unit 2
cuboid      10 13.97 0.0 2p60.643 111.68 -.318
media 3 1 10
boundary 10
global unit 3
cuboid 10 52.708 0.0 2p60.643 111.68 -.318
cuboid 20 70.708 -18.0 2p78.643 111.68 -.318
array 1 10 place 1 1 1 4.128 0.0 0.0
media 3 1 20 -10
boundary 20
end geom
read array ara=1 nux=5 nuy=1 nuz=1 fill 1 2 1 2 1 end fill end array

```

```

end data
end

=csas26
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al 2 1 end
end comp
slab end
1 3.81 noextermod 2 4.12 noextermod end zone
read param npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cuboid 10 2p3.81 2p60.325 65.81 0
cuboid 20 2p4.128 2p60.643 65.81 -.318
cuboid 30 2p4.128 2p65. 150. -1.
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 2
cuboid 10 2p7.417 2p60.325 65.81 0
cuboid 20 2p7.735 2p60.643. 65.81 -.318
cuboid 30 2p7.735 2p65.0 150.0 -1.0
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 3
cuboid 10 38.1 0 2p65. 150. -1.
media 0 1 10
boundary 10
global unit 4
cuboid 10 54.091 -7.735 2p65.0 150.0 -1.0
array 1 10 place 1 1 1 0.0 0.0 0.0
boundary 10
end geom
read array ara=1 nux=3 nuy=1 nuz=1 fill 2 3 1 end fill end array
end data
end

```

```

=csas26
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al 2 1 end
end comp
slab end
1 3.81 noextermod 2 4.12 noextermod end zone
read param npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cuboid 10 2p3.81 2p60.325 19.63 0
cuboid 20 2p4.128 2p60.643 19.63 -.318
cuboid 30 2p4.128 2p65. 150. -1.
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20

```

```

boundary 30
unit 2
cuboid 10 2p7.417 2p60.325 19.63 0
cuboid 20 2p7.735 2p60.643 19.63 -.318
cuboid 30 2p7.735 2p65. 150. -1.
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
global unit 3
cuboid 10 27.854 -4.128 2p65.0 150.0 -1.0
array 1 10 place 1 1 1 0.0 0.0 0.0
boundary 10
end geom
read array ara=1 nux=3 nuy=1 nuz=1 fill 1 2 1 end fill end array
end data
end

=csas26
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al 2 1 end
end comp
slab end
1 3.81 noextermod 2 4.12 noextermod end zone
read param npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cuboid 10 2p3.81 2p60.325 62.56 0
cuboid 20 2p4.128 2p60.643 62.56 -.318
cuboid 30 2p4.128 2p65. 150. -1.
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 2
cuboid 10 2p7.417 2p60.325 62.56 0
cuboid 20 2p7.735 2p60.643 62.56 -.318
cuboid 30 2p7.735 2p65. 150. -1.
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 3
cuboid 10 50.8 0 2p65. 150. -1.
media 0 1 10
boundary 10
global
unit 4
cuboid 10 129.454 -4.128 2p65.0 150.0 -1.0
array 1 10 place 1 1 1 0.0 0.0 0.0
boundary 10
end geom
read array ara=1 nux=5 nuy=1 nuz=1 fill 1 3 2 3 1 end fill end array
end data
end

```

```

=csas26
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al 2 1 end
end comp
slab end
1 7.62 noextermod 2 7.94 noextermod end zone
read param npg=3000 fdn=yes nub=yes end param
read geom
unit 1
cuboid 10 2p3.81 2p60.325 58.19 0
cuboid 20 2p4.128 2p60.643 58.19 -.318
cuboid 30 2p4.128 2p65. 150. -1.
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 2
cuboid 10 2p.318 2p60.325 58.19 0
cuboid 20 2p7.938 2p60.325 58.19 0
cuboid 30 2p8.256 2p60.643 58.19 -.318
cuboid 40 2p8.574 2p65. 150. -1.
media 2 1 10
media 1 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
unit 3
cuboid 10 30.48 0 2p65. 150. -1.
media 0 1 10
boundary 10
global
unit 4
cuboid 10 47.31 -8.574 2p65.0 150.0 -1.0
array 1 10 place 1 1 1 0.0 0.0 0.0
boundary 10
end geom
read array ara=1 nux=3 nuy=1 nuz=1 fill 2 3 1 end fill end array
end data
end

```

```

=csas26
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al 2 1 end
end comp
slab end
1 7.62 noextermod 2 7.94 noextermod end zone
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cuboid 10 2p3.81 2p60.325 83.11 0
cuboid 20 2p4.128 2p60.643 83.11 -.318
cuboid 30 2p4.128 2p65. 150. -1.
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30

```

