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Neutronics Benchmarks of Mixed-Oxide Fuels using the SCALE/CENTRM Sequence

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ABSTRACT

The purpose of this study is to determine and document the reactor physics parameters (multiplication factors, spatially dependent flux ratios, and spacially dependent reaction rates) for several distinct sets of problems using two distinct resonance cross-section processing techniques. In SCALE, by default, resonances are processed using NITAWL, which utilizes the Nordheim Integral Treatment. The results produced using this sequence are considered to be the base results. A second set of results are produced by replacing NITAWL with CENTRM/PMC. CENTRM produces point-wise fluxes for a given geometry configuration and set of isotopes. Using these fluxes, PMC produces problem-dependent self-shielding cross sections. Both sequences use ENDF/B-V cross-section data.

1. INTRODUCTION

This report examines four sets of problems that are used to evaluate the differences between the NITAWL resonance processor and the CENTRM/PMC resonance processor. All the problems are predominantly thermal, with the energy of the average lethargy causing fission (EALCF) being below 1 eV. They are all water-moderated fuel rod lattices of various dimensions and fuel materials. The objective of this report is to compare the differences between the NITAWL and CENTRM/PMC resolved-resonance processors for the class of problems presented in this report. The existence of severe resonance overlap when mixing uranium and plutonium could cause a significant problem with the NITAWL results. CENTRM/PMC does not contain this potential problem, which is a limitation of the Nordheim Integral Treatment.

All problem were processed using SCALE5.0, which allows one to choose which resolved resonance processor will be used to self-shield the nuclides, NITAWL or CENTRM/PMC. SCALE5.0 is a developmental version of the SCALE code system. The current version of SCALE, SCALE4.4, does not contain CENTRM but is essentially the same in all other aspects to SCALE5.0. SCALE5.0 has the ability to use either NITAWL or CENTRM/PMC as the resolved-resonance processor. All problems were run first using CENTRM/PMC and then using NITAWL. The results were then analyzed and compared. [1, 2]

1.1 THE SCALE 5.0 SEQUENCES

SCALE 5.0 contains two distinct sequences used for processing cross-section data. The original sequence consisting of the codes CSAS, BONAMI, and NITAWL process all resolved resonance data in NITAWL. The new computational sequence added to SCALE5.0 uses the following sequence to process the cross sections: CSAS, BONAMI, NITAWL, CENTRM, PMC, WORKER. CENTRM/PMC process the resolved resonances cross sections in the unit cell. All other resolved resonance cross sections are processed using NITAWL. To calculate the desired physics parameters, the three experimental benchmark sets then use KENO-V.a and the set of computational benchmarks uses XSDRNPM. Many of the physics parameters are compared with direct experimental data and others are compared only with the same parameters calculated using difference codes and cross sections.

1.2 NITAWL

NITAWL performs problem-dependent resonance self-shielding using the Nordheim Integral Treatment, which involves solving for the energy dependence of the neutron flux in a material region containing a resonance absorber and a maximum of two moderating materials. The resonance self-shielding is made with reference to infinite dilution cross-section values. The material region is either infinite or a one-dimensional (1-D) slab, cylinder, or sphere surrounded by moderator. In the moderator, the neutron flux is assumed to be spatially flat and slowly varying with energy. The presence of more than one fuel region in the moderator, such as a lattice, is accounted for using a Dancoff factor.

There are many problems where the Nordheim Integral Treatment may not be appropriate because of the following assumptions:

1. Each resonance nuclide can be treated without consideration of other resonance nuclides present in the system.
2. The neutron flux is spatially uniform in the absorber and moderator regions.
3. Neutron transport into and out of the absorber region can be treated with first-flight escape probabilities.
4. The presence of other absorber lumps in the system can be accounted for with a Dancoff factor which corresponds to the first-flight transmission probability across the moderator. A Dancoff factor of zero corresponds to a single lump in the moderator. A Dancoff factor of 1 corresponds to an infinite medium of the absorber material with no moderator outside the absorber lump.

1.3 CENTRM/PMC

The new resolved-resonance processor is composed of two codes that are executed sequentially. The first code, CENTRM, is a discrete-ordinance code that produces a point-wise continuous-energy flux spectrum for a given infinite or 1-D problem. Subsequently, PMC uses this point flux spectrum to collapse point cross sections to a problem-dependent multigroup cross-section set. To generate the flux profile and produce new group cross sections, the two codes use a pointwise continuous cross-section library that contain all the nuclides present in the selected multigroup cross-section library. All the cases in this report were analyzed using the 238-group ENDF/B-V multigroup cross-section library.

CENTRM has several options that determine the range over which the flux spectrum will be generated and the parameters used for generating the flux spectrum. Although pointwise continuous in energy, the flux spectrum is generated on a specified 1-D spacial mesh. For all cases in this report, the spatial mesh is over an infinite cylinder that is automatically generated by the code. The flux spectrum is generated from 20 MeV to 1.0E-5 eV over the spatial mesh using a default quadrature of 8. CENTRM uses the specified quadrature to generate Legendre coefficients for the scattering component of the pointwise flux.

CENTRM is capable of using a fixed or fission input source to generate the flux profile. For simplicity and because the benchmarks are fission problems, a spacially flat fission source is assumed as an initial guess. Two other parameters that can affect the flux are the point convergence criterion and the tolerance used for thinning the pointwise cross sections. These parameters are both set to default values of 0.0001 for the convergence criterion and 0.0025 for the thinning tolerance.

In order for CENTRM to generate the flux profile it first combines the pointwise continuous-energy cross sections of all nuclides in each zone. Each zone contains only one material but is divided into many intervals, with each interval being a mesh point where the entire energy spectrum of the flux is calculated. There is no code limit on the number of materials and 1-D zones. However, for large problems involving many materials and zones, computer memory and CPU speed may be a limiting factor.

By default, the flux profile is generated using an S_N calculation over the entire spectrum. The option exists to perform several other types of calculations independently over the fast, thermal, and pointwise ranges. Over all energy ranges, scattering for the pointwise continuous cross sections is assumed to be elastic and isotropic in the center of mass system. Consequently, no scattering data are contained in the point library, only 1-D cross sections.

PMC replaces the cross sections for specified nuclides and energy groups in the problem-dependent multigroup library. PMC reads the pointwise flux file, the pointwise continuous cross sections, and the problem-dependent multigroup library; generates new multigroup data from the point data; and finally rewrites the multigroup library with the new multigroup data. PMC can produce multigroup cross sections over three ranges for all nuclides: the entire point library range, the resolved resonance range, or the pointwise flux range. For the problems, in this report PMC produces multigroup cross sections over the resolved resonance range of each nuclide in the unit cell data.

PMC has three methods for computing the scattering component of the new multigroup cross sections. The P_N components of the original multigroup scattering cross sections can be renormalized to the new 1-D scattering cross sections. The P_N components of the original multigroup scattering cross sections can be renormalized using the scalar flux. Finally, new P_N components for the scattering cross section can be computed using the pointwise flux moments. For the problems in this report, the first option of renormalizing the P_N components using the new 1-D cross sections is used.

A set of pointwise continuous cross sections are available for use by CENTRM and PMC. The point cross sections used in the report were generated using the AMPX code system from the ENDF/B-V nuclear data library. The library contains all the nuclides present in both the 238-group and 44-group ENDF/B-V multigroup libraries. The library contains the total, elastic scattering, and radiative capture cross sections for each nuclide. If a nuclide is fissionable, the fission cross section is also present. Also, if a nuclide contains inelastic data at higher energies, inelastic data are also included in the library. The pointwise continuous library is divided up into files, with each file containing all the cross-section data for one nuclide. The ENDF/B-V pointwise library was generated to be used with the ENDF/B-V multigroup libraries. Using it with any other type of library, such as one generated using ENDF/B-VI data, could produce incorrect results.

2. MIX-COMP-THERM-2 (PNL-30 to PNL-35)

2.1 DESCRIPTION

This section describes a set of six critical experiments, each consisting of a square-pitched array of mixed plutonium-uranium fuel rods submerged in water surrounded by a water reflector. The water contains boron concentrations from 0.9 to 767.2 ppm. This set of experiments is contained in the *International Handbook of Evaluated Criticality Safety Benchmark Experiments*.[3]

This set of experiments was performed between December 1975 and March 1976 at the Plutonium Recycle Critical Facility at Pacific Northwest Laboratory. The benchmark experiments are light-water-moderated critical assemblies consisting of a core array supported by upper and lower lattice plates. The lattice plates are 2.54 cm thick and located at the top and bottom of the fuel region . The reactor is brought to critical by raising the water level in the tank, thus avoiding the use of control rods. The fuel rods sit on a support plate above the bottom of the tank. The tank is wide enough to assume an infinite moderator on the sides and bottom (~30 cm of water).

All fuel rods have the same physical dimensions. A schematic diagram of the fuel rods and bottom reflector is given in Fig. 2.1. Each fuel rod has an active fuel length of 86.6775 cm, 0.5 cm of UO_2 at the bottom of the fuel, a 0.6985-cm cladding plug on the bottom and a 0.8255-cm cladding plug on the top. The fuel has a radius of 0.64135 cm. The cladding has an outside radius of 0.71755 cm. A 0.3175-cm water gap is located between the top of the aluminum support plate and the bottom of the lower lattice plate. The aluminum support plate is 2.8575 cm thick. There is a 0.889-cm water gap between the bottom of the lead plate and the top of the upper lattice plate. The lead plate is 0.9525 cm thick. The top reflector varies depending on the water level for the particular problem.

The primary differences between the six benchmarks are lattice pitch, number of rods in the lattice, water level, and boron concentrations. All other benchmark characteristics are constant. There are three different lattice pitches, with each pitch used in two problems: 1.778 cm, 2.20914 cm, and 2.51447 cm. The fuel is arranged in a square-pitched lattice. The characteristics of each of the four lattices are given in Table 2.1. Table 2.2 contains the atom densities for all the materials in the problem except B-10 and B-11. The atom densities in Table 2.2 are constant for all benchmarks. Table 2.3 contain the atom densities of B-10 and B-11 for each benchmark. All material temperatures are assumed to be 23ºC (295 K).

As shown in Table 2.1, the six benchmark problems change by moderator boron concentration, number of fuel rods, lattice pitch and upper-reflector thickness. To simplify the accumulation of power densities, advantage was taken in the symmetry of the problem whenever possible. The entire problem was explicitly modeled, but instead of having a separate unit for each pin, 1/8th symmetry was used for every problem except PNL-32. Due to an irregular placement of outer rods, this problem needed to be modeled using a unit for each pin. The lattice is then filled from the 1/8th section by inserting additional pins in a mirror image. Figures 2.2 through 2.6 show the lattice map for each problem. Figure 2.4 shows a full-lattice mapping; the other figures contain only 1/8th lattices. The remaining lattice can be extrapolated from these 1/8th sections.

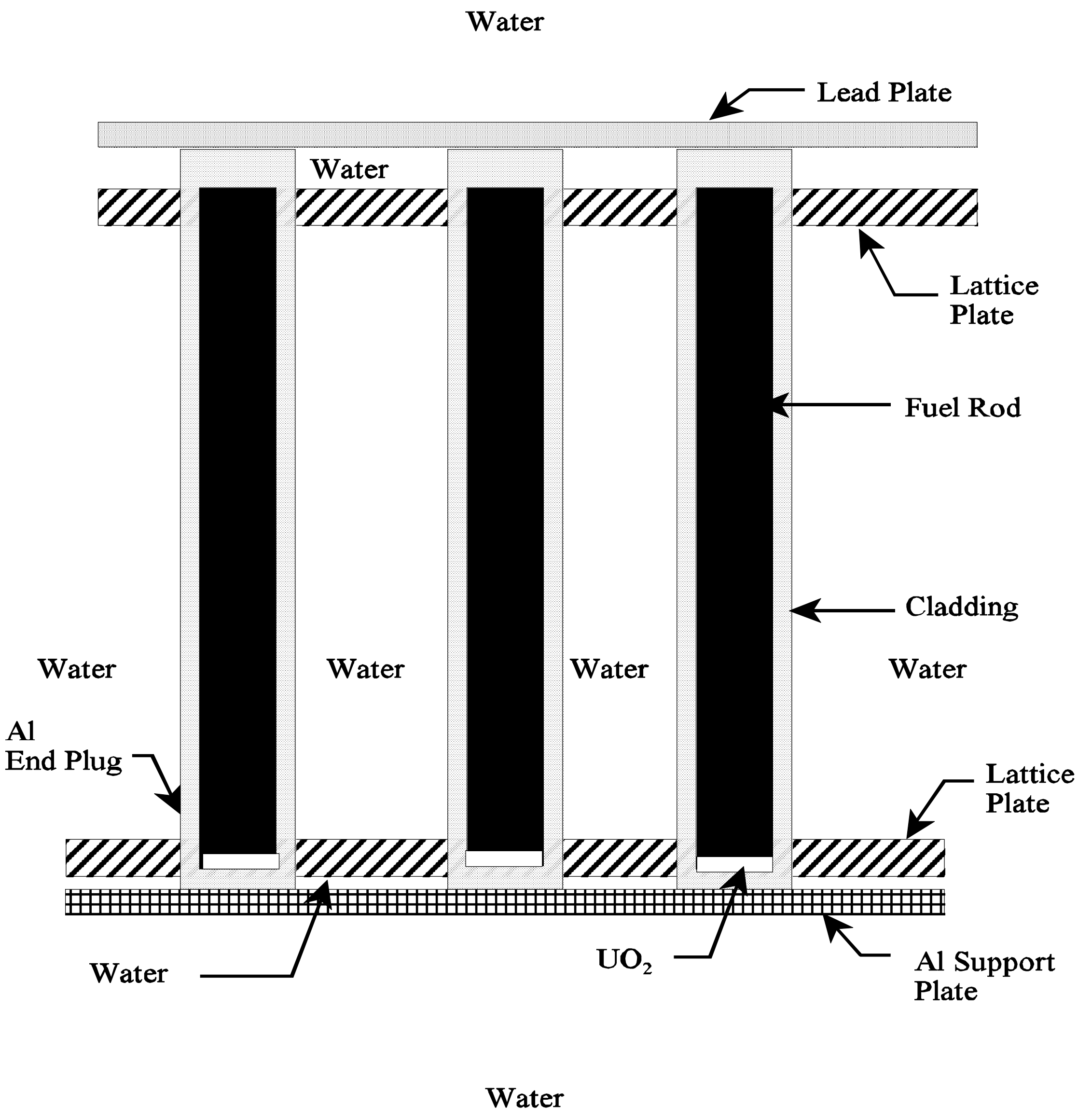

Fig. 2.1. Schematic of the PNL fuel rods with reflector.

Table 2.1. Lattice description for benchmarks

Benchmark No.	Boron con. (ppm)	Critical No. rods	Lattice pitch (cm)	Water level above lead (cm)
30	1.7	469	1.778	13.462
31	687.9	761	1.778	13.462
32	0.9	195	2.20914	3.937
33	1090.4	761	2.20914	13.462
34	1.6	160	2.51447	0.508
35	767.2	689	2.51447	13.462

Table 2.2. Constant benchmark atom densities

Material	Isotope	Atom density (atoms/barn-cm)	Material	Isotope	Atom density (atoms/barn-cm)
Fuel	U-234	1.2458×10^{-6}	Lattice plate	Si	1.3742×10^{-2}
UO_2-PuO_2	U-235	1.4886×10^{-4}	Support plate	Fe	4.5919×10^{-2}
(9.54 g/cc)	U-236	2.0936×10^{-9}		Cu	1.1532×10^{-4}
	U-238	2.0936×10^{-2}		Mn	9.6395×10^{-4}
	Pu-238	3.8836×10^{-8}		Mg	1.2388×10^{-4}
	Pu-239	3.9462×10^{-4}		Cr	1.7409×10^{-3}
	Pu-240	3.3206×10^{-5}		Zn	1.6617×10^{-2}
	Pu-241	1.6081×10^{-6}		Ti	4.6052×10^{-4}
	Pu-242	1.1882×10^{-7}		Al	1.5025×10^{-3}
	Am-241	1.4954×10^{-6}			
	O-16	4.3779×10^{-2}			
Natural UO_2	U-234	1.2406×10^{-6}	Cladding	Sn	4.8328×10^{-4}
(9.286 g/cc)	U-235	1.4824×10^{-4}		Fe	9.5642×10^{-5}
	U-236	2.0848×10^{-9}		Cr	7.6093×10^{-5}
	U-238	2.0525×10^{-2}		Ni	3.0336×10^{-5}
	O-16	4.1943×10^{-2}		Zr	4.2621×10^{-2}
			Lead	Pb	3.2174×10^{-2}

Table 2.3. Moderator atom densities

Benchmark No.	Atom densities (atoms/barn-cm)			
	H	O	B-10	B-11
PNL-30	6.6706×10^{-2}	3.3353×10^{-2}	1.8706×10^{-8}	7.5770×10^{-8}
PNL-31	6.6605×10^{-2}	3.3400×10^{-2}	7.5838×10^{-6}	3.0718×10^{-5}
PNL-32	6.6706×10^{-2}	3.3353×10^{-2}	9.9034×10^{-9}	4.0114×10^{-8}
PNL-33	6.6672×10^{-2}	3.3427×10^{-2}	1.2034×10^{-5}	4.8746×10^{-5}
PNL-34	6.6706×10^{-2}	3.3353×10^{-2}	1.7606×10^{-8}	7.1313×10^{-8}
PNL-35	6.6682×10^{-2}	3.3405×10^{-2}	8.4597×10^{-5}	3.4266×10^{-5}

2.2 ANALYSIS

All six computational benchmarks in this section were processed twice using SCALE 5.0. The set labeled NITAWL uses the NITAWL resonance processor to self-shield the resolved resonance region for all nuclides in the fuel and clad. An identical set, labeled CENTRM, replaces NITAWL with the CENTRM/PMC code sequence for the nuclides in the unit cell. The NITAWL and CENTRM results are then compared.

Table 2.4 contains the k_{eff} and energy of the average lethargy causing fission (EALCF). The k_{eff} values for all the benchmark cases are close to 1.0: the worst NITAWL benchmark is 0.90% high, and the worst CENTRM case is 0.68% high. A small negative bias does appear between NITAWL and CENTRM, with the CENTRM cases about 0.25% lower on average than the NITAWL cases.

The EALCF is also shown in this table. The EALCF values listed are from the CENTRM cases. EALCF is the energy of the average lethargy causing fission and is calculated by summing the lethargies of the neutrons that undego fission, dividing the value by the number of fissions, and converting this value to energy. For all cases, the difference between this value for CENTRM and NITAWL was less than 0.1%. Both CENTRM and NITAWL produce excellent and consistent results for the k_{eff} and fission energy for this set of problems.

Additional parameters calculated for each problem include: pin-power distributions; absortption, $\nu\Sigma_f$, and fission reaction rates and fluxes in the pin fuel, clad, and moderator; and four group cross sections and fluxes for a corner outside pin and the innermost pin. Each of these sets of data are calculated using both CENTRM and NITAWL. All the data for each case are contained in Figs. 2.7a through 2.12b and Tables 2.5 through 2.64.

The pin-power distributions for this problem assumed 1/8th core symmetry with a surrounding reflector for all benchmark cases except PNL-32. Because of a lack of symmetry in two outer pins the entire assembly needed to be modeled. The pin-power data consist of a value and a standard deviation for each pin. The values for the pin powers are actually in units of fissions per cm^3-s-source particle $\times 10^{-5}$. The value in parentheses is the percent standard deviation of the pin-power value.

In most cases the CENTRM and NITAWL results for each benchmark case fall within 2 standard deviations. The peak-to-low power changes with change in pitch and boron concentration.

The peak-to-low power ratio changed from a low of 1.86 for the smallest pitch with no boron added to a high of 4.19 at the largest pitch with added boron. The addition of boron significantly shifts the flux profile to the center of the assembly by depressing the thermal flux in the moderator.

The reaction rates, total fluxes, and flux ratios for the CENTRM and NITAWL cases of each benchmark case are also in good agreement, seldom varying by more than 1%. These values are included for a corner pin and the center pin for each case. All the reaction rates and fluxes increase as the pins approach the center of the assembly if the outer two layers of the arrays are excluded. The lowest power pin occurs in either the outer layer or the next inner layer of the array. The flux ratios over the fuel, clad, and moderator are relatively constant for a given pitch and boron concentration. However, as the pitch increases, the proportion of the total pin flux in the moderator increases.

Finally, four-group fluxes and cross sections were calculated for selected nuclides in the fuel region of the same corner and center pins. The macroscopic cross sections listed include the radiative capture, fission, and nu*fission cross sections for U-235, U-238, and Pu-239. The four groups are collapsed from the 238-group multigroup cross-section set using the flux profile calculated in KENO-V.a as follows: group 1 is from 20 Mev to 9.5 keV, group 2 is from 9.5 keV to 3.0 eV, group 3 is from 3 eV to 0.4 eV, and group 4 is from 0.4 eV to 10^{-5} eV. The 0.4 eV was chosen as a boundary because it is the cadmium cutoff energy. Groups 2 and 3 contain the resolved resonance regions for most of the nuclides used in these cases. Most of the cross-section data for the CENTRM and NITAWL cases of a given benchmark case agree within 1%.

2.3 CONCLUSIONS

For this set of benchmark cases, using either NITAWL and CENTRM as the resonance region processor produces acceptable results of the k_{eff} values. All other values produced using CENTRM and NITAWL are also consistent with each. For all cases, the k_{eff}*'s* produced using CENTRM are slightly lower, ~0.25%, than those produced using NITAWL to do the resonance self-shielding. As a result, the average k_{eff} of all the CENTRM cases is closer to 1.0 than the average k_{eff} of all the NITAWL cases for this set of benchmarks. The pin-power distributions, fluxes, reactions rates, and macroscopic cross sections all agree to approximately 1% between CENTRM and NITAWL.

The presence of boron in the moderator depresses the fraction of the flux in the moderator, thus creating a larger difference between the highest- and lowest-power pins. No significant differences were identified between the results produced by NITAWL and CENTRM for these benchmark cases.

Table 2.4. Comparison of k_{eff} and EALCF from CENTRM and NITAWL

CASE MIX-COMP-THERM-2	NITAWL k_{eff} (±F)	CENTRM k_{eff} (±F)	% DIFF	EALCF (eV)
PNL-30	1.000 (0.0005)[a]	0.9966 (0.0004)	-0.34	0.575
PNL-31	1.0026 (0.0004)	0.9987 (0.0003)	-0.39	0.768
PNL-32	1.0021 (0.0004)	1.0000 (0.0004)	-0.21	0.193
PNL-33	1.0090 (0.0003)	1.0064 (0.0004)	-0.26	0.282
PNL-34	1.0046 (0.0004)	1.0020 (0.0005)	-0.26	0.138
PNL-35	1.0079 (0.0004)	1.0068 (0.0004)	-0.11	0.182

[a] Values in parentheses is the percent standard deviation.

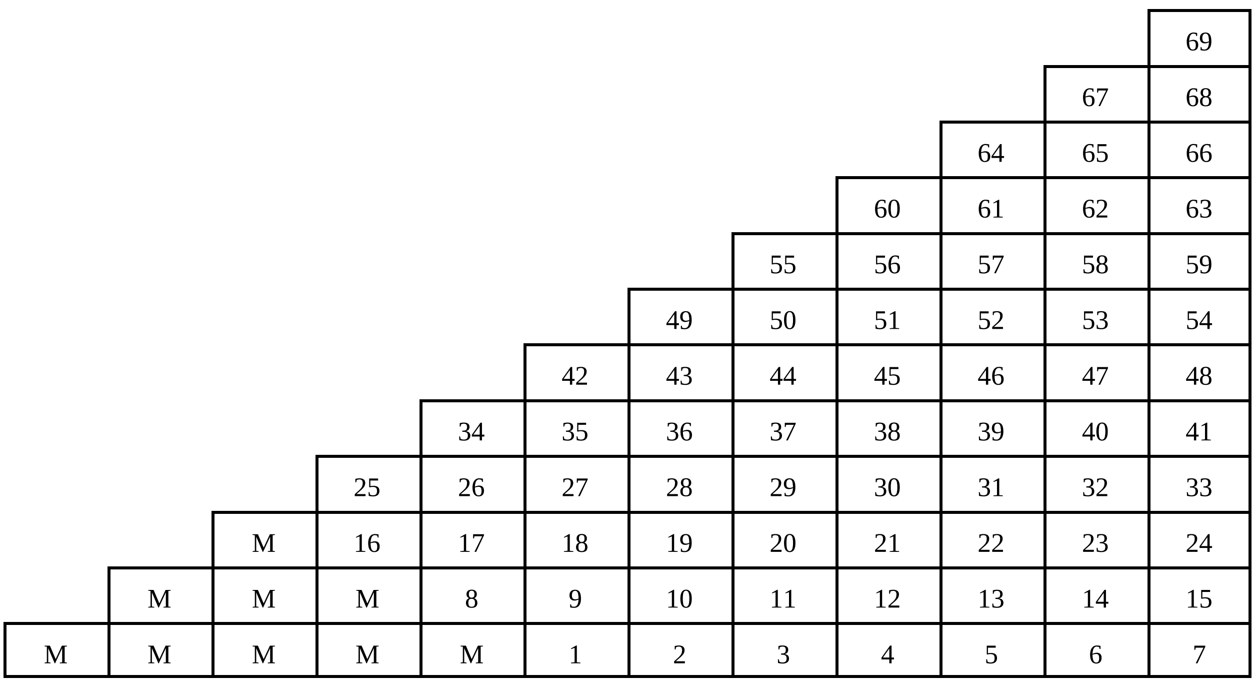

Fig. 2.2. Pin layout of benchmark case PNL-30.

											109
										107	108
									104	105	106
								100	101	102	103
							95	96	97	98	99
						89	90	91	92	93	94
					82	83	84	85	86	87	88
				74	75	76	77	78	79	80	81
			65	66	67	68	69	70	71	72	73
		55	56	57	58	59	60	61	62	63	64
	44	45	46	47	48	49	50	51	52	53	54
32	33	34	35	36	37	38	39	40	41	42	43
M	21	22	23	24	25	26	27	28	29	30	31
M	M	M	12	13	14	15	16	17	18	19	20
M	M	M	M	M	5	6	7	8	9	10	11
M	M	M	M	M	M	M	M	1	2	3	4

Fig. 2.3. Pin layout of benchmark cases PNL-31 and PNL-33.

M	M	M	M	M	M	M	193	194	195	M	M	M	M	M	M	M
M	M	M	M	M	M	187	188	189	190	191	192	M	M	M	M	M
M	M	M	M	178	179	180	181	182	183	184	185	186	M	M	M	M
M	M	M	167	168	169	170	171	172	173	174	175	176	177	M	M	M
M	M	154	155	156	157	158	159	160	161	162	163	164	165	166	M	M
M	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	M
M	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	M
107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123
90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89
M	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	M
M	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	M
M	M	30	31	32	33	34	35	36	37	38	39	40	41	42	M	M
M	M	M	19	20	21	22	23	24	25	26	27	28	29	M	M	M
M	M	M	M	10	11	12	13	14	15	16	17	18	M	M	M	M
M	M	M	M	M	4	5	6	7	8	9	M	M	M	M	M	M
M	M	M	M	M	M	M	1	2	3	M	M	M	M	M	M	M

Fig. 2.4. Pin layout of benchmark case PNL-32.

								27
							25	26
						22	23	24
					18	19	20	21
				13	14	15	16	17
			M	8	9	10	11	12
		M	M	M	4	5	6	7
	M	M	M	M	M	M	2	3
M	M	M	M	M	M	M	M	1

Fig. 2.5. Pin layout of benchmark case PNL-34.

										99
									97	98
								94	95	96
							90	91	92	93
						85	86	87	88	89
					79	80	81	82	83	84
				72	73	74	75	76	77	78
			64	65	66	67	68	69	70	71
		55	56	57	58	59	60	61	62	63
	45	46	47	48	49	50	51	52	53	54
34	35	36	37	38	39	40	41	42	43	44
M	24	25	26	27	28	29	30	31	32	33
M	M	15	16	17	18	19	20	21	22	23
M	M	M	7	8	9	10	11	12	13	14
M	M	M	M	M	1	2	3	4	5	6

Fig. 2.6. Pin layout of benchmark case PNL-35.

											2.475 (0.91)
										2.458 (0.46)	2.460 (0.46)
									2.413 (0.48)	2.427 (0.31)	2.423 (0.44)
								2.235 (0.48)	2.337 (0.35)	2.354 (0.35)	2.386 (0.43)
							2.095 (0.46)	2.183 (0.35)	2.220 (0.32)	2.275 (0.33)	2.293 (0.46)
						1.883 (0.57)	1.982 (0.35)	2.074 (0.32)	2.127 (0.36)	2.150 (0.35)	2.168 (0.49)
					1.636 (0.58)	1.761 (0.41)	1.860 (0.35)	1.947 (0.35)	1.999 (0.36)	2.033 (0.35)	2.042 (0.49)
				1.423 (0.62)	1.534 (0.40)	1.616 (0.35)	1.707 (0.41)	1.792 (0.38)	1.833 (0.35)	1.874 (0.35)	1.877 (0.50)
			1.530 (0.56)	1.381 (0.46)	1.416 (0.43)	1.483 (0.40)	1.557 (0.42)	1.624 (0.38)	1.670 (0.33)	1.710 (0.38)	1.714 (0.55)
		0	2.213 (0.35)	1.510 (0.44)	1.358 (0.41)	1.367 (0.43)	1.423 (0.42)	1.493 (0.39)	1.530 0.43)	1.566 (0.39)	1.566 (0.55)
	0	0	0	2.160 (0.37)	1.519 (0.43)	1.391 (0.43)	1.437 (0.44)	1.480 (0.39)	1.539 (0.40)	1.566 (0.39)	1.573 (0.54)
0	0	0	0	0	2.311 (0.40)	2.001 (0.43)	2.035 (0.39)	2.124 (0.40)	2.197 (0.36)	2.225 (0.39)	2.254 (0.57)

Fig. 2.7a. Pin-power distribution for CENTRM benchmark PNL-30. Value in parentheses is the percent standard deviation.

											2.509 (0.86)
										2.465 (0.42)	2.484 (0.42)
									2.402 (0.39)	2.440 (0.)32	2.451 (0.43)
								2.268 (0.48)	2.325 (0.33)	2.350 (0.32)	2.378 (0.46)
							2.115 (0.45)	2.180 (0.36)	2.246 (0.34)	2.285 (0.35)	2.287 (0.44)
						1.891 (0.50)	1.999 (0.35)	2.088 (0.32)	2.138 (0.32)	2.166 (0.36)	2.181 (0.49)
					1.642 (0.55)	1.773 (0.40)	1.865 (0.38)	1.941 (0.32)	1.998 (0.36)	2.033 (0.32)	2.037 (0.47)
				1.424 (0.59)	1.525 (0.40)	1.622 (0.39)	1.734 (0.37)	1.802 (0.35)	1.862 (0.36)	1.885 (0.32)	1.904 (0.53)
			1.511 (0.56)	1.397 (0.41)	1.409 (0.41)	1.491 (0.37)	1.568 (0.41)	1.640 (0.42)	1.686 (0.31)	1.712 (0.39)	1.711 (0.55)
		0	2.211 (0.36)	1.510 (0.38)	1.350 (0.41)	1.372 (0.40)	1.440 (0.39)	1.498 (0.37)	1.544 (0.42)	1.571 (0.39)	1.589 (0.52)
	0	0	0	2.156 (0.35)	1.499 (0.41)	1.405 (0.45)	1.436 (0.39)	1.489 (0.38)	1.550 (0.40)	1.571 (0.39)	1.567 (0.57)
0	0	0	0	0	2.299 (0.39)	2.002 (0.42)	2.039 (0.35)	2.122 (0.36)	2.201 (0.34)	2.231 (0.35)	2.259 (0.50)

Fig. 2.7b. Pin-power distribution for NITAWL benchmark PNL-30. Value in parentheses is the percent standard deviation.