```

unit 2
cuboid      10  2p.318  2p60.325 83.11  0
cuboid      20  2p7.938  2p60.325 83.11  0
cuboid      30  2p8.256  2p60.643 83.11 -.318
cuboid      40  2p8.574  2p65.    150.   -1.
media  2 1 10
media  1 1 20 -10
media  2 1 30 -20
media  0 1 40 -30
boundary  40
unit 3
cuboid      10 76.2  0 2p65. 150. -1.
media  0 1 10
boundary  10
global
unit 4
cuboid  10  93.03 -8.574  2p65. 150.0  -1.0
array   1 10  place 1 1 1  0.0 0.0 0.0
boundary  10
end geom
read array nux=3 nuy=1 nuz=1 fill 2 3 1 end fill end array
end data
end

=csas26
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2  1 81.845 0 1 293  92235 93.2
92238 6.8 end
al          2 1 end
end comp
slab end
1 7.62 noextermod 2 7.94 noextermod end zone
read param npg=2000  fdn=yes  nub=yes   end param
read geom
unit 1
cuboid      10  2p7.417  2p60.325 32.79  0
cuboid      20  2p7.735  2p60.643 32.79  -.318
cuboid      30  2p15.354 2p65.    150.   -1.
media  1 1 10
media  2 1 20 -10
media  0 1 30 -20
boundary  30
unit 2
cuboid      10  2p.318  2p60.325 32.79  0
cuboid      20  2p7.938  2p60.325 32.79  0
cuboid      30  2p8.256  2p60.643 32.79 -.318
cuboid      40  2p15.875 2p65. 150.   -1.
media  2 1 10
media  1 1 20 -10
media  2 1 30 -20
media  0 1 40 -30
boundary  40
global
unit 3
cuboid  10  47.104  -15.354  2p65.0 150.0 -1.0
array   1 10  place 1 1 1 0.0 0.0 0.0
boundary  10
end geom
read array nux=2 nuy=1 nuz=1 fill 1 2 end fill end array
end data
end

```

```

=csas26
93.2% uo2f2 h/u-235=337
238groupndf5 multiregion
solnuo2f2 1 81.845 0 1 293 92235 93.2
92238 6.8 end
al 2 1 end
end comp
slab end
1 7.62 noextermod 2 7.94 noextermod end zone
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cuboid 10 2p7.417 2p60.325 73.23 0
cuboid 20 2p7.735 2p60.643 73.23 -.318
cuboid 30 2p68.694 2p65. 150. -1.
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
unit 2
cuboid 10 2p.318 2p60.325 73.23 0
cuboid 20 2p7.938 2p60.325 73.23 0
cuboid 30 2p8.256 2p60.643 73.34 -.318
cuboid 40 2p69.215 2p65. 150. -1.
media 2 1 10
media 1 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global
unit 3
cuboid 10 207.124 -68.694 65.0 -65.0 150.0 -1.0
array 1 10 place 1 1 1 0.0 0.0 0.0
boundary 10
end geom
read array nux=2 nuy=1 nuz=1 fill 1 2 end fill end array
end data
end

=csas26
uo2(no3)2 63.3 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 63.3 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
arbmwood .640525 3 0 0 0 6012 44.435 1001 6.2639 8016 49.301 3 end
carbonsteel 4 end
reg-concrete 5 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param npg=2000 fdn=yes nub=yes plt=no end param
read geom

unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p11.365 19.615 -1.845
media 1 1 10
media 0 1 20 -10

```

```

media 2 1 30 -20
media 0 1 40 -30
boundary 40
unit 2
cuboid 10 56.825 -11.365 56.825 -11.365 62.535 -1.8450
cuboid 20 4p200. 250. -50.
array 1 10 place 1 1 1 0.0 0.0 0.0
media 0 1 20 -10
boundary 20
unit 3
cylinder 10 142.8 224. -48.
cylinder 20 144.8 224. -50.
cuboid 30 218.1 -181.9 215. -185. 250. -50.
media 0 1 10
media 4 1 20 -10
media 0 1 30 -20
boundary 30
unit 4
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p11.365 19.615 -1.845
media 6 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global
unit 5
cuboid 5 600.0 -200.0 200.0 -200.0 250.0 -50.
cuboid 10 657.40 -257.0 460.0 -559.2 650.0 -50
cuboid 20 657.40 -257.0 460.0 -559.2 650.0 -50.32
cuboid 30 657.40 -257.0 460.0 -559.2 650.0 -51.59
cuboid 40 657.40 -257.0 460.0 -559.2 650.0 -52.23
cuboid 50 657.40 -257.0 460.0 -559.2 650.0 -427.23
cuboid 60 687.40 -307.00 490.00 -589.20 680.0 -457.23
array 2 5 place 1 1 1 0.0 0.0 0.0
media 0 1 10 -5
media 2 1 20 -10
media 3 1 30 -20
media 4 1 40 -30
media 0 1 50 -40
media 5 1 60 -50
boundary 60
end geom
read array
ara=1 nux=3 nuy=3 nuz=3 fill f1 end fill
ara=2 nux=2 nuy=1 nuz=1 fill 2 3 end fill
end array
end data
end

=csas26
uo2(no3)2 279 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 279 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
arbmwood .640525 3 0 0 0 6012 44.435 1001 6.2639 8016 49.301 3 end
carbonsteel 4 end
reg-concrete 5 end
end comp
cylindrical end

```

```

1 9.52 oneextermod    2 10.16 noextermod end zone
read param   plt=no  npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10  9.52 17.5609 0.
cylinder 20  9.52 17.77 0.
cylinder 30  10.16 18.41 -.64
cuboid   40  4p10.875 19.125 -1.355
media   1 1 10
media   0 1 20 -10
media   2 1 30 -20
media   0 1 40 -30
boundary 40
unit 2
cuboid   10 32.625 -10.875 32.625 -10.875 39.605 -1.355
cuboid   20 4p200. 250. -50.
array    1 10 place 1 1 1 0.0 0.0 0.0
media   0 1 20 -10
boundary 20
unit 3
cylinder 10 142.8 224. -48.
cylinder 20 144.8 224. -50.
cuboid   30 218.1 -181.9 215. -185. 250. -50.
media   0 1 10
media   4 1 20 -10
media   0 1 30 -20
boundary 30
global
unit 4
cuboid   5 600.0 -200.0 200.0 -200.0 250.0 -50.
cuboid   10 657.40 -257.0 460.0 -559.2 650.0 -50
cuboid   20 657.40 -257.0 460.0 -559.2 650.0 -50.32
cuboid   30 657.40 -257.0 460.0 -559.2 650.0 -51.59
cuboid   40 657.40 -257.0 460.0 -559.2 650.0 -52.23
cuboid   50 657.40 -257.0 460.0 -559.2 650.0 -427.23
cuboid   60 687.40 -307.00 490.00 -589.20 680.0 -457.23
array    2 5 place 1 1 1 0.0 0.0 0.0
media   0 1 10 -5
media   2 1 20 -10
media   3 1 30 -20
media   4 1 40 -30
media   0 1 50 -40
media   5 1 60 -50
boundary 60
end geom
'read start xsm=178 xsp=222 ysm=178 ysp=222 zsm=50 zsp=91 end start
read array ara=1 nux=2 nuy=2 nuz=2 fill f1 end fill
ara=2 nux=2 nuy=1 nuz=1 fill 2 3 end fill end array
end data
end

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
arbmwood .640525 3 0 0 0 6012 44.435 1001 6.2639 8016 49.301 3 end
carbonsteel 4 end
reg-concrete 5 end
end comp
cylindrical end
1 9.52 oneextermod    2 10.16 noextermod end zone

```

```

read param      plt=no   npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10  9.52 17.5609 0.
cylinder 20  9.52 17.77 0.
cylinder 30  10.16 18.41 -.64
cuboid   40  4p13.40 21.65 -3.88
media   1 1 10
media   0 1 20 -10
media   2 1 30 -20
media   0 1 40 -30
boundary 40
unit 2
cuboid   10  67.0 -13.40 67.0 -13.40    72.71  -3.88
cuboid   20  4p200. 250. -50.
array    1 10 place 1 1 1  0.0 0.0 0.0
media   0 1 20 -10
boundary 20
unit 3
cylinder 10  142.8 224. -48.
cylinder 20  144.8 224. -50.
cuboid   30  218.1 -181.9 215. -185. 250. -50.
media   0 1 10
media   4 1 20 -10
media   0 1 30 -20
boundary 30
global
unit 4
cuboid   5  600.0 -200.0 200.0 -200.0 250.0 -50.
cuboid   10 657.40 -257.0 460.0 -559.2 650.0 -50
cuboid   20 657.40 -257.0 460.0 -559.2 650.0 -50.32
cuboid   30 657.40 -257.0 460.0 -559.2 650.0 -51.59
cuboid   40 657.40 -257.0 460.0 -559.2 650.0 -52.23
cuboid   50 657.40 -257.0 460.0 -559.2 650.0 -427.23
cuboid   60 687.40 -307.00 490.00 -589.20 680.0 -457.23
array    2 5 place 1 1 1 0.0 0.0 0.0
media   0 1 10 -5
media   2 1 20 -10
media   3 1 30 -20
media   4 1 40 -30
media   0 1 50 -40
media   5 1 60 -50
boundary 60
end geom
read array ara=1 nux=3 nuy=3 nuz=3 fill f1 end fill
ara=2 nux=2 nuy=1 nuz=1 fill 2 3 end fill end array
'read plot
'xul=113.2 yul=286.8 zul=60. xlr=286.8 ylr=113.2 zlr=60.
'uax=1 vdn=-1 nax=125 end
'xul=437.1 yul=329.8 zul=60. xlr=726.7 ylr=40.2 zlr=60. end
'end plot
end data
end

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
arbwood .640525 3 0 0 0 6012 44.435 1001 6.2639 8016 49.301 3 end
carbonsteel 4 end
reg-concrete 5 end

```