Table 2.5. PNL-30 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.417E-05	2.311E-05	8.244E-06	1.385E-2	0.412
1	Clad	2.864E-07	0.0	0.0	2.672E-3	0.079
	Mod.	5.922E-07	0.0	0.0	1.710E-2	0.509
	Fuel	1.809E-05	2.453E-05	8.727E-06	3.412E-2	0.410
69	Clad	4.701E-07	0.0	0.0	6.638E-3	0.080
	Mod.	5.476E-07	0.0	0.0	4.237E-2	0.510

Table 2.6. PNL-30 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.407E-05	2.297E-05	8.192E-06	1.384E-2	0.412
1	Clad	2.802E-07	0.0	0.0	2.660E-3	0.079
	Mod.	5.895E-07	0.0	0.0	1.707E-2	0.509
	Fuel	1.835E-05	2.515E-05	8.948E-06	3.395E-2	0.410
69	Clad	4.678E-07	0.0	0.0	6.629E-3	0.080
	Mod.	5.644E-07	0.0	0.0	4.232E-2	0.510

Table 2.7. PNL-30, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	7.308E-05	7.296E-05
2	2.292E-05	2.291E-05
3	5.145E-06	5.269E-06
4	2.251E-05	2.239E-05

Table 2.8. PNL-30, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.31102E-04	5.17496E-04	2.00508E-04	2.30990E-04	5.17470E-04	2.00433E-04
2	5.24167E-03	8.10227E-03	3.32510E-03	5.22152E-03	8.04138E-03	3.30010E-03
3	8.11652E-03	1.64870E-02	6.76610E-03	8.06149E-03	1.64181E-02	6.73784E-03
4	7.34638E-02	1.52885E-01	6.27423E-02	7.34430E-02	1.52842E-01	6.27253E-02

Table 2.9. PNL-30, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.78395E-03	1.18456E-02	4.21512E-03	6.78829E-03	1.18801E-02	4.22404E-03
2	4.50410E-02	5.66348E-06	2.34636E-06	4.43898E-02	5.54963E-06	2.29918E-06
3	1.10308E-02	3.81572E-08	1.58093E-08	1.10387E-02	3.82177E-08	1.58343E-08
4	4.21801E-02	1.98117E-07	8.20835E-08	4.21730E-02	1.98085E-07	8.20706E-08

Table 2.10. PNL-30, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.31247E-04	2.10623E-03	6.81955E-04	7.31013E-04	2.10628E-03	6.81768E-04
2	1.46556E-02	2.42259E-02	8.41230E-03	1.42800E-02	2.35796E-02	8.18791E-03
3	4.46091E-02	8.80453E-02	3.05734E-02	4.45318E-02	8.79178E-02	3.05291E-02
4	3.81701E-01	7.65540E-01	2.64839E-01	3.80931E-01	7.64203E-01	2.64376E-01

Table 2.11. PNL-30, Pin-69 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	1.978E-04	1.958E-04
2	7.342E-05	7.309E-05
3	1.445E-05	1.458E-05
4	1.901E-05	1.966E-05

Table 2.12. PNL-30, Pin-69 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.40583E-04	5.25394E-04	2.05274E-04	2.40289E-04	5.25082E-04	2.05125E-04
2	5.09194E-03	7.87946E-03	3.23366E-03	4.90525E-03	7.60379E-03	3.12052E-03
3	8.03087E-03	1.62800E-02	6.68118E-03	8.07572E-03	1.64173E-02	6.73752E-03
4	6.44140E-02	1.33756E-01	5.48922E-02	6.49323E-02	1.34838E-01	5.53362E-02

Table 2.13. PNL-30, Pin-69 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.48013E-03	1.00639E-02	3.58425E-03	6.50153E-03	1.01355E-02	3.61266E-03
2	4.33496E-02	5.86890E-06	2.43146E-06	4.25035E-02	5.67595E-06	2.35151E-06
3	1.10028E-02	3.78364E-08	1.56763E-08	1.10397E-02	3.81740E-08	1.58162E-08
4	3.74989E-02	1.75656E-07	7.27780E-08	3.77530E-02	1.76873E-07	7.32818E-08

Table 2.14. PNL-30, Pin-69 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.34312E-04	2.06900E-03	6.75303E-04	7.34377E-04	2.07025E-03	6.75577E-04
2	1.41486E-02	2.33093E-02	8.09402E-03	1.38472E-02	2.29011E-02	7.95226E-03
3	4.37500E-02	8.64152E-02	3.00072E-02	4.41986E-02	8.73169E-02	3.03204E-02
4	4.24647E-01	8.20289E-01	2.83994E-01	4.24708E-01	8.21267E-01	2.84326E-01

											1.824 (0.90)
										1.821 (0.58)	1.818 (0.53)
									1.780 (0.50)	1.785 (0.32)	1.817 (0.48)
								1.693 (0.56)	1.725 (038.)	1.759 (0.36)	1.764 (0.47)
							1.611 (055.)	1.650 (0.34)	1.683 (0.35)	1.706 (0.36)	1.687 (0.50)
						1.492 (0.52)	1.535 (0.38)	1.601 (0.35)	1.624 (0.40)	1.633 (0.38)	1.634 (052.)
					1.338 (0.58)	1.419 (0.41)	1.476 (0.41)	1.509 (0.35)	1.550 (0.37)	1.562 (0.41)	1.570 (0.57)
				1.202 (064.)	1.271 (0.42)	1.332 (0.39)	1.385 (0.40)	1.437 (0.36)	1.460 (0.44)	1.488 (0.40)	1.500 (0.51)
			1.018 (0.65)	1.098 (0.46)	1.175 (0.42)	1.245 (0.48)	1.304 (0.38)	1.346 (0.40)	1.359 (0.40)	1.393 (0.40)	1.393 (0.59)
		0.861 (0.74)	0.930 (0.45)	1.016 (0.48)	1.078 (0.45)	1.139 (0.45)	1.195 (0.46)	1.228 (0.40)	1.261 (0.41)	1.282 (0.45)	1.288 (0.58)
	0.719 (0.74)	0.777 (0.57)	0.849 (0.55)	0.919 (0.46)	0.978 (0.53)	1.026 (0.43)	1.088 (0.43)	1.121 (0.49)	1.157 (0.44)	1.164 (0.45)	1.181 (0.66)
0.924 (0.72)	0.737 (0.59)	0.737 (0.54)	0.771 (0.57)	0.822 (0.52)	0.872 (0.47)	0.918 (0.48)	0.965 (0.46)	1.011 (0.51)	1.043 (0.47)	1.054 (0.45)	1.056 (0.64)
0	0.985 (0.52)	0.860 (0.51)	0.772 (0.55)	0.756 (0.56)	0.787 (0.57)	0.818 (0.53)	0.862 (0.51)	0.888 (0.48)	0.916 (0.53)	0.932 (0.42)	0.944 (0.67)
0	0	0	1.046 (0.49)	0.900 (0.48)	0.789 (0.52)	0.782 (0.57)	0.792 (0.56)	0.788 (0.56)	0.803 (0.49)	0.820 (0.51)	0.821 (0.70)
0	0	0	0	0	1.065 (0.45)	0.946 (0.50)	0.890 (0.55)	0.781 (0.59)	0.745 (0.55)	0.751 (0.60)	0.764 (0.79)
0	0	0	0	0	0	0	0	1.051 (0.45)	0.917 (0.54)	0.911 (0.50)	0.903 (0.77)

Fig. 2.8a. Pin-power distribution for CENTRM benchmark PNL-31. Value in parentheses is percent standard deviation.

											1.829 (1.01)
										1.827 (0.51)	1.832 (0.53)
									1.775 (0.50)	1.798 (0.35)	1.794 (0.52)
								1.722 (0.57)	1.742 (0.35)	1.776 (0.37)	1.785 (0.51)
							1.612 (0.53)	1.666 (0.36)	1.698 (0.38)	1.716 (0.35)	1.724 (0.50)
						1.502 (0.53)	1.549 (0.38)	1.593 (0.40)	1.640 (0.35)	1.644 (0.37)	1.646 (0.56)
					1.353 (0.57)	1.418 (0.43)	1.474 (0.37)	1.525 (0.38)	1.566 (0.38)	1.580 (0.38)	1.572 (0.51)
				1.192 (0.61)	1.274 (0.44)	1.343 (0.39)	1.402 (0.41)	1.435 (0.38)	1.478 (0.41)	1.493 (0.37)	1.486 (0.58)
			1.017 (0.66)	1.107 (0.47)	1.177 (0.43)	1.252 (0.40)	1.299 (0.39)	1.359 (0.42)	1.381 (0.44)	1.384 (0.40)	1.399 (0.55)
		0.860 (0.75)	0.929 (0.51)	1.010 (0.46)	1.079 (0.46)	1.145 (0.45)	1.202 (0.41)	1.245 (0.43)	1.272 (0.39)	1.295 (0.43)	1.297 (0.59)
	0.722 (0.79)	0.771 (0.55)	0.841 (0.55)	0.915 (0.51)	0.977 (0.43)	1.041 (0.47)	1.106 (0.47)	1.131 (0.43)	1.162 (0.43)	1.179 (0.48)	1.181 (0.60)
0.937 (0.68)	0.736 (0.61)	0.728 (0.54)	0.766 (0.58)	0.825 (0.55)	0.880 (0.47)	0.917 (0.49)	0.982 (0.47)	1.013 (0.45)	1.031 (0.46)	1.049 (0.45)	1.064 (0.66)
0	0.991 (0.51)	0.853 (0.52)	0.774 (0.57)	0.771 (0.53)	0.795 (0.53)	0.827 (0.53)	0.866 (0.48)	0.891 (0.52)	0.918 (0.52)	0.925 (0.44)	0.936 (0.67)
0	0	0	1.039 (0.54)	0.888 (0.51)	0.787 (0.50)	0.778 (0.47)	0.787 (0.60)	0.798 (0.55)	0.803 (0.52)	0.811 (0.51)	0.817 (0.72)
0	0	0	0	0	1.064 (0.49)	0.952 (0.45)	0.896 (0.51)	0.782 (0.53)	0.751 (0.55)	0.757 (0.55)	0.744 (0.80)
0	0	0	0	0	0	0	0	1.052 (0.48)	0.917 (0.52)	0.905 (0.49)	0.914 (0.71)

Fig. 2.8b. Pin power distribution for NITAWL benchmark PNL-31. Value in parentheses is percent standard deviation.

Table 2.15. PNL-31 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	6.732E-06	1.0493E-05	3.738E-06	7.748E-3	0.412
1	Clad	1.407E-07	0.0	0.0	1.494E-3	0.079
	Mod.	5.801E-07	0.0	0.0	9.563E-3	0.509
	Fuel	1.352E-05	1.821E-05	6.477E-06	2.577E-2	0.410
109	Clad	3.513E-07	0.0	0.0	5.039E-3	0.081
	Mod.	8.806E-07	0.0	0.0	3.197E-2	0.509

Table 2.16. PNL-31 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	6.745E-06	1.049E-05	3.740E-06	7.754E-3	0.412
1	Clad	1.404E-07	0.0	0.0	1.500E-3	0.079
	Mod.	5.820E-07	0.0	0.0	9.588E-3	0.509
	Fuel	1.362E-05	1.838E-05	6.538E-06	2.583E-2	0.411
109	Clad	3.478E-07	0.0	0.0	5.033E-3	0.080
	Mod.	8.960E-07	0.0	0.0	3.200E-2	0.509

Table 2.17. PNL-31, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	4.151E-05	4.145E-05
2	1.455E-05	1.468E-05
3	3.350E-06	3.351E-06
4	9.754E-06	9.744E-06

Table 2.18. PNL-31, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.34277E-04	5.20559E-04	2.02137E-04	2.34433E-04	5.20890E-04	2.02275E-04
2	5.31166E-03	8.16900E-03	3.35248E-03	5.27939E-03	8.08910E-03	3.31969E-03
3	8.11675E-03	1.65287E-02	6.78319E-03	8.06329E-03	1.64082E-02	6.73381E-03
4	7.08071E-02	1.47273E-01	6.04396E-02	7.10855E-02	1.47857E-01	6.06792E-02

Table 2.19. PNL-31, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.72455E-03	1.13885E-02	4.04980E-03	6.74729E-03	1.14467E-02	4.07385E-03
2	4.56936E-02	5.60056E-06	2.32029E-06	4.55851E-02	5.56831E-06	2.30692E-06
3	1.10516E-02	3.83036E-08	1.58698E-08	1.10407E-02	3.82095E-08	1.58309E-08
4	4.08111E-02	1.91551E-07	7.93633E-08	4.09499E-02	1.92215E-07	7.96381E-08

Table 2.20. PNL-31, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.32515E-04	2.09589E-03	6.79949E-04	7.32859E-04	2.09690E-03	6.80273E-04
2	1.48948E-02	2.45228E-02	8.51540E-03	1.45238E-02	2.40236E-02	8.34210E-03
3	4.46260E-02	8.81024E-02	3.05931E-02	4.49138E-02	8.86079E-02	3.07687E-02
4	3.92873E-01	7.79195E-01	2.69624E-01	3.93098E-01	7.80112E-01	2.69936E-01

Table 2.21. PNL-31, Pin-109 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	1.485E-04	1.486E-04
2	5.674E-05	5.667E-05
3	1.105E-05	1.126E-05
4	1.379E-05	1.412E-05

Table 2.22. PNL-31, Pin-109 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.40011E-04	5.25238E-04	2.05020E-04	2.41044E-04	5.25948E-04	2.05500E-04
2	5.08433E-03	7.90435E-03	3.24387E-03	5.05763E-03	7.83928E-03	3.21717E-03
3	7.87603E-03	1.60055E-02	6.56854E-03	7.93289E-03	1.60894E-02	6.60295E-03
4	6.39052E-02	1.32666E-01	5.44450E-02	6.44026E-02	1.33734E-01	5.48830E-02

Table 2.23. PNL-31, Pin-109 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.52904E-03	1.02652E-02	3.65253E-03	6.48723E-03	1.00441E-02	3.57473E-03
2	4.26228E-02	5.78745E-06	2.39771E-06	4.25107E-02	5.49843E-06	2.27798E-06
3	1.10023E-02	3.78561E-08	1.56844E-08	1.09805E-02	3.77877E-08	1.56562E-08
4	3.72074E-02	1.74257E-07	7.21979E-08	3.74882E-02	1.75595E-07	7.27521E-08

Table 2.24. PNL-31, Pin-109 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.34579E-04	2.07331E-03	6.76047E-04	7.34616E-04	2.06809E-03	6.74966E-04
2	1.42795E-02	2.36502E-02	8.21241E-03	1.41529E-02	2.32927E-02	8.08827E-03
3	4.25902E-02	8.43169E-02	2.92786E-02	4.25863E-02	8.42498E-02	2.92554E-02
4	4.32807E-01	8.32922E-01	2.88390E-01	4.26617E-01	8.23669E-01	2.85166E-01

0	0	0	0	0	0	0	4.104	3.592	3.967	0	0	0	0	0	0	0
0	0	0	0	0	0	4.526	3.498	3.291	3.407	3.866	4.466	0	0	0	0	0
0	0	0	0	4.931	4.345	3.900	3.723	3.716	3.703	3.685	3.685	4.587	0	0	0	0
0	0	0	4.714	3.978	4.001	4.116	4.282	4.343	4.308	4.142	3.941	3.917	4.729	0	0	0
0	0	4.627	3.919	4.040	4.348	4.602	4.824	4.909	4.867	4.690	4.406	4.053	3.954	4.586	0	0
0	4.571	3.828	3.932	4.394	4.732	5.084	5.314	5.470	5.314	5.046	4.789	4.388	3.947	3.705	4.529	0
0	3.922	3.663	4.307	4.687	5.147	5.525	5.761	5.808	5.730	5.474	5.132	4.724	4.133	3.716	3.894	0
4.157	3.430	3.833	4.318	4.889	5.371	5.758	5.973	6.000	5.910	5.721	5.336	4.926	4.334	3.776	3.452	4.097
3.718	3.346	3.822	4.366	4.891	5.430	5.794	6.009	6.086	6.014	5.818	5.526	4.983	4.389	3.801	3.329	3.647
4.092	3.451	3.831	4.371	4.841	5.391	5.711	5.923	5.990	5.928	5.707	5.408	4.879	4.329	3.765	3.512	4.149
0	3.884	3.703	4.188	4.675	5.207	5.526	5.712	5.786	5.739	5.492	5.143	4.681	4.107	3.701	3.953	0
0	4.583	3.803	4.002	4.472	4.861	5.180	5.299	5.429	5.395	5.173	4.764	4.385	3.921	3.733	4.522	0
0	0	4.695	3.920	4.100	4.404	4.715	4.886	4.992	4.915	4.709	4.402	4.043	3.925	4.545	0	0
0	0	0	4.721	3.921	3.954	4.219	4.362	4.377	4.325	4.198	3.946	3.951	4.748	0	0	0
0	0	0	0	4.639	3.762	3.701	3.821	3.812	3.789	3.926	4.415	4.865	0	0	0	0
0	0	0	0	0	4.516	3.925	3.438	3.393	3.471	4.512	0	0	0	0	0	0
0	0	0	0	0	0	0	4.100	3.642	4.175	0	0	0	0	0	0	0

Fig. 2.9a. Pin-power distribution for CENTRM benchmark PNL-32 with standard deviation between 0.59 and 0.87% of the value.

0	0	0	0	0	0	0	4.193	3.696	4.139	0	0	0	0	0	0	0
0	0	0	0	0	0	4.568	3.565	3.354	3.466	3.987	4.530	0	0	0	0	0
0	0	0	0	4.902	4.409	3.981	3.841	3.804	3.753	3.706	3.767	4.624	0	0	0	0
0	0	0	4.739	3.971	4.071	4.190	4.304	4.352	4.301	4.177	3.952	3.930	4.705	0	0	0
0	0	4.625	3.956	4.080	4.417	4.773	4.884	4.914	4.907	4.720	4.427	4.010	3.991	4.684	0	0
0	4.612	3.769	4.039	4.470	4.913	5.191	5.404	5.433	5.357	5.142	4.790	4.319	3.940	3.779	4.489	0
0	3.884	3.700	4.150	4.792	5.200	5.595	5.759	5.763	5.729	5.484	5.192	4.683	4.164	3.727	3.874	0
4.153	3.500	3.842	4.455	4.989	5.431	5.783	5.974	5.974	5.953	5.726	5.346	4.840	4.324	3.784	3.470	4.059
3.735	3.352	3.825	4.417	4.978	5.524	5.756	6.026	6.099	5.988	5.801	5.425	4.969	4.412	3.818	3.329	3.711
4.211	3.533	3.823	4.416	4.969	5.395	5.781	5.929	5.958	5.856	5.731	5.360	4.817	4.315	3.757	3.404	4.099
0	3.894	3.705	4.182	4.755	5.208	5.492	5.682	5.749	5.595	5.475	5.095	4.677	4.078	3.680	3.876	0
0	4.558	3.742	4.015	4.413	4.846	5.195	5.336	5.383	5.265	5.059	4.737	4.377	3.944	3.712	4.465	0
0	0	4.614	3.980	4.088	4.380	4.731	4.941	4.880	4.853	4.659	4.358	4.024	3.882	4.574	0	0
0	0	0	4.789	3.910	3.973	4.142	4.350	4.423	4.348	4.130	3.973	3.904	4.683	0	0	0
0	0	0	0	4.625	3.768	3.664	3.837	3.803	3.735	3.920	4.301	4.912	0	0	0	0
0	0	0	0	0	4.516	3.907	3.442	3.317	3.414	4.463	0	0	0	0	0	0
0	0	0	0	0	0	0	4.045	3.626	4.106	0	0	0	0	0	0	0

Fig. 2.9b. Pin-power distribution for NITAWL benchmark PNL-32 with standard deviation between 0.57 and 0.90% of the values.

Table 2.25. PNL-32 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	2.451E-05	4.086E-05	1.457E-05	2.060E-2	0.267
1	Clad	4.627E-07	0.0	0.0	3.943E-3	0.051
	Mod.	1.135E-06	0.0	0.0	5.259E-2	0.682
	Fuel	3.946E-05	6.076E-05	2.164E-05	4.729E-2	0.266
98	Clad	8.113E-07	0.0	0.0	9.173E-3	0.052
	Mod.	1.536E-06	0.0	0.0	1.121E-2	0.682

Table 2.26. PNL-32 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	2.429E-05	4.063E-05	1.449E-05	2.033E-2	0.266
1	Clad	4.624E-07	0.0	0.0	3.930E-3	0.051
	Mod.	1.136E-06	0.0	0.0	5.223E-2	0.683
	Fuel	3.963E-05	6.092E-05	2.169E-05	4.753E-2	0.267
98	Clad	8.007E-07	0.0	0.0	9.195E-3	0.052
	Mod.	1.550E-06	0.0	0.0	1.214E-1	0.681

Table 2.27. PNL-32, Pin-1 four-group fluxes

Group	CENTRM Φ (cm^{-2} - s^{-1})	NITAWL Φ (cm^{-2} - s^{-1})
1	1.048E-04	1.029E-04
2	3.087E-05	3.073E-05
3	7.654E-06	7.310E-06
4	4.050E-05	4.057E-05

Table 2.28. PNL-32, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.28226E-04	5.15645E-04	1.99145E-04	2.28198E-04	5.16018E-04	1.99123E-04
2	5.29819E-03	8.08102E-03	3.31639E-03	5.44312E-03	8.33186E-03	3.41933E-03
3	8.13381E-03	1.64731E-02	6.76041E-03	8.07192E-03	1.63713E-02	6.71862E-03
4	7.46578E-02	1.55396E-01	6.37731E-02	7.43303E-02	1.54714E-01	6.34932E-02

Table 2.29. PNL-32, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.95603E-03	1.26008E-02	4.48409E-03	6.96190E-03	1.26902E-02	4.50424E-03
2	4.76213E-02	5.91756E-06	2.45162E-06	4.49401E-02	5.50696E-06	2.28152E-06
3	1.10199E-02	3.80020E-08	1.57448E-08	1.10245E-02	3.79821E-08	1.57367E-08
4	4.27798E-02	2.00991E-07	8.32743E-08	4.26310E-02	2.00282E-07	8.29805E-08

Table 2.30. PNL-32, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.30986E-04	2.12139E-03	6.84695E-04	7.30230E-04	2.12081E-03	6.84023E-04
2	1.53809E-02	2.53859E-02	8.81516E-03	1.48494E-02	2.44809E-02	8.50088E-03
3	4.46591E-02	8.80834E-02	3.05866E-02	4.50509E-02	8.87866E-02	3.08308E-02
4	3.79625E-01	7.64299E-01	2.64388E-01	3.77128E-01	7.59495E-01	2.62726E-01

Table 2.31. PNL-32, Pin-98 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.586E-04	2.586E-04
2	8.866E-05	8.976E-05
3	1.956E-05	2.042E-05
4	5.545E-05	5.552E-05

Table 2.32. PNL-32, Pin-98 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.34086E-04	5.20599E-04	2.02092E-04	2.34329E-04	5.21021E-04	2.02251E-04
2	5.15153E-03	7.96071E-03	3.26701E-03	5.21152E-03	7.99933E-03	3.28285E-03
3	8.14944E-03	1.65985E-02	6.81186E-03	8.16239E-03	1.66200E-02	6.82071E-03
4	7.06334E-02	1.46886E-01	6.02804E-02	7.03727E-02	1.46337E-01	6.00555E-02

Table 2.33. PNL-32, Pin-98 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.75406E-03	1.14805E-02	4.08322E-03	6.78241E-03	1.15393E-02	4.10572E-03
2	4.75024E-02	5.74765E-06	2.38123E-06	4.63517E-02	5.42737E-06	2.24854E-06
3	1.10577E-02	3.83380E-08	1.58842E-08	1.10567E-02	3.83610E-08	1.58937E-08
4	4.07001E-02	1.91006E-07	7.91378E-08	4.05670E-02	1.90373E-07	7.88750E-08

Table 2.34. PNL-32, Pin-98 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.32645E-04	2.09793E-03	6.80410E-04	7.32954E-04	2.09852E-03	6.80530E-04
2	1.46368E-02	2.41261E-02	8.37768E-03	1.46065E-02	2.41771E-02	8.39539E-03
3	4.63098E-02	9.11738E-02	3.16598E-02	4.55958E-02	8.98849E-02	3.12122E-02
4	3.98803E-01	7.88748E-01	2.72941E-01	3.99072E-01	7.88716E-01	2.72936E-01

											2.024 (1.15)
										2.037 (0.53)	2.025 (0.53)
									1.958 (0.50)	2.001 (0.40)	2.009 (0.55)
								1.872 (0.50)	1.935 (0.32)	1.955 (0.40)	1.973 (0.54)
							1.783 (0.57)	1.848 (0.41)	1.869 (0.37)	1.905 (0.40)	1.904 (0.51)
						1.626 (0.54)	1.702 (0.39)	1.760 (0.37)	1.801 (0.37)	1.832 (0.41)	1.848 (0.47)
					1.461 (0.56)	1.539 (0.42)	1.624 (0.37)	1.661 (0.37)	1.707 (0.41)	1.721 (0.37)	1.746 (0.55)
				1.275 (0.64)	1.368 (0.47)	1.450 (0.43)	1.509 (0.45)	1.564 (0.43)	1.599 (0.37)	1.636 (0.40)	1.638 (0.55)
			1.065 (0.68)	1.155 (0.47)	1.251 (0.50)	1.341 (0.45)	1.403 (0.43)	1.448 (0.39)	1.485 (0.43)	1.512 (0.41)	1.518 (0.58)
		0.850 (0.79)	0.954 (0.52)	1.040 (0.51)	1.130 (051.)	1.204 (0.45)	1.258 (0.45)	1.323 (0.45)	1.358 (0.43)	1.373 (0.42)	1.386 (0.60)
	0.639 (0.83)	0.738 (0.57)	0.846 (0.54)	0.910 (0.58)	1.008 (0.49)	1.077 (0.48)	1.137 (0.49)	1.182 (0.53)	1.213 (0.50)	1.231 (0.48)	1.240 (0.72)
0.564 (1.07)	0.554 (0.78)	0.633 (0.62)	0.712 (0.59)	0.793 (0.58)	0.866 (0.60)	0.931 (0.48)	0.991 (0.45)	1.039 (0.53)	1.078 (0.48)	1.092 (0.54)	1.099 (0.62)
0	0.565 (0.69)	0.594 (0.73)	0.618 (0.63)	0.663 (0.64)	0.731 (0.57)	0.786 (0.54)	0.838 (0.57)	0.883 (0.53)	0.932 (0.52)	0.942 (0.51)	0.937 (0.74)
0	0	0	0.621 (0.69)	0.628 (0.59)	0.628 (0.52)	0.658 (0.61)	0.702 (0.63)	0.735 (0.62)	0.761 (0.54)	0.783 (0.62)	0.783 (0.86)
0	0	0	0	0	0.622 (0.64)	0.618 (0.65)	0.639 (0.63)	0.619 (0.63)	0.623 (0.66)	0.641 (0.63)	0.659 (0.97)
0	0	0	0	0	0	0	0	0.610 (0.66)	0.570 (0.66)	0.585 (0.75)	0.604 (0.90)

Fig. 2.10a. Pin-power distribution for CENTRM benchmark PNL-33. Value in parentheses is percent standard deviation.

											2.037 (0.95)
										2.052 (0.57)	2.057 (0.51)
									2.004 (0.50)	2.007 (0.40)	2.018 (0.53)
								1.884 (0.57)	1.950 (0.36)	1.981 (0.38)	1.981 (0.51)
							1.783 (0.53)	1.833 (0.41)	1.883 (0.35)	1.917 (0.38)	1.917 (0.54)
						1.646 (0.55)	1.711 (0.38)	1.772 (0.37)	1.804 (0.40)	1.823 (0.40)	1.827 (0.49)
					1.466 (0.59)	1.553 (0.39)	1.610 (0.40)	1.670 (0.43)	1.718 (0.41)	1.736 (0.37)	1.751 (0.50)
				1.245 (0.60)	1.362 (0.43)	1.456 (0.39)	1.527 (0.40)	1.572 (0.41)	1.604 (0.41)	1.643 (0.40)	1.638 (0.54)
			1.067 (0.72)	1.155 (0.45)	1.257 (0.46)	1.330 (0.48)	1.403 (0.43)	1.447 (0.43)	1.491 (0.43)	1.509 (0.42)	1.528 (0.55)
		0.839 (0.75)	0.943 (0.60)	1.050 (0.52)	1.135 (0.48)	1.220 (0.47)	1.283 (0.45)	1.321 (0.48)	1.371 (0.47)	1.393 (0.45)	1.391 (0.60)
	0.632 (0.82)	0.731 (0.65)	0.824 (0.57)	0.919 (0.50)	1.004 (0.50)	1.069 (0.49)	1.141 (0.47)	1.181 (0.52)	1.220 (0.44)	1.247 (0.44)	1.249 (063.)
0.565 (0.98)	0.561 (0.63)	0.631 (0.62)	0.703 (0.54)	0.788 (0.53)	0.880 (0.54)	0.938 (0.51)	0.990 (0.53)	1.042 (0.53)	1.071 (0.53)	1.099 (0.50)	1.088 (0.73)
0	0.566 (0.64)	0.586 (0.69)	0.617 (0.62)	0.672 (0.68)	0.729 (0.58)	0.795 (0.53)	0.845 (0.55)	0.886 (0.53)	0.922 (0.55)	0.941 (0.55)	0.947 (0.78)
0	0	0	0.619 (0.69)	0.618 (0.67)	0.625 (0.68)	0.665 (0.63)	0.708 (0.54)	0.737 (0.61)	0.763 (0.54)	0.776 (0.62)	0.797 (0.82)
0	0	0	0	0	0.621 (0.67)	0.619 (0.68)	0.637 (0.67)	0.618 (0.65)	0.629 (0.68)	0.634 (0.69)	0.642 (0.97)
0	0	0	0	0	0	0	0	0.608 (0.65)	0.579 (0.62)	0.588 (0.72)	0.590 (0.96)

Fig. 2.10b. Pin-power distribution for NITAWL benchmark PNL-33. Value in parentheses is percent standard deviation.

Table 2.35. PNL-33 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	3.818E-06	6.043E-06	2.152E-06	3.853E-3	0.267
1	Clad	7.376E-08	0.0	0.0	7.423E-4	0.051
	Mod.	4.770E-07	0.0	0.0	9.836E-3	0.682
	Fuel	1.360E-05	2.034E-05	7.243E-06	1.705E-2	0.265
109	Clad	2.788E-07	0.0	0.0	3.401E-3	0.051
	Mod.	1.498E-06	0.0	0.0	4.516E-2	0.684

Table 2.36. PNL-33 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	3.812E-06	6.048E-06	2.155E-06	3.867E-3	0.267
1	Clad	7.253E-08	0.0	0.0	7.426E-4	0.052
	Mod.	4.787E-07	0.0	0.0	9.858E-3	0.681
	Fuel	1.375E-05	2.067E-05	7.357E-06	1.779E-2	0.268
109	Clad	2.783E-07	0.0	0.0	3.442E-3	0.052
	Mod.	1.505E-06	0.0	0.0	4.521E-2	0.680

Table 2.37. PNL-33, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.014E-05	2.016E-05
2	6.869E-06	6.908E-06
3	1.672E-06	1.719E-06
4	5.718E-06	5.745E-06

Table 2.38. PNL-33, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.31933E-04	5.20055E-04	2.01129E-04	2.31159E-04	5.18686E-04	2.00672E-04
2	5.35943E-03	8.22495E-03	3.37546E-03	5.34155E-03	8.22719E-03	3.37636E-03
3	8.26154E-03	1.68721E-02	6.92416E-03	8.25026E-03	1.68098E-02	6.89860E-03
4	7.10700E-02	1.47828E-01	6.06675E-02	7.10641E-02	1.47819E-01	6.06639E-02

Table 2.39. PNL-33, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.93024E-03	1.22507E-02	4.34474E-03	6.91791E-03	1.22576E-02	4.35689E-03
2	4.93469E-02	5.63616E-06	2.33504E-06	4.72956E-02	5.71788E-06	2.36889E-06
3	1.10965E-02	3.87293E-08	1.60462E-08	1.10697E-02	3.84758E-08	1.59412E-08
4	4.09384E-02	1.92170E-07	7.96200E-08	4.09467E-02	1.92207E-07	7.96350E-08

Table 2.40. PNL-33, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.32468E-04	2.11213E-03	6.82512E-04	7.31890E-04	2.11186E-03	6.82669E-04
2	1.55242E-02	2.53875E-02	8.81569E-03	1.47320E-02	2.43541E-02	8.45686E-03
3	4.75761E-02	9.35353E-02	3.24798E-02	4.58342E-02	9.03415E-02	3.13708E-02
4	3.92576E-01	7.79160E-01	2.69612E-01	3.91025E-01	7.76590E-01	2.68717E-01

Table 2.41. PNL-33, Pin-109 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	9.567E-05	9.796E-05
2	3.454E-05	3.486E-05
3	8.083E-06	7.903E-06
4	1.794E-05	1.809E-05

Table 2.42. PNL-33, Pin-109 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.35819E-04	5.23015E-04	2.03090E-04	2.36391E-04	5.23032E-04	2.03334E-04
2	5.23295E-03	8.08842E-03	3.31943E-03	5.36724E-03	8.21076E-03	3.36962E-03
3	8.20877E-03	1.67738E-02	6.88382E-03	8.26627E-03	1.68900E-02	6.93152E-03
4	6.90920E-02	1.43635E-01	5.89465E-02	6.84549E-02	1.42274E-01	5.83881E-02

Table 2.43. PNL-33, Pin-109 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.78959E-03	1.14474E-02	4.06739E-03	6.75365E-03	1.12640E-02	4.00886E-03
2	4.77122E-02	5.87328E-06	2.43327E-06	4.72083E-02	5.94071E-06	2.46121E-06
3	1.10759E-02	3.86960E-08	1.60324E-08	1.11162E-02	3.88436E-08	1.60936E-08
4	3.99038E-02	1.87192E-07	7.75574E-08	3.95563E-02	1.85520E-07	7.68646E-08

Table 2.44. PNL-33, Pin-109 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.33828E-04	2.09652E-03	6.79997E-04	7.33983E-04	2.09254E-03	6.79479E-04
2	1.54018E-02	2.52039E-02	8.75191E-03	1.50735E-02	2.48369E-02	8.62447E-03
3	4.51535E-02	8.91184E-02	3.09459E-02	4.89102E-02	9.59904E-02	3.33323E-02
4	4.06251E-01	7.98367E-01	2.76308E-01	4.12182E-01	8.07020E-01	2.79323E-01

								7.799 (0.66)
							7.518 (0.37)	7.649 (0.35)
						6.835 (0.40)	7.190 (0.27)	7.306 (0.37)
					5.772 (0.44)	6.293 (0.30)	6.617 (0.26)	6.772 (0.35)
				4.766 (0.47)	5.125 (0.31)	5.558 (0.30)	5.878 (0.29)	5.991 (0.39)
			0	5.095 (0.29)	4.633 (0.33)	4.852 (0.31)	5.064 (0.30)	5.107 (0.46)
		0	0	0	5.015 (0.27)	4.688 (0.34)	4.382 (0.33)	4.282 (0.47)
	0	0	0	0	0	0	4.431 (0.34)	3.764 (0.52)
0	0	0	0	0	0	0	0	4.082 (0.48)

Fig. 2.11a. Pin-power distribution for CENTRM benchmark PNL-34. Value in parentheses is percent standard deviation.

								7.789 (0.58)
							7.559 (0.29)	7.692 (0.25)
						6.856 (0.30)	7.211 (0.20)	7.342 (0.28)
					5.778 (0.31)	6.319 (0.21)	6.661 (0.21)	6.794 (0.32)
				4.790 (0.33)	5.142 (0.25)	5.607 (0.23)	5.928 (0.22)	5.991 (0.32)
			0	5.108 (0.24)	4.634 (0.25)	4.865 (0.21)	5.047 (0.23)	5.134 (0.33)
		0	0	0	5.009 (0.25)	4.689 (0.24)	4.367 (0.26)	4.295 (0.36)
	0	0	0	0	0	0	4.412 (0.26)	3.775 (0.40)
0	0	0	0	0	0	0	0	4.055 (0.41)

Fig. 2.11b. Pin-power distribution for NITAWL benchmark PNL-34. Value in parentheses is percent standard deviation.

Table 2.45. PNL-34 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	2.378E-05	4.072E-05	1.453E-05	1.638E-2	0.205
1	Clad	4.283E-07	0.0	0.0	3.115E-3	0.039
	Mod.	1.208E-06	0.0	0.0	6.042E-2	0.756
	Fuel	4.850E-05	7.778E-05	2.772E-05	4.812E-2	0.206
27	Clad	9.350E-07	0.0	0.0	9.315E-3	0.039
	Mod.	2.117E-06	0.0	0.0	1.767E-1	0.755

Table 2.46. PNL-34 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	2.359E-05	4.048E-05	1.444E-05	1.632E-2	0.205
1	Clad	4.263E-07	0.0	0.0	3.103E-3	0.039
	Mod.	1.204E-06	0.0	0.0	6.010E-2	0.756
	Fuel	4.865E-05	7.795E-5	2.778E-05	4.833E-2	0.206
27	Clad	9.241E-07	0.0	0.0	9.314E-3	0.040
	Mod.	2.122E-06	0.0	0.0	1.768E-1	0.754

Table 2.47. PNL-34, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	7.853E-05	7.833E-05
2	2.067E-05	2.085E-05
3	5.292E-06	5.285E-06
4	4.175E-05	4.127E-05

Table 2.48. PNL-34, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.24131E-04	5.12577E-04	1.97109E-04	2.23704E-04	5.11854E-04	1.96816E-04
2	5.42283E-03	8.35085E-03	3.42710E-03	5.42556E-03	8.28643E-03	3.40068E-03
3	8.31740E-03	1.69753E-02	6.96653E-03	8.31298E-03	1.69590E-02	6.95981E-03
4	7.54771E-02	1.57143E-01	6.44898E-02	7.58120E-02	1.57838E-01	6.47754E-02

Table 2.49. PNL-34, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	7.08275E-03	1.34026E-02	4.75965E-03	7.06095E-03	1.33747E-02	4.74910E-03
2	5.08244E-02	6.00968E-06	2.48979E-06	4.81132E-02	5.51775E-06	2.28598E-06
3	1.11012E-02	3.87466E-08	1.60534E-08	1.11191E-02	3.89584E-08	1.61412E-08
4	4.32220E-02	2.03118E-07	8.41557E-08	4.33792E-02	2.03865E-07	8.44652E-08

Table 2.50. PNL-34, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	7.29345E-04	2.13767E-03	6.87363E-04	7.28644E-04	2.13663E-03	6.86999E-04
2	1.53106E-02	2.52664E-02	8.77363E-03	1.54151E-02	2.54295E-02	8.83026E-03
3	4.67356E-02	9.20261E-02	3.19556E-02	4.76683E-02	9.37614E-02	3.25584E-02
4	3.72031E-01	7.53188E-01	2.60517E-01	3.73795E-01	7.56765E-01	2.61754E-01

Table 2.51. PNL-34, Pin-27 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.549E-04	2.550E-04
2	8.111E-05	8.287E-05
3	1.947E-05	1.947E-05
4	7.406E-05	7.415E-05

Table 2.52. PNL-34, Pin-27 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.32268E-04	5.19584E-04	2.01251E-04	2.31678E-04	5.19278E-04	2.00931E-04
2	5.33129E-03	8.13383E-03	3.33805E-03	5.40039E-03	8.25888E-03	3.38937E-03
3	8.21787E-03	1.67382E-02	6.86918E-03	8.24787E-03	1.68440E-02	6.91263E-03
4	7.26200E-02	1.51090E-01	6.20057E-02	7.26900E-02	1.51227E-01	6.20624E-02

Table 2.53. PNL-34, Pin-27 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	6.87156E-03	1.19877E-02	4.26261E-03	6.88984E-03	1.21250E-02	4.30392E-03
2	4.88942E-02	5.93992E-06	2.46088E-06	4.94199E-02	5.55323E-06	2.30068E-06
3	1.10643E-02	3.83905E-08	1.59059E-08	1.11102E-02	3.88583E-08	1.60997E-08
4	4.17166E-02	1.95887E-07	8.11600E-08	4.17541E-02	1.96065E-07	8.12334E-08

Table 2.54. PNL-34, Pin-27 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	7.32585E-04	2.10845E-03	6.82303E-04	7.32086E-04	2.11047E-03	6.82341E-04
2	1.52932E-02	2.51849E-02	8.74535E-03	1.50659E-02	2.45838E-02	8.53662E-03
3	4.71772E-02	9.27560E-02	3.22091E-02	4.72429E-02	9.29723E-02	3.22843E-02
4	3.90512E-01	7.78732E-01	2.69434E-01	3.90550E-01	7.78815E-01	2.69459E-01

										2.316 (1.24)
									2.296 (0.53)	2.287 (0.52)
								2.231 (0.55)	2.256 (0.39)	2.273 (0.58)
							2.099 (0.52)	2.175 (0.40)	2.223 (0.43)	2.208 (0.54)
						1.961 (0.55)	2.034 (0.41)	2.098 (0.41)	2.134 (0.38)	2.135 (0.61)
					1.756 (0.64)	1.872 (0.43)	1.941 (0.42)	1.996 (0.39)	2.057 (0.38)	2.047 (0.55)
				1.554 (0.67)	1.667 (0.45)	1.768 (0.42)	1.831 (0.46)	1.888 (0.45)	1.915 (0.41)	1.936 (0.60)
			1.322 (0.73)	1.441 (0.50)	1.550 (0.43)	1.640 (0.45)	1.704 (0.46)	1.742 (0.40)	1.797 (0.43)	1.788 (0.57)
		1.050 (0.80)	1.196 (0.58)	1.301 (0.46)	1.414 (0.47)	1.498 (0.52)	1.567 (0.46)	1.606 (0.46)	1.640 (0.43)	1.640 (0.61)
	0.798 (0.83)	0.924 (0.60)	1.047 (0.60)	1.159 (0.53)	1.254 (0.49)	1.331 (0.51)	1.400 (0.49)	1.441 (0.49)	1.475 (0.45)	1.488 (0.64)
0.657 (0.98)	0.680 (0.66)	0.780 (0.67)	0.888 (0.60)	1.002 (0.60)	1.099 (0.58)	1.163 (0.52)	1.236 (0.55)	1.270 (0.55)	1.299 (0.48)	1.291 (0.76)
0	0.645 (0.64)	0.667 (0.70)	0.755 (0.71)	0.838 (0.66)	0.926 (0.58)	1.004 (0.57)	1.052 (0.58)	1.091 (0.50)	1.122 (0.56)	1.114 (0.73)
0	0	0.605 (0.73)	0.620 (0.71)	0.685 (0.66)	0.759 (0.64)	0.821 (0.68)	0.868 (0.53)	0.902 (0.62)	0.924 (0.56)	0.929 (0.81)
0	0	0	0.562 (0.81)	0.591 (0.78)	0.617 (0.75)	0.649 (0.79)	0.696 (0.66)	0.736 (0.69)	0.753 (0.64)	0.760 (0.98)
0	0	0	0	0	0.553 (0.78)	0.558 (0.83)	0.591 (0.70)	0.619 (0.71)	0.642 (0.75)	0.645 (1.12)

Fig. 2.12a. Pin-power distribution for CENTRM benchmark PNL-35. Value in parentheses is percent standard deviation.

										2.333 (0.98)
									2.308 (0.50)	2.324 (0.46)
								2.251 (0.49)	2.275 (0.36)	2.283 (0.54)
							2.133 (0.50)	2.193 (0.)36	2.202 (0.36)	2.210 (0.48)
						1.973 (0.50)	2.044 (0.36)	2.110 (0.35)	2.131 (0.37)	2.142 (0.54)
					1.790 (0.55)	1.887 (0.38)	1.950 (0.40)	2.004 (0.36)	2.038 (0.35)	2.050 (0.48)
				1.583 (0.60)	1.688 (0.41)	1.765 (0.40)	1.827 (0.40)	1.890 (0.38)	1.916 (0.37)	1.941 (0.52)
			1.329 (0.66)	1.460 (0.45)	1.552 (0.42)	1.636 (0.38)	1.692 (0.38)	1.766 (0.39)	1.772 (0.40)	1.802 (0.60)
		1.065 (0.73)	1.212 (0.48)	1.315 (0.50)	1.409 (0.45)	1.482 (0.42)	1.566 (0.44)	1.603 (0.42)	1.622 (0.42)	1.645 (0.59)
	8.130 (0.80)	9.340 (0.58)	1.060 (0.54)	1.164 (0.47)	1.252 (0.50)	1.329 (0.47)	1.391 (0.45)	1.433 (0.44)	1.479 (0.41)	1.488 (0.61)
6.750 (0.89)	6.790 (0.62)	7.980 (0.63)	9.02 (0.55)	1.011 (0.53)	1.095 (0.48)	1.159 (0.50)	1.220 (0.46)	1.258 (0.46)	1.301 (0.47)	1.315 (0.61)
0	0.651 (0.64)	0.663 (0.67)	0.742 (0.60)	0.837 (0.60)	0.927 (0.54)	0.994 (0.54)	1.033 (0.52)	1.087 (0.53)	1.101 (0.49)	1.123 (0.72)
0	0	0.607 (0.74)	0.616 (0.66)	0.677 (0.65)	0.765 (0.57)	0.819 (0.56)	0.870 (0.59)	0.900 (0.53)	0.920 (0.59)	0.921 (0.77)
0	0	0	0.565 (0.68)	0.591 (0.65)	0.606 (0.66)	0.653 (0.63)	0.686 (0.66)	0.717 (0.59)	0.744 (0.59)	0.755 (0.87)
0	0	0	0	0	0.557 (0.69)	0.554 (0.69)	0.600 (0.73)	0.615 (0.71)	0.640 (0.70)	0.650 (0.96)

Fig. 2.12b. Pin-power distribution for NITAWL benchmark PNL-35. Value in parentheses is percent standard deviation.

Table 2.55. PNL-35 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	3.409E-06	5.555E-06	1.980E-06	3.018E-3	0.205
1	Clad	6.266E-08	0.0	0.0	5.795E-4	0.039
	Mod.	3.753E-07	0.0	0.0	1.113E-2	0.756
	Fuel	1.478E-05	2.314E-05	8.243E-06	1.578E-2	0.206
99	Clad	2.862E-07	0.0	0.0	3.049E-3	0.039
	Mod.	1.467E-06	0.0	0.0	5.794E-2	0.755

Table 2.56. PNL-35 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	3.418E-06	5.589E-06	1.992E-06	3.030E-3	0.206
1	Clad	6.288E-08	0.0	0.0	5.820E-4	0.040
	Mod.	3.743E-07	0.0	0.0	1.107E-2	0.754
	Fuel	1.486E-05	2.341E-05	8.338E-06	1.603E-2	0.207
99	Clad	2.817E-07	0.0	0.0	3.073E-3	0.040
	Mod.	1.487E-06	0.0	0.0	5.834E-2	0.753

Table 2.57. PNL-35, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	1.534E-05	1.545E-05
2	4.935E-06	4.897E-06
3	1.254E-06	1.264E-06
4	5.413E-06	5.443E-06

Table 2.58. PNL-35, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.29059E-04	5.17093E-04	1.99589E-04	2.29390E-04	5.17691E-04	1.99788E-04
2	5.45929E-03	8.37664E-03	3.43769E-03	5.46541E-03	8.36718E-03	3.43382E-03
3	8.30534E-03	1.69238E-02	6.94538E-03	8.28758E-03	1.68623E-02	6.92012E-03
4	7.30078E-02	1.51919E-01	6.23460E-02	7.27680E-02	1.51408E-01	6.21367E-02

Table 2.59. PNL-35, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.96200E-03	1.25983E-02	4.46724E-03	6.97774E-03	1.26269E-02	4.47453E-03
2	5.05345E-02	5.59431E-06	2.31769E-06	4.85328E-02	5.78528E-06	2.39681E-06
3	1.11140E-02	3.88695E-08	1.61043E-08	1.10876E-02	3.87287E-08	1.60460E-08
4	4.19366E-02	1.96955E-07	8.16021E-08	4.18109E-02	1.96348E-07	8.13505E-08

Table 2.60. PNL-35, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.31004E-04	2.12002E-03	6.83898E-04	7.31003E-04	2.11949E-03	6.83599E-04
2	1.57027E-02	2.57978E-02	8.95814E-03	1.48272E-02	2.46432E-02	8.55722E-03
3	4.68010E-02	9.21946E-02	3.20143E-02	4.68134E-02	9.21519E-02	3.19994E-02
4	3.84903E-01	7.69989E-01	2.66394E-01	3.86636E-01	7.72458E-01	2.67253E-01

Table 2.61. PNL-35, Pin-99 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	8.383E-05	8.501E-05
2	2.858E-05	2.911E-05
3	6.805E-06	7.098E-06
4	2.163E-05	2.187E-05

Table 2.62. PNL-35, Pin-99 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.33860E-04	5.21028E-04	2.02116E-04	2.31754E-04	5.19152E-04	2.00942E-04
2	5.36679E-03	8.26977E-03	3.39384E-03	5.36675E-03	8.27252E-03	3.39496E-03
3	8.17348E-03	1.67070E-02	6.85640E-03	8.15523E-03	1.66066E-02	6.81524E-03
4	7.08756E-02	1.47418E-01	6.04988E-02	7.06159E-02	1.46859E-01	6.02693E-02

Table 2.63. PNL-35, Pin-99 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.85097E-03	1.17780E-02	4.19479E-03	6.87710E-03	1.20714E-02	4.28595E-03
2	5.03681E-02	5.57278E-06	2.30878E-06	4.60701E-02	5.75479E-06	2.38419E-06
3	1.10871E-02	3.86935E-08	1.60313E-08	1.10723E-02	3.85789E-08	1.59839E-08
4	4.08300E-02	1.91640E-07	7.94004E-08	4.06994E-02	1.91015E-07	7.91408E-08

Table 2.64. PNL-35, Pin-99 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.33474E-04	2.10363E-03	6.81678E-04	7.31953E-04	2.10893E-03	6.82076E-04
2	1.48751E-02	2.48097E-02	8.61505E-03	1.48705E-02	2.44772E-02	8.49959E-03
3	4.59681E-02	9.06342E-02	3.14723E-02	4.52842E-02	8.93873E-02	3.10394E-02
4	3.95694E-01	7.84138E-01	2.71343E-01	3.95679E-01	7.83429E-01	2.71097E-01

3. MIX-COMP-THERM-3 (SAXTON-1 TO SAXTON-6)

3.1 DESCRIPTION

This section describes a set of six critical experiments, each consisting of a square-pitched array of mixed plutonium-uranium fuel rods submerged in water surrounded by a water reflector. The fuel rods are identical in all cases. Criticality is controlled by varying the number of rods, rod pitch, boron in water, and water level. This set of experiments is contained in the *International Handbook of Evaluated Criticality Safety Benchmark Experiments*.[3]

This set of experiments was performed in 1965 at the in the Critical Reactor Experiment Facility at the Westinghouse Reactor Evaluation Center. The benchmark experiments are light-water-moderated critical assemblies consisting of a core array supported by upper, middle, and lower lattice plates. The lower and middle lattice plates are 0.635 cm thick. The upper lattice plate is 1.27 cm thick. The middle lattice plate was not included in the models to facilitate the accumulation of pin-power distributions. The reactor is brought to critical by raising the water level in the tank, thus avoiding the use of control rods. The fuel rods sit on a support plate above the bottom of the tank. The tank is wide enough to assume an infinite moderator on the sides and bottom (~30 cm of water).

All fuel rods have the same physical dimensions. A schematic diagram of the fuel rods and bottom reflector is given in Fig. 3.1. Each fuel rod has an active fuel length of 92.964 cm, a 1.905-cm-long cladding plug on the bottom and a 4.320-cm-long cladding plug on the top. The fuel has a diameter of 0.856996 cm. The cladding outside diameter is 0.99314 cm with a 0.059055-cm-thick wall. This leaves a 0.009017-cm gap between the fuel and cladding.

The bottom of the fuel rod and lower lattice plate rest on a 2.54-cm aluminum support plate. Between the bottom of the aluminum support plate and the top of a 5.08-cm aluminum slab is 6.35 cm of water. The space between the top of the lower lattice plate and bottom of the middle lattice plate is 46.99 cm. The space between the top of the middle lattice plate and bottom of the top lattice plate is 47.625 cm. To simplify the problem the middle lattice plate was removed and replaced with water. The water level varies with each problem but is always between the middle and upper lattice plates. The tank is large enough to assume an infinite water reflector on the sides and bottom. An infinite water reflector can be effectively modeled using 30 cm of water, which is used to model the reflector for this set of benchmarks.

The primary differences between the six benchmarks are lattice pitch, number of rods in the lattice, water level, and for problem 3, boron density in the water. The physical characteristics of each benchmark case, including moderator temperature, are given in Table 3.1. The atom densities for all the materials in the problem except B-10, B-11 H, and O in the moderator are contained in Table 3.2. The atom densities in Table 3.2 are constant for all benchmarks. Table 3.3 contain the atom densities of B-10, B-11, H, and O in the moderator for each benchmark.

The lattice is filled from the 1/8th or 1/4th section by inserting additional pins in a mirror image. Figures 3.2 through 3.6 show the lattice map for each problem. Figure 3.2 shows a 1/4th lattice mapping while the other figures contain only 1/8th lattices. This difference exists because SAXTON-1 contains a different number of pins in the X and Y directions.

Table 3.1. Lattice description for SAXTON benchmark cases

Benchmark No.	Boron con. (ppm)	Lattice	Lattice pitch (cm)	Water level from bottom of fuel (cm)	Water temp. (°C)
1	0.0	22 × 23	1.3208	82.90	25.8
2	0.0	19 × 19	1.4224	80.80	17.0
3	337	21 × 21	1.4224	88.06	18.0
4	0.0	13 × 13	1.86789	68.41	24.1
5	0.0	12 × 12	2.01158	76.76	16.1
6	0.0	11 × 11	2.6416	79.50	19.9

Table 3.2. Constant benchmark atom densities

Material	Isotope	Atom density (atoms/barn-cm)	Material	Isotope	Atom density (atoms/barn-cm)
Fuel UO_2-PuO_2	U-234	4.6590×10^{-6}	Cladding and end plugs	Sn	4.6590×10^{-4}
	U-235	1.5301×10^{-4}		Fe	1.4148×10^{-4}
	U-238	2.1097×10^{-2}		Cr	7.5977×10^{-5}
	Pu-239	1.3526×10^{-3}		O	2.9630×10^{-4}
	Pu-240	1.2759×10^{-4}		Zr	4.2517×10^{-2}
	Pu-241	1.1407×10^{-5}	Al lattice plate, Al support plate, Al slab (2.69 gm/cc)	Al	6.0039×10^{-2}
	Pu-242	6.0318×10^{-7}			
	Am-241	1.7783×10^{-6}			
	O-16	4.3779×10^{-2}			

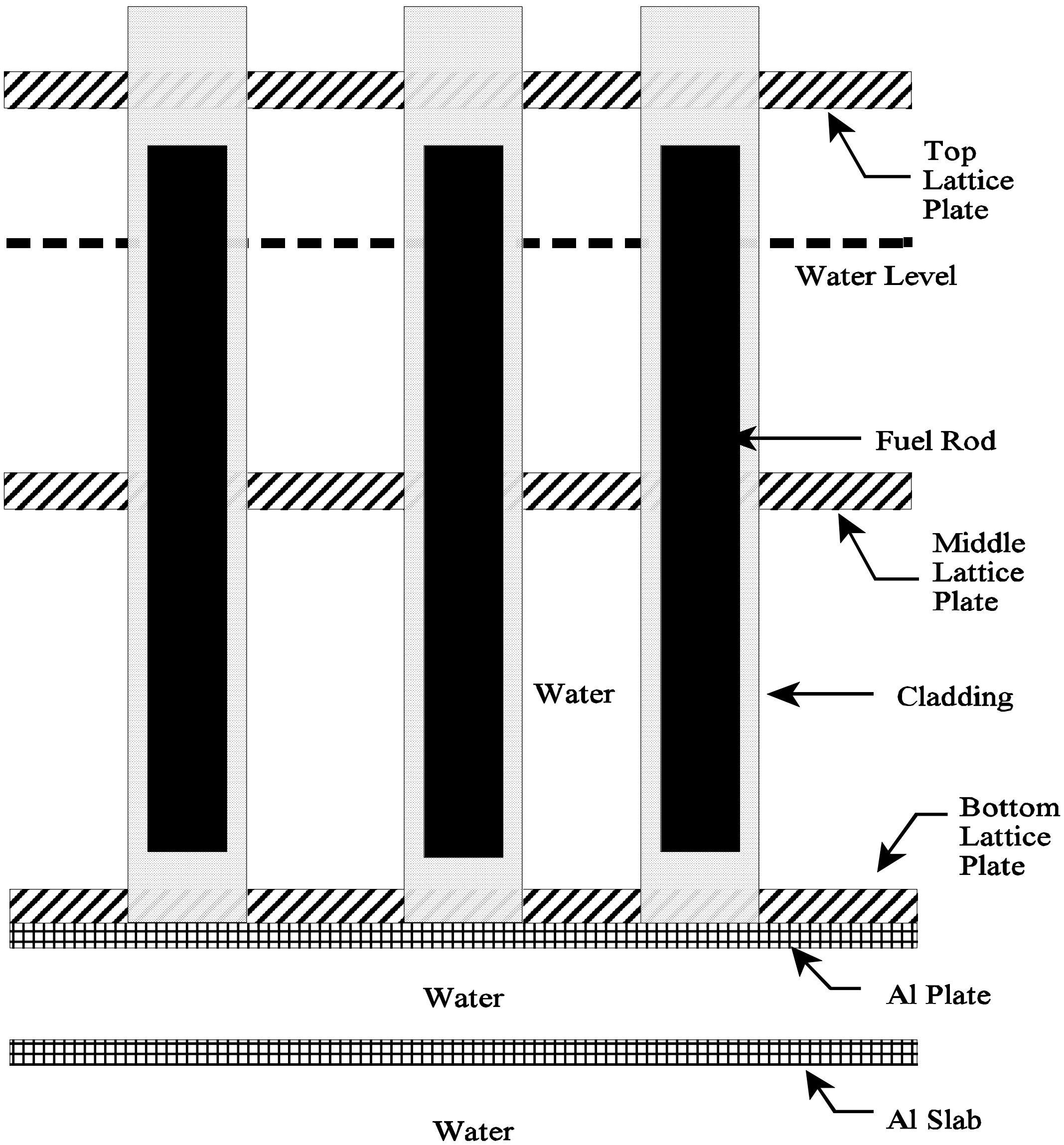

Fig. 3.1. Schematic of the SAXTON fuel rods with reflector.

Table 3.3. Moderator atom densities

Benchmark No.	Atom densities (atoms/barn-cm)			
	H	O	B-10	B-11
SAXTON-1	6.6643×10^{-2}	3.3322×10^{-2}	0.0	0.0
SAXTON-2	6.6781×10^{-2}	3.3390×10^{-2}	0.0	0.0
SAXTON-3	6.6751×10^{-2}	3.3404×10^{-2}	3.7338×10^{-6}	1.5029×10^{-5}
SAXTON-4	6.6673×10^{-2}	3.3336×10^{-2}	0.0	0.0
SAXTON-5	6.6783×10^{-2}	3.3392×10^{-2}	0.0	0.0
SAXTON-6	6.6737×10^{-2}	3.3368×10^{-2}	0.0	0.0

3.2 ANALYSIS

All six computational benchmarks in this section were processed twice using SCALE 5.0. The set labeled NITAWL uses the NITAWL resonance processor to self-shield the resolved resonance region for all nuclides in the unit cell. An identical set, labeled CENTRM, replaces NITAWL with the CENTRM/PMC code sequence. The NITAWL and CENTRM results are then compared.

Table 3.4 contains the k_{eff} and Energy of the Average Lethargy Causing Fission (EALCF). The k_{eff} values for all the benchmark cases are very close to 1.0, the worst NITAWL benchmark being 0.68% high and the worst CENTRM case being 0.59% high. There appears to be a small negative bias between NITAWL and CENTRM, the CENTRM cases being about 0.3% lower on average than the NITAWL cases. The EALCF values listed are from the CENTRM cases. For all cases, the difference between this value for CENTRM and NITAWL was less than 0.1%. Both CENTRM and NITAWL produce excellent results for the k_{eff} and EALCF for this set of problems.

Also, calculated for each problem are the pin-power distributions; absorption, $\nu\Sigma_f$, and fission reaction rates and fluxes in the pin fuel, clad, and moderator; and four group cross sections and fluxes for a corner outside pin and the center pin. Each set of data is calculated using both CENTRM and NITAWL. All the data for each case are contained in the following Figs. 3.7a through 3.12b and Tables 3.5 through 3.64.

The pin-power distributions for the first problem assume 1/4th core symmetry, the pin-power distributions for the remaining problems assume 1/8th core symmetry, with a surrounding reflector in all problems. The pin-power data consist of a value and a standard deviation for each pin. The values for the pin power are actually in units of fissions per cm^3-source particle $\times 10^{-5}$. The value in parentheses is the percent standard deviation of the pin-power value. The pin-power distributions in the 1/8th or full-core representations are the portion of the pin covered by water. The value off to the side in the pin-power distributions represents all the fuel not covered by water. Separating the fuel rod was necessary to model this in KENO-V.a.

In most cases the CENTRM and NITAWL results for each benchmark case agree within 2 standard deviations. The peak-to-low power changes with respect to pitch. The peak-to-low power ratio initially decreased with increasing pitch, starting with a high of 2.6 for SAXTON-1 and decreasing to a low of 1.8 for SAXTON-5. A further increase in pitch, as shown in SAXTON-6, increases the ratio to 2.5. The small pitch in SAXTON-1 and -2 cause the array to be under moderated. This under moderation results in the highest power pin being on the edge of the array and the lowest power pin being several pins in from the edge where the thermal flux is low due to lack of moderator and the fast flux is also low because it is not deep within the array.

The total fluxes, and flux ratios for the CENTRM and NITAWL cases of each benchmark case, are also in good agreement, seldom varying by more than 1%. These values are included for a corner pin and the center pin for each case. The reaction rates in the fuel and cladding are also in good agreement. However, the reaction rates for the moderator appear to be significantly different, with the CENTRM value being almost a factor of 2 higher for all cases.

Finally, four-group fluxes and cross sections were calculated for selected nuclides in the fuel region of the same corner and center pins. The macroscopic cross sections listed include the radiative capture, fission, and nu*fission cross sections for U-235, U-238, and Pu-239. The four groups are collapsed from the 238-group multigroup cross-section set using the flux profile calculated in KENO-V.a as follows: group 1 is from 20 Mev to 9.5 keV, group 2 is from 9.5 keV to 3.0 eV, group 3 is from 3 eV to 0.4 eV, and group 4 is from 0.4 eV to 10^{-5} eV. The 0.4 eV was chosen as a boundary because it is the cadmium cutoff energy. Groups 2 and 3 contain the resolved resonance regions for most of the nuclides used in these cases. Most of the cross-section data for the CENTRM and NITAWL cases of a given benchmark case agree within 1%.

3.3 CONCLUSIONS

For this set of benchmark cases using either NITAWL and CENTRM as the resonance region processor produces acceptable results of the k_{eff} values. All other values produced using CENTRM and NITAWL are also consistent with each. For all cases, the k_{eff}*'s* produced using CENTRM are slightly lower (~0.3%) than those produced using NITAWL to do the resonance self-shielding. As a result the average k_{eff} of all the CENTRM cases is closer to 1.0 than the average k_{eff} of all the NITAWL cases for this set of benchmarks. The pin-power distributions, fluxes, most reactions rates, and macroscopic cross sections generally agree to approximately 1% between CENTRM and NITAWL. The only significant discrepancy is the absorption reaction rate for the moderator. CENTRM calculates a value that is about a factor of 2 higher than the same value using NITAWL.

Table 3.4 Comparison of k_{eff} and EALCF from CENTRM and NITAWL[a]

CASE MIX-COMP-THERM-3	NITAWL k_{eff} (±σ)	CENTRM k_{eff} (±σ)	% DIFF	EALCF (eV)
SAXTON-1	1.0046 (0.0005)	1.0007 (0.0004)	-0.39	0.881
SAXTON-2	1.0058 (0.0004)	1.0012 (0.0004)	-0.46	0.537
SAXTON-3	1.0054 (0.0004)	1.0017 (0.0004)	-0.37	0.633
SAXTON-4	1.0056 (0.0004)	1.0029 (0.0004)	-0.27	0.186
SAXTON-5	1.0062 (0.0004)	1.0035 (0.0004)	-0.27	0.154
SAXTON-6	1.0068 (0.0005)	1.0059 (0.0004)	-0.09	0.100

[a] Value in parentheses is percent standard deviation.

121	122	123	124	125	126	127	128	129	130	131	132
109	110	111	112	113	114	115	116	117	118	119	120
97	98	99	100	101	102	103	104	105	106	107	108
85	86	87	88	89	90	91	92	93	94	95	96
73	74	75	76	77	78	79	80	81	82	83	84
61	62	63	64	65	66	67	68	69	70	71	72
49	50	51	52	53	54	55	56	57	58	59	60
37	38	39	40	41	42	43	44	45	46	47	48
25	26	27	28	29	30	31	32	33	34	35	36
13	14	15	16	17	18	19	20	21	22	23	24
1	2	3	4	5	6	7	8	9	10	11	12

Fig.3.2. Pin layout of benchmark case SAXTON-1.

									55
								53	54
							50	51	52
						46	47	48	49
					41	42	43	44	45
				35	36	37	38	39	40
			28	29	30	31	32	33	34
		20	21	22	23	24	25	26	27
	11	12	13	14	15	16	17	18	19
1	2	3	4	5	6	7	8	9	10

Fig. 3.3. Pin layout of benchmark case SAXTON-2.

										66
									64	65
								61	62	63
							57	58	59	60
						52	53	54	55	56
					46	47	48	49	50	51
				39	40	41	42	43	44	45
			31	32	33	34	35	36	37	38
		22	23	24	25	26	27	28	29	30
	12	13	14	15	16	17	18	19	20	21
1	2	3	4	5	6	7	8	9	10	11

Fig. 3.4. Pin layout of benchmark case SAXTON-3.

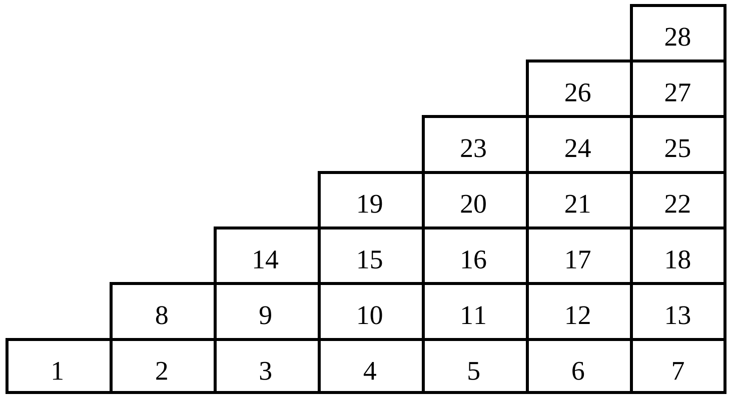

Fig. 3.5. Pin layout of benchmark case SAXTON-4.

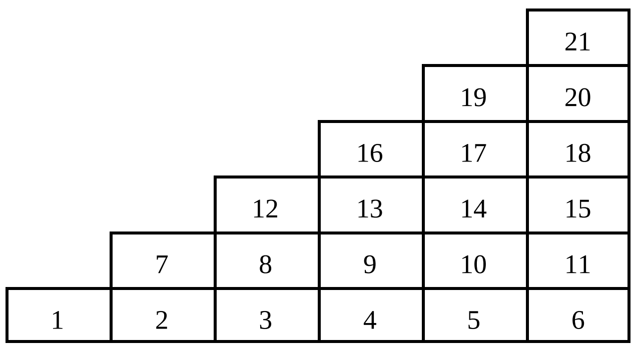

Fig. 3.6. Pin layout of benchmark cases SAXTON-5 and 6.

						0.150 (0.73)					
6.485 (0.53)	3.658 (0.59)	3.513 (0.64)	3.704 (0.60)	3.968 (0.55)	4.199 (0.57)	4.486 (0.55)	4.633 (0.49)	4.770 (0.54)	4.894 (0.55)	4.914 (0.50)	4.971 (0.73)
6.446 (0.50)	3.716 (0.58)	3.461 (0.61)	3.693 (0.61)	3.957 (0.59)	4.222 (0.55)	4.421 (0.57)	4.570 (0.57)	4.687 (0.51)	4.871 (0.51)	4.858 (0.53)	4.962 (0.66)
6.319 (0.48)	3.630 (0.63)	3.434 (0.62)	3.601 (0.61)	3.837 (0.54)	4.133 (0.57)	4.381 (0.56)	4.493 (0.49)	4.664 (0.56)	4.782 (0.56)	4.846 (0.52)	4.847 (0.71)
6.148 (0.50)	3.531 (0.62)	3.368 (0.59)	3.524 (0.66)	3.729 (0.56)	3.986 (0.58)	4.175 (0.52)	4.397 (0.55)	4.503 (0.50)	4.649 (0.51)	4.680 (0.52)	4.705 (0.75)
5.884 (0.49)	3.410 (0.63)	3.176 (0.67)	3.433 (0.59)	3.686 (0.59)	3.876 (0.58)	4.087 (0.61)	4.247 (0.55)	4.338 (0.54)	4.491 (0.54)	4.514 (0.53)	4.556 (0.75)
5.635 (0.50)	3.234 (0.67)	3.058 (0.64)	3.231 (0.66)	3.496 (0.60)	3.668 (0.54)	3.879 (0.60)	4.029 (0.57)	4.171 (0.52)	4.254 (0.57)	4.283 (0.51)	4.344 (0.75)
5.340 (0.53)	3.066 (0.66)	2.898 (0.63)	3.037 (0.71)	3.280 (0.62)	3.477 (0.56)	3.662 (0.61)	3.794 (0.59)	3.908 (0.61)	4.018 (0.57)	4.067 (0.56)	4.085 (0.75)
4.988 (0.55)	2.822 (0.70)	2.693 (0.72)	2.864 (0.66)	3.054 (0.70)	3.264 (0.61)	3.412 (0.61)	3.552 (0.61)	3.652 (0.59)	3.747 (0.59)	3.772 (0.58)	3.830 (0.84)
4.609 (0.58)	4.609 (0.67)	2.520 (0.72)	2.716 (0.71)	2.878 (0.67)	3.057 (0.67)	3.187 (0.62)	3.360 (0.58)	3.473 (0.62)	3.531 (0.59)	3.574 (0.70)	3.571 (0.88)
4.611 (0.62)	2.773 (0.75)	2.701 (0.67)	2.827 (0.68)	3.079 (0.65)	3.255 (0.69)	3.427 (0.66)	3.557 (0.63)	3.717 (0.60)	3.757 (0.54)	3.81 (0.62)	3.815 (0.88)
6.090 (0.50)	4.599 (0.56)	4.683 (0.52)	5.010 (0.56)	5.313 (0.51)	5.712 (0.53)	5.943 (0.52)	6.227 (0.49)	6.425 (0.51)	6.539 (0.50)	6.636 (0.48)	6.635 (0.67)

Fig. 3.7a. Pin-power distribution for CENTRM benchmark SAXTON-1. Value in parentheses is the percent standard deviation.

						4.967 (0.78)					
6.502 (0.50)	3.746 (0.64)	3.555 (0.60)	3.711 (0.62)	4.013 (0.54)	4.274 (0.56)	4.457 (0.58)	4.689 (0.54)	4.801 (0.55)	4.913 (0.55)	4.997 (0.49)	4.967 (0.78)
6.441 (0.49)	3.706 (0.59)	3.493 (0.67)	3.699 (0.65)	3.939 (0.63)	4.244 (0.56)	4.422 (0.53)	4.641 (0.55)	4.780 (0.55)	4.840 (0.51)	4.917 (0.49)	4.912 (0.74)
6.347 (0.45)	3.634 (0.54)	3.368 (0.65)	3.599 (0.59)	3.884 (0.61)	4.115 (0.57)	4.390 (0.51)	4.502 (0.52)	4.684 (0.54)	4.757 (0.56)	4.854 (0.51)	4.879 (0.78)
6.197 (0.52)	3.522 (0.63)	3.356 (0.64)	3.356 (0.59)	3.836 (0.60)	4.052 (0.56)	4.279 (0.57)	4.446 (0.54)	4.547 (0.54)	4.614 (0.55)	4.711 (0.49)	4.737 (0.76)
5.882 (0.52)	3.391 (0.62)	3.212 (0.63)	3.408 (0.64)	3.685 (0.61)	3.868 (0.56)	4.112 (0.57)	4.229 (0.55)	4.343 (049.)	4.500 (0.54)	4.497 (0.57)	4.520 (0.76)
5.619 (0.54)	3.243 (0.70)	3.060 (0.66)	3.260 (0.61)	3.477 (0.64)	3.708 (0.59)	3.880 (0.57)	4.050 (0.60)	4.189 (0.60)	4.265 (0.55)	4.321 (0.58)	4.305 (0.71)
5.353 (0.51)	3.065 (0.67)	2.880 (0.64)	3.041 (0.64)	3.296 (0.66)	3.479 (0.62)	3.650 (0.59)	3.879 (0.60)	3.922 (0.67)	3.990 (0.52)	4.087 (0.54)	4.126 (0.78)
4.982 (0.54)	2.844 (0.73)	2.673 (0.69)	2.857 (0.73)	3.063 (0.66)	3.264 (0.62)	3.422 (0.68)	3.577 (0.62)	3.698 (0.59)	3.787 (0.62)	3.847 (0.59)	3.823 (0.83)
4.689 (0.60)	2.684 (0.76)	2.526 (0.71)	2.697 (0.68)	2.904 (0.69)	3.064 (0.68)	3.243 (0.65)	3.361 (0.64)	3.478 (0.62)	3.538 (0.61)	3.578 (0.63)	3.626 (0.89)
4.621 (0.58)	2.801 (0.72)	2.677 (0.75)	2.839 (0.78)	3.079 (0.61)	3.258 (0.64)	3.417 (0.65)	3.558 (0.61)	3.735 (0.53)	3.801 (0.60)	3.882 (0.63)	3.872 (0.86)
6.047 (0.48)	4.602 (0.56)	4.618 (0.58)	4.932 (0.58)	5.360 (0.51)	5.681 (0.53)	6.037 (0.46)	6.282 (0.44)	6.440 (0.48)	6.562 (0.47)	6.694 (0.48)	6.750 (0.68)

Fig. 3.7b. Pin-power distribution for NITAWL benchmark SAXTON-1. Value in parentheses is the percent standard deviation.