```

solnuo2(no3)2 6 279 0 1 293 92235 92.6 92238 7.4 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param plt=no npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p13.365 21.615 -3.845
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
unit 2
cuboid 10 66.825 -13.365 66.825 -13.365 72.535 -3.845
cuboid 20 4p200. 250. -50.
array 1 10 place 1 1 1 0.0 0.0 0.0
media 0 1 20 -10
boundary 20
unit 3
cylinder 10 142.8 224. -48.
cylinder 20 144.8 224. -50.
cuboid 30 218.1 -181.9 215. -185. 250. -50.
media 0 1 10
media 4 1 20 -10
media 0 1 30 -20
boundary 30
unit 4
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p13.365 21.615 -3.845
media 6 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global
unit 5
cuboid 5 600.0 -200.0 200.0 -200.0 250.0 -50.
cuboid 10 657.40 -257.0 460.0 -559.2 650.0 -50
cuboid 20 657.40 -257.0 460.0 -559.2 650.0 -50.32
cuboid 30 657.40 -257.0 460.0 -559.2 650.0 -51.59
cuboid 40 657.40 -257.0 460.0 -559.2 650.0 -52.23
cuboid 50 657.40 -257.0 460.0 -559.2 650.0 -427.23
cuboid 60 687.40 -307.00 490.00 -589.20 680.0 -457.23
array 2 5 place 1 1 1 0.0 0.0 0.0
media 0 1 10 -5
media 2 1 20 -10
media 3 1 30 -20
media 4 1 40 -30
media 0 1 50 -40
media 5 1 60 -50
boundary 60
end geom
read array
ara=1 nux=3 nuy=3 nuz=3 fill 10r1 4 1 3r4 1 4 10r1 end fill
ara=2 nux=2 nuy=1 nuz=1 fill 2 3 end fill
end array
end data

```

```

end

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p16.13 24.38 -6.61
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global
unit 2
cuboid 10 80.65 -16.13 80.65 -16.13 86.36 -6.61
cuboid 20 83.19 -18.67 83.19 -18.67 88.9 -6.61
cuboid 30 83.19 -18.67 83.19 -18.67 88.9 -21.85
array 1 10 place 1 1 1 0.0 0.0 0.0
media 2 1 20 -10
media 3 1 30 -20
boundary 30
end geom
read array
ara=1 nux=3 nuy=3 nuz=3 fill f1 end fill
end array
end data
end

```

```

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p18.085 26.335 -8.565
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global

```

```

unit 2
cuboid 10  90.425  -18.085  90.425  -18.085  96.135  -8.565
cuboid 20  105.665  -25.705  105.665  -25.705  103.755  -23.805
array   1 10 place 1 1 1  0.0 0.0 0.0
media   3 1 20 -10
boundary 20
end geom
read array
ara=1 nux=3 nuy=3 nuz=3 fill f1 end fill
end array
end data
end

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2  1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass    2 1 end
para(h2o)      3 1 end
end comp
cylindrical end
1 9.52 oneextermod  2 10.16 noextermod end zone
read param     npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid    40 4p14.67 22.92 -5.15
media   1 1 10
media   0 1 20 -10
media   2 1 30 -20
media   0 1 40 -30
boundary 40
global
unit 2
cuboid 10  73.35  -14.67  73.35  -14.67  79.06  -5.15
cuboid 20  74.62  -15.94  74.62  -15.94  80.33  -6.42
array   1 10 place 1 1 1  0.0 0.0 0.0
media   3 1 20 -10
boundary 20
end geom
read array
ara=1 nux=3 nuy=3 nuz=3 fill f1 end fill
end array
end data
end

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2  1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass    2 1 end
para(h2o)      3 1 end
end comp
cylindrical end
1 9.52 oneextermod  2 10.16 noextermod end zone
read param     npg=2000 fdn=yes nub=yes end param
read geom

```

```

unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p11.965 20.215 -2.445
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global
unit 2
cuboid 10 35.895 -11.965 35.895 -11.965 42.875 -2.445
cuboid 20 37.165 -13.235 37.165 -13.235 44.145 -2.445
cuboid 30 37.165 -13.235 37.165 -13.235 44.145 -17.685
array 1 10 place 1 1 1 0.0 0.0 0.0
media 2 1 20 -10
media 3 1 30 -20
boundary 30
end geom
read array
ara=1 nux=2 nuy=2 nuz=2 fill f1 end array
end data
end

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p12.865 21.115 -3.345
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global
unit 2
cuboid 10 38.595 -12.865 38.595 -12.865 45.575 -3.345
cuboid 20 41.135 -15.405 41.135 -15.405 48.116 -3.345
cuboid 30 41.135 -15.405 41.135 -15.405 48.116 -18.585
array 1 10 place 1 1 1 0.0 0.0 0.0
media 2 1 20 -10
media 3 1 30 -20
boundary 30
end geom
read array
ara=1 nux=2 nuy=2 nuz=2 fill f1 end array
end data
end

```

```

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p14.48 22.73 -4.96
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global
unit 2
cuboid 10 43.44 -14.48 43.44 -14.48 50.42 -4.96
cuboid 20 49.79 -20.83 49.79 -20.83 56.77 -4.96
cuboid 30 49.79 -20.83 49.79 -20.83 56.77 -20.2
array 1 10 place 1 1 1 0.0 0.0 0.0
media 2 1 20 -10
media 3 1 30 -20
boundary 30
end geom
read array
ara=1 nux=2 nuy=2 nuz=2 fill f1 end array
end data
end

```