Table 3.5. SAXTON-1 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	3.400E-05	6.075E-05	2.123E-05	7.209E-03	0.344
1	Clad	3.137E-07	0.0	0.0	2.114E-03	0.101
	Mod.	1.303E-06	0.0	0.0	1.162E-02	0.555
	Fuel	3.446E-05	5.001E-05	1.747E-05	1.905E-02	0.339
132	Clad	5.304E-07	0.0	0.0	5.690E-03	0.101
	Mod.	9.171E-07	0.0	0.0	3.141E-02	0.559

Table 3.6. SAXTON-1 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	3.407E-05	6.097E-05	2.131E-05	7.160E-03	0.344
1	Clad	3.038E-07	0.0	0.0	2.102E-03	0.101
	Mod.	6.505E-07	0.0	0.0	1.157E-02	0.556
	Fuel	3.445E-05	4.998E-05	1.746E-05	1.895E-02	0.338
132	Clad	5.131E-07	0.0	0.0	5.682E-03	0.101
	Mod.	4.648E-07	0.0	0.0	3.143E-02	0.561

Table 3.7. SAXTON-1, Pin-1 four-group fluxes

Group	CENTRM ϕ ($cm^{-2} - s^{-1}$)	NITAWL ϕ ($cm^{-2} - s^{-1}$)
1	9.920E-05	9.850E-05
2	2.598E-05	2.555E-05
3	5.448E-06	5.416E-06
4	2.012E-05	2.026E-05

Table 3.8. SAXTON-1, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.32297E-04	5.28702E-04	2.03588E-04	2.31560E-04	5.28129E-04	2.03214E-04
2	5.36940E-03	8.29315E-03	3.40344E-03	5.43045E-03	8.32423E-03	3.41618E-03
3	7.84363E-03	1.58948E-02	6.52311E-03	7.88612E-03	1.60166E-02	6.57304E-03
4	7.43305E-02	1.54727E-01	6.34985E-02	7.41841E-02	1.54426E-01	6.33751E-02

Table 3.9. SAXTON-1, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.21435E-03	1.34429E-02	4.77316E-03	7.22446E-03	1.35539E-02	4.80883E-03
2	5.31239E-02	5.82914E-06	2.41498E-06	5.09276E-02	5.71143E-06	2.36622E-06
3	1.12361E-02	3.85156E-08	1.59577E-08	1.12440E-02	3.86270E-08	1.60039E-08
4	4.26642E-02	2.00382E-07	8.30224E-08	4.25934E-02	2.00045E-07	8.28825E-08

Table 3.10. SAXTON-1, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.51521E-03	7.34395E-03	2.36412E-03	2.51413E-03	7.35233E-03	2.36542E-03
2	4.31528E-02	7.26582E-02	2.52301E-02	4.23284E-02	7.17029E-02	2.48984E-02
3	1.42157E-01	2.82164E-01	9.79800E-02	1.43048E-01	2.83783E-01	9.85430E-02
4	1.26177E+00	2.54082E+00	8.78966E-01	1.25963E+00	2.53651E+00	8.77483E-01

Table 3.11. SAXTON-1, Pin-132 four-group fluxes

Group	CENTRM Φ (cm^{-2} - s^{-1})	NITAWL Φ (cm^{-2} - s^{-1})
1	2.750E-04	2.726E-04
2	9.570E-05	9.640E-05
3	1.651E-05	1.607E-05
4	1.110E-05	1.112E-05

Table 3.12. SAXTON-1, Pin-132 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.45122E-04	5.39109E-04	2.10038E-04	2.44993E-04	5.38844E-04	2.09938E-04
2	5.15441E-03	7.97880E-03	3.27443E-03	5.09111E-03	7.85028E-03	3.22168E-03
3	7.58571E-03	1.52693E-02	6.26638E-03	7.63367E-03	1.54170E-02	6.32701E-03
4	6.21247E-02	1.28918E-01	5.29069E-02	6.23526E-02	1.29385E-01	5.30985E-02

Table 3.13. SAXTON-1, Pin-132 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.80382E-03	1.10027E-02	3.91622E-03	6.78188E-03	1.09576E-02	3.89839E-03
2	4.89435E-02	6.26429E-06	2.59527E-06	4.75272E-02	6.04762E-06	2.50550E-06
3	1.11343E-02	3.75412E-08	1.55540E-08	1.11699E-02	3.77752E-08	1.56510E-08
4	3.63750E-02	1.70185E-07	7.05107E-08	3.64831E-02	1.70704E-07	7.07262E-08

Table 3.14. SAXTON-1, Pin-132 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.52991E-03	7.17411E-03	2.33467E-03	2.52913E-03	7.17146E-03	2.33393E-03
2	4.10734E-02	6.89915E-02	2.39569E-02	3.95781E-02	6.68722E-02	2.32210E-02
3	1.30973E-01	2.61059E-01	9.06517E-02	1.35790E-01	2.70087E-01	9.37866E-02
4	1.45288E+00	2.78304E+00	9.63703E-01	1.45769E+00	2.79201E+00	9.66808E-01

									7.032 (0.91)
	0.171 (0.75)							7.088 (0.42)	7.085 (0.46)
							6.809 (0.46)	6.904 (0.32)	6.960 (0.49)
						6.408 (0.49)	6.587 (0.33)	6.701 (0.33)	6.721 (0.48)
					5.874 (0.49)	6.137 (0.35)	6.268 (0.37)	6.459 (0.35)	6.431 (0.48)
				5.267 (0.53)	5.498 (0.34)	5.807 (0.36)	5.922 (0.34)	6.082 (0.36)	6.127 (0.49)
			4.501 (0.61)	4.877 (0.40)	5.169 (0.39)	5.362 (0.37)	5.580 (0.37)	5.629 (0.38)	5.695 (0.52)
		3.937 (0.61)	4.239 (0.41)	4.533 (0.40)	4.826 (0.42)	5.017 (0.39)	5.191 (0.39)	5.256 (0.37)	5.308 (0.56)
	4.056 (0.65)	4.036 (0.42)	4.308 (0.40)	4.628 (0.40)	4.898 (0.37)	5.101 (0.39)	5.261 (0.38)	5.374 (0.35)	5.422 (0.51)
7.779 (0.47)	6.169 (0.37)	6.394 (0.34)	6.876 (0.36)	7.378 (0.34)	7.815 (0.30)	8.167 (0.33)	8.417 (0.30)	8.574 (0.31)	8.669 (0.41)

Fig. 3.8a. Pin-power distribution for CENTRM benchmark SAXTON-2. Value in parentheses is percent standard deviation.

0.172 (0.72)									7.111 (0.85)
								7.073 (0.45)	7.107 (0.46)
							6.803 (0.46)	6.929 (0.32)	7.015 (0.47)
						6.476 (0.49)	6.655 (0.35)	6.786 (0.34)	6.773 (0.44)
					5.890 (0.52)	6.194 (0.36)	6.362 (0.34)	6.449 (0.34)	6.504 (0.46)
				5.255 (0.53)	5.527 (0.39)	5.826 (0.36)	5.985 (0.35)	6.159 (0.37)	6.139 (0.50)
			4.556 (0.57)	4.871 (0.39)	5.198 (0.36)	5.449 (0.38)	5.562 (0.37)	5.690 (0.38)	5.706 (0.48)
		3.988 (0.57)	4.229 (0.40)	4.534 (0.40)	4.839 (040.)	5.022 (0.42)	5.209 (0.39)	5.298 (0.39)	5.338 (054.)
	4.073 (0.62)	3.989 (0.46)	4.314 (0.38)	4.651 (0.40)	4.909 (0.36)	5.172 (0.39)	5.260 (040.)	5.401 (0.36)	5.401 (048.)
7.878 (0.40)	6.193 (0.34)	6.355 (0.33)	6.870 (0.34)	7.353 (0.32)	7.839 (0.32)	8.201 (0.30)	8.457 (0.29)	8.657 (0.29)	8.684 (0.44)

Fig. 3.8b. Pin-power distribution for NITAWL benchmark SAXTON-2. Value in parentheses is percent standard deviation.

Table 3.15. SAXTON-2 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	4.361E-05	7.811E-05	2.729E-05	8.590E-03	0.296
1	Clad	3.882E-07	0.0	0.0	2.531E-03	0.087
	Mod.	1.731E-06	0.0	0.0	1.793E-02	0.617
	Fuel	4.675E-05	7.033E-05	2.457E-05	2.148E-02	0.293
55	Clad	6.310E-07	0.0	0.0	6.403E-03	0.087
	Mod.	1.351E-06	0.0	0.0	4.552E-02	0.620

Table 3.16. SAXTON-2 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	4.393E-05	7.895E-05	2.759E-05	8.596E-03	0.296
1	Clad	3.874E-07	0.0	0.0	2.523E-03	0.087
	Mod.	8.732E-07	0.0	0.0	1.790E-02	0.617
	Fuel	4.723E-05	7.130E-05	2.491E-05	2.145E-02	0.292
55	Clad	6.079E-07	0.0	0.0	6.411E-03	0.087
	Mod.	6.803E-07	0.0	0.0	4.565E-02	0.621

Table 3.17. SAXTON-2, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	1.210E-04	1.209E-04
2	3.068E-05	3.075E-05
3	6.650E-06	6.426E-06
4	2.598E-05	2.635E-05

Table 3.18. SAXTON-2, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.31295E-04	5.28168E-04	2.03137E-04	2.31046E-04	5.27611E-04	2.02942E-04
2	5.50818E-03	8.46995E-03	3.47598E-03	5.34062E-03	8.20683E-03	3.36800E-03
3	7.88307E-03	1.60481E-02	6.58600E-03	7.88335E-03	1.59830E-02	6.55932E-03
4	7.48945E-02	1.55911E-01	6.39846E-02	7.47985E-02	1.55708E-01	6.39009E-02

Table 3.19. SAXTON-2, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	7.27299E-03	1.37200E-02	4.87017E-03	7.25772E-03	1.36913E-02	4.86098E-03
2	5.45685E-02	6.04055E-06	2.50257E-06	5.15366E-02	5.85011E-06	2.42368E-06
3	1.12498E-02	3.86744E-08	1.60235E-08	1.12126E-02	3.84197E-08	1.59180E-08
4	4.29376E-02	2.01691E-07	8.35643E-08	4.28896E-02	2.01461E-07	8.34691E-08

Table 3.20. SAXTON-2, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.51538E-03	7.36394E-03	2.36798E-03	2.51302E-03	7.35725E-03	2.36609E-03
2	4.36441E-02	7.27138E-02	2.52495E-02	4.25694E-02	7.20315E-02	2.50126E-02
3	1.44153E-01	2.85821E-01	9.92499E-02	1.40219E-01	2.78403E-01	9.66744E-02
4	1.26117E+00	2.54337E+00	8.79827E-01	1.26115E+00	2.54272E+00	8.79601E-01

Table 3.21. SAXTON-2, Pin-55 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	3.168E-04	3.145E-04
2	1.074E-04	1.086E-04
3	1.945E-05	1.953E-05
4	1.722E-05	1.751E-05

Table 3.22 SAXTON-2, Pin-55 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.42818E-04	5.37235E-04	2.08871E-04	2.42331E-04	5.36480E-04	2.08578E-04
2	5.28301E-03	8.16913E-03	3.35254E-03	5.21227E-03	8.02944E-03	3.29521E-03
3	7.65558E-03	1.53980E-02	6.31918E-03	7.58530E-03	1.53401E-02	6.29544E-03
4	6.42364E-02	1.33386E-01	5.47403E-02	6.47836E-02	1.34511E-01	5.52022E-02

Table 3.23. SAXTON-2, Pin-55 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	6.89564E-03	1.14866E-02	4.08747E-03	6.87320E-03	1.14586E-02	4.07844E-03
2	5.10445E-02	5.98081E-06	2.47782E-06	5.07872E-02	5.96084E-06	2.46955E-06
3	1.11261E-02	3.76231E-08	1.55879E-08	1.11419E-02	3.76606E-08	1.56035E-08
4	3.74682E-02	1.75440E-07	7.26882E-08	3.77212E-02	1.76632E-07	7.31816E-08

Table 3.24. SAXTON-2, Pin-55 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.52700E-03	7.20417E-03	2.33954E-03	2.52549E-03	7.20372E-03	2.33961E-03
2	4.23034E-02	7.11892E-02	2.47201E-02	4.01978E-02	6.76656E-02	2.34965E-02
3	1.33769E-01	2.66117E-01	9.24077E-02	1.31144E-01	2.61407E-01	9.07727E-02
4	1.41690E+00	2.73612E+00	9.47311E-01	1.43265E+00	2.76589E+00	9.57596E-01

0.186 (0.99)										5.900 (0.99)
									5.929 (0.48)	5.958 (0.50)
								5.672 (0.51)	5.819 (0.31)	5.884 (0.49)
							5.436 (0.48)	5.585 (0.33)	5.666 (0.33)	5.630 (0.49)
						5.000 (0.54)	5.206 (0.35)	5.373 (0.33)	5.425 (0.33)	5.486 (0.55)
					4.473 (0.49)	4.718 (0.35)	4.935 (0.37)	5.060 (0.34)	5.148 (0.34)	5.191 (0.)55
				3.921 (0.58)	4.189 (0.42)	4.440 (0.38)	4.590 (0.38)	4.750 (0.36)	4.833 (0.34)	4.836 (0.52)
			3.331 (0.66)	3.599 (0.45)	3.842 (0.38)	4.096 (0.43)	4.271 (0.41)	4.357 (0.41)	4.399 (0.42)	4.447 (0.52)
		2.821 (0.75)	3.029 (0.47)	3.314 (0.50)	3.555 (0.43)	3.722 (0.39)	3.898 (0.40)	3.976 (0.39)	4.078 (0.39)	4.096 (0.57)
	2.693 (0.80)	2.750 (0.51)	2.987 (0.44)	3.235 (0.47)	3.464 (0.40)	3.672 (0.41)	3.860 (0.41)	3.906 (0.40)	3.977 (0.41)	3.972 (0.56)
4.495 (0.57)	3.726 (0.48)	3.956 (0.41)	4.320 (0.37)	4.667 (0.37)	5.028 (0.37)	5.272 (0.37)	5.506 (0.38)	5.679 (0.38)	5.763 (0.36)	5.781 (0.51)

Fig. 3.9a. Pin-power distribution for CENTRM benchmark SAXTON-3. Value in parentheses is percent standard deviation.

0.187 (1.06)										5.920 (1.07)
									5.932 (0.47)	5.983 (0.45)
								5.779 (0.48)	5.826 (0.33)	5.906 (0.48)
							5.446 (0.46)	5.598 (0.33)	5.704 (0.33)	5.705 (0.45)
						5.019 (0.56)	5.257 (0.36)	5.406 (0.36)	5.478 (0.36)	5.496 (0.47)
					4.482 (0.54)	4.743 (0.40)	4.946 (0.34)	5.088 (0.35)	5.205 (0.34)	5.195 (0.51)
				3.988 (0.58)	4.209 (0.38)	4.447 (0.36)	4.582 (0.37)	4.738 (0.36)	4.822 (0.36)	4.866 (0.54)
			3.317 (0.60)	3.625 (0.44)	3.856 (0.39)	4.081 (0.38)	4.245 (0.37)	4.400 (0.36)	4.439 (0.34)	4.515 (0.51)
		2.787 (0.67)	3.058 (0.48)	3.340 (0.44)	3.557 (0.45)	3.734 (0.42)	3.912 (0.43)	4.022 (0.39)	4.049 (0.41)	4.134 (0.59)
	2.676 (0.74)	2.740 (0.51)	3.007 (0.46)	3.254 (0.49)	3.491 (0.42)	3.663 (0.47)	3.821 (0.42)	3.954 (0.42)	4.004 (0.43)	4.050 (0.61)
4.515 (0.53)	3.758 (0.45)	3.949 (0.41)	4.335 (0.40)	4.695 (0.39)	5.019 (0.36)	5.313 (0.36)	5.493 (0.38)	5.685 (0.38)	5.746 (0.34)	5.823 (0.46)

Fig. 3.9b. Pin-power distribution for NITAWL benchmark SAXTON-3. Value in parentheses is percent standard deviation.

Table 3.25. SAXTON-3 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	2.543E-05	4.469E-05	1.562E-05	6.051E-03	0.295
1	Clad	2.340E-07	0.0	0.0	1.781E-03	0.087
	Mod.	1.588E-06	0.0	0.0	1.266E-02	0.618
	Fuel	3.944E-05	5.901E-05	2.061E-05	1.985E-02	0.292
66	Clad	5.323E-07	0.0	0.0	5.950E-03	0.087
	Mod.	1.782E-06	0.0	0.0	4.227E-02	0.621

Table 3.26. SAXTON-3 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	2.574E-05	4.529E-05	1.589E-05	6.060E-03	0.295
1	Clad	2.313E-07	0.0	0.0	1.785E-03	0.087
	Mod.	7.923E-07	0.0	0.0	1.270E-02	0.618
	Fuel	3.956E-05	5.952E-05	2.079E-05	1.999E-02	0.293
66	Clad	5.281E-07	0.0	0.0	5.968E-03	0.087
	Mod.	8.857E-07	0.0	0.0	4.235E-02	0.620

Table 3.27. SAXTON-3, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	7.796E-05	7.800E-05
2	2.181E-05	2.192E-05
3	4.829E-06	4.689E-06
4	1.453E-05	1.470E-05

Table 3.28. SAXTON-3, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.32521E-04	5.28612E-04	2.03658E-04	2.32862E-04	5.29454E-04	2.03931E-04
2	5.50005E-03	8.43228E-03	3.46053E-03	5.39193E-03	8.28878E-03	3.40165E-03
3	7.92452E-03	1.60789E-02	6.59865E-03	7.90441E-03	1.60146E-02	6.57223E-03
4	7.31686E-02	1.52279E-01	6.24939E-02	7.33599E-02	1.52663E-01	6.26517E-02

Table 3.29. SAXTON-3, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	7.20136E-03	1.33762E-02	4.75174E-03	7.23290E-03	1.34483E-02	4.77628E-03
2	5.41784E-02	5.69922E-06	2.36116E-06	5.29886E-02	5.86670E-06	2.43054E-06
3	1.12448E-02	3.86080E-08	1.59959E-08	1.12161E-02	3.84319E-08	1.59231E-08
4	4.20736E-02	1.97550E-07	8.18486E-08	4.21529E-02	1.97922E-07	8.20034E-08

Table 3.30. SAXTON-3, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.51444E-03	7.33436E-03	2.36219E-03	2.51691E-03	7.34278E-03	2.36421E-03
2	4.43213E-02	7.47680E-02	2.59628E-02	4.17771E-02	7.10830E-02	2.46832E-02
3	1.44573E-01	2.86496E-01	9.94842E-02	1.40383E-01	2.78776E-01	9.68036E-02
4	1.27177E+00	2.55010E+00	8.82257E-01	1.28214E+00	2.56855E+00	8.88646E-01

Table 3.31. SAXTON-3, Pin-66 four-group fluxes

Group	CENTRM Φ (cm^{-2} - s^{-1})	NITAWL Φ (cm^{-2} - s^{-1})
1	2.666E-04	2.684E-04
2	9.313E-05	9.364E-05
3	1.707E-05	1.685E-05
4	1.407E-05	1.456E-05

Table 3.32. SAXTON-3, Pin-66 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.42733E-04	5.37472E-04	2.08870E-04	2.43387E-04	5.37876E-04	2.09178E-04
2	5.30011E-03	8.16540E-03	3.35100E-03	5.27422E-03	8.12879E-03	3.33598E-03
3	7.70943E-03	1.55532E-02	6.38289E-03	7.67703E-03	1.54383E-02	6.33579E-03
4	6.52259E-02	1.35439E-01	5.55832E-02	6.49576E-02	1.34906E-01	5.53641E-02

Table 3.33. SAXTON-3, Pin-66 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	6.92119E-03	1.15793E-02	4.11808E-03	6.86967E-03	1.13727E-02	4.04314E-03
2	5.09692E-02	6.02439E-06	2.49588E-06	4.92231E-02	6.08021E-06	2.51901E-06
3	1.11677E-02	3.78609E-08	1.56865E-08	1.11602E-02	3.77671E-08	1.56476E-08
4	3.79241E-02	1.77598E-07	7.35821E-08	3.78323E-02	1.77181E-07	7.34093E-08

Table 3.34. SAXTON-3, Pin-66 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.52720E-03	7.21032E-03	2.34053E-03	2.52750E-03	7.19788E-03	2.33835E-03
2	4.12518E-02	6.95573E-02	2.41534E-02	4.03271E-02	6.74581E-02	2.34245E-02
3	1.37500E-01	2.73101E-01	9.48330E-02	1.37757E-01	2.73564E-01	9.49941E-02
4	1.43800E+00	2.77757E+00	9.61635E-01	1.41120E+00	2.73126E+00	9.45577E-01

0.218 (0.73)						18.89 (0.69)
					18.60 (0.33)	18.82 (0.36)
				17.23 (0.35)	17.81 (0.24)	18.18 (0.33)
			14.90 (0.35)	16.09 (0.26)	1.6.9 (0.26)	16.95 (0.35)
		12.39 (0.38)	13.62 (0.29)	14.58 (0.24)	15.18 (0.25)	15.37 (0.38)
	10.54 (0.30)	11.44 (0.28)	12.55 (0.28)	13.40 (0.26)	13.91 (0.27)	14.11 (0.40)
13.71 (0.41)	12.57 (0.29)	13.86 (0.29)	15.06 (0.26)	16.18 (0.25)	16.83 (0.25)	17.04 (0.30)

Fig. 3.10a. Pin-power distribution for CENTRM benchmark SAXTON-4. Value in parentheses is percent standard deviation.

0.216 (0.71)						19.22 (0.63)
					18.69 (0.34)	18.74 (0.33)
				17.22 (0.35)	17.97 (0.23)	18.11 (0.32)
			15.01 (0.37)	16.06 (0.26)	16.70 (0.24)	16.94 (0.35)
		12.38 (0.42)	13.63 (0.29)	14.56 (0.25)	15.19 (0.26)	15.46 (0.37)
	10.58 (0.45)	11.45 (0.28)	12.55 (0.30)	13.47 (0.29)	14.02 (0.27)	14.19 (0.39)
13.72 (0.38)	12.61 (0.27)	13.89 (0.27)	15.18 (0.25)	16.16 (0.28)	16.86 (0.24)	17.12 (0.33)

Fig. 3.10b. Pin-power distribution for NITAWL benchmark SAXTON-4. Value in parentheses is percent standard deviation.

Table 3.35. SAXTON-4 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
1	Fuel	7.531E-05	1.363E-04	4.765E-05	1.085E-02	0.172
	Clad	6.208E-07	0.0	0.0	3.159E-03	0.050
	Mod.	3.325E-06	0.0	0.0	4.911E-02	0.778
28	Fuel	1.133E-04	1.888E-04	6.597E-05	2.644E-02	0.170
	Clad	1.093E-06	0.0	0.0	7.857E-03	0.051
	Mod.	4.152E-06	0.0	0.0	1.212E-01	0.779

Table 3.36. SAXTON-4 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
1	Fuel	7.555E-05	1.372E-04	4.796E-05	1.091E-02	0.172
	Clad	6.298E-07	0.0	0.0	3.186E-03	0.050
	Mod.	1.677E-06	0.0	0.0	4.926E-02	0.778
28	Fuel	1.153E-04	1.923E-04	6.721E-05	2.661E-02	0.171
	Clad	1.090E-06	0.0	0.0	7.874E-03	0.050
	Mod.	2.076E-06	0.0	0.0	1.214E-01	0.779

Table 3.37. SAXTON-4, Pin-1 four-group fluxes

Group	CENTRM M (cm^{-2} - s^{-1})	NITAWL M (cm^{-2} - s^{-1})
1	1.767E-04	1.772E-04
2	4.238E-05	4.314E-05
3	9.788E-06	9.606E-06
4	4.606E-05	4.644E-05

Table 3.38. SAXTON-4, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	G_a	$\triangleleft G_f$	G_f	G_a	$\triangleleft G_f$	G_f
1	2.28768E-04	5.25936E-04	2.01824E-04	2.28888E-04	5.26218E-04	2.01905E-04
2	5.58388E-03	8.56052E-03	3.51317E-03	5.50211E-03	8.45190E-03	3.46859E-03
3	8.12596E-03	1.65337E-02	6.78529E-03	8.00644E-03	1.62619E-02	6.67374E-03
4	7.52875E-02	1.56735E-01	6.43226E-02	7.54139E-02	1.57003E-01	6.44324E-02

Table 3.39. SAXTON-4, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	G_a	$\triangleleft G_f$	G_f	G_a	$\triangleleft G_f$	G_f
1	7.34533E-03	1.41658E-02	5.02602E-03	7.35536E-03	1.41852E-02	5.03150E-03
2	5.77836E-02	6.06902E-06	2.51437E-06	5.53505E-02	5.94471E-06	2.46287E-06
3	1.12800E-02	3.90072E-08	1.61613E-08	1.12638E-02	3.87636E-08	1.60605E-08
4	4.31348E-02	2.02633E-07	8.39546E-08	4.31960E-02	2.02927E-07	8.40764E-08

Table 3.40. SAXTON-4, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	G_a	$\triangleleft G_f$	G_f	G_a	$\triangleleft G_f$	G_f
1	2.51088E-03	7.39032E-03	2.37191E-03	2.51148E-03	7.39283E-03	2.37221E-03
2	4.48570E-02	7.50776E-02	2.60703E-02	4.28458E-02	7.19822E-02	2.49954E-02
3	1.48740E-01	2.94317E-01	1.02200E-01	1.46544E-01	2.90227E-01	1.00780E-01
4	1.25958E+00	2.54316E+00	8.79726E-01	1.25886E+00	2.54285E+00	8.79615E-01

Table 3.41. SAXTON-4, Pin-28 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	4.435E-04	4.456E-04
2	1.401E-04	1.409E-04
3	2.995E-05	2.997E-05
4	5.644E-05	5.789E-05

Table 3.42. SAXTON-4, Pin-28 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.37576E-04	5.33610E-04	2.06345E-04	2.36654E-04	5.32933E-04	2.05880E-04
2	5.42624E-03	8.34946E-03	3.42656E-03	5.49204E-03	8.44613E-03	3.46621E-03
3	8.00180E-03	1.62249E-02	6.65856E-03	7.91521E-03	1.60134E-02	6.57174E-03
4	7.09472E-02	1.47553E-01	6.05542E-02	7.02795E-02	1.46150E-01	5.99789E-02

Table 3.43. SAXTON-4, Pin-28 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	7.11109E-03	1.26244E-02	4.48453E-03	7.14856E-03	1.28317E-02	4.55624E-03
2	5.52425E-02	5.99818E-06	2.48502E-06	5.40680E-02	5.89807E-06	2.44355E-06
3	1.12522E-02	3.86845E-08	1.60276E-08	1.12054E-02	3.82593E-08	1.58516E-08
4	4.09068E-02	1.91933E-07	7.95213E-08	4.05719E-02	1.90337E-07	7.88606E-08

Table 3.44. SAXTON-4, Pin-28 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.52286E-03	7.28582E-03	2.35416E-03	2.52139E-03	7.29800E-03	2.35595E-03
2	4.55287E-02	7.65767E-02	2.65909E-02	4.36759E-02	7.33527E-02	2.54713E-02
3	1.45672E-01	2.88541E-01	1.00195E-01	1.41609E-01	2.80817E-01	9.75128E-02
4	1.32655E+00	2.62741E+00	9.09199E-01	1.32947E+00	2.62807E+00	9.09471E-01

0.274 (0.94)					20.09 (0.35)
				18.84 (0.33)	19.55 (0.23)
			16.65 (0.35)	17.71 (0.21)	18.36 (0.23)
		13.79 (0.34)	15.16 (0.22)	16.11 (0.24)	16.66 (0.24)
	11.35 (0.40)	12.45 (0.27)	13.69 (0.26)	14.59 (0.26)	15.00 (0.23)
13.36 (0.35)	12.75 (0.28)	14.14 (0.23)	15.59 (0.23)	16.47 (0.23)	17.04 (0.24)

Fig. 3.11a. Pin-power distribution for CENTRM benchmark SAXTON-5. Value in parentheses is percent standard deviation.

0.273 (0.90)					20.26 (0.30)
				19.04 (0.33)	19.51 (0.21)
			16.69 (0.35)	17.88 (0.23)	18.32 (0.22)
		13.84 (0.38)	15.25 (0.24)	16.23 (0.23)	16.66 (0.23)
	11.26 (0.44)	12.43 (0.29)	13.78 (0.25)	14.67 (0.26)	15.07 (0.25)
13.29 (0.34)	12.74 (0.26)	14.20 (0.24)	15.58 (0.22)	16.46 (0.22)	17.07 (0.24)

Fig. 3.11b. Pin-power distribution for NITAWL Benchmark SAXTON-5. Value in parentheses is percent standard deviation.

Table 3.45. SAXTON-5 CENTRM reaction rates and fluxes

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$<G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	7.340E-05	1.334E-04	4.665E-05	1.142E-02	0.148
1	Clad	6.001E-07	0.0	0.0	3.327E-03	0.043
	Mod.	3.369E-06	0.0	0.0	6.246E-02	0.809
	Fuel	1.175E-04	2.005E-04	7.008E-05	2.753E-02	0.147
21	Clad	1.081E-06	0.0	0.0	8.169E-03	0.043
	Mod.	4.571E-06	0.0	0.0	1.519E-01	0.810

Table 3.46. SAXTON-5 NITAWL reaction rates and fluxes

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$<G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	7.276E-05	1.326E-04	4.636E-05	1.134E-02	0.147
1	Clad	5.939E-07	0.0	0.0	3.314E-03	0.043
	Mod.	1.683E-06	0.0	0.0	6.233E-02	0.810
	Fuel	1.185E-04	2.024E-04	7.072E-05	2.776E-02	0.147
21	Clad	1.081E-06	0.0	0.0	8.220E-03	0.044
	Mod.	2.306E-06	0.0	0.0	1.528E-01	0.809

Table 3.47. SAXTON-5, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	1.642E-04	1.632E-04
2	3.938E-05	3.897E-05
3	9.086E-06	8.830E-06
4	4.517E-05	4.505E-05

Table 3.48. SAXTON-5, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.28516E-04	5.26334E-04	2.01776E-04	2.28104E-04	5.25678E-04	2.01507E-04
2	5.57692E-03	8.53438E-03	3.50244E-03	5.57593E-03	8.52166E-03	3.49720E-03
3	8.00912E-03	1.62733E-02	6.67842E-03	7.98496E-03	1.61621E-02	6.63276E-03
4	7.58687E-02	1.57957E-01	6.48244E-02	7.56584E-02	1.57516E-01	6.46433E-02

Table 3.49. SAXTON-5, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	7.40499E-03	1.43721E-02	5.09562E-03	7.36961E-03	1.43170E-02	5.07374E-03
2	6.01938E-02	6.08276E-06	2.52006E-06	5.60690E-02	5.89946E-06	2.44412E-06
3	1.12744E-02	3.88600E-08	1.61004E-08	1.12557E-02	3.87165E-08	1.60410E-08
4	4.34215E-02	2.04004E-07	8.45229E-08	4.33185E-02	2.03512E-07	8.43190E-08

Table 3.50. SAXTON-5, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	2.51193E-03	7.40536E-03	2.37431E-03	2.51011E-03	7.40294E-03	2.37356E-03
2	4.59985E-02	7.75008E-02	2.69116E-02	4.40523E-02	7.41950E-02	2.57639E-02
3	1.50511E-01	2.97520E-01	1.03313E-01	1.47223E-01	2.91456E-01	1.01207E-01
4	1.25860E+00	2.54527E+00	8.80429E-01	1.25753E+00	2.54209E+00	8.79338E-01

Table 3.51. SAXTON-5, Pin-21 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	4.092E-04	4.112E-04
2	1.239E-04	1.261E-04
3	2.677E-05	2.696E-05
4	6.193E-05	6.260E-05

Table 3.52. SAXTON-5, Pin-21 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.36162E-04	5.32867E-04	2.05677E-04	2.35623E-04	5.32179E-04	2.05354E-04
2	5.48935E-03	8.40097E-03	3.44768E-03	5.44674E-03	8.35559E-03	3.42905E-03
3	7.96989E-03	1.61823E-02	6.64109E-03	7.98750E-03	1.62231E-02	6.65779E-03
4	7.21016E-02	1.49992E-01	6.15555E-02	7.19091E-02	1.49587E-01	6.13891E-02

Table 3.53. SAXTON-5, Pin-21 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.19130E-03	1.30115E-02	4.61767E-03	7.19283E-03	1.30642E-02	4.63670E-03
2	5.75995E-02	6.14358E-06	2.54525E-06	5.55646E-02	6.04202E-06	2.50319E-06
3	1.12575E-02	3.87725E-08	1.60642E-08	1.12617E-02	3.87641E-08	1.60607E-08
4	4.14883E-02	1.94726E-07	8.06790E-08	4.13946E-02	1.94278E-07	8.04931E-08

Table 3.54. SAXTON-5, Pin-21 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.52182E-03	7.31114E-03	2.35818E-03	2.52033E-03	7.31286E-03	2.35814E-03
2	4.59107E-02	7.65671E-02	2.65875E-02	4.38622E-02	7.38489E-02	2.56436E-02
3	1.46728E-01	2.90546E-01	1.00891E-01	1.47469E-01	2.91907E-01	1.01364E-01
4	1.31306E+00	2.61230E+00	9.03898E-01	1.31380E+00	2.61230E+00	9.03907E-01

0.349 (1.00)					26.71 (0.54)
				25.24 (0.26)	26.06 (0.27)
			22.18 (0.30)	23.68 (0.19)	24.15 (0.28)
		17.62 (0.35)	19.75 (0.21)	21.10 (0.19)	21.46 (0.29)
	12.89 (0.35)	15.03 (0.22)	16.85 (0.22)	17.95 (0.20)	18.30 (0.31)
10.69 (0.39)	11.87 (0.28)	13.89 (0.26)	15.51 (0.25)	16.58 (0.23)	16.92 (0.35)

Fig. 3.12a. Pin-power distribution for CENTRM benchmark SAXTON-6. Value in parentheses is percent standard deviation.