```

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p14.515 22.765 -4.995
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global
unit 2
cuboid 10 43.545 -14.515 43.545 -14.515 50.525 -4.995
cuboid 20 51.165 -22.135 51.165 -22.135 58.145 -20.235
array 1 10 place 1 1 1 0.0 0.0 0.0

```

```

media 3 1 20 -10
boundary 20
end geom
read array
ara=1 nux=2 nuy=2 nuz=2 fill f1 end array
end data
end

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p11.80 20.05 -2.28
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20
media 0 1 40 -30
boundary 40
global
unit 2
cuboid 10 35.4 -11.80 35.4 -11.80 42.38 -2.28
cuboid 20 36.67 -13.07 36.67 -13.07 43.65 -3.55
array 1 10 place 1 1 1 0.0 0.0 0.0
media 3 1 20 -10
boundary 20
end geom
read array
ara=1 nux=2 nuy=2 nuz=2 fill f1 end array
end data
end

=csas26
uo2(no3)2 415 g u/l
238groupndf5 multiregion
solnuo2(no3)2 1 415 0 1 293 92235 92.6 92238 7.4 end
plexiglass 2 1 end
para(h2o) 3 1 end
end comp
cylindrical end
1 9.52 oneextermod 2 10.16 noextermod end zone
read param npg=2000 fdn=yes nub=yes end param
read geom
unit 1
cylinder 10 9.52 17.5609 0.
cylinder 20 9.52 17.77 0.
cylinder 30 10.16 18.41 -.64
cuboid 40 4p13.615 21.865 -4.095
media 1 1 10
media 0 1 20 -10
media 2 1 30 -20

```

```
media 0 1 40 -30
boundary 40
global
unit 2
cuboid 10    40.845 -13.615  40.845 -13.615   47.825 -4.095
cuboid 20    44.655 -17.425  44.655 -17.425   51.635 -7.905
array    1 10 place 1 1 1  0.0 0.0 0.0
media  3 1 20 -10
boundary 20
end geom
read array
ara=1 nux=2 nuy=2 nuz=2 fill f1 end array
end data
end
```

Table B.6. Table 6 input data

```

=csas26
eta experiments exp 1
238groupndf5 infhommedium
u-233      1 0 0.0      end
u-234      1 0 0.00538-4 end
u-235      1 0 0.48006-4 end
u-236      1 0 0.00138-4 end
u-238      1 0 0.02807-4 end
n          1 0 1.869-4   end
h          1 0 0.066228  end
o          1 0 0.033736  end
b-10       1 0 0.0      end
b-11       1 0 0.0      end
th-232     1 0 0.0      end
al         2 1           end
ss316      3 1           end
carbonsteel 4 1           end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
sphere 10 34.5948
sphere 20 34.9148
cuboid 30 6p34.9148
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

=csas26
eta experiments exp 2
238groupndf5 infhommedium
u-233      1 0 0.0      end
u-234      1 0 0.00631-4 end
u-235      1 0 0.56206-4 end
u-236      1 0 0.00163-4 end
u-238      1 0 0.03281-4 end
n          1 0 2.129-4   end
h          1 0 0.066148  end
o          1 0 0.033800  end
b-10       1 0 0.01029-4 end
b-11       1 0 0.04166-4 end
th-232     1 0 0.0      end
al         2 1           end
ss316      3 1           end
carbonsteel 4 1           end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
sphere 10 34.5948
sphere 20 34.9148
cuboid 30 6p34.9148
media 1 1 10

```

```

media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

=csas26
eta experiments exp 3
238groupndf5 infhommedium
u-233      1 0 0.0      end
u-234      1 0 0.00716-4 end
u-235      1 0 0.63944-4 end
u-236      1 0 0.00184-4 end
u-238      1 0 0.03734-4 end
n          1 0 2.392-4   end
h          1 0 0.066070  end
o          1 0 0.033865  end
b-10       1 0 0.02057-4 end
b-11       1 0 0.08332-4 end
th-232     1 0 0.0      end
al         2 1           end
ss316      3 1           end
carbonsteel 4 1           end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
sphere 10 34.5948
sphere 20 34.9148
cuboid 30 6p34.9148
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

=csas26
eta experiments exp 4
238groupndf5 infhommedium
u-233      1 0 0.0      end
u-234      1 0 0.00762-4 end
u-235      1 0 0.67959-4 end
u-236      1 0 0.00197-4 end
u-238      1 0 0.03967-4 end
n          1 0 2.548-4   end
h          1 0 0.066028  end
o          1 0 0.034028  end
b-10       1 0 0.02532-4 end
b-11       1 0 0.10255-4 end
th-232     1 0 0.0      end
al         2 1           end
ss316      3 1           end
carbonsteel 4 1           end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global

```

```

unit 1
sphere 10 34.5948
sphere 20 34.9148
cuboid 30 6p34.9148
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

=csas26
eta experiments exp 5
238groupndf5 infhommedium
u-233      1 0 0.43284-4 end
u-234      1 0 0.00716-4 end
u-235      1 0 0.00018-4 end
u-236      1 0 0.0 end
u-238      1 0 0.00281-4 end
n          1 0 1.178-4 end
h          1 0 0.066360 end
o          1 0 0.033608 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000196-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
sphere 10 34.5948
sphere 20 34.9148
cuboid 30 6p34.9148
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

=csas26
eta experiments exp 6
238groupndf5 infhommedium
u-233      1 0 0.45120-4 end
u-234      1 0 0.00744-4 end
u-235      1 0 0.00018-4 end
u-236      1 0 0.0 end
u-238      1 0 0.00291-4 end
n          1 0 1.224-4 end
h          1 0 0.066345 end
o          1 0 0.033621 end
b-10       1 0 0.00263-4 end
b-11       1 0 0.01066-4 end
th-232     1 0 0.000205-3 end
al         2 1 end
ss316      3 1 end

```

```

carbonsteel 4 1           end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
sphere 10 34.5948
sphere 20 34.9148
cuboid 30 6p34.9148
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

=csas26
eta experiments exp 7
238groupndf5 infhommedium
u-233      1 0 0.46798-4 end
u-234      1 0 0.00772-4 end
u-235      1 0 0.00018-4 end
u-236      1 0 0.0 end
u-238      1 0 0.00301-4 end
n          1 0 1.274-4 end
h          1 0 0.066329 end
o          1 0 0.033634 end
b-10       1 0 0.00512-4 end
b-11       1 0 0.02075-4 end
th-232     1 0 0.000213-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
sphere 10 34.5948
sphere 20 34.9148
cuboid 30 6p34.9148
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

=csas26
eta experiments exp 8
238groupndf5 infhommedium
u-233      1 0 0.48455-4 end
u-234      1 0 0.00801-4 end
u-235      1 0 0.00021-4 end
u-236      1 0 0.0 end
u-238      1 0 0.00311-4 end
n          1 0 1.319-4 end
h          1 0 0.066315 end
o          1 0 0.033646 end

```

```

b-10      1  0  0.00758-4  end
b-11      1  0  0.03069-4  end
th-232    1  0  0.000221-3 end
al       2  1           end
ss316    3  1           end
carbonsteel 4  1           end
end comp
read param npg=2000 fdn=yes  nub=yes  tme=59  end param
read geom
global
unit 1
sphere 10 34.5948
sphere 20 34.9148
cuboid 30 6p34.9148
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

```

```

=csas26
eta experiments exp 9
238groupndf5 infhommedium
u-233      1  0  0.5066-4  end
u-234      1  0  0.00827-4  end
u-235      1  0  0.00021-4  end
u-236      1  0  0.0           end
u-238      1  0  0.00327-4  end
n          1  0  1.363-4   end
h          1  0  0.0663    end
o          1  0  0.033659  end
b-10     1  0  0.01005-4  end
b-11     1  0  0.04070-4  end
th-232    1  0  0.000227-3 end
al       2  1           end
ss316    3  1           end
carbonsteel 4  1           end
end comp
read param npg=2000 fdn=yes  nub=yes  tme=59  end param
read geom
global
unit 1
sphere 10 34.5948
sphere 20 34.9148
cuboid 30 6p34.9148
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

```

```

=csas26
eta experiments exp 10
238groupndf5 infhommedium
u-233      1  0  0.0           end
u-234      1  0  0.00409-4  end
u-235      1  0  0.36185-4  end

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u-236      1  0  0.00220-4  end
u-238      1  0  0.01985-4  end
n          1  0  1.116-4   end
h          1  0  0.066394  end
o          1  0  0.033592  end
b-10       1  0  0.0    end
b-11       1  0  0.0    end
th-232     1  0  0.0    end
al         2  1    end
ss316      3  1    end
carbonsteel 4  1    end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
sphere 10 61.0108
sphere 20 61.7808
cuboid 30 6p61.7808
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

=csas26
eta experiments exp 11
238groupndf5 infhommedium
u-233      1  0  0.33460-4  end
u-234      1  0  0.00525-4  end
u-235      1  0  0.00010-4  end
u-236      1  0  0.0    end
u-238      1  0  0.00256-4  end
n          1  0  0.753-4   end
h          1  0  0.066467  end
o          1  0  0.033525  end
b-10       1  0  0.0    end
b-11       1  0  0.0    end
th-232     1  0  0.000148-3 end
al         2  1    end
ss316      3  1    end
carbonsteel 4  1    end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
sphere 10 61.0108
sphere 20 61.7808
cuboid 30 6p61.7808
media 1 1 10
media 2 1 20 -10
media 0 1 30 -20
boundary 30
end geom
end data
end

```