0.341 (1.01)					26.34 (0.53)
				25.27 (0.28)	25.86 (0.27)
			22.14 (0.31)	23.68 (0.20)	24.16 (0.27)
		17.65 (0.32)	19.77 (0.21)	21.15 (0.19)	21.58 (0.30)
	12.84 (0.40)	15.03 (0.24)	16.86 (0.23)	17.98 (0.20)	18.46 (0.31)
10.75 (0.42)	11.84 (0.27)	13.94 (0.26)	15.58 (0.24)	16.62 (0.23)	16.94 (0.30)

Fig. 3.12b. Pin-power distribution for NITAWL benchmark SAXTON-6. Value in parentheses is percent standard deviation.

Table 3.55. SAXTON-6 CENTRM reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	5.801E-05	1.068E-04	3.734E-05	8.227E-03	0.085
1	Clad	4.571E-07	0.0	0.0	2.381E-03	0.024
	Mod.	2.974E-06	0.0	0.0	8.646E-02	0.891
	Fuel	1.483E-04	2.649E-04	9.259E-05	2.605E-02	0.085
21	Clad	1.224E-06	0.0	0.0	7.665E-03	0.025
	Mod.	6.914E-06	0.0	0.0	2.718E-01	0.890

Table 3.56. SAXTON-6 NITAWL reaction rates and fluxes

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	5.849E-05	1.078E-04	3.768E-05	8.318E-03	0.085
1	Clad	4.597E-07	0.0	0.0	2.405E-03	0.025
	Mod.	1.489E-06	0.0	0.0	8.696E-02	0.890
	Fuel	1.484E-04	2.656E-04	9.284E-05	2.592E-02	0.085
21	Clad	1.212E-06	0.0	0.0	7.589E-03	0.025
	Mod.	3.439E-06	0.0	0.0	2.708E-01	0.890

Table 3.57. SAXTON-6, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	1.127E-04	1.136E-04
2	2.431E-05	2.487E-05
3	5.596E-06	5.708E-06
4	3.680E-05	3.720E-05

Table 3.58. SAXTON-6, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.25419E-04	5.23524E-04	2.00192E-04	2.25627E-04	5.23460E-04	2.00250E-04
2	5.64554E-03	8.59223E-03	3.52618E-03	5.66043E-03	8.68922E-03	3.56598E-03
3	8.10920E-03	1.64809E-02	6.76363E-03	8.14676E-03	1.65761E-02	6.80268E-03
4	7.66356E-02	1.59575E-01	6.54883E-02	7.61884E-02	1.58640E-01	6.51043E-02

Table 3.59. SAXTON-6, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.46961E-03	1.48484E-02	5.26453E-03	7.45908E-03	1.47830E-02	5.24259E-03
2	6.30267E-02	6.27162E-06	2.59830E-06	5.76920E-02	5.74105E-06	2.37850E-06
3	1.12849E-02	3.89762E-08	1.61485E-08	1.13126E-02	3.92234E-08	1.62510E-08
4	4.38120E-02	2.05877E-07	8.52986E-08	4.35935E-02	2.04834E-07	8.48667E-08

Table 3.60. SAXTON-6, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.50829E-03	7.44201E-03	2.38103E-03	2.50741E-03	7.43347E-03	2.37922E-03
2	4.78379E-02	8.01259E-02	2.78233E-02	4.63764E-02	7.75412E-02	2.69258E-02
3	1.52214E-01	3.00611E-01	1.04386E-01	1.54150E-01	3.04373E-01	1.05692E-01
4	1.24949E+00	2.53488E+00	8.76780E-01	1.24891E+00	2.53120E+00	8.75527E-01

Table 3.61. SAXTON-6, Pin-21 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	3.626E-04	3.592E-04
2	9.528E-05	9.575E-05
3	2.230E-05	2.206E-05
4	8.798E-05	8.816E-05

Table 3.62. SAXTON-6, Pin-21 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.30565E-04	5.27350E-04	2.02688E-04	2.30477E-04	5.28068E-04	2.02763E-04
2	5.63375E-03	8.59935E-03	3.52909E-03	5.56879E-03	8.53534E-03	3.50283E-03
3	8.06789E-03	1.64302E-02	6.74278E-03	8.03178E-03	1.64159E-02	6.73694E-03
4	7.49118E-02	1.55931E-01	6.39925E-02	7.47374E-02	1.55564E-01	6.38420E-02

Table 3.63. SAXTON-6, Pin-21 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	7.31139E-03	1.38701E-02	4.92308E-03	7.34112E-03	1.40133E-02	4.96478E-03
2	6.04901E-02	6.16474E-06	2.55402E-06	5.89630E-02	6.22799E-06	2.58023E-06
3	1.12898E-02	3.90791E-08	1.61912E-08	1.12885E-02	3.90972E-08	1.61987E-08
4	4.29311E-02	2.01652E-07	8.35480E-08	4.28370E-02	2.01200E-07	8.33613E-08

Table 3.64. SAXTON-6, Pin-21 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	2.51210E-03	7.36437E-03	2.36645E-03	2.51355E-03	7.37904E-03	2.36928E-03
2	4.63848E-02	7.74581E-02	2.68969E-02	4.49666E-02	7.52761E-02	2.61392E-02
3	1.47063E-01	2.91411E-01	1.01191E-01	1.47665E-01	2.92500E-01	1.01570E-01
4	1.27191E+00	2.56133E+00	8.86051E-01	1.27598E+00	2.56709E+00	8.88067E-01

4. MIX-COMP-THERM-4 (TCA-1 TO TCA-11)

4.1 DESCRIPTION

This section describes a set of 11 critical experiments, each consisting of a square-pitched array of mixed Plutonium-Uranium fuel rods partially submerged in water surrounded by a water reflector. The water-to-fuel ratios for the arrays range from 2.4 to 5.6. This set of experiments is contained in the *International Handbook of Evaluated Criticality Safety Benchmark Experiments*.[3]

This set of experiments was performed between 1972 and 1975 at the Tokai Research Establishment of JAERI. The Tank-Type Critical Assembly (TCA) benchmark cases are light-water moderated critical assemblies, consisting of a core array supported by upper, middle, and lower grid plates. The grid plates do not pass through the fuel region. The fuel is sufficiently long such that the water level is below the top of the fuel region in all cases. The reactor is brought to critical by raising the water level in the tank, thus avoiding the use of control rods. The fuel rods sit on a support plate above the bottom of the tank. The tank is wide enough to assume an infinite moderator on the sides (~30 cm of water).

All fuel rods have the same physical dimensions. A schematic diagram of the fuel rods and bottom reflector is given in Fig. 4.1. Each fuel rod has an active fuel length of 70.6 cm and a 16.83-cm-long bottom aluminum end plug that sits on a 1.27-cm-thick aluminum support plate. The fuel has a radius of 0.5325 cm. The cladding has an outside radius of 0.6115 cm. For the calculation, the cladding is extended 9.97 cm above the active fuel to the bottom of the middle grid plate. The middle grid plate and everything above are assumed to be insignificant and thus excluded from the model. The fuel lattice is surrounded by 30 cm of water on the four sides from the bottom of the tank to the top of the critical water level.

From the top of the aluminum support plate is a 4.445-cm water gap and 0.601-cm lower aluminum grid plate. Below the aluminum support plate is a 2.2-cm-thick stainless steel (SS) support plate, a 13.8-cm water gap, 0.5-cm-thick SS tank liner and 37.0 cm of concrete.

The primary differences between the 11 benchmarks are lattice pitch, number of rods in the lattice, water level, and Pu-241 and Am-241 number densities. All other benchmark characteristics are constant. The 11 benchmarks are divided into four different lattice pitches: 1.825 cm, 1.956 cm, 2.225 cm, and 2.474 cm. For a given pitch, the number of pins in the lattice is given. The fuel is arranged in a square-pitched square lattice. The characteristics of each of the four lattices are given in Table 4.1. The critical fuel height variations are due to the changes in Pu-241 and Am-241 atom densities. Table 4.2 contains the atom densities for all the materials in the problem except Pu-241 and Am-241. The atom densities in Table 4.2 are constant for all benchmarks. Table 4.3 contains the atom densities for Pu-241 and Am-241 for each benchmark. All material temperatures are assumed to be 20ºC.

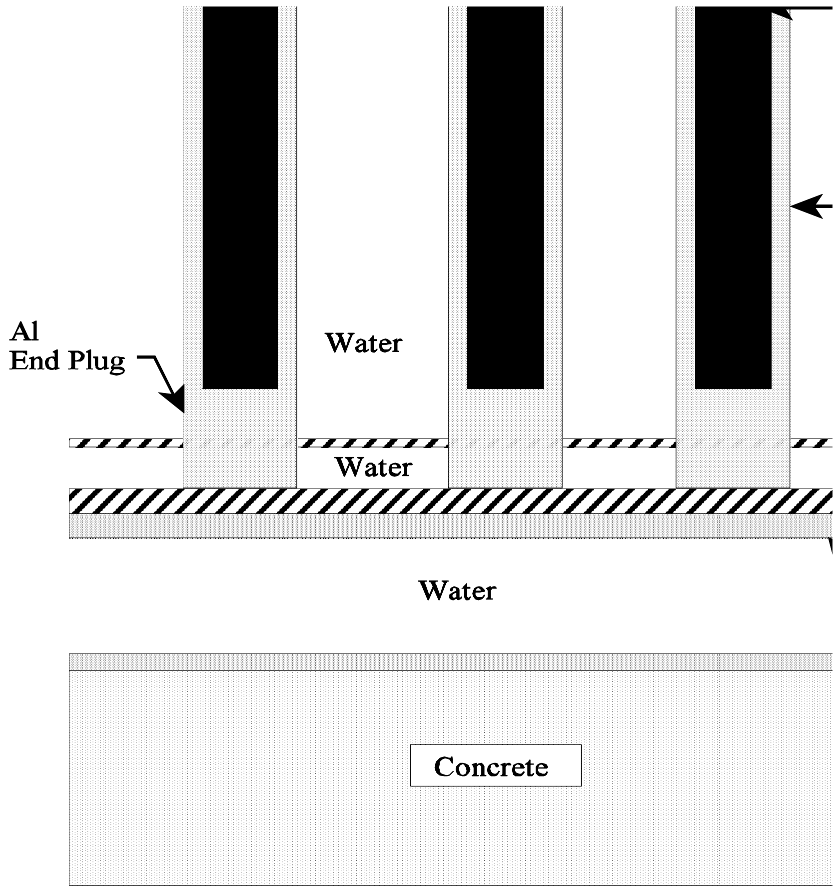

Fig. 4.1. Schematic of the TCA fuel rods and bottom reflector.

Table 4.1. Lattice description for benchmarks

Benchmark No.	Water/Fuel volume ratio (H/Pu ratio)	Lattice pitch (cm)	Number of rods on a Side	Lattice side dimension (cm)	Critical water level (cm)
1	2.42 (402)	1.825	23	41.975	59.5
2					91.90
3					64.06
4	2.98 (494)	1.956	21	41.076	61.50
5					64.40
6					69.40
7	4.24 (703)	p2.225	20	44.500	60.32
8					62.99
9					65.63
10	5.55 (921)	2.474	21	51.954	62.05
11					64.53

The first three benchmarks; TCA-1, TCA-2, and TCA-3 have a pitch of 1.825 cm and 23 × 23 pin lattice. This pitch produces a water-to-fuel volume ratio of 2.42 cm and a H/Pu ratio of 402. To simplify the production of the lattice pin-power distribution and improve the statistics, the lattice advantage is taken of the lattice symmetry. Only 1/8th of the lattice needs to be modeled precisely to produce the pin-power distribution. The lattice is then filled from the 1/8th section by inserting additional pins in a mirror image. Figure 4.2 is a lattice map of the pin locations.

The same approach is used for the next three benchmarks: TCA-4, TCA-5, and TCA-6. These benchmarks have a pitch of 1.956 cm and 21 × 21 pin lattice. This pitch produces a water-to-fuel volume ratio of 2.98 cm and a H/Pu ratio of 494. The symmetry of the lattice is used in the same way it was used in the first three benchmarks. One-eighth of the lattice is filled, and the remaining lattice is filled assuming a mirror image. Figure 4.3 is a lattice map of the pin locations.

The next three benchmark problems**C**TCA-7, TCA-8, and TCA-9**C**again use the same approach. These benchmarks have a pitch of 2.225 cm and a 20 × 20 pin lattice. This pitch produces a water-to-fuel volume ratio of 4.24 cm and a H/Pu ratio of 703. Figure 4.4 is a lattice map of the pin locations.

The last benchmark problems**C**TCA-10 and TCA-11**C**have the same lattice arrangement as the second set of benchmarks (see Fig. 4.3). However, these benchmarks have of pitch of 2.474 cm which produces a water-to-fuel volume ratio of 5.55 cm and a H/Pu ratio of 921. The input files for each of the benchmark problems can be found in Appendix C.

4.2 ANALYSIS

All 11 computational benchmarks in this section were processed twice using SCALE 5.0. The set labeled NITAWL uses the NITAWL resonance processor to self-shield the resolved resonance region for all nuclides in the fuel and clad. An identical set, labeled CENTRM, replaces NITAWL with the CENTRM/PMC code sequence. The NITAWL and CENTRM results are then compared.

Table 4.4 contains the k_{eff} and Energy of the Average Lethargy Causing Fission (EALCF). The k_{eff} values for all the benchmark cases are very close to 1.0: the worst NITAWL benchmark is 0.26% high, and the worst CENTRM case is 0.37% low. There does appear to be a small negative bias between NITAWL and CENTRM, the CENTRM cases being about 0.2% lower on average than the NITAWL cases. The EALCF values listed are from the CENTRM cases. For all cases the difference between this value for CENTRM and NITAWL was less than 0.1%. Both CENTRM and NITAWL produce excellent results for the k_{eff} and fission energy for this set of problems.

Also, calculated for each problem is the: pin-power distributions; absorption, $\nu\Sigma_f$, and fission reaction rates and fluxes in the pin fuel, clad, and moderator; and four group cross sections and fluxes for a corner outside pin and the innermost pin. Each of these sets of data are calculated using both CENTRM and NITAWL. The data for each case are contained in Figs. 4.5a through 4.15b and Tables 4.5 through 4.114.

The pin-power distributions for this problem assumed 1/8th core symmetry with a surrounding reflector. The pin-power data consist of a value and a standard deviation for each pin. The values for the pin-powers are actually in units of fissions per cm^3-s-source particle $\times 10^{-5}$. The value in parentheses is the percent standard deviation of the pin-power value. In most cases, the CENTRM and NITAWL results for each benchmark case agree within 2 standard deviations. The pin-power distributions represent that portion of the pin covered by water. The value off to the side in the pin-power distributions represents all the fuel not covered by water. The peak-to-low power changed with respect to pitch. The peak-to-low-power ratio changed from a low of 2.7 for the smallest pitch to a high of 4.9 at the largest pitch.

The reaction rates, total fluxes, and flux ratios for the CENTRM and NITAWL cases of each benchmark case are also in good agreement, seldom varying by more than 1%. These values are included for a corner pin and the center pin for each case. The flux ratios over the fuel, clad, and moderator stay relatively constant for a given pitch. However, as the pitch increases the proportion of the total pin flux in the moderator increases.

Finally, four-group fluxes and cross sections were calculated for selected nuclides in the fuel region of the same corner and center pins. The macroscopic cross sections include the radiative capture, fission, and nu*fission cross sections for U-235, U-238, and Pu-239. The four groups are collapsed from the 238-group multigroup cross-section set using the flux profile calculated in KENO-V.a as follows: group 1 is from 20 Mev to 9.5 keV, group 2 is from 9.5 keV to 3.0 eV, Group 3 is from 3 eV to 0.4 eV, and group 4 is from 0.4 eV to 10^{-5} eV. The 0.4 eV was chosen as a boundary because it is the cadmium cutoff energy. Groups 2 and 3 contain the resolved resonance regions for most of the nuclides used in these cases. Most of the cross-section data for the CENTRM and NITAWL cases of a given benchmark case agree within 1%.

4.3 CONCLUSIONS

For this set of benchmark cases, using either NITAWL and CENTRM as the resonance region processor produces acceptable results of the k_{eff} values. All other values produced using CENTRM and NITAWL are also consistent with each. The k_{eff} values are slightly lower, ~0.2%, for all CENTRM cases. The pin-power distributions, fluxes, reaction rates, and macroscopic cross sections generally agree within approximately 1% between CENTRM and NITAWL. No significant differences were identified between the results produced by NITAWL and CENTRM for these benchmark cases.

Table 4.2. Benchmark atom densities

Material	Isotope	Atom density (atoms/barn-cm)	Material	Isotope	Atom density (atoms/barn-cm)
Fuel	U-234	7.1749×10^{-7}	Ordinary concrete	H	1.3742×10^{-2}
	U-235	9.3926×10^{-5}		O	4.5919×10^{-2}
	U-238	1.2951×10^{-2}		C	1.1532×10^{-4}
	Pu-238	2.0003×10^{-6}		Na	9.6395×10^{-4}
	Pu-239	2.7491×10^{-4}		Mg	1.2388×10^{-4}
	Pu-240	8.8417×10^{-5}		Al	1.7409×10^{-3}
	Pu-241	(See Table 3.3)		Si	1.6617×10^{-2}
	Pu-242	8.1234×10^{-6}		K	4.6052×10^{-4}
	Am-241	(See Table 3.3)		Ca	1.5025×10^{-3}
	O-16	2.7837×10^{-2}		Fe	3.4492×10^{-4}
	B-10	6.0418×10^{-8}			
	B-11	2.4319×10^{-7}			
Cladding + Air gap	Zr	3.7772×10^{-2}	Stainless steel (SS-304L)	C	1.1928×10^{-4}
	Sn	4.3737×10^{-4}		Si	1.7003×10^{-3}
	Fe	8.8570×10^{-5}		Mn	1.7385×10^{-3}
	Cr	6.6119×10^{-5}		P	6.9381×10^{-5}
	Ni	3.5864×10^{-5}		S	4.4673×10^{-5}
				Ni	8.9506×10^{-3}
				Cr	1.7450×10^{-2}
				Fe	5.7202×10^{-2}
Water (20^{o} C) 0.9982 g/cc	H	6.6735×10^{-2}	Aluminum	Al	6.0224×10^{-2}
	O	3.3368×10^{-2}			

Table 4.3. Pu-241 and Am-241 atom densities

Benchmark No.	Atom densities (atoms/barn-cm)	
	Pu-241	Am-241
1	2.7923×10^{-5}	1.3531×10^{-6}
2	2.6701×10^{-5}	2.5812×10^{-6}
3	2.5447×10^{-5}	3.8361×10^{-6}
4	2.8003×10^{-5}	1.2793×10^{-6}
5	2.6670×10^{-5}	2.6129×10^{-6}
6	2.4228×10^{-5}	5.0543×10^{-6}
7	2.8133×10^{-5}	1.1498×10^{-6}
8	2.6649×10^{-5}	2.6340×10^{-6}
9	2.5373×10^{-5}	3.9098×10^{-6}
10	2.8077×10^{-5}	1.2053×10^{-6}
11	2.6617×10^{-5}	2.6656×10^{-6}

Table 4.4. Comparison of k_{eff} and EALCF from CENTRM and NITAWL[a]

Benchmark identification	CENTRM k_{eff} (±F)	NITAWL k_{eff} (±F)	EALF (eV)	k_{eff} % DIFF
TCA-1	0.9963 (0.0005)	0.9993 (0.0004)	0.145	-0.3
TCA-2	0.9969 (0.0004)	1.0001 (0.0004)	0.144	-0.32
TCA-3	0.9985 (0.0005)	1.0002 (0.0004)	0.143	-0.17
TCA-4	0.9973 (0.0004)	0.9995 (0.0004)	0.119	-0.22
TCA-5	0.9982 (0.0004)	1.0008 (0.0004)	0.118	-0.26
TCA-6	0.9988 (0.0004)	1.0003 (0.0003)	0.117	-0.15
TCA-7	0.9994 (0.0004)	1.0016 (0.0004)	0.0927	-0.22
TCA-8	1.0002 (0.0004)	1.0017 (0.0003)	0.0923	-0.15
TCA-9	1.0009 (0.0004)	1.0024 (0.0004)	0.0916	-0.15
TCA-10	1.0003 (0.0003)	1.0020 (0.0004)	0.0797	-0.17
TCA-11	1.0010 (0.0004)	1.0026 (0.0004)	0.0792	-0.16

[a] Value in parentheses is percent standard deviation.

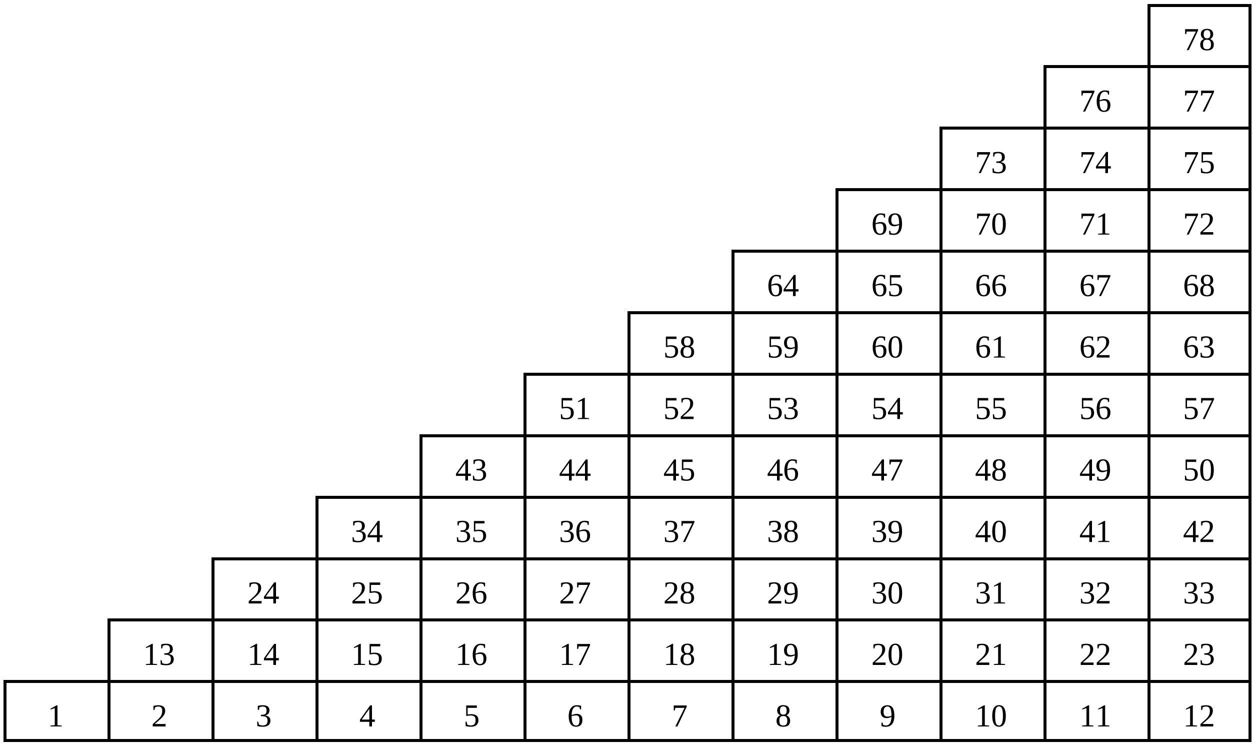

Fig. 4.2. Pin layout of benchmark cases TCA-1, TCA-2, and TCA-3.

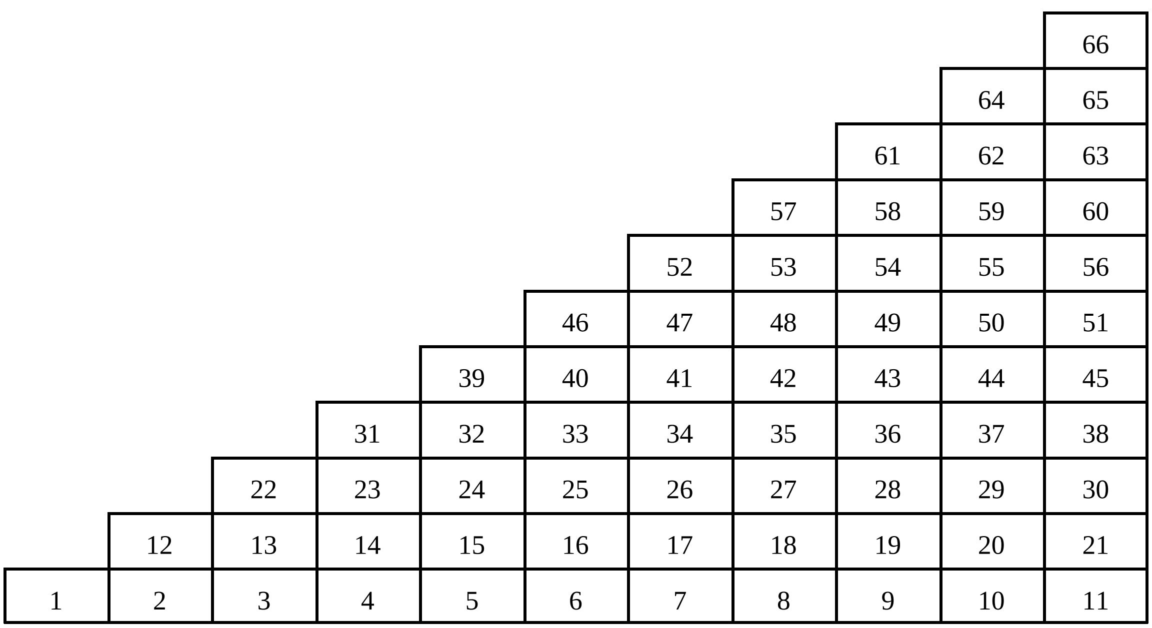

Fig. 4.3. Pin layout of benchmark cases TCA-4, TCA-5 ,TCA-6, TCA-10, and TCA-11.

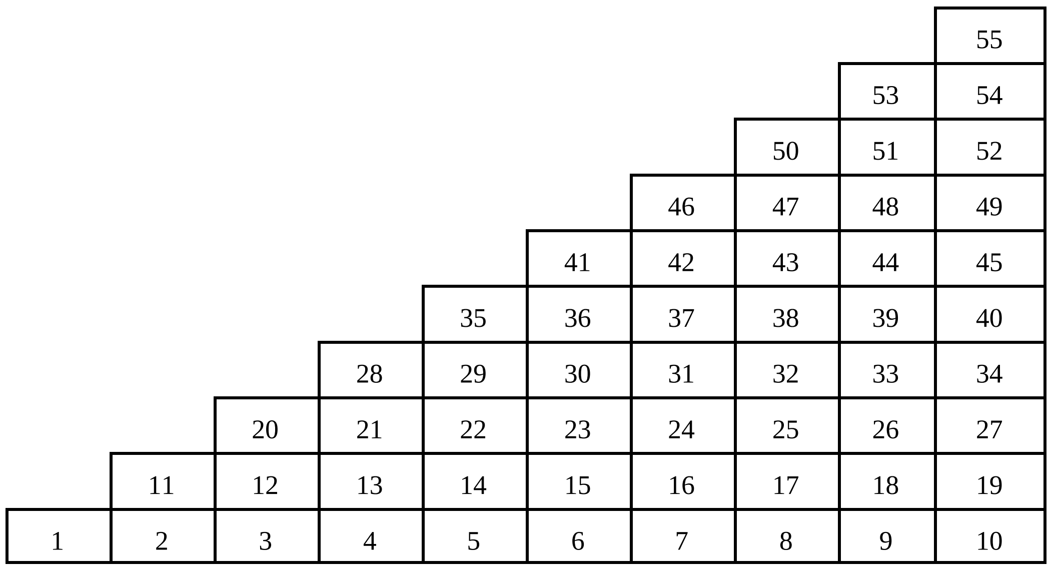

Fig. 4.4. Pin layout of benchmark cases TCA-7, TCA-8, and TCA-9.

											5.299 (0.91)
	0.131 (0.59)									5.191 (0.46)	5.175 (0.48)
									4.954 (0.48)	5104 (0.36)	5.242 (0.48)
								4.722 (0.51)	4.871 (0.33)	4.971 (0.34)	4.937 (0.48)
							4.426 (0.51)	4.601 (0.33)	4.697 (0.36)	4.759 (0.36)	4.815 (0.54)
						3.982 (0.50)	4.212 (0.39)	4.340 (0.37)	4.479 0.36)	4.554 (0.33)	4.551 (0.44)
					3.535 (0.54)	3.766 (0.44)	3.934 (0.40)	4.068 (0.40)	4.184 (0.38)	4.252 (0.38)	4.286 (0.53)
				3.058 (060)	3.295 (0.43)	3.456 (0.45)	3.650 (0.35)	3.781 (0.36)	3.895 (0.37)	3.942 (0.39)	3.989 (0.53)
			2.518 (0.75)	2.769 (0.48)	2.963 (0.45)	3.180 (0.44)	3.354 (0.46)	3.457 (0.41)	3.555 (0.38)	3.617 (0.40)	3.640 (0.56)
		2.104 (0.83)	2.321 (0.51)	2.533 (0.48)	2.736 (0.45)	2.893 (0.47)	3.058 (0.39)	3.159 (0.41)	3.257 (0.42)	3.271 (0.41)	3.331 (0.58)
	1.889 (0.78)	1.980 (0.57)	2.223 (0.55)	2.402 (0.51)	2.624 (0.50)	2.789 (0.41)	2.917 (0.41)	3.037 (0.47)	3.092 (0.45)	3.150 (0.42)	3.184 (0.65)
2.329 (0.66)	2.178 (0.54)	2.356 (0.50)	2.589 (0.47)	2.844 (0.47)	3.066 (0.41)	3.258 (0.42)	3.398 (0.43)	3.576 (0.39)	3.644 (0.44)	3.710 (0.40)	3.729 (0.57)

Fig. 4.5a. Pin-power distribution for CENTRM benchmark TCA-1. Value in parentheses is percent standard deviation.

											5.219 (0.86)
	0.131 (0.53)									5.153 (0.50)	5.235 (0.47)
									5.022 (0.49)	5.083 (0.36)	5.140 (0.46)
								4.775 (0.48)	4.893 (0.35)	4.968 (0.38)	5.010 (0.49)
							4.453 (0.54	4.607 (0.35)	4.712 (0.36)	4.779 (0.33)	4.840 (0.50)
						4.006 (0.55)	4.225 (0.41)	4.384 (0.36)	4.474 (0.36)	4.594 (0.35)	4.547 (0.53)
					3.541 (0.55)	3.807 (0.39)	3.978 (0.41)	4.086 (0.36)	4.200 (0.39)	4.270 (0.37)	4.341 (0.47)
				3.013 (0.60)	3.298 (0.40)	3.496 (0.39)	3.645 (0.42)	3.821 (0.38)	3.921 (0.43)	3.981 (0.37)	3.948 (0.55)
			2.552 (0.65)	2.767 (0.46)	2.999 (0.44)	3.200 (0.40)	3.362 (0.36)	3.471 (0.38)	3.581 (0.41)	3.631 (0.41)	3.624 (0.59)
		2.113 (0.73)	2.284 (0.48)	2.509 0.50)	2.749 (0.46)	2.906 (0.47)	3.036 (0.42)	3.153 (0.42)	3.238 (0.41)	3.276 (0.44)	3.329 (0.53)
	1.911 (0.77)	1.997 (0.47)	2.202 (0.57)	2.417 (0.51)	2.623 (0.44)	2.768 (0.46)	2.927 (0.46)	3.029 (0.40)	3.071 (0.44)	3.176 (0.41)	3.180 (0.65)
2.279 (0.69)	2.171 (0.53)	2.347 (0.50)	2.571 (0.48)	2.845 (0.43)	3.066 (0.47)	3.274 (0.39)	3.446 (0.41)	3.601 (0.38)	3.673 (0.38)	3.729 (0.41)	3.776 (0.55)

Fig. 4.5b. Pin-power distribution for NITAWL benchmark TCA-1. Value in parentheses is percent standard deviation.

Table 4.5. Selected reaction rates for CENTRM case TCA-1

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.400E-05	2.320E-05	8.219E-06	5.406E-03	0.271
1	Clad	2.686E-07	0.0	0.0	1.687E-03	0.085
	Mod.	7.396E-07	0.0	0.0	1.285E-02	0.644
	Fuel	3.547E-05	5.287E-05	1.869E-05	2.162E-02	0.270
78	Clad	7.404E-07	0.0	0.0	6.840E-03	0.085
	Mod.	1.542E-06	0.0	0.0	5.169E-02	0.645

Table 4.6. Selected reaction rates for NITAWL case TCA-1

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.386E-05	2.292E-05	8.121E-06	5.354E-03	0.271
1	Clad	2.641E-07	0.0	0.0	1.665E-03	0.084
	Mod.	7.348E-07	0.0	0.0	1.277E-02	0.645
	Fuel	3.457E-05	5.164E-05	1.827E-05	2.134E-02	0.268
78	Clad	7.151E-07	0.0	0.0	6.771E-03	0.085
	Mod.	1.529E-06	0.0	0.0	5.146E-02	0.647

Table 4.7. TCA-1, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	5.205E-05	5.150E-05
2	1.550E-05	1.533E-05
3	3.677E-06	3.705E-06
4	3.068E-05	3.040E-05

Table 4.8. TCA-1, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.43276E-04	3.25948E-04	1.25443E-04	1.43133E-04	3.25491E-04	1.25308E-04
2	3.47383E-03	5.32334E-03	2.18465E-03	3.41501E-03	5.21704E-03	2.14103E-03
3	5.07797E-03	1.03603E-02	4.25178E-03	5.13482E-03	1.05164E-02	4.31584E-03
4	4.86542E-02	1.01291E-01	4.15691E-02	4.83612E-02	1.00680E-01	4.13181E-02

Table 4.9. TCA-1, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.48868E-03	8.37908E-03	2.97182E-03	4.45235E-03	8.27583E-03	2.93388E-03
2	3.79279E-02	3.70803E-06	1.53622E-06	3.78200E-02	3.60508E-06	1.49357E-06
3	6.96274E-03	2.42790E-08	1.00592E-08	6.99725E-03	2.45979E-08	1.01914E-08
4	2.76422E-02	1.29929E-07	5.38321E-08	2.75005E-02	1.29251E-07	5.35513E-08

Table 4.10. TCA-1, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.12119E-04	1.49477E-03	4.80859E-04	5.11680E-04	1.49305E-03	4.80499E-04
2	1.13759E-02	1.87090E-02	6.49658E-03	1.06255E-02	1.76083E-02	6.11439E-03
3	3.27337E-02	6.44523E-02	2.23808E-02	3.35760E-02	6.60534E-02	2.29368E-02
4	2.66846E-01	5.40163E-01	1.86831E-01	2.66855E-01	5.39595E-01	1.86638E-01

Table 4.11. TCA-1, Pin-78 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.399E-04	2.360E-04
2	8.524E-05	8.507E-05
3	1.867E-05	1.851E-05
4	6.380E-05	6.276E-05

Table 4.12. TCA-1, Pin-78 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.48131E-04	3.30102E-04	1.27921E-04	1.47652E-04	3.28787E-04	1.27540E-04
2	3.33968E-03	5.12318E-03	2.10251E-03	3.40930E-03	5.23865E-03	2.14990E-03
3	5.10391E-03	1.04015E-02	4.26869E-03	5.13030E-03	1.04663E-02	4.29526E-03
4	4.54602E-02	9.45345E-02	3.87961E-02	4.53139E-02	9.42388E-02	3.86748E-02

Table 4.13. TCA-1, Pin-78 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.34327E-03	7.48462E-03	2.65627E-03	4.30530E-03	7.37008E-03	2.62250E-03
2	3.98175E-02	3.68536E-06	1.52683E-06	3.74190E-02	3.60909E-06	1.49523E-06
3	6.98275E-03	2.43235E-08	1.00777E-08	6.98957E-03	2.44139E-08	1.01151E-08
4	2.59889E-02	1.21997E-07	5.05458E-08	2.59301E-02	1.21719E-07	5.04304E-08

Table 4.14. TCA-1, Pin-78 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.14181E-04	1.47485E-03	4.77461E-04	5.13292E-04	1.47159E-03	4.76847E-04
2	1.06372E-02	1.75772E-02	6.10359E-03	1.08006E-02	1.79107E-02	6.21938E-03
3	3.42975E-02	6.73203E-02	2.33768E-02	3.44553E-02	6.76072E-02	2.34764E-02
4	2.85886E-01	5.65284E-01	1.95610E-01	2.82398E-01	5.59148E-01	1.93483E-01

											4.965 (0.99)
	0.139 (0.64)									4.937 (0.46)	4.994 (0.49)
									4.776 (0.50)	4.866 (0.34)	4.932 (0.47)
								4.569 (0.53)	4.688 (0.32)	4.750 (0.35)	4.781 (0.47)
							4.283 (0.57)	4.402 (0.38)	4.527 (0.36)	4.600 (0.35)	4.677 (0.48)
						3.846 (0.55)	4.048 (0.38)	4.205 (0.37)	4.302 (0.36)	4.359 (0.34)	4.376 (0.50)
					3.405 (0.57)	3.636 (0.43)	3.795 (0.37)	3.946 (0.36)	4.058 (0.34)	4.111 (0.39)	4.125 (0.49)
				2.910 (0.64)	3.171 (0.47)	3.388 (0.42)	3.532 (0.36)	3.649 (0.41)	3.739 (0.41)	3.822 (0.40)	3.849 (0.55)
			2.455 (0.64)	2.666 (0.48)	2.882 (0.43)	3.063 (0.42)	3.207 (0.41)	3.324 (0.42)	3.449 (0.41)	3.489 (0.42)	3.486 (0.55)
		2.021 (0.74)	2.222 (0.54)	2.433 0.46)	2.634 (0.46)	2.808 (0.47)	2.906 (0.42)	3.043 (0.45)	3.141 (0.44)	3.166 (0.45)	3.189 (0.61)
	1.841 (0.80)	1.935 (0.54)	2.120 (0.48)	2.324 (0.52)	2.503 (0.44)	2.645 (0.46)	2.825 (0.44)	2.902 (0.43)	2.982 (0.43)	3.040 (0.46)	3.036 (0.61)
2.226 (0.69)	2.099 (0.51)	2.276 (0.50)	2.506 (0.50)	2.739 (0.44)	2.952 (0.41)	3.138 (0.43)	3.341 (0.35)	3.425 (0.39)	3.533 (0.37)	3.606 (0.40)	3.590 (0.59)

Fig. 4.6a. Pin-power distribution for CENTRM benchmark TCA-2. Value in parentheses is percent standard deviation.

											5.023 (0.99)
	0.139 (0.63)									4.960 (0.46)	5.042 (0.47)
									4.835 (0.48)	4.922 (0.33)	4.929 (0.47)
								4.569 (0.52)	4.721 (0.32)	4.780 (0.36)	4.776 (0.48)
							4.250 (0.50)	4.420 (0.35)	4.521 (0.36)	4.608 (0.35)	4.612 (0.50)
						3.803 (0.58)	4.057 (0.34)	4.179 (0.39)	4.303 (0.35)	4.406 (0.35)	4.409 (0.51)
					3.430 (0.58)	3.641 (0.41)	3.836 (0.39)	3.972 (0.37)	4.049 (0.39)	4.121 (0.37)	4.127 (0.54)
				2.949 (0.66)	3.164 (0.42)	3.374 (0.41)	3.549 (0.43)	3.649 (0.40)	3.775 (0.38)	3.806 (0.42)	3.858 (0.53)
			2.447 (0.66)	2.659 (0.43)	2.876 (0.44)	3.101 (0.45)	3.229 (0.44)	3.359 (0.40)	3.459 (0.38)	3.487 (0.43)	3.504 (0.59)
		2.029 (0.71)	2.232 (0.51)	2.431 0.48)	2.644 (0.45)	2.793 (0.49)	2.940 (0.44)	3.042 (0.45)	3.132 (0.39)	3.194 (0.43)	3.205 (0.58)
	1.837 (0.75)	1.930 (0.56)	2.140 (0.51)	2.325 (0.53)	2.522 (0.47)	2.677 (0.44)	2.816 (0.44)	2.936 (0.40)	3.008 (0.44)	3.035 (0.40)	3.064 (0.61)
2.222 (0.68)	2.106 (0.51)	2.274 (0.52)	2.527 (0.47)	2.756 (0.43)	2.976 (0.41)	3.149 (0.44)	3.323 (0.39)	3.477 (0.38)	3.562 (0.38)	3.583 (0.41)	3.598 (0.59)

Fig. 4.6b. Pin-power distribution for NITAWL benchmark TCA-2. Value in parentheses is percent standard deviation.

Table 4.15. Selected reaction rates for CENTRM case TCA-2

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.356E-05	2.236E-05	7.923E-06	5.453E-03	0.270
1	Clad	2.613E-07	0.0	0.0	1.705E-03	0.085
	Mod.	7.206E-07	0.0	0.0	1.301E-02	0.645
	Fuel	3.394E-05	5.051E-05	1.786E-05	2.155E-02	0.269
78	Clad	7.023E-07	0.0	0.0	6.812E-03	0.085
	Mod.	1.495E-06	0.0	0.0	5.179E-02	0.646

Table 4.16. Selected reaction rates for NITAWL case TCA-2

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.356E-05	2.241E-05	7.942E-06	5.429E-03	0.271
1	Clad	2.591E-07	0.0	0.0	1.693E-03	0.084
	Mod.	7.211E-07	0.0	0.0	1.293E-02	0.645
	Fuel	3.354E-05	5.009E-05	1.771E-05	2.137E-02	0.268
78	Clad	6.772E-07	0.0	0.0	6.756E-03	0.084
	Mod.	1.478E-06	0.0	0.0	5.172E-02	0.648

Table 4.17. TCA-2, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	5.046E-05	5.017E-05
2	1.503E-05	1.485E-05
3	3.705E-06	3.620E-06
4	2.970E-05	2.981E-05

Table 4.18. TCA-2, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.43119E-04	3.25379E-04	1.25277E-04	1.42796E-04	3.25595E-04	1.25157E-04
2	3.53013E-03	5.42307E-03	2.22558E-03	3.53101E-03	5.37976E-03	2.20780E-03
3	5.06839E-03	1.03472E-02	4.24642E-03	5.21793E-03	1.06593E-02	4.37445E-03
4	4.85643E-02	1.01103E-01	4.14919E-02	4.86105E-02	1.01201E-01	4.15317E-02

Table 4.19. TCA-2, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.44405E-03	8.24665E-03	2.92378E-03	4.49711E-03	8.46895E-03	2.99705E-03
2	3.85408E-02	3.81629E-06	1.58108E-06	3.63117E-02	3.48554E-06	1.44405E-06
3	6.97263E-03	2.42518E-08	1.00480E-08	6.99494E-03	2.45706E-08	1.01801E-08
4	2.75966E-02	1.29711E-07	5.37418E-08	2.76225E-02	1.29835E-07	5.37930E-08

Table 4.20. TCA-2, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.11583E-04	1.49239E-03	4.80303E-04	5.11437E-04	1.49567E-03	4.80666E-04
2	1.10651E-02	1.80525E-02	6.26864E-03	1.07872E-02	1.76378E-02	6.12465E-03
3	3.33360E-02	6.55390E-02	2.27581E-02	3.37318E-02	6.63232E-02	2.30304E-02
4	2.67093E-01	5.40384E-01	1.86909E-01	2.66605E-01	5.39661E-01	1.86656E-01

Table 4.21. TCA-2, Pin-78 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.302E-04	2.272E-04
2	8.173E-05	8.176E-05
3	1.759E-05	1.791E-05
4	6.122E-05	6.071E-05

Table 4.22. TCA-2, Pin-78 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.47775E-04	3.29361E-04	1.27654E-04	1.47727E-04	3.29384E-04	1.27666E-04
2	3.40270E-03	5.23267E-03	2.14744E-03	3.44284E-03	5.28022E-03	2.16695E-03
3	5.19904E-03	1.06173E-02	4.35723E-03	5.12518E-03	1.04631E-02	4.29398E-03
4	4.56001E-02	9.48282E-02	3.89167E-02	4.54184E-02	9.44484E-02	3.87607E-02

Table 4.23. TCA-2, Pin-78 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.32970E-03	7.46321E-03	2.65044E-03	4.32945E-03	7.46893E-03	2.65359E-03
2	3.93173E-02	3.71651E-06	1.53973E-06	3.66084E-02	3.70903E-06	1.53663E-06
3	7.00819E-03	2.46566E-08	1.02156E-08	6.99481E-03	2.44808E-08	1.01429E-08
4	2.60606E-02	1.22341E-07	5.06882E-08	2.59687E-02	1.21901E-07	5.05058E-08

Table 4.24. TCA-2, Pin-78 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.13614E-04	1.47354E-03	4.77076E-04	5.13794E-04	1.47461E-03	4.77474E-04
2	1.10415E-02	1.82425E-02	6.33460E-03	1.06940E-02	1.76497E-02	6.12879E-03
3	3.48073E-02	6.83161E-02	2.37224E-02	3.39004E-02	6.66510E-02	2.31443E-02
4	2.84748E-01	5.63652E-01	1.95041E-01	2.85625E-01	5.64792E-01	1.95441E-01

											4.889 (1.00)
	0.143 (0.72)									4.823 (0.45)	4.841 (0.48)
									4.680 (0.49)	4.775 (0.35)	4.801 (0.51)
								4.418 (0.49)	4.556 (0.35)	4.662 (0.34)	4.671 (0.44)
							4.131 (0.53)	4.290 (0.37)	4.381 (0.40)	4.473 (0.37)	4.486 (0.50)
						3.736 (0.54)	3.929 (0.37)	4.067 (0.37)	4.181 (0.37)	4.232 (0.35)	4.253 (0.47)
					3.282 (0.51)	3.485 (0.38)	3.672 (0.38)	3.812 (0.35)	3.911 (0.36)	3.997 (0.36)	4.014 (0.57)
				2.803 (0.63)	3.040 (0.42)	3.236 (0.40)	3.429 (0.41)	3.556 (0.41)	3.634 (0.40)	3.682 (0.39)	3.716 (0.53)
			2.356 (0.60)	2.576 (0.50)	2.763 (0.42)	2.948 (0.40)	3.121 (0.39)	3.244 (0.43)	3.319 (0.40)	3.364 (0.43)	3.384 (0.59)
		1.962 (0.81)	2.133 (0.49)	2.338 0.47)	2.571 (0.43)	2.695 (0.42)	2.838 (0.44)	2.947 (0.47)	3.038 (0.46)	3.085 (0.43)	3.097 (0.55)
	1.782 (0.78)	1.874 (0.52)	2.046 (0.52)	2.263 (0.47)	2.423 (0.44)	2.573 (0.48)	2.708 (0.46)	2.819 (0.40)	2.891 (0.44)	2.907 (0.42)	2.936 (0.54)
2.156 (0.74)	2.021 (0.52)	2.204 (0.50)	2.429 (0.49)	2.663 (0.44)	2.876 (0.42)	3.083 (0.41)	3.215 (0.40)	3.338 (0.42)	3.414 (0.40)	3.474 (0.33)	3.480 (0.59)

Fig. 4.7a. Pin-power distribution for CENTRM benchmark TCA-3. Value in parentheses is percent standard deviation.

											4.857 (1.00)
	0.143 (0.73)									4.845 (0.46)	4.826 (0.50)
									4.692 (0.49)	4.713 (0.37)	4.814 (0.46)
								4.430 (0.53)	4.565 (0.34)	4.635 (0.34)	4.646 (0.48)
							4.145 (0.54)	4.284 (0.39)	4.400 (0.36)	4.464 (0.36)	4.512 (0.50)
						3.718 (0.51)	3.929 (0.35)	4.066 (0.38)	4.195 (0.37)	4.262 (0.33)	4.242 (0.50)
					3.318 (0.57)	3.525 (0.36)	3.701 (0.40)	3.836 (0.37)	3.934 (0.37)	3.997 (0.35)	4.006 (0.51)
				2.807 (0.61)	3.095 (0.41)	3.287 (0.39)	3.406 (0.41)	3.538 (0.40)	3.646 (0.36)	3.714 (0.36)	3.704 (0.49)
			2.365 (0.67)	2.589 (0.48)	2.799 (0.44)	2.975 (0.41)	3.132 (0.41)	3.230 (0.40)	3.314 (0.41)	3.391 (0.39)	3.396 (0.59)
		1.949 (0.76)	2.150 (0.51)	2.363 0.47)	2.541 (0.48)	2.706 (0.45)	2.838 (0.44)	2.977 (0.42)	3.035 (0.43)	3.082 (0.43)	3.092 (0.55)
	1.762 (0.77)	1.861 (0.58)	2.063 (0.49)	2.238 (0.53)	2.433 (0.47)	2.572 (0.46)	2.729 (0.48)	2.840 (0.40)	2.894 (0.44)	2.944 (0.42)	2.962 (0.59)
2.155 (0.76)	2.037 (0.53)	2.194 (0.47	2.420 (0.50)	2.654 (0.46)	2.866 (0.42)	3.058 (0.41)	3.225 (0.40)	3.315 (0.41)	3.430 (0.39)	3.480 (0.37)	3.483 (0.58)

Fig. 4.7b. Pin-power distribution for NITAWL benchmark TCA-3. Value in parentheses is percent standard deviation.

Table 4.25. Selected reaction rates for CENTRM case TCA-3

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.307E-05	2.156E-05	7.643E-06	5.476E-03	0.271
1	Clad	2.496E-07	0.0	0.0	1.701E-03	0.085
	Mod.	6.938E-07	0.0	0.0	1.300E-02	0.644
	Fuel	3.318E-05	4.938E-05	1.747E-05	2.182E-02	0.269
78	Clad	6.794E-07	0.0	0.0	6.875E-03	0.085
	Mod.	1.442E-06	0.0	0.0	5.233E-02	0.646

Table 4.26. Selected reaction rates for NITAWL case TCA-3

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.296E-05	2.142E-05	7.591E-06	5.418E-03	0.272
1	Clad	2.463E-07	0.0	0.0	1.676E-03	0.084
	Mod.	6.886E-07	0.0	0.0	1.285E-02	0.644
	Fuel	3.290E-05	4.896E-05	1.732E-05	2.172E-02	0.269
78	Clad	6.746E-07	0.0	0.0	6.861E-03	0.085
	Mod.	1.449E-06	0.0	0.0	5.222E-02	0.646

Table 4.27. TCA-3, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	4.915E-05	4.860E-05
2	1.453E-05	1.440E-05
3	3.519E-06	3.300E-06
4	2.876E-05	2.864E-05

Table 4.28. TCA-3, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.42818E-04	3.25054E-04	1.25124E-04	1.43107E-04	3.25739E-04	1.25325E-04
2	3.36929E-03	5.19745E-03	2.13299E-03	3.46178E-03	5.31513E-03	2.18128E-03
3	5.17928E-03	1.05930E-02	4.34726E-03	5.19818E-03	1.06224E-02	4.35933E-03
4	4.86050E-02	1.01190E-01	4.15275E-02	4.84951E-02	1.00958E-01	4.14323E-02

Table 4.29. TCA-3, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.44993E-03	8.27601E-03	2.93516E-03	4.47772E-03	8.36366E-03	2.96352E-03
2	3.65872E-02	3.54715E-06	1.46957E-06	3.65101E-02	3.54449E-06	1.46847E-06
3	7.01523E-03	2.46279E-08	1.02038E-08	7.00700E-03	2.46391E-08	1.02084E-08
4	2.76173E-02	1.29810E-07	5.37830E-08	2.75642E-02	1.29555E-07	5.36770E-08

Table 4.30. TCA-3, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.11491E-04	1.49361E-03	4.80637E-04	5.11798E-04	1.49459E-03	4.80689E-04
2	1.09264E-02	1.82048E-02	6.32153E-03	1.06379E-02	1.74194E-02	6.04882E-03
3	3.56962E-02	6.99270E-02	2.42818E-02	3.44527E-02	6.76673E-02	2.34972E-02
4	2.66921E-01	5.40191E-01	1.86841E-01	2.66795E-01	5.39735E-01	1.86684E-01

Table 4.31. TCA-3, Pin-78 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.243E-04	2.215E-04
2	8.038E-05	8.190E-05
3	1.810E-05	1.765E-05
4	5.962E-05	5.956E-05

Table 4.32. TCA-3, Pin-78 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.47728E-04	3.29228E-04	1.27610E-04	1.47738E-04	3.29429E-04	1.27667E-04
2	3.36825E-03	5.14716E-03	2.11235E-03	3.40828E-03	5.21512E-03	2.14023E-03
3	5.12983E-03	1.04660E-02	4.29517E-03	5.13172E-03	1.04717E-02	4.29747E-03
4	4.59777E-02	9.56112E-02	3.92380E-02	4.54550E-02	9.45238E-02	3.87918E-02

Table 4.33. TCA-3, Pin-78 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.31758E-03	7.42746E-03	2.63695E-03	4.34475E-03	7.50781E-03	2.66748E-03
2	3.69603E-02	3.91179E-06	1.62064E-06	3.60504E-02	3.75949E-06	1.55755E-06
3	6.98884E-03	2.44361E-08	1.01243E-08	6.98652E-03	2.44809E-08	1.01429E-08
4	2.62422E-02	1.23201E-07	5.10444E-08	2.59876E-02	1.21988E-07	5.05418E-08

Table 4.34. TCA-3, Pin-78 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.13304E-04	1.47258E-03	4.76835E-04	5.13774E-04	1.47465E-03	4.77404E-04
2	1.08802E-02	1.78741E-02	6.20669E-03	1.05497E-02	1.73471E-02	6.02371E-03
3	3.36764E-02	6.62210E-02	2.29950E-02	3.26723E-02	6.44142E-02	2.23675E-02
4	2.87561E-01	5.69182E-01	1.96949E-01	2.86127E-01	5.65714E-01	1.95759E-01

										6.107 (0.90)
	0.155 (0.61)								6.067 (0.43)	6.093 (0.43)
								5.865 (0.43)	5.933 (0.35)	5.977 (0.46)
							5.480 (0.46)	5.673 (0.35)	5.759 (0.31)	5.797 (0.43)
						4.989 (0.43)	5.244 (0.34)	5.447 (0.34)	5.513 (0.35)	5.571 (0.47)
					4.464 (0.56)	4.722 (0.35)	4.957 (0.33)	5.109 (0.36)	5.207 (0.35)	5.226 (0.47)
				3.839 (0.55)	4.125 (0.38)	4.412 (0.33)	4.611 (0.35)	4.762 (0.32)	4.805 (0.34)	4.824 (0.46)
			3.152 (0.60)	3.489 (0.40)	3.765 (0.38)	3.994 (0.35)	4.201 (0.34)	4.308 (0.38)	4.384 (0.35)	4.402 (0.52)
		2.601 (0.64)	2.827 (0.45)	3.120 (0.42)	3.374 (0.40)	3.577 (0.41)	3.735 (0.37)	3.861 (0.39)	3.933 (0.37)	3.954 (0.56)
	2.180 (0.76)	2.373 (0.47)	2.634 (0.45)	2.897 (0.44)	3.116 (0.42)	3.317 (0.44)	3.488 (0.39)	3.597 (0.37)	3.641 (0.41)	3.642 (0.57)
2.423 (0.70)	2.365 (0.50)	2.614 (0.49)	2.928 (0.42)	3.239 (0.43)	3.492 (0.39)	3.697 (0.36)	3.883 (0.36)	3.998 (0.39)	4.081 (0.36)	4.134 (0.53)

Fig. 4.8a. Pin-power distribution for CENTRM benchmark TCA-4. Value in parentheses is percent standard deviation.

										6.212 (0.86)
	1.54 (0.66)								6.114 (0.44)	6.159 (0.45)
								5.831 (0.44)	5.974 (0.31)	5.984 (0.46)
							5.529 (0.46)	5.708 (0.33)	5.770 (0.31)	5.819 (0.41)
						5.102 (0.47)	5.229 (0.35)	5.445 (0.32)	5.522 (0.33)	5.533 (0.42)
					4.470 (0.51)	4.777 (0.34)	4.968 (0.33)	5.140 (0.35)	5.202 (0.33)	5.243 (0.45)
				3.832 (0.54)	4.116 (0.40)	4.387 (0.37)	4.630 (0.35)	4.727 (0.32)	4.837 (0.33)	4.850 (0.46)
			3.129 (0.62)	3.495 (0.38)	3.735 (0.41)	4.030 (0.39)	4.197 (0.38)	4.309 (0.34)	4.374 (0.35)	4.458 (0.50)
		2.582 (0.69)	2.840 (0.45)	3.132 (0.46)	3.388 (0.42)	3.581 (0.39)	3.754 (0.40)	3.870 (0.38)	3.961 (0.38)	3.971 (0.51)
	2.185 (0.71)	2.350 (0.49)	2.643 (0.44)	2.904 (0.44)	3.128 (0.43)	3.330 (0.42)	3.500 (0.40)	3.601 (0.40)	3.672 (0.39)	3.710 (0.48)
2.436 (0.71)	2.386 (0.49)	2.626 (0.48)	2.916 (0.44)	3.228 (0.44)	3.505 (0.41)	3.706 (0.43)	3.883 (0.39)	3.981 (0.41)	4.062 (0.38)	4.100 (0.55)

Fig. 4.8b. Pin-power distribution for NITAWL benchmark TCA-4. Value in parentheses is percent standard deviation.

Table 4.35. Selected reaction rates for CENTRM case TCA-4

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$<G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	1.440E-05	2.393E-05	8.480E-06	5.581E-03	0.235
1	Clad	2.746E-07	0.0	0.0	1.739E-03	0.073
	Mod.	7.889E-07	0.0	0.0	1.642E-02	0.692
	Fuel	4.055E-05	6.181E-05	2.186E-05	2.281E-02	0.235
66	Clad	8.066E-07	0.0	0.0	7.166E-03	0.074
	Mod.	1.867E-06	0.0	0.0	6.712E-02	0.691

Table 4.36. Selected reaction rates for NITAWL case TCA-4

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$<G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	1.464E-05	2.446E-05	8.665E-06	5.642E-03	0.236
1	Clad	2.772E-07	0.0	0.0	1.754E-03	0.073
	Mod.	7.942E-07	0.0	0.0	1.652E-02	0.691
	Fuel	4.061E-05	6.263E-05	2.216E-05	2.295E-02	0.234
66	Clad	8.106E-07	0.0	0.0	7.227E-03	0.074
	Mod.	1.885E-06	0.0	0.0	6.790E-02	0.692

Table 4.37. TCA-4, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	5.137E-05	5.198E-05
2	1.508E-05	1.488E-05
3	3.637E-06	3.684E-06
4	3.178E-05	3.244E-05

Table 4.38. TCA-4, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.42972E-04	3.25729E-04	1.25284E-04	1.42717E-04	3.25108E-04	1.25072E-04
2	3.54777E-03	5.40060E-03	2.21636E-03	3.49262E-03	5.32638E-03	2.18590E-03
3	5.19612E-03	1.06384E-02	4.36591E-03	5.19563E-03	1.06220E-02	4.35917E-03
4	4.87823E-02	1.01563E-01	4.16806E-02	4.89171E-02	1.01845E-01	4.17962E-02

Table 4.39. TCA-4, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.51308E-03	8.46385E-03	3.00241E-03	4.47482E-03	8.38222E-03	2.97205E-03
2	3.86113E-02	3.72395E-06	1.54282E-06	3.54513E-02	3.52350E-06	1.45977E-06
3	7.00737E-03	2.46436E-08	1.02103E-08	7.01355E-03	2.47048E-08	1.02357E-08
4	2.77151E-02	1.30278E-07	5.39767E-08	2.77735E-02	1.30557E-07	5.40922E-08

Table 4.40. TCA-4, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.12178E-04	1.49692E-03	4.81232E-04	5.11274E-04	1.49406E-03	4.80446E-04
2	1.11540E-02	1.83841E-02	6.38377E-03	1.08239E-02	1.78689E-02	6.20489E-03
3	3.46250E-02	6.79736E-02	2.36035E-02	3.48586E-02	6.84167E-02	2.37574E-02
4	2.65578E-01	5.38310E-01	1.86183E-01	2.66229E-01	5.39667E-01	1.86654E-01

Table 4.41. TCA-4, Pin-66 four-group fluxes

Group	CENTRM M (cm^{-2} - s^{-1})	NITAWL M (cm^{-2} - s^{-1})
1	2.378E-04	2.383E-04
2	8.358E-05	8.422E-05
3	1.882E-05	1.898E-05
4	7.623E-05	7.746E-05

Table 4.42. TCA-4, Pin-66 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	G_a	$<G_f$	G_f	G_a	$<G_f$	G_f
1	1.47181E-04	3.29323E-04	1.27404E-04	1.47030E-04	3.28757E-04	1.27281E-04
2	3.46397E-03	5.28525E-03	2.16902E-03	3.45056E-03	5.27803E-03	2.16605E-03
3	5.05350E-03	1.03193E-02	4.23494E-03	5.07799E-03	1.03695E-02	4.25556E-03
4	4.64067E-02	9.65304E-02	3.96152E-02	4.62458E-02	9.61957E-02	3.94779E-02

Table 4.43. TCA-4, Pin-66 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	G_a	$<G_f$	G_f	G_a	$<G_f$	G_f
1	4.36716E-03	7.64672E-03	2.70927E-03	4.35812E-03	7.61288E-03	2.70342E-03
2	4.02182E-02	3.82265E-06	1.58372E-06	3.67393E-02	3.69650E-06	1.53144E-06
3	6.96068E-03	2.41878E-08	1.00214E-08	6.97476E-03	2.43271E-08	1.00792E-08
4	2.64749E-02	1.24324E-07	5.15096E-08	2.63939E-02	1.23940E-07	5.13506E-08

Table 4.44. TCA-4, Pin-66 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	G_a	$<G_f$	G_f	G_a	$<G_f$	G_f
1	5.13616E-04	1.47840E-03	4.77839E-04	5.13256E-04	1.47677E-03	4.77633E-04
2	1.11268E-02	1.82952E-02	6.35292E-03	1.07160E-02	1.75431E-02	6.09175E-03
3	3.23976E-02	6.38268E-02	2.21636E-02	3.30910E-02	6.51217E-02	2.26133E-02
4	2.81830E-01	5.60508E-01	1.93933E-01	2.81951E-01	5.60363E-01	1.93887E-01

										5.973 (0.85)
	0.164 (0.72)								5.841 (0.44)	5.875 (0.49)
								5.617 (0.45)	5.723 (0.34)	5.821 (0.42)
							5.245 (0.44)	5.464 (0.33)	5.537 (0.33)	5.623 (0.44)
						4.824 (0.47)	5.071 (0.31)	5.205 (0.30)	5.288 (0.29)	5.352 (0.47)
					4.271 (0.53)	4.523 (0.33)	4.753 (0.30)	4.916 (0.31)	4.981 (0.34)	5.050 (0.44)
				3.643 (0.55)	3.966 (0.37)	4.187 (0.38)	4.389 (0.35)	4.507 (0.34)	4.630 (0.34)	4.648 (0.50)
			3.029 (0.59)	3.330 (0.42)	3.604 (0.41)	3.798 (0.40)	3.987 (0.38)	4.110 (0.36)	4.165 (0.36)	4.228 (0.48)
		2.450 (0.65)	2.713 (0.44)	2.973 (0.41)	3.230 (0.39)	3.385 (0.41)	3.574 (0.39)	3.709 (0.42)	3.777 (0.37)	3.781 (0.56)
	2.050 (0.75)	2.254 (0.48)	2.522 (0.47)	2.750 (0.45)	2.981 (0.46)	3.176 (0.38)	3.331 (0.38)	3.429 (0.35)	3.508 (0.41)	3.534 (0.55)
2.283 (0.66)	2.260 (0.50)	2.500 (0.47)	2.828 (0.43)	3.060 (0.41)	3.331 (0.40)	3.528 (0.37)	3.725 (0.37)	3.815 (0.39)	3.867 (0.37)	3.921 (0.50)

Fig. 4.9a. Pin-power distribution for CENTRM benchmark TCA-5. Value in parentheses is percent standard deviation.

										5.872 (0.90)
	0.161 (0.77)								5.824 (0.44)	5.930 (0.43)
								5.663 (0.47)	5.775 (0.33)	5.815 (0.46)
							5.278 (0.44)	5.523 (0.31)	5.575 (0.32)	5.572 (0.46)
						4.844 (0.50)	5.069 (0.31)	5.219 (0.32)	5.311 (0.31)	5.323 (0.47)
					4.326 (0.49)	4.538 (0.35)	4.742 (0.33)	4.945 (0.33)	5.011 (0.32)	5.054 (0.46)
				3.679 (0.54)	3.942 (0.34)	4.189 (0.36)	4.400 (0.36)	4.534 (0.35)	4.638 (0.33)	4.691 (0.53)
			3.002 (0.59)	3.342 (0.40)	3.606 (0.38)	3.840 (0.35)	4.021 (0.35)	4.138 (0.38)	4.209 (0.38)	4.213 (0.54)
		2.468 (0.64)	2.720 (0.49)	2.999 (0.42)	3.225 (0.45)	3.440 (0.39)	3.582 (0.41)	3.702 (0.40)	3.771 (0.38)	3.783 (0.53)
	2.075 (0.66)	2.259 (0.54)	2.518 (0.45)	2.768 (0.45)	3.015 (0.41)	3.168 (0.43)	3.345 (0.39)	3.455 (0.40)	3.474 (0.39)	3.504 (0.54)
2.297 (0.69)	2.263 (0.45)	2.480 (0.49)	2.792 (0.42)	3.046 (0.38)	3.316 (0.41)	3.535 (0.39)	3.708 (0.38)	3.801 (0.38)	3.876 (0.36)	3.904 (0.55)

Fig. 4.9b. Pin-power distribution for NITAWL benchmark TCA-5. Value in parentheses is percent standard deviation.

Table 4.45. Selected reaction rates for CENTRM case TCA-5

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.374E-05	2.280E-05	8.078E-06	5.603E-03	0.235
1	Clad	2.618E-07	0.0	0.0	1.747E-03	0.074
	Mod.	7.503E-07	0.0	0.0	1.646E-02	0.691
	Fuel	3.907E-05	5.970E-05	2.112E-05	2.311E-02	0.235
66	Clad	7.783E-07	0.0	0.0	7.263E-03	0.074
	Mod.	1.793E-06	0.0	0.0	6.806E-02	0.691

Table 4.46. Selected reaction rates for NITAWL case TCA-5

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.378E-05	2.293E-05	8.127E-06	5.603E-03	0.235
1	Clad	2.619E-07	0.0	0.0	1.745E-03	0.074
	Mod.	7.543E-07	0.0	0.0	1.646E-02	0.691
	Fuel	3.868E-05	5.889E-05	2.084E-05	2.304E-02	0.234
66	Clad	7.727E-07	0.0	0.0	7.281E-03	0.074
	Mod.	1.803E-06	0.0	0.0	6.824E-02	0.692

Table 4.47. TCA-5, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	4.939E-05	4.938E-05
2	1.446E-05	1.412E-05
3	3.466E-06	3.579E-06
4	3.035E-05	3.059E-05

Table 4.48. TCA-5, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.42994E-04	3.26070E-04	1.25328E-04	1.43122E-04	3.25555E-04	1.25325E-04
2	3.42309E-03	5.26214E-03	2.15954E-03	3.47849E-03	5.29943E-03	2.17484E-03
3	5.14146E-03	1.04884E-02	4.30436E-03	5.22434E-03	1.06706E-02	4.37913E-03
4	4.87407E-02	1.01475E-01	4.16445E-02	4.86829E-02	1.01355E-01	4.15953E-02

Table 4.49. TCA-5, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.50583E-03	8.47688E-03	2.99982E-03	4.48281E-03	8.35527E-03	2.96632E-03
2	3.83667E-02	3.84273E-06	1.59203E-06	3.62671E-02	3.53982E-06	1.46653E-06
3	7.00150E-03	2.45134E-08	1.01563E-08	7.02110E-03	2.47448E-08	1.02522E-08
4	2.76871E-02	1.30144E-07	5.39213E-08	2.76564E-02	1.30000E-07	5.38614E-08

Table 4.50. TCA-5, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.12069E-04	1.49754E-03	4.81215E-04	5.11841E-04	1.49393E-03	4.80664E-04
2	1.09615E-02	1.82420E-02	6.33444E-03	1.10261E-02	1.81861E-02	6.31503E-03
3	3.50990E-02	6.88148E-02	2.38956E-02	3.48620E-02	6.84733E-02	2.37771E-02
4	2.66585E-01	5.39901E-01	1.86737E-01	2.66263E-01	5.39232E-01	1.86508E-01

Table 4.51. TCA-5, Pin-66 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.303E-04	2.296E-04
2	8.041E-05	8.059E-05
3	1.804E-05	1.799E-05
4	7.411E-05	7.336E-05

Table 4.52. TCA-5, Pin-66 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.47516E-04	3.29683E-04	1.27617E-04	1.46906E-04	3.28595E-04	1.27226E-04
2	3.45804E-03	5.28540E-03	2.16908E-03	3.42799E-03	5.19278E-03	2.13107E-03
3	5.21778E-03	1.06625E-02	4.37578E-03	5.17950E-03	1.05856E-02	4.34425E-03
4	4.63091E-02	9.63284E-02	3.95323E-02	4.61333E-02	9.59635E-02	3.93825E-02

Table 4.53. TCA-5, Pin-66 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.38259E-03	7.65041E-03	2.71517E-03	4.35318E-03	7.60571E-03	2.70175E-03
2	3.76966E-02	3.76282E-06	1.55892E-06	3.76657E-02	3.47384E-06	1.43920E-06
3	7.01397E-03	2.46319E-08	1.02054E-08	6.99839E-03	2.45177E-08	1.01581E-08
4	2.64310E-02	1.24116E-07	5.14236E-08	2.63412E-02	1.23688E-07	5.12462E-08

Table 4.54. TCA-5, Pin-66 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.14155E-04	1.47850E-03	4.78094E-04	5.13349E-04	1.47737E-03	4.77888E-04
2	1.09920E-02	1.80785E-02	6.27768E-03	1.06624E-02	1.75079E-02	6.07953E-03
3	3.48251E-02	6.83614E-02	2.37382E-02	3.45711E-02	6.78516E-02	2.35613E-02
4	2.81194E-01	5.59228E-01	1.93491E-01	2.80259E-01	5.57291E-01	1.92823E-01

										5.446 (0.87)
	0.191 (1.58)								5.462 (0.45)	5.433 (0.42)
								5.225 (0.40)	5.327 (0.30)	5.357 (0.42)
							4.915 (0.44)	5.049 (0.30)	5.160 (0.34)	5.185 (0.43)
						4.477 (0.48)	4.691 (0.37)	4.860 (0.33)	4.954 (0.36)	4.957 (0.47)
					3.976 (0.52)	4.231 (0.37)	4.430 (0.37)	4.569 (0.33)	4.651 (0.31)	4.688 (0.46)
				3.440 (0.56)	3.685 (0.42)	3.916 (0.36)	4.084 (0.36)	4.239 (0.34)	4.317 (0.35)	4.338 (0.50)
			2.811 (0.62)	3.097 (0.39)	3.347 (0.37)	3.552 (0.34)	3.704 (0.36)	3.855 (0.39)	3.900 (0.33)	3.925 (0.48)
		2.272 (0.65)	2.533 (0.42)	2797 (0.37)	3.010 (0.43)	3.216 (0.43)	3.339 (0.40)	3.445 (0.33)	3.528 (0.38)	3.528 (0.59)
	1.928 (0.76)	2.090 (0.51)	2.327 (0.47)	2.570 (0.45)	2.789 (0.40)	2.962 (0.40)	3.081 (0.42)	3.182 (0.38)	3.274 (0.42)	3.260 (0.56)
2.123 (0.72)	2.094 (0.47)	2.324 (0.47)	2.602 (0.41)	2.847 (0.39)	3.072 (0.40)	3.294 (0.40)	3.461 (0.41)	3.543 (0.36)	3.638 (0.36)	3.680 (0.54)

Fig. 4.10a. Pin-power distribution for CENTRM benchmark TCA-6. Value in parentheses is percent standard deviation.