```

=csas26
eta experiments exp 12
238groupndf5 infhommedium
u-233      1 0 0.00000-4 end
u-234      1 0 0.00469-4 end
u-235      1 0 0.41364-4 end
u-236      1 0 0.00243-4 end
u-238      1 0 0.02271-4 end
n          1 0 1.27200-4 end
h          1 0 0.066345 end
o          1 0 0.033624 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000000-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
cylinder 10 77.3684 45.1358 0.0
cylinder 20 77.3684 264.0 0.0
cylinder 30 77.4984 264.13 -0.13
cuboid    40 4p77.4984 264.13 -0.13
media   1 1 10
media   0 1 20 -10
media   3 1 30 -20
media   0 1 40 -30
boundary 40
end geom
end data
end

```

```

=csas26
eta experiments exp 13
238groupndf5 infhommedium
u-233      1 0 0.00000-4 end
u-234      1 0 0.00451-4 end
u-235      1 0 0.40595-4 end
u-236      1 0 0.00222-4 end
u-238      1 0 0.02339-4 end
n          1 0 1.40900-4 end
h          1 0 0.066343 end
o          1 0 0.033655 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000000-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
cylinder 10 77.3684 47.4472 0.0
cylinder 20 77.3684 264.0 0.0
cylinder 30 77.4984 264.13 -0.13
cuboid    40 4p77.4984 264.13 -0.13
media   1 1 10

```

```

media 0 1 20 -10
media 3 1 30 -20
media 0 1 40 -30
boundary 40
end geom
end data
end

=csas26
eta experiments exp 14
238groupndf5 infhommedium
u-233      1 0 0.00000-4 end
u-234      1 0 0.00409-4 end
u-235      1 0 0.36452-4 end
u-236      1 0 0.00209-4 end
u-238      1 0 0.02048-4 end
n          1 0 1.18500-4 end
h          1 0 0.066383 end
o          1 0 0.033605 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000000-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
cylinder 10 77.3684    72.7456   0.0
cylinder 20 77.3684    264.0     0.0
cylinder 30 77.4984    264.13   -0.13
cuboid   40 4p77.4984  264.13   -0.13
media 1 1 10
media 0 1 20 -10
media 3 1 30 -20
media 0 1 40 -30
boundary 40
end geom
end data
end

=csas26
eta experiments exp 15
238groupndf5 infhommedium
u-233      1 0 0.00000-4 end
u-234      1 0 0.00397-4 end
u-235      1 0 0.34845-4 end
u-236      1 0 0.00194-4 end
u-238      1 0 0.01962-4 end
n          1 0 1.20800-4 end
h          1 0 0.066389 end
o          1 0 0.033609 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000000-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp

```

```

read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
cylinder 10 77.3684 105.2068 0.0
cylinder 20 77.3684 264.0 0.0
cylinder 30 77.4984 264.13 -0.13
cuboid 40 4p77.4984 264.13 -0.13
media 1 1 10
media 0 1 20 -10
media 3 1 30 -20
media 0 1 40 -30
boundary 40
end geom
end data
end

=csas26
eta experiments exp 16
238groupndf5 infhommedium
u-233 1 0 0.00000-4 end
u-234 1 0 0.00384-4 end
u-235 1 0 0.33519-4 end
u-236 1 0 0.00186-4 end
u-238 1 0 0.01924-4 end
n 1 0 1.24400-4 end
h 1 0 0.066391 end
o 1 0 0.033615 end
b-10 1 0 0.0 end
b-11 1 0 0.0 end
th-232 1 0 0.000000-3 end
al 2 1 end
ss316 3 1 end
carbonsteel 4 1 end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
cylinder 10 77.3684 203.2762 0.0
cylinder 20 77.3684 264.0 0.0
cylinder 30 77.4984 264.13 -0.13
cuboid 40 4p77.4984 264.13 -0.13
media 1 1 10
media 0 1 20 -10
media 3 1 30 -20
media 0 1 40 -30
boundary 40
end geom
end data
end

=csas26
eta experiments exp 17
238groupndf5 infhommedium
u-233 1 0 0.36517-4 end
u-234 1 0 0.00556-4 end
u-235 1 0 0.00000-4 end
u-236 1 0 0.00000-4 end
u-238 1 0 0.00410-4 end
n 1 0 0.82600-4 end

```

```

h          1  0  0.066439  end
o          1  0  0.033539  end
b-10      1  0  0.0  end
b-11      1  0  0.0  end
th-232    1  0  0.000037-3 end
al         2  1  end
ss316     3  1  end
carbonsteel 4  1  end
end comp
read param npg=2000 fdn=yes  nub=yes  tme=59  end param
read geom
global
unit 1
cylinder 10  77.3684    49.5046  0.0
cylinder 20  77.3684    264.0    0.0
cylinder 30  77.4984    264.13   -0.13
cuboid   40  4p77.4984  264.13   -0.13
media   1 1 10
media   0 1 20 -10
media   3 1 30 -20
media   0 1 40 -30
boundary 40
end geom
end data
end

=csas26
eta experiments exp 18
238groupndf5 infhommedium
u-233      1  0  0.34978-4  end
u-234      1  0  0.00525-4  end
u-235      1  0  0.00000-4  end
u-236      1  0  0.00000-4  end
u-238      1  0  0.00395-4  end
n          1  0  0.84900-4  end
h          1  0  0.066444  end
o          1  0  0.033542  end
b-10      1  0  0.0  end
b-11      1  0  0.0  end
th-232    1  0  0.000032-3 end
al         2  1  end
ss316     3  1  end
carbonsteel 4  1  end
end comp
read param npg=2000 fdn=yes  nub=yes  tme=59  end param
read geom
global
unit 1
cylinder 10  77.3684    59.2074  0.0
cylinder 20  77.3684    264.0    0.0
cylinder 30  77.4984    264.13   -0.13
cuboid   40  4p77.4984  264.13   -0.13
media   1 1 10
media   0 1 20 -10
media   3 1 30 -20
media   0 1 40 -30
boundary 40
end geom
end data
end

```

```

=csas26
eta experiments exp 19
238groupndf5 infhommedium
u-233      1 0 0.33292-4 end
u-234      1 0 0.00507-4 end
u-235      1 0 0.00000-4 end
u-236      1 0 0.00000-4 end
u-238      1 0 0.00375-4 end
n          1 0 0.80200-4 end
h          1 0 0.066459 end
o          1 0 0.033533 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000037-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
cylinder 10 77.3684    77.6732  0.0
cylinder 20 77.3684    264.0     0.0
cylinder 30 77.4984    264.13   -0.13
cuboid    40 4p77.4984  264.13   -0.13
media    1 1 10
media    0 1 20 -10
media    3 1 30 -20
media    0 1 40 -30
boundary 40
end geom
end data
end

```

```

=csas26
eta experiments exp 20
238groupndf5 infhommedium
u-233      1 0 0.31567-4 end
u-234      1 0 0.00481-4 end
u-235      1 0 0.00000-4 end
u-236      1 0 0.00000-4 end
u-238      1 0 0.00354-4 end
n          1 0 0.79500-4 end
h          1 0 0.066470 end
o          1 0 0.033531 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000258-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
cylinder 10 77.3684    138.9126  0.0
cylinder 20 77.3684    264.0     0.0
cylinder 30 77.4984    264.13   -0.13
cuboid    40 4p77.4984  264.13   -0.13
media    1 1 10

```

```

media 0 1 20 -10
media 3 1 30 -20
media 0 1 40 -30
boundary 40
end geom
end data
end

=csas26
eta experiments exp 21
238groupndf5 infhommedium
u-233      1 0 0.00000-4 end
u-234      1 0 0.00397-4 end
u-235      1 0 0.33940-4 end
u-236      1 0 0.00240-4 end
u-238      1 0 0.01975-4 end
n          1 0 1.40700-4 end
h          1 0 0.066367 end
o          1 0 0.033645 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000000-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
cylinder 10 136.7790    90.8812   0.0
cylinder 20 136.7790    274.0     0.0
cylinder 30 138.6840    275.905   -1.905
cuboid    40 4p138.6840  275.905   -1.905
media 1 1 10
media 0 1 20 -10
media 3 1 30 -20
media 0 1 40 -30
boundary 40
end geom
end data
end

=csas26
eta experiments exp 22
238groupndf5 infhommedium
u-233      1 0 0.00000-4 end
u-234      1 0 0.00381-4 end
u-235      1 0 0.33124-4 end
u-236      1 0 0.00232-4 end
u-238      1 0 0.01942-4 end
n          1 0 1.36700-4 end
h          1 0 0.066374 end
o          1 0 0.033634 end
b-10       1 0 0.0 end
b-11       1 0 0.0 end
th-232     1 0 0.000000-3 end
al         2 1 end
ss316      3 1 end
carbonsteel 4 1 end
end comp

```

```

read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
cylinder 10 136.7790      122.4280    0.0
cylinder 20 136.7790      274.0       0.0
cylinder 30 138.6840      275.905   -1.905
cuboid   40 4p138.6840    275.905   -1.905
media   1 1 10
media   0 1 20 -10
media   3 1 30 -20
media   0 1 40 -30
boundary 40
end geom
end data
end

=csas26
eta experiments exp 23
238groupndf5 infhommedium
u-233      1 0 0.00000-4 end
u-234      1 0 0.00368-4 end
u-235      1 0 0.32347-4 end
u-236      1 0 0.00220-4 end
u-238      1 0 0.01894-4 end
n          1 0 1.33800-4 end
h          1 0 0.066385 end
o          1 0 0.033631 end
b-10       1 0 0.0       end
b-11       1 0 0.0       end
th-232     1 0 0.000000-3 end
al         2 1           end
ss316      3 1           end
carbonsteel 4 1           end
end comp
read param npg=2000 fdn=yes nub=yes tme=59 end param
read geom
global
unit 1
cylinder 10 136.7790      241.1222    0.0
cylinder 20 136.7790      274.0       0.0
cylinder 30 138.6840      275.905   -1.905
cuboid   40 4p138.6840    275.905   -1.905
media   1 1 10
media   0 1 20 -10
media   3 1 30 -20
media   0 1 40 -30
boundary 40
end geom
end data
end

```


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