										5.535 (0.82)
	0.192 (1.50)								5.433 (0.45)	5.485 (0.41)
								5.208 (0.43)	5.336 (0.30)	5.380 (0.44)
							4.903 (0.45)	5.056 (0.32)	5.155 (0.31)	5.224 (0.42)
						4.478 (0.50)	4.745 (0.32)	4.840 (0.32)	4.949 (0.31)	5.009 (0.47)
					3.945 (0.51)	4.219 (0.35)	4.437 (0.34)	4.592 (0.34)	4.656 (0.35)	4.662 (0.46)
				3.402 (0.55)	3.677 (0.37)	3.935 (0.36)	4.103 (0.36)	4.259 (0.35)	4.279 (0.33)	4.347 (0.51)
			2.808 (0.56)	3.096 (0.43)	3.349 (0.38)	3.556 (0.37)	3.711 (0.36)	3.858 (0.35)	3.908 (0.35)	3.932 (0.47)
		2.286 (0.62)	2.545 (0.44)	2795 (0.38)	3.014 (0.42)	3.211 (0.41)	3.340 (0.38)	3.434 (0.35)	3.501 (0.39)	3.547 (0.56)
	1.930 (0.79)	2.114 (0.47)	2.328 (0.48)	2.571 (0.47)	2.784 (0.43)	2.977 (0.38)	3.106 (0.36)	3.198 (0.41)	3.269 (0.38)	3.308 (0.52)
2.129 (0.65)	2.105 (0.45)	2.328 (0.49)	2.622 (0.41)	2.861 (0.43)	3.096 (0.38)	3.292 (0.40)	3.450 (0.38)	3.563 (0.40)	3.618 (0.35)	3.656 (0.57)

Fig. 4.10b. Pin-power distribution for NITAWL benchmark TCA-6. Value in parentheses is percent standard deviation.

Table 4.55. Selected reaction rates for CENTRM case TCA-6

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$<G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	1.298E-05	2.136E-05	7.574E-06	5.637E-03	0.235
1	Clad	2.474E-07	0.0	0.0	1.759E-03	0.073
	Mod.	7.049E-07	0.0	0.0	1.659E-02	0.692
	Fuel	3.599E-05	5.470E-05	1.936E-05	2.295E-02	0.234
66	Clad	7.226E-07	0.0	0.0	7.268E-03	0.074
	Mod.	1.669E-06	0.0	0.0	6.776E-02	0.692

Table 4.56. Selected reaction rates for NITAWL case TCA-6

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$<G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	1.301E-05	2.152E-05	7.630E-06	5.677E-03	0.236
1	Clad	2.482E-07	0.0	0.0	1.771E-03	0.073
	Mod.	7.104E-07	0.0	0.0	1.663E-02	0.691
	Fuel	3.641E-05	5.549E-05	1.964E-05	2.328E-02	0.235
66	Clad	7.250E-07	0.0	0.0	7.322E-03	0.074
	Mod.	1.692E-06	0.0	0.0	6.857E-02	0.691

Table 4.57. TCA-6, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	4.562E-05	4.614E-05
2	1.353E-05	1.361E-05
3	3.260E-06	3.167E-06
4	2.877E-05	2.891E-05

Table 4.58. TCA-6, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.43180E-04	3.25454E-04	1.25334E-04	1.42890E-04	3.25301E-04	1.25170E-04
2	3.45574E-03	5.26068E-03	2.15894E-03	3.46874E-03	5.30446E-03	2.17691E-03
3	5.12187E-03	1.04432E-02	4.28580E-03	5.18636E-03	1.05942E-02	4.34774E-03
4	4.87091E-02	1.01408E-01	4.16173E-02	4.87392E-02	1.01468E-01	4.16413E-02

Table 4.59. TCA-6, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.44759E-03	8.24022E-03	2.92337E-03	4.46693E-03	8.35598E-03	2.96179E-03
2	3.90256E-02	3.50820E-06	1.45343E-06	3.57765E-02	3.56985E-06	1.47897E-06
3	6.98181E-03	2.44734E-08	1.01398E-08	7.00395E-03	2.46168E-08	1.01992E-08
4	2.76742E-02	1.30082E-07	5.38954E-08	2.76818E-02	1.30118E-07	5.39104E-08

Table 4.60. TCA-6, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.11662E-04	1.49257E-03	4.80489E-04	5.11324E-04	1.49329E-03	4.80338E-04
2	1.13135E-02	1.86601E-02	6.47963E-03	1.07085E-02	1.75213E-02	6.08419E-03
3	3.39736E-02	6.67666E-02	2.31844E-02	3.36473E-02	6.62052E-02	2.29895E-02
4	2.66162E-01	5.39117E-01	1.86465E-01	2.67553E-01	5.41501E-01	1.87294E-01

Table 4.61. TCA-6, Pin-66 four-group fluxes

Group	CENTRM Φ (cm^{-2} - s^{-1})	NITAWL Φ (cm^{-2} - s^{-1})
1	2.129E-04	2.141E-04
2	7.322E-05	7.593E-05
3	1.668E-05	1.698E-05
4	6.844E-05	6.955E-05

Table 4.62. TCA-6, Pin-66 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.46734E-04	3.28401E-04	1.27150E-04	1.47522E-04	3.29450E-04	1.27598E-04
2	3.38204E-03	5.17330E-03	2.12307E-03	3.41355E-03	5.23610E-03	2.14885E-03
3	5.13990E-03	1.04899E-02	4.30497E-03	5.04984E-03	1.02714E-02	4.21529E-03
4	4.64337E-02	9.65915E-02	3.96403E-02	4.61970E-02	9.60939E-02	3.94361E-02

Table 4.63. TCA-6, Pin-66 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.34898E-03	7.60907E-03	2.70457E-03	4.36295E-03	7.58351E-03	2.69381E-03
2	3.85262E-02	3.68752E-06	1.52772E-06	3.74174E-02	3.59244E-06	1.48833E-06
3	6.99508E-03	2.44889E-08	1.01462E-08	6.96908E-03	2.42193E-08	1.00345E-08
4	2.64864E-02	1.24380E-07	5.15332E-08	2.63675E-02	1.23812E-07	5.12979E-08

Table 4.64. TCA-6, Pin-66 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.13250E-04	1.47784E-03	4.78051E-04	5.13989E-04	1.47716E-03	4.77940E-04
2	1.13093E-02	1.84779E-02	6.41636E-03	1.07147E-02	1.76559E-02	6.13092E-03
3	3.39521E-02	6.67206E-02	2.31683E-02	3.32187E-02	6.53557E-02	2.26946E-02
4	2.81522E-01	5.60045E-01	1.93774E-01	2.81843E-01	5.60105E-01	1.93799E-01

									7.308 (0.44)
	0.155 (0.61)							7.112 (0.39)	7.241 (0.35)
							6.694 (0.43)	6.907 (0.26)	7.038 (0.31)
						6.068 (0.46)	6.408 (0.30)	6.595 (0.30)	6.694 (0.30)
					5.368 (0.55)	5.743 (0.35)	6.028 (0.33)	6.153 (0.34)	6.308 (0.29)
				4.563 (0.47)	4.998 (0.34)	5.297 (0.35)	5.515 (0.33)	5.710 (0.30)	5.792 (0.32)
			3.708 (0.54)	4.107 (0.38)	4.467 (0.38)	4.726 (0.34)	4.996 (0.34)	5.135 (0.34)	5.182 (0.36)
		2.884 (0.72)	3.250 (0.41)	3.615 (0.38)	3.950 (0.39)	4.203 (0.34)	4.373 (0.37)	4.511 (0.36)	4.579 (0.39)
	2.218 (0.76)	2.524 (0.48)	2.866 (0.44)	3.179 (0.45)	3.463 (0.41)	3.694 (0.41)	3.852 (0.37)	3.966 (0.40)	4.027 (0.40)
2.112 (0.73)	2.218 (0.54)	2.550 (0.48)	2.879 (0.44)	3.211 (0.40)	3.481 (0.45)	3.706 (0.38)	3.893 (0.38)	4.026 (0.39)	4.085 (0.37)

Fig. 4.11a. Pin-power distribution for CENTRM benchmark TCA-7. Value in parentheses is percent standard deviation.

									7.408 (0.42)
	0.157 (0.64)							7.147 (0.41)	7.221 (0.26)
							6.690 (0.44)	6.948 (0.30)	7.021 (0.30)
						6.147 (0.44)	6.439 (0.33)	6.607 (0.32)	6.750 (0.30)
					5.413 (0.49)	5.784 (0.37)	6.036 (0.33)	6.174 (0.32)	6.317 (0.30)
				4.575 (0.52)	5.009 (0.37)	5.294 (0.35)	5.496 (0.34)	5.716 (0.32)	5.817 (0.31)
			3.668 (0.55)	4.106 (0.38)	4.503 (0.34)	4.750 (0.37)	4.980 (0.35)	5.1116 (0.36)	5.231 (0.33)
		2.847 (0.66)	3.251 (0.41)	3.587 (0.40)	3.919 (0.38)	4.192 (0.41)	4.381 (0.40)	4.515 (0.36)	4.586 (0.37)
	2.218 (0.66)	2.533 (0.50)	2.857 (0.45)	3.206 (0.44)	3.499 (0.42)	3.700 (0.35)	3.863 (0.35)	3.987 (0.43)	4.057 (0.39)
2.101 (0.67)	2.211 (0.53)	2.557 (0.45)	2.878 (0.46)	3.214 (0.43)	3.494 (0.40)	3.723 (0.40)	3.929 (0.39)	4.019 (0.36)	4.082 (0.39)

Fig. 4.11b. Pin-power distribution for NITAWL benchmark TCA-7. Value in parentheses is percent standard deviation.

Table 4.65. Selected reaction rates for CENTRM case TCA-7

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$\lhd G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	1.250E-05	2.098E-05	7.436E-06	4.475E-03	0.181
1	Clad	2.338E-07	0.0	0.0	1.390E-03	0.056
	Mod.	7.159E-07	0.0	0.0	1.884E-02	0.763
	Fuel	4.638E-05	7.357E-05	2.604E-05	2.167E-02	0.182
55	Clad	8.926E-07	0.0	0.0	6.796E-03	0.057
	Mod.	2.331E-06	0.0	0.0	9.081E-02	0.761

Table 4.66. Selected reaction rates for NITAWL case TCA-7

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$\lhd G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	1.239E-05	2.081E-05	7.375E-06	4.405E-03	0.181
1	Clad	2.328E-07	0.0	0.0	1.370E-03	0.056
	Mod.	7.088E-07	0.0	0.0	1.861E-02	0.763
	Fuel	4.646E-05	7.384E-05	2.619E-05	2.180E-02	0.182
55	Clad	8.849E-07	0.0	0.0	6.807E-03	0.057
	Mod.	2.324E-06	0.0	0.0	9.112E-02	0.761

Table 4.67. TCA-7, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	4.076E-05	4.002E-05
2	1.156E-05	1.122E-05
3	2.916E-06	2.849E-06
4	2.805E-05	2.789E-05

Table 4.68. TCA-7, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.42491E-04	3.25106E-04	1.25005E-04	1.41299E-04	3.24300E-04	1.24414E-04
2	3.44975E-03	5.22773E-03	2.14542E-03	3.47152E-03	5.26026E-03	2.15876E-03
3	5.21159E-03	1.06607E-02	4.37503E-03	5.27529E-03	1.08126E-02	4.43738E-03
4	4.89248E-02	1.01867E-01	4.18053E-02	4.88655E-02	1.01743E-01	4.17544E-02

Table 4.69. TCA-7, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.51148E-03	8.48982E-03	3.01170E-03	4.53551E-03	8.70929E-03	3.08361E-03
2	3.80608E-02	3.86401E-06	1.60085E-06	3.81145E-02	3.57483E-06	1.48104E-06
3	7.01523E-03	2.46902E-08	1.02296E-08	7.02506E-03	2.48652E-08	1.03021E-08
4	2.77876E-02	1.30626E-07	5.41212E-08	2.77567E-02	1.30480E-07	5.40602E-08

Table 4.70. TCA-7, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.11889E-04	1.49757E-03	4.81327E-04	5.11022E-04	1.50238E-03	4.81994E-04
2	1.09768E-02	1.79177E-02	6.22185E-03	1.09889E-02	1.81187E-02	6.29163E-03
3	3.46245E-02	6.80175E-02	2.36188E-02	3.47959E-02	6.83577E-02	2.37369E-02
4	2.64817E-01	5.37348E-01	1.85848E-01	2.63994E-01	5.35812E-01	1.85317E-01

Table 4.71. TCA-7, Pin-55 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.186E-04	2.205E-04
2	7.342E-05	7.405E-05
3	1.743E-05	1.715E-05
4	9.388E-05	9.404E-05

Table 4.72. TCA-7, Pin-55 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.46008E-04	3.28325E-04	1.26835E-04	1.45867E-04	3.28061E-04	1.26745E-04
2	3.45407E-03	5.28814E-03	2.17020E-03	3.44685E-03	5.26736E-03	2.16167E-03
3	5.22363E-03	1.06689E-02	4.37843E-03	5.15115E-03	1.05143E-02	4.31500E-03
4	4.73673E-02	9.85703E-02	4.04524E-02	4.74047E-02	9.86425E-02	4.04820E-02

Table 4.73. TCA-7, Pin-55 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.42752E-03	7.91693E-03	2.81011E-03	4.41279E-03	7.88612E-03	2.79909E-03
2	3.99843E-02	3.82517E-06	1.58476E-06	3.88724E-02	3.70637E-06	1.53553E-06
3	7.01291E-03	2.46832E-08	1.02267E-08	6.99207E-03	2.45220E-08	1.01599E-08
4	2.69759E-02	1.26733E-07	5.25080E-08	2.69906E-02	1.26799E-07	5.25354E-08

Table 4.74. TCA-7, Pin-55 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.13362E-04	1.48414E-03	4.78998E-04	5.13238E-04	1.48384E-03	4.78975E-04
2	1.13505E-02	1.86607E-02	6.47983E-03	1.09736E-02	1.80388E-02	6.26385E-03
3	3.48495E-02	6.84159E-02	2.37571E-02	3.38470E-02	6.65440E-02	2.31071E-02
4	2.74694E-01	5.50591E-01	1.90475E-01	2.75966E-01	5.52786E-01	1.91235E-01

									7.058 (0.42)
	0.163 (0.75)							6.778 (0.45)	6.930 (0.30)
							6.434 (0.40)	6.596 (0.28)	6.745 (0.31)
						5.871 (0.47)	6.133 (0.33)	6.327 (0.30)	6.451 (0.29)
					5.168 (0.48)	5.489 (0.32)	5.742 (0.35)	5.939 (0.31)	6.053 (0.31)
				4.377 (0.49)	4.767 (0.33)	5.039 (0.34)	5.336 (0.33)	5.465 (0.33)	5.519 (0.32)
			3.520 (0.56)	3.936 (0.40)	4.294 (0.38)	4.552 (0.35)	4.754 (0.36)	4.920 (0.32)	4.979 (0.34)
		2.777 (0.66)	3.119 (0.45)	3.500 (0.39)	3.787 (0.45)	4.040 (0.37)	4.186 (0.35)	4.325 (0.33)	4.397 (0.36)
	2.148 (0.70)	2.439 (0.51)	2.772 (0.46)	3.062 (0.39)	3.330 (0.39)	3.540 (0.40)	3.714 (0.42)	3.803 (0.37)	3.857 (0.39)
2.037 (0.75)	2.140 (0.50)	2.445 (0.49)	2.777 (0.46)	3.109 (0.42)	3.342 (0.42)	3.553 (0.38)	3.728 (0.41)	3.851 (0.40)	3.923 (0.39)

Fig. 4.12a. Pin-power distribution for CENTRM benchmark TCA-8. Value in parentheses is percent standard deviation.

									7.087 (0.46)
	0.162 (0.72)							6.790 (0.41)	6.919 (0.28)
							6.419 (0.42)	6.669 (0.27)	6.737 (0.32)
						5.900 (0.43)	6.151 (0.30)	6.328 (0.27)	6.378 (0.33)
					5.179 (0.50)	5.512 (0.31)	5.799 (0.30)	5.942 (0.31)	6.021 (0.31)
				4.388 (0.53)	4.751 (0.35)	5.082 (0.35)	5.308 (0.31)	5.501 (0.31)	5.566 (0.31)
			3.547 (0.55)	3.954 (0.39)	4.305 (0.40)	4.595 (0.33)	4.764 (0.36)	4.941 (0.34)	4.987 (0.34)
		2.717 (0.67)	3.141 (0.42)	3.469 (0.43)	3.797 (0.38)	4.026 (0.36)	4.223 (0.36)	4.326 (0.36)	4.387 (0.37)
	2.140 (0.71)	2.434 (0.47)	2.753 (0.43)	3.061 (0.44)	3.313 (0.40)	3.540 (0.40)	3.695 (0.40)	3.832 (0.42)	3.886 (0.38)
2.055 (0.75)	2.128 (0.49)	2.452 (0.45)	2.780 (0.44)	3.082 (0.44)	3.377 (0.39)	3.615 (0.40)	3.740 (0.39)	3.859 (0.40)	3.928 (0.38)

Fig. 4.12b. Pin-power distribution for NITAWL benchmark TCA-8. Value in parentheses is percent standard deviation.

Table 4.75. Selected reaction rates for CENTRM case TCA-8

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$\lhd G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	1.219E-05	2.033E-05	7.204E-06	4.521E-03	0.182
1	Clad	2.267E-07	0.0	0.0	1.397E-03	0.056
	Mod.	6.904E-07	0.0	0.0	1.890E-02	0.762
	Fuel	4.454E-05	7.082E-05	2.507E-05	2.182E-02	0.182
55	Clad	8.569E-07	0.0	0.0	6.833E-03	0.057
	Mod.	2.247E-06	0.0	0.0	9.140E-02	0.761

Table 4.76. Selected reaction rates for NITAWL case TCA-8

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$\lhd G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	1.228E-05	2.056E-05	7.288E-06	4.508E-03	0.182
1	Clad	2.273E-07	0.0	0.0	1.396E-03	0.056
	Mod.	6.917E-07	0.0	0.0	1.890E-02	0.762
	Fuel	4.442E-05	7.058E-05	2.499E-05	2.172E-02	0.182
55	Clad	8.512E-07	0.0	0.0	6.810E-03	0.057
	Mod.	2.244E-06	0.0	0.0	9.104E-02	0.761

Table 4.77. TCA-8, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	3.944E-05	3.890E-05
2	1.103E-05	1.116E-05
3	2.823E-06	2.632E-06
4	2.727E-05	2.765E-05

Table 4.78. TCA-8, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.42334E-04	3.25312E-04	1.24980E-04	1.42088E-04	3.25219E-04	1.24828E-04
2	3.53127E-03	5.35172E-03	2.19630E-03	3.46204E-03	5.26653E-03	2.16133E-03
3	5.12848E-03	1.04583E-02	4.29199E-03	5.21250E-03	1.06698E-02	4.37876E-03
4	4.88629E-02	1.01736E-01	4.17514E-02	4.88872E-02	1.01784E-01	4.17714E-02

Table 4.79. TCA-8, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.53489E-03	8.60396E-03	3.05003E-03	4.52758E-03	8.62663E-03	3.05064E-03
2	4.11256E-02	3.90524E-06	1.61793E-06	3.90452E-02	3.64034E-06	1.50818E-06
3	6.97793E-03	2.43563E-08	1.00913E-08	7.01079E-03	2.46993E-08	1.02334E-08
4	2.77529E-02	1.30460E-07	5.40521E-08	2.77661E-02	1.30523E-07	5.40785E-08

Table 4.80. TCA-8, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.11790E-04	1.49952E-03	4.81643E-04	5.11429E-04	1.50018E-03	4.81447E-04
2	1.15051E-02	1.87178E-02	6.49966E-03	1.06573E-02	1.75647E-02	6.09924E-03
3	3.42439E-02	6.71877E-02	2.33306E-02	3.42088E-02	6.72576E-02	2.33550E-02
4	2.65649E-01	5.38621E-01	1.86291E-01	2.65522E-01	5.38441E-01	1.86228E-01

Table 4.81. TCA-8, Pin-55 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.110E-04	2.107E-04
2	7.037E-05	6.962E-05
3	1.673E-05	1.667E-05
4	9.070E-05	9.010E-05

Table 4.82. TCA-8, Pin-55 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.45480E-04	3.27674E-04	1.26526E-04	1.45435E-04	3.27709E-04	1.26510E-04
2	3.39048E-03	5.20276E-03	2.13517E-03	3.47111E-03	5.30325E-03	2.17640E-03
3	5.13229E-03	1.04562E-02	4.29112E-03	5.19965E-03	1.06013E-02	4.35069E-03
4	4.74630E-02	9.87671E-02	4.05332E-02	4.77188E-02	9.92999E-02	4.07518E-02

Table 4.83. TCA-8, Pin-55 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.41327E-03	7.93014E-03	2.81274E-03	4.42132E-03	7.95819E-03	2.82199E-03
2	3.87344E-02	3.80772E-06	1.57752E-06	3.76439E-02	3.63710E-06	1.50684E-06
3	6.98380E-03	2.43899E-08	1.01051E-08	7.00174E-03	2.45717E-08	1.01805E-08
4	2.70204E-02	1.26942E-07	5.25946E-08	2.71446E-02	1.27535E-07	5.28402E-08

Table 4.84. TCA-8, Pin-55 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.12787E-04	1.48453E-03	4.78981E-04	5.12848E-04	1.48514E-03	4.79084E-04
2	1.11398E-02	1.83762E-02	6.38104E-03	1.10696E-02	1.81030E-02	6.28615E-03
3	3.39692E-02	6.67376E-02	2.31743E-02	3.43528E-02	6.74775E-02	2.34313E-02
4	2.75637E-01	5.52375E-01	1.91090E-01	2.76264E-01	5.53948E-01	1.91632E-01

									6.747 (0.46)
	0.172 (0.90)							6.520 (0.40)	6.616 (0.30)
							6.164 (0.40)	6.297 (0.32)	6.417 (0.30)
						5.649 (0.43)	5.915 (0.30)	6.064 (0.29)	6.158 (0.28)
					4.974 (0.43)	5.311 (0.34)	5.553 (0.30)	5.732 (0.31)	5.793 (0.30)
				4.210 (0.48)	4.568 (0.33)	4.907 (0.35)	5.111 (0.33)	5.265 (0.31)	5.318 (0.33)
			3.447 (0.56)	3.807 (0.37)	4.124 (0.34)	4.379 (0.38)	4.589 (0.34)	4.729 (0.33)	4.777 (0.33)
		2.642 (0.62)	2.995 (0.40)	3.353 (0.42)	3.657 (0.39)	3.869 (0.38)	4.027 (0.38)	4.147 (0.35)	4.236 (0.38)
	2.049 (0.75)	2.330 (0.49)	2.663 (0.46)	3.948 (0.44)	3.206 (0.42)	3.412 (0.41)	3.586 (0.37)	3.704 (0.39)	3.745 (0.38)
1.975 (0.75)	2.076 (0.52)	2.378 (0.48)	2.685 (0.44)	2.993 (0.43)	3.228 (0.41)	3.452 (0.36)	3.579 (0.39)	3.723 (0.38)	3.736 (0.38)

Fig. 4.13a. Pin-power distribution for CENTRM benchmark TCA-9. Value in parentheses is percent standard deviation.

									6.800 (0.46)
	0.171 (0.91)							6.580 (0.38)	6.670 (0.31)
							6.176 (0.41)	6.363 (0.29)	6.453 (0.30)
						5.635 (0.47)	5.898 (0.29)	6.091 (0.28)	6.195 (0.30)
					5.005 (0.45)	5.293 (0.32)	5.511 (0.31)	5.719 (0.32)	5.831 (0.31)
				4.282 (0.51)	4.566 (0.35)	4.892 (0.32)	5.110 (0.33)	5.264 (0.32)	5.384 (0.35)
			3.411 (0.61)	3.800 (0.41)	4.089 (0.37)	4.402 (0.33)	4.609 (0.32)	4.756 (0.36)	4.821 (0.34)
		2.650 (0.64)	3.001 (0.39)	3.317 (0.42)	3.641 (0.39)	3.876 (0.38)	4.059 (0.39)	4.143 (0.33)	4.226 (0.35)
	2.086 (0.76)	2.348 (0.51)	2.677 (0.50)	3.966 (0.40)	3.202 (0.42)	3.410 (0.40)	3.561 (0.40)	3.662 (0.37)	3.742 (0.39)
1.957 (0.65)	2.055 (0.51)	2.361 (0.51)	2.691 (0.44)	3.012 (0.43)	3.213 (0.43)	3.430 (0.40)	3.584 (0.37)	3.714 (0.37)	3.782 (0.39)

Fig. 4.13b. Pin-power distribution for NITAWL benchmark TCA-9. Value in parentheses is percent standard deviation.

Table 4.85. Selected reaction rates for CENTRM case TCA-9

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.197E-05	1.995E-05	7.072E-06	4.613E-03	0.183
1	Clad	2.247E-07	0.0	0.0	1.425E-03	0.056
	Mod.	6.729E-07	0.0	0.0	1.919E-02	0.761
	Fuel	4.255E-05	6.730E-05	2.383E-05	2.168E-02	0.181
55	Clad	8.192E-07	0.0	0.0	6.794E-03	0.057
	Mod.	2.155E-06	0.0	0.0	9.111E-02	0.762

Table 4.86. Selected reaction rates for NITAWL case TCA-9

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	1.173E-05	1.955E-05	6.931E-06	4.554E-03	0.182
1	Clad	2.206E-07	0.0	0.0	1.420E-03	0.056
	Mod.	6.680E-07	0.0	0.0	1.910E-02	0.762
	Fuel	4.279E-05	6.771E-05	2.398E-05	2.188E-02	0.182
55	Clad	8.213E-07	0.0	0.0	6.844E-03	0.057
	Mod.	2.172E-06	0.0	0.0	9.168E-02	0.761

Table 4.87. TCA-9, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	3.851E-05	3.808E-05
2	1.088E-05	1.068E-05
3	2.665E-06	2.690E-06
4	2.684E-05	2.644E-05

Table 4.88. TCA-9, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.42657E-04	3.25414E-04	1.25101E-04	1.41875E-04	3.24320E-04	1.24670E-04
2	3.42835E-03	5.22619E-03	2.14479E-03	3.51588E-03	5.33745E-03	2.19045E-03
3	5.02206E-03	1.01901E-02	4.18195E-03	5.22963E-03	1.07319E-02	4.40428E-03
4	4.91554E-02	1.02344E-01	4.20007E-02	4.86914E-02	1.01377E-01	4.16040E-02

Table 4.89. TCA-9, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.50192E-03	8.46604E-03	2.99920E-03	4.50218E-03	8.53582E-03	3.03046E-03
2	4.14411E-02	3.76574E-06	1.56013E-06	3.83075E-02	3.58055E-06	1.48341E-06
3	6.94867E-03	2.40724E-08	9.97362E-09	7.02602E-03	2.48603E-08	1.03001E-08
4	2.78966E-02	1.31143E-07	5.43353E-08	2.76690E-02	1.30061E-07	5.38869E-08

Table 4.90 TCA-9, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.11763E-04	1.49708E-03	4.81127E-04	5.10995E-04	1.49750E-03	4.81258E-04
2	1.10924E-02	1.84326E-02	6.40062E-03	1.10329E-02	1.80993E-02	6.28488E-03
3	3.20870E-02	6.32248E-02	2.19544E-02	3.47840E-02	6.83283E-02	2.37267E-02
4	2.66228E-01	5.40183E-01	1.86826E-01	2.64971E-01	5.37118E-01	1.85773E-01

Table 4.91. TCA-9, Pin-55 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.010E-04	2.034E-04
2	6.739E-05	6.769E-05
3	1.576E-05	1.591E-05
4	8.667E-05	8.728E-05

Table 4.92. TCA-9, Pin-55 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.45454E-04	3.27423E-04	1.26486E-04	1.45607E-04	3.27771E-04	1.26597E-04
2	3.41193E-03	5.23067E-03	2.14662E-03	3.48574E-03	5.30232E-03	2.17602E-03
3	5.17154E-03	1.05678E-02	4.33692E-03	5.13163E-03	1.04658E-02	4.29508E-03
4	4.74074E-02	9.86494E-02	4.04848E-02	4.74735E-02	9.87892E-02	4.05423E-02

Table 4.93. TCA-9, Pin-55 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.40327E-03	7.89249E-03	2.80210E-03	4.40840E-03	7.90103E-03	2.80352E-03
2	3.82984E-02	3.87376E-06	1.60488E-06	3.80297E-02	3.68119E-06	1.52510E-06
3	6.99689E-03	2.45553E-08	1.01737E-08	6.98259E-03	2.44124E-08	1.01145E-08
4	2.69919E-02	1.26807E-07	5.25386E-08	2.70262E-02	1.26972E-07	5.26067E-08

Table 4.94. TCA-9, Pin-55 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.12642E-04	1.48335E-03	4.78804E-04	5.12945E-04	1.48419E-03	4.78995E-04
2	1.10458E-02	1.82405E-02	6.33394E-03	1.08837E-02	1.78922E-02	6.21299E-03
3	3.38276E-02	6.65209E-02	2.30991E-02	3.35685E-02	6.60145E-02	2.29233E-02
4	2.75620E-01	5.52218E-01	1.91037E-01	2.75080E-01	5.51449E-01	1.90770E-01

										6.856 (0.85)
	0.141 (0.76)								6.768 (0.41)	6.823 (0.42)
								6.535 (0.43)	6.644 (0.30)	6.692 (0.44)
							6.073 (0.44)	6.278 (0.31)	6.452 (0.32)	6.462 (0.48)
						5.443 (0.46)	5.760 (0.35)	5.984 (0.30)	6.074 (0.35)	6.161 (0.44)
					4.729 (0.48)	5.080 (0.34)	5.339 (0.33)	5.561 (0.32)	5.648 (0.33)	5.659 (0.48)
				3.888 (0.57)	4.322 (0.37)	4.641 (0.36)	4.858 (0.32)	5.062 (0.33)	5.192 (0.34)	5.200 (0.49)
			3.115 (0.64)	3.500 (0.43)	3.840 (0.39)	4.093 (0.37)	4.339 (0.38)	4.483 (0.39)	4.605 (0.39)	4.604 (0.53)
		2.358 (0.72)	2.681 (0.47)	3.033 (0.43)	3.323 (0.38)	3.532 (0.43)	3.760 (0.40)	3.875 (0.42)	3.955 (0.37)	3.936 (0.55)
	1.684 (0.85)	1.983 (0.56)	2.291 (0.51)	2.553 (0.46)	2.823 (0.46)	3.029 (0.41)	3.208 (0.45)	3.286 (0.41)	3.384 (0.39)	3.418 (0.59)
1.428 (0.77)	1.569 (0.61)	1.859 (0.57)	2.158 (0.49)	2.398 (0.51)	2.643 (0.49)	2.831 (0.45)	2.995 (0.47)	3.099 (0.42)	3.141 (0.43)	3.185 (0.58)

Fig. 4.14a. Pin-power distribution for CENTRM benchmark TCA-10. Value in parentheses is percent standard deviation.

										6.908 (0.85)
	0.144 (0.76)								6.810 (0.41)	6.858 (0.43)
								6.535 (0.42)	6.640 (0.31)	6.685 (0.43)
							6.057 (0.47)	6.279 (0.33)	6.387 (0.31)	6.470 (0.43)
						5.486 (0.45)	5.776 (0.31)	6.008 (0.31)	6.085 (0.33)	6.152 (0.45)
					4.750 (0.51)	5.094 (0.33)	5.371 (0.31)	5.545 (0.30)	5.669 (0.34)	5.702 (0.44)
				3.961 (0.55)	4.306 (0.33)	4.671 (0.38)	4.906 (0.32)	5.079 (0.34)	5.159 (0.36)	5.240 (0.48)
			3.100 (0.59)	3.517 (0.38)	3.850 (0.40)	4.088 (0.40)	4.342 (0.36)	4.512 (0.35)	4.599 (0.34)	4.621 (0.50)
		2.323 (0.70)	2.712 (0.44)	3.010 (0.46)	3.318 (0.45)	3.576 (0.42)	3.745 (0.40)	3.898 (0.41)	3.962 (0.39)	4.025 (0.59)
	1.667 (0.84)	2.010 (0.56)	2.295 (0.51)	2.584 (0.45)	2.808 (0.48)	3.022 (0.46)	3.184 (0.45)	3.312 (0.43)	3.374 (0.41)	3.412 (0.57)
1.422 (0.85)	1.576 (0.65)	1.865 (0.58)	2.122 (0.51)	2.401 (0.50)	2.644 (0.46)	2.824 (0.47)	2.996 (0.45)	3.102 (0.39)	3.155 (0.44)	3.217 (0.56)

Fig. 4.14b. Pin-power distribution for NITAWL benchmark TCA-10. Value in parentheses is percent standard deviation.

Table 4.95. Selected reaction rates for CENTRM case TCA-10

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$<G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	8.487E-06	1.430E-05	5.068E-06	2.952E-03	0.146
1	Clad	1.587E-07	0.0	0.0	9.168E-04	0.046
	Mod.	4.949E-07	0.0	0.0	1.630E-02	0.808
	Fuel	4.238E-05	6.861E-05	2.429E-05	1.833E-02	0.147
66	Clad	8.072E-07	0.0	0.0	5.748E-03	0.046
	Mod.	2.263E-06	0.0	0.0	1.007E-01	0.807

Table 4.96. Selected reaction rates for NITAWL case TCA-10

Pin	Region	$G_a M$ (cm^{-3} - s^{-1})	$<G_f M$ (cm^{-3} - s^{-1})	$G_f M$ (cm^{-3} - s^{-1})	M (cm - s^{-1})	M/M_t
	Fuel	8.415E-06	1.413E-05	5.006E-06	2.931E-03	0.146
1	Clad	1.562E-07	0.0	0.0	9.141E-04	0.046
	Mod.	4.895E-07	0.0	0.0	1.618E-02	0.808
	Fuel	4.266E-05	6.930E-05	2.454E-05	1.832E-02	0.147
66	Clad	8.014E-07	0.0	0.0	5.729E-03	0.045
	Mod.	2.297E-06	0.0	0.0	1.009E-01	0.808

Table 4.97. TCA-10, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.547E-05	2.512E-05
2	7.003E-06	7.231E-06
3	1.709E-06	1.737E-06
4	1.922E-05	1.894E-05

Table 4.98. TCA-10, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.40788E-04	3.23363E-04	1.24110E-04	1.41106E-04	3.24338E-04	1.24311E-04
2	3.64170E-03	5.55391E-03	2.27928E-03	3.51527E-03	5.32391E-03	2.18488E-03
3	5.30350E-03	1.08803E-02	4.46517E-03	5.18458E-03	1.06225E-02	4.35935E-03
4	4.91298E-02	1.02298E-01	4.19822E-02	4.92076E-02	1.02458E-01	4.20476E-02

Table 4.99. TCA-10, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.53168E-03	8.72356E-03	3.09660E-03	4.53467E-03	8.75482E-03	3.09219E-03
2	4.29217E-02	3.81724E-06	1.58147E-06	4.01630E-02	3.94182E-06	1.63309E-06
3	7.03335E-03	2.49018E-08	1.03173E-08	7.00443E-03	2.45869E-08	1.01868E-08
4	2.78924E-02	1.31130E-07	5.43293E-08	2.79251E-02	1.31284E-07	5.43933E-08

Table 4.100. TCA-10, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.10742E-04	1.50232E-03	4.82148E-04	5.10768E-04	1.50322E-03	4.81907E-04
2	1.13157E-02	1.86831E-02	6.48763E-03	1.14534E-02	1.87359E-02	6.50593E-03
3	3.56099E-02	6.98250E-02	2.42465E-02	3.42803E-02	6.73431E-02	2.33847E-02
4	2.63607E-01	5.35739E-01	1.85285E-01	2.64216E-01	5.36885E-01	1.85682E-01

Table 4.101. TCA-10, Pin-66 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	1.721E-04	1.716E-04
2	5.659E-05	5.611E-05
3	1.360E-05	1.336E-05
4	8.928E-05	9.041E-05

Table 4.102. TCA-10, Pin-66 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.44765E-04	3.27146E-04	1.26179E-04	1.44207E-04	3.26568E-04	1.25881E-04
2	3.42458E-03	5.21627E-03	2.14071E-03	3.45678E-03	5.26794E-03	2.16191E-03
3	5.10952E-03	1.04097E-02	4.27204E-03	5.28578E-03	1.08415E-02	4.44925E-03
4	4.80156E-02	9.99418E-02	4.10152E-02	4.77411E-02	9.93647E-02	4.07783E-02

Table 4.103. TCA-10, Pin-66 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.43964E-03	8.07600E-03	2.86439E-03	4.43787E-03	8.12821E-03	2.88138E-03
2	3.89892E-02	3.80924E-06	1.57815E-06	3.85192E-02	3.58239E-06	1.48417E-06
3	6.97667E-03	2.43379E-08	1.00837E-08	7.03071E-03	2.48865E-08	1.03109E-08
4	2.73091E-02	1.28331E-07	5.31703E-08	2.71792E-02	1.27709E-07	5.29124E-08

Table 4.104. TCA-10, Pin-66 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.12740E-04	1.48833E-03	4.79719E-04	5.12294E-04	1.48952E-03	4.79891E-04
2	1.11449E-02	1.83349E-02	6.36671E-03	1.12214E-02	1.84762E-02	6.41579E-03
3	3.30546E-02	6.50683E-02	2.25947E-02	3.57615E-02	7.00931E-02	2.43396E-02
4	2.70972E-01	5.45716E-01	1.88771E-01	2.70533E-01	5.44404E-01	1.88319E-01

										6.654 (0.79)
	0.147 (0.81)								6.562 (0.44)	6.611 (0.46)
								6.263 (0.44)	6.409 (0.32)	6.449 (0.43)
							5.818 (0.46)	6.026 (0.31)	6.170 (0.31)	6.207 (0.44)
						5.216 (0.46)	5.552 (0.35)	5.746 (0.30)	5.878 (0.30)	5.943 (0.39)
					4.527 (0.58)	4.898 (0.35)	5.157 (0.31)	5.351 (0.31)	5.483 (0.32)	5.471 (0.45)
				3.745 (0.51)	4.139 (0.38)	4.467 (0.35)	4.724 (0.35)	4.888 (0.33)	5.001 (0.33)	4.991 (0.49)
			3.030 (0.65)	3.377 (0.41)	3.691 (0.40)	3.991 (0.38)	4.178 (0.39)	4.331 (0.34)	4.457 (0.36)	4.431 (0.50)
		2.212 (0.70)	2.576 (0.52)	2.912 (0.43)	3.174 (0.42)	3.439 (0.38)	3.611 (0.39)	3.748 (0.36)	3.825 (0.40)	3.884 (0.50)
	1.604 (0.82)	1.905 (0.50)	2.200 (0.49)	2.472 (0.45)	2.710 (0.48)	2.905 (0.41)	3.084 (0.47)	3.215 (0.41)	3.268 (0.43)	3.263 (0.55)
1.350 (0.84)	1.492 (0.56)	1.764 (0.57)	2.050 (0.50)	2.302 (0.49)	2.553 (0.45)	2.722 (0.44)	2.886 (0.45)	2.980 (0.46)	3.036 (0.44)	3.092 (0.56)

Fig. 4.15a. Pin-power distribution for CENTRM benchmark TCA-11. Value in parentheses is percent standard deviation.

										6.756 (0.82)
	0.148 (0.84)								6.609 (0.41)	6.637 (0.39)
								6.358 (0.42)	6.453 (0.31)	6.510 (0.44)
							5.866 (0.43)	6.087 (0.31)	6.184 (0.31)	6.208 (0.44)
						5.248 (0.45)	5.518 (0.31)	5.748 (0.29)	5.874 (0.31)	5.922 (0.43)
					4.565 (0.51)	4.901 (0.35)	5.149 (0.31)	5.364 (0.31)	5.480 (0.32)	5.535 (0.47)
				3.782 (0.57)	4.171 (0.39)	4.444 (0.38)	4.672 (0.37)	4.911 (0.33)	4.984 (0.30)	5.039 (0.47)
			2.969 (0.61)	3.380 (0.38)	3.683 (0.38)	3.961 (0.37)	4.175 (0.40)	4.337 (0.35)	4.431 (0.36)	4.489 (0.53)
		2.266 (0.73)	2.599 (0.49)	2.912 (0.47)	3.209 (0.40)	3.419 (0.44)	3.625 (0.39)	3.746 (0.38)	3.823 (0.39)	3.855 (0.60)
	1.628 (0.86)	1.918 (0.54)	2.205 (0.51)	2.470 (0.48)	2.727 (0.45)	2.946 (0.52)	3.062 (0.42)	3.184 (0.42)	3.282 (0.42)	3.293 (0.59)
1.376 (0.81)	1.498 (0.61)	1.770 (0.54)	2.049 (0.51)	2.320 (0.50)	2.536 (0.45)	2.723 (0.45)	2.861 (0.49)	2.983 (0.44)	3.037 (0.42)	3.032 (0.61)

Fig. 4.15b. Pin-power distribution for NITAWL benchmark TCA-11. Value in parentheses is percent standard deviation.

Table 4.105. Selected reaction rates for CENTRM case TCA-11

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	7.995E-06	1.342E-05	4.759E-06	2.922E-03	0.146
1	Clad	1.494E-07	0.0	0.0	8.994E-04	0.046
	Mod.	4.727E-07	0.0	0.0	1.613E-02	0.808
	Fuel	4.112E-05	6.652E-05	2.356E-05	1.831E-02	0.147
66	Clad	7.801E-07	0.0	0.0	5.719E-03	0.045
	Mod.	2.193E-06	0.0	0.0	1.009E-01	0.808

Table 4.106. Selected reaction rates for NITAWL case TCA-11

Pin	Region	$\Sigma_a \phi$ (cm^{-3} - s^{-1})	$\nu\Sigma_f \phi$ (cm^{-3} - s^{-1})	$\Sigma_f \phi$ (cm^{-3} - s^{-1})	ϕ (cm - s^{-1})	ϕ/ϕ_t
	Fuel	8.237E-06	1.382E-05	4.898E-06	2.946E-03	0.146
1	Clad	1.536E-07	0.0	0.0	9.201E-04	0.046
	Mod.	4.780E-07	0.0	0.0	1.632E-02	0.808
	Fuel	4.210E-05	6.785E-05	2.403E-05	1.881E-02	0.149
66	Clad	7.944E-07	0.0	0.0	5.881E-03	0.045
	Mod.	2.226E-06	0.0	0.0	1.019E-01	0.805

Table 4.107. TCA-11, Pin-1 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	2.428E-05	2.418E-05
2	6.754E-06	6.771E-06
3	1.616E-06	1.716E-06
4	1.818E-05	1.859E-05

Table 4.108. TCA-11, Pin-1 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	1.41872E-04	3.24906E-04	1.24701E-04	1.41020E-04	3.23700E-04	1.24222E-04
2	3.59017E-03	5.46494E-03	2.24276E-03	3.58779E-03	5.48985E-03	2.25299E-03
3	5.18994E-03	1.06233E-02	4.35970E-03	5.10914E-03	1.04368E-02	4.28316E-03
4	4.91039E-02	1.02248E-01	4.19618E-02	4.92082E-02	1.02458E-01	4.20477E-02

Table 4.109. TCA-11, Pin-1 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	4.53707E-03	8.65445E-03	3.06352E-03	4.50757E-03	8.64413E-03	3.06142E-03
2	3.77442E-02	3.89227E-06	1.61256E-06	4.14119E-02	3.44468E-06	1.42711E-06
3	6.97847E-03	2.44523E-08	1.01310E-08	6.97541E-03	2.44034E-08	1.01108E-08
4	2.78818E-02	1.31080E-07	5.43088E-08	2.79222E-02	1.31269E-07	5.43873E-08

Table 4.110. TCA-11, Pin-1 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	σ_a	$\nu\sigma_f$	σ_f	σ_a	$\nu\sigma_f$	σ_f
1	5.11446E-04	1.50099E-03	4.81647E-04	5.10571E-04	1.50108E-03	4.81762E-04
2	1.15859E-02	1.88543E-02	6.54708E-03	1.15115E-02	1.90902E-02	6.62899E-03
3	3.43188E-02	6.73416E-02	2.33841E-02	3.42125E-02	6.71562E-02	2.33196E-02
4	2.62911E-01	5.34534E-01	1.84867E-01	2.65492E-01	5.39053E-01	1.86434E-01

Table 4.111. TCA-11, Pin-66 four-group fluxes

Group	CENTRM ϕ (cm^{-2} - s^{-1})	NITAWL ϕ (cm^{-2} - s^{-1})
1	1.657E-04	1.701E-04
2	5.293E-05	5.558E-05
3	1.316E-05	1.301E-05
4	8.674E-05	8.849E-05

Table 4.112. TCA-11, Pin-66 four-group U-235 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	1.44711E-04	3.27220E-04	1.26172E-04	1.44755E-04	3.27436E-04	1.26225E-04
2	3.46220E-03	5.28876E-03	2.17045E-03	3.45516E-03	5.25847E-03	2.15802E-03
3	5.16589E-03	1.05595E-02	4.33352E-03	5.18064E-03	1.05839E-02	4.34357E-03
4	4.81825E-02	1.00288E-01	4.11571E-02	4.80322E-02	9.99713E-02	4.10273E-02

Table 4.113. TCA-11, Pin-66 four-group U-238 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	4.47467E-03	8.17996E-03	2.90346E-03	4.47739E-03	8.19447E-03	2.90690E-03
2	3.91615E-02	3.93752E-06	1.63130E-06	4.02064E-02	3.76053E-06	1.55797E-06
3	6.99303E-03	2.44910E-08	1.01470E-08	6.99198E-03	2.45410E-08	1.01678E-08
4	2.73917E-02	1.28724E-07	5.33326E-08	2.73197E-02	1.28377E-07	5.31893E-08

Table 4.114. TCA-11, Pin-66 four-group Pu-239 cross sections

Group	CENTRM cross sections (cm^{-1})			NITAWL cross sections (cm^{-1})		
	Σ_a	$\nu\Sigma_f$	Σ_f	Σ_a	$\nu\Sigma_f$	Σ_f
1	5.12696E-04	1.48906E-03	4.79759E-04	5.13031E-04	1.49057E-03	4.80148E-04
2	1.14152E-02	1.88409E-02	6.54241E-03	1.11940E-02	1.81913E-02	6.31686E-03
3	3.48957E-02	6.84264E-02	2.37608E-02	3.45817E-02	6.78782E-02	2.35705E-02
4	2.71706E-01	5.47283E-01	1.89309E-01	2.72174E-01	5.47792E-01	1.89488E-01

5. CALCULATIONAL BENCHMARKS

5.1 DESCRIPTION

The calculational benchmarks examined in this report are divided into two distinct geometric sets of cases. The first set of cases consists of an infinitely long pin in an infinite triangular-pitched lattice. The second set of cases consists of a buckled pin in an infinite triangular-pitched lattice. The radii of the fuel, clad, and moderator are all the same for all variants and states. Also, the buckling height is the same in all buckled problems. All variants and states are calculated in both geometric configurations. The state parameters are given in Table 5.1. [4]

The calculational benchmarks in each geometric set are divided into variants, with five states in each of the variants. The variants differ only by the isotopic composition of the fuel. Within each variant, the fuel composition is the same for each state, with the exception of the presence or absence of ^{135}Xe and ^{149}Sm. The differences in the states are due to the presence or absence of ^{135}Xe and ^{149}Sm in the fuel, the fuel temperature, and the type of moderator.

There are four basic types of fuel: fresh uranium fuel, fresh MOX fuel, spent uranium fuel and fresh MOX fuel containing Pu recycled from a reactor. The spent uranium fuel is used in two variants: variant V3 uses spent uranium fuel with only the actinides, whereas variant V4 uses spent uranium fuel with actinides and fission products. There are also four variations of the fresh MOX fuel: fresh MOX fuel, MOX fuel with only ^{239}Pu, MOX fuel with only ^{240}Pu, and MOX fuel with only ^{241}Pu. The basic fuel material isotopic composition for each variant is given in Table 5.2.

There are four nonfuel material compositions in the set of calculational benchmarks: 1 clad composition, which is common to all problems, and 3 moderator material compositions. The variations in the moderator compositions are due to the presence or absence of ^{10}B and ^{11}B, the clad and moderator temperature, and the moderator density. The material isotopic compositions for the clad and each moderator are given in Table 5.3.

Table 5.1. State parameters for the calculational benchmark variants

State	Fuel zone temp (K)	Nonfuel zone temp (K)	^{135}Xe, ^{149}Sm in fuel	^{10}B, ^{11}B in moderator	Moderator material
S1	1027	579	Yes	Yes	MOD1
S3	1027	579	Yes	No	MOD2
S4	1027	579	No	Yes	MOD1
S5	579	579	No	Yes	MOD1
S6	300	300	No	Yes	MOD3

Table 5.2. Basic fuel isotopic composition for each computational benchmark variant

Variant	Comment	Isotope	Atom density (10^{-24} cm^{-3})	Isotop e	Atom density (10^{-24} cm^{-3})
V1	Fresh uranium fuel	^{235}U	8.7370×10^{-4}	^{16}O	3.9235×10^{-2}
		^{238}U	1.8744×10^{-2}		
V2	Fresh MOX fuel	^{235}U	3.8393×10^{-5}	^{239}Pu	6.5875×10^{-4}
		^{238}U	1.8917×10^{-2}	^{240}Pu	4.2323×10^{-5}
		^{16}O	4.1707×10^{-2}	^{41}Pu	7.0246×10^{-4}
V3	Spent uranium fuel with no fission products (actinides only)	^{235}U	3.7843×10^{-4}	^{242}Pu	4.7576×10^{-6}
		^{236}U	8.6365×10^{-5}	^{241}Am	4.9491×10^{-7}
		^{238}U	1.8327×10^{-2}	^{242m}Am	7.9194×10^{-9}
		^{237}Np	2.4823×10^{-5}	^{243}Am	6.6925×10^{-7}
		^{238}Pu	6.7254×10^{-6}	^{242}Cm	1.2582×10^{-7}
		^{239}Np	1.8332×10^{-6}	^{243}Cm	2.0629×10^{-9}
		^{239}Pu	1.3111×10^{-4}	^{244}Cm	1.2387×10^{-7}
		^{240}Pu	3.6233×10^{-5}	^{16}O	3.9235×10^{-2}
		^{241}Pu	2.1701×10^{-5}		
V4	Spent uranium fuel (actinides + fission products) (V3 + listed isotopes)	^{103}Rh	1.8890×10^{-4}	^{145}Nd	1.9975×10^{-6}
		^{131}Xe	1.4255×10^{-5}	^{153}Eu	2.4801×10^{-7}
		^{143}Nd	2.6692×10^{-2}	^{109}Ag	2.2037×10^{-9}
		^{147}Pm	6.1574×10^{-5}	^{155}Eu	9.6857×10^{-7}
		^{133}Cs	3.5974×10^{-6}	^{95}Mo	3.3720×10^{-7}
		^{99}Tc	3.3320×10^{-6}	^{154}Eu	5.1189×10^{-9}
		^{152}Sm	2.6842×10^{-4}	^{101}Ru	3.1134×10^{-7}
		^{151}Sm	3.0757×10^{-5}		
V7	Fresh MOX fuel with ^{239}Pu as only Pu	^{235}U	3.8393×10^{-5}	^{239}Pu	6.5875×10^{-4}
		^{238}U	1.8917×10^{-2}	^{16}O	4.1707×10^{-2}
V8	Fresh MOX fuel with ^{240}Pu as only Pu	^{235}U	6.9714×10^{-4}	^{240}Pu	4.2323×10^{-5}
		^{238}U	1.8917×10^{-2}	^{16}O	4.1707×10^{-2}
V9	Fresh MOX fuel with ^{241}Pu as only Pu	^{235}U	3.8393×10^{-5}	^{41}Pu	6.6577×10^{-4}
		^{238}U	1.8917×10^{-2}	^{16}O	4.1707×10^{-2}
V10	Fresh MOX fuel with recycled reactor Pu	^{235}U	5.0000×10^{-5}	^{240}Pu	4.9000×10^{-4}
		^{238}U	2.2100×10^{-2}	^{241}Pu	1.9000×10^{-4}
		^{16}O	4.6300×10^{-2}	^{242}Pu	1.0500×10^{-4}
		^{238}Pu	3.0000×10^{-5}	^{241}Am	2.5000×10^{-5}
		^{239}Pu	1.1600×10^{-3}		

Table 5.3. Nonfuel material isotopic composition

Material	Comment	Isotope	Atom density (10^{-24} cm^{-3})	Isotope	Atom density (10^{-24} cm^{-3})
Clad	Cladding	Zr	4.2300×10^{-2}		
MOD1	Hot moderator	H	4.7830×10^{-2}	^{10}B	4.7344×10^{-6}
	with boric acid	^{16}O	2.3910×10^{-2}	^{11}B	1.9177×10^{-5}
MOD2	Hot moderator	H	4.7830×10^{-2}		
	without boric acid	^{16}O	2.3910×10^{-2}		
MOD3	Cold moderator	H	6.6940×10^{-2}	^{10}B	6.6262×10^{-6}
	with boric acid	^{16}O	3.3470×10^{-2}	^{11}B	2.6839×10^{-5}

5.2 ANALYSIS

All computational benchmarks were processed using SCALE 5.0. The cases labeled NITAWL utilize the following sequence: CSAS, BONAMI, NITAWL, XSDRNPM. The cases labeled CENTRM utilize the following sequence: CSAS, BONAMI, NITAWL, CENTRM, PMC, WORKER, XSDRNPM. In the NITAWL cases the resolved resonance region is self-shielded using NITAWL. In the CENTRM cases the resolved resonance region is self-shielded using CENTRM and PMC, which removes the limitations of the Nordheim Integral Treatment. Table 5.4 contains the results for the infinite arrays, and Table 5.5 contains the results for the buckled arrays.

For each variant and state, the differences between the NITAWL and CENTRM multiplication factors (k_4 and buckled k_4) and the energy of the average lethargy causing fission (EALCF) are almost identical for the infinite and buckled geometries as shown in Tables 5.4 and 5.5. The differences in the multiplication between the CENTRM and NITAWL cases range from -0.09% to -0.55%. Trends are apparent based on both fuel material and temperature. The smallest difference occurs for variant V4, state S6, which is spent uranium fuel with actinides and fission products at room temperature. The largest difference occurs for variant V9, state S1, which is fresh MOX fuel with all the Pu as ^{241}Pu at reactor temperatures.

The selection and number of nuclides in the fuel has little effect on the difference between NITAWL and CENTRM, at most ~0.25%, which occurs when the amount of ^{241}Pu is at its maximum. The effects of resonance overlap do not seem to be significant. The lowest difference at any given temperature occurs for spent uranium fuel with actinides and fission products. The amount of absorbers in the fuel (^{135}Xe and ^{149}Sm) and in the moderator (^{10}B) also does not affect the differences.

Fuel and moderator temperature have the most obvious, albeit still small, effect on the difference between NITAWL and CENTRM results. For a given variant, the largest difference always occurs with the fuel at 1027 K and the moderator at 579 K. Decreasing the fuel temperature to 579 K always decreases the difference, as much as 0.1% . Further decreasing the fuel and moderator temperature to 300 K always further decreases the difference, as much as another 0.1%. Both NITAWL and

CENTRM interpolate data between temperatures.

The EALCF is also calculated for each variant and state. The differences in the average-energy between the NITAWL and CENTRM cases range from a low of -0.41% to a high of 1.66%. Trends are apparent based only on temperature. The smallest differences with each variant occur in state S6, and the largest differences occurs for states 1, 2, and 3. As the pin temperature drops, the differences between the CSAS and CENTRM results lessen.

5.3 CONCLUSIONS

For this set of cases using either NITAWL or CENTRM as the resonance region processor produces consistent results. The k_{eff} values are slightly lower, ~0.3%, for all CENTRM cases. The nuclides selected do not appear to have an effect on the difference, but the temperature of the system does have a slight effect: the point library has temperature data well above that available in the multigroup library. The approximations used to process the resolved resonance data in NITAWL do not significantly affect the results, as shown by the good agreement with the CENTRM results.

Table 5.4a. k_4 and EALCF values and differences for the variant cases

VARIANTS V1 - V4	NITAWL k_4	CENTRM k_4	k_4 % DIFF	NITAWL EALCF (eV)	CENTRM EALCF (eV)	EALCF % DIFF
V1S1	1.2593	1.2541	-0.41	0.7766	0.7806	0.52
V1S3	1.3144	1.3090	-0.41	0.6984	0.7019	0.5
V1S4	1.3069	1.3015	-0.41	0.7052	0.7087	0.5
V1S5	1.3249	1.3205	-0.33	0.6846	0.6877	0.45
V1S6	1.3669	1.3634	-0.26	0.2808	0.2819	0.39
V2S1	1.2074	1.2017	-0.47	1.5678	1.5873	1.24
V2S3	1.2360	1.2300	-0.49	1.4690	1.4871	1.23
V2S4	1.2270	1.2212	-0.47	1.4907	1.5090	1.23
V2S5	1.2474	1.2428	-0.37	1.4305	1.4460	1.08
V2S6	1.3256	1.3210	-0.35	0.5514	0.5568	0.98
V3S1	1.0821	1.0767	-0.5	0.9976	1.0064	0.88
V3S3	1.1267	1.1210	-0.51	0.8982	0.9058	0.85
V3S4	1.1218	1.1162	-0.5	0.9027	0.9103	0.84
V3S5	1.1412	1.1357	-0.48	0.8694	0.877	0.87
V3S6	1.1902	1.1862	-0.34	0.3271	0.3289	0.55
V4S1	1.0158	1.0140	-0.18	1.1496	1.1532	0.31
V4S3	1.0558	1.0536	-0.21	1.0346	1.0385	0.38
V4S4	1.0510	1.0490	-0.19	1.0411	1.0442	0.3
V4S5	1.0688	1.0669	-0.18	1.0081	1.0055	-0.26
V4S6	1.1197	1.1187	-0.09	0.3678	0.368	0.05

Table 5.4b. k_4 and EALCF values and differences for the variant cases (cont.)

VARIANTS V7 - V10	CSAS k_4	CENTRM k_4	k_4 % DIFF	CSAS EALCF (eV)	CENTRM EALCF (eV)	EALCF % DIFF
V7S1	1.3047	1.2984	-0.48	1.2704	1.2851	1.16
V7S3	1.3372	1.3307	-0.49	1.1922	1.2058	1.14
V7S4	1.3270	1.3206	-0.48	1.2090	1.2228	1.14
V7S5	1.3459	1.3404	-0.41	1.1687	1.1816	1.1
V7S6	1.4112	1.4067	-0.32	0.4793	0.4835	0.88
V8S1	1.0904	1.0859	-0.41	0.8038	0.8083	0.56
V8S3	1.1442	1.1395	-0.41	0.7108	0.7146	0.53
V8S4	1.1399	1.1351	-0.42	0.7147	0.7186	0.55
V8S5	1.1596	1.1557	-0.34	0.6881	0.6912	0.45
V8S6	1.2115	1.2084	-0.26	0.2694	0.2704	0.37
V9S1	1.5290	1.5207	-0.54	1.4193	1.4140	-0.37
V9S3	1.5644	1.5561	-0.53	1.3346	1.3293	-0.4
V9S4	1.5515	1.5432	-0.53	1.3585	1.3529	-0.41
V9S5	1.5736	1.5668	-0.43	1.3191	1.3181	-0.08
V9S6	1.6195	1.6140	-0.34	0.5601	0.5602	0.02
V10S1	1.0952	1.0902	-0.46	9.5809	9.7345	1.6
V10S3	1.1078	1.1027	-0.46	9.118	9.2636	1.6
V10S4	1.1010	1.0958	-0.47	9.3374	9.4863	1.59
V10S5	1.1196	1.1160	-0.32	8.7717	8.8831	1.27
V10S6	1.1937	1.1917	-0.17	2.614	2.6373	0.89

Table 5.5a. Buckled k_4 and EALCF values and differences for the variant cases

VARIANTS V1 - V4	CSAS buckled k_4	CENTRM buckled k_4	k_4 % DIFF	CSAS EALCF (eV)	CENTRM EALCF (eV)	EALCF % DIFF
V1S1	1.0802	1.0757	-0.42	0.8408	0.8455	0.56
V1S3	1.1266	1.1218	-0.43	0.755	0.7592	0.56
V1S4	1.1201	1.1154	-0.42	0.7628	0.7670	0.55
V1S5	1.1353	1.1314	-0.34	0.7402	0.7438	0.49
V1S6	1.2286	1.2253	-0.27	0.2932	0.2944	0.41
V2S1	1.0396	1.0346	-0.48	1.6927	1.7146	1.29
V2S3	1.0638	1.0586	-0.49	1.5847	1.605	1.28
V2S4	1.0562	1.0511	-0.48	1.6086	1.6293	1.29
V2S5	1.1050	1.1007	-0.39	1.5477	1.5659	1.18
V2S6	1.2167	1.2125	-0.35	0.5755	0.5814	1.03
V3S1	0.9547	0.9499	-0.5	1.0872	1.0973	0.93
V3S3	0.9932	0.9882	-0.5	0.9775	0.9863	0.9
V3S4	0.9889	0.9839	-0.51	0.9827	0.9917	0.92
V3S5	1.0059	1.0011	-0.48	0.9457	0.9542	0.9
V3S6	1.0887	1.0850	-0.34	0.3425	0.3445	0.58
V4S1	0.8975	0.8958	-0.19	1.2555	1.2600	0.36
V4S3	0.9322	0.9301	-0.23	1.1285	1.1334	0.43
V4S4	0.9279	0.9261	-0.19	1.1361	1.1400	0.34
V4S5	0.9435	0.9418	-0.18	1.0923	1.0963	0.37
V4S6	1.0253	1.0242	-0.11	0.3847	0.3858	0.29

Table 5.5b. Buckled k_4 and EALCF values and differences for the variant cases (cont.)

VARIANTS V7 - V10	CSAS buckled k_4	CENTRM buckled k_4	k_4 % DIFF	CSAS EALCF (eV)	CENTRM EALCF (eV)	EALCF % DIFF
V7S1	1.1560	1.1504	-0.48	1.3698	1.3865	1.22
V7S3	1.1844	1.1786	-0.49	1.2846	1.300	1.2
V7S4	1.1755	1.1697	-0.49	1.3031	1.3187	1.2
V7S5	1.1920	1.1870	-0.42	1.2589	1.2734	1.15
V7S6	1.2955	1.2913	-0.32	0.4991	0.5037	0.92
V8S1	0.9628	0.9588	-0.42	0.8777	0.8831	0.62
V8S3	1.0093	1.0050	-0.43	0.7748	0.7794	0.59
V8S4	1.0055	1.0012	-0.43	0.7794	0.7841	0.6
V8S5	1.0227	1.0192	-0.34	0.7496	0.7534	0.51
V8S6	1.1095	1.1066	-0.26	0.2819	0.2829	0.35
V9S1	1.3591	1.3515	-0.56	1.5135	1.5087	-0.32
V9S3	1.3901	1.3825	-0.55	1.4225	1.4177	-0.34
V9S4	1.3788	1.3712	-0.55	1.4481	1.4431	-0.35
V9S5	1.3982	1.3920	-0.44	1.4055	1.4052	-0.02
V9S6	1.4906	1.4855	-0.34	0.5802	0.5803	0.02
V10S1	0.9876	0.9831	-0.46	10.483	10.657	1.66
V10S3	0.9988	0.9941	-0.47	9.9769	10.142	1.65
V10S4	0.9927	0.9881	-0.46	10.216	10.385	1.65
V10S5	1.0094	1.0061	-0.33	9.5901	9.7165	1.32
V10S6	1.1087	1.1069	-0.16	2.7455	2.7705	0.91

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APPENDIX A

SCALE INPUT OF MIX-COMP-THERM-2 PROBLEM SET

APPENDIX A
SCALE INPUT OF MIX-COMP-THERM-2 PROBLEM SET

This appendix contains the CENTRM inputs for the six MIX-COMP-THERM-02 cases, PNL30 , PNL31, PNL32, PNL33, PNL34, and PNL35. The inputs can be changed to standard CSAS cases by replacing the =CSASC5 record with =CSAS25. The input for the cases are listed below.

```
=csasc5          parm=(size=2000000)
pnl-30 fuel
238group latticecell
'PNL30 - MOX fuel
u-235   1  0  1.4886-4  295  end
u-238   1  0  2.0611-2  295  end
o       1  0  4.3779-2  295  end
u-234   1  0  1.2458-6  295  end
u-236   1  0  2.0936-9  295  end
pu-238  1  0  3.8836-8  295  end
pu-239  1  0  3.9262-4  295  end
pu-240  1  0  3.3206-5  295  end
pu-241  1  0  1.6081-6  295  end
pu-242  1  0  1.1882-7  295  end
am-241  1  0  1.4891-6  295  end
'clad (ZR-2)
zr      2  0  4.2621-2  295  end
sn      2  0  4.8328-4  295  end
ni      2  0  3.0336-5  295  end
cr      2  0  7.6093-5  295  end
fe      2  0  9.5642-5  295  end
'water(Refletor)
h       3  0  6.6706-2  295  end
o       3  0  3.3353-2  295  end
b-10    3  0  1.8706-8  295  end
b-11    3  0  7.5770-8  295  end
'Lattice Grid
si      4  0  3.4607-4  295  end
fe      4  0  1.0152-4  295  end
cu      4  0  6.3731-5  295  end
mn      4  0  2.2115-5  295  end
mg      4  0  6.6651-4  295  end
cr      4  0  6.2310-5  295  end
ti      4  0  2.5375-5  295  end
al      4  0  5.8433-2  295  end
'UO2
u-234   5  0  1.2406-6  295  end
u-235   5  0  1.4824-4  295  end
u-236   5  0  2.0848-9  295  end
u-238   5  0  2.0525-2  295  end
o       5  0  4.1943-2  295  end
'Aluminum
si      6  0  3.4607-4  295  end
fe      6  0  1.0152-4  295  end
cu      6  0  6.3731-5  295  end
mn      6  0  2.2115-5  295  end
mg      6  0  6.6651-4  295  end
cr      6  0  6.2310-5  295  end
ti      6  0  2.5375-5  295  end
al      6  0  5.8433-2  295  end
'lead
pb      7  0  3.2174-2  295  end
end comp
squarepitch  1.778  1.2827  1 2  1.4351  3  end
more data
limcen=20000000
end more
PNL-30
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
plt=no lng=2000000
end param
read geometry
'
unit 1
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 2
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 3
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 4
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 5
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
```

```
'
unit 6
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 7
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 8
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 9
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 10
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 11
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 12
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 13
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 14
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 15
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 16
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 17
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 18
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 19
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 20
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 21
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 22
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 23
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 24
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
```

```
'
unit 25
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 26
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 27
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 28
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 29
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 30
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 31
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 32
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 33
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 34
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 35
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 36
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 37
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 38
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 39
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 40
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 41
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 42
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 43
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
```

```
'
unit 44
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 45
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 46
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 47
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 48
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 49
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 50
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 51
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 52
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 53
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 54
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 55
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 56
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 57
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 58
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 59
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 60
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 61
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 62
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
```

```
'
unit 63
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 64
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 65
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 66
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 67
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 68
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 69
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 81
com='Fuel - Lower Clad + Moderator'
cylinder 2 1 0.7176 0.3175 0.0
cuboid 3 1 4p0.889  0.3175 0.0
'
unit 82
com='Fuel - Lower PuO2/UO2 + UO2 + Clad + Moderator
+ Lattice Grid'
cylinder 1 1 0.6414    2.54 0.881
cylinder 5 1 0.6414    2.54 0.381
cylinder 2 1 0.7176    2.54 0.0
cuboid   3 1 4p0.73025 2.54 0.0
cuboid   4 1 4p0.889   2.54 0.0
'
unit 83
com='Fuel - Upper PuO2/UO2 + Clad + Moderator +
Lattice Grid'
cylinder 1 1 0.6414    2.54 0.0
cylinder 2 1 0.7176    2.54 0.0
cuboid   3 1 4p0.73025 2.54 0.0
cuboid   4 1 4p0.889   2.54 0.0
'
unit 84
com='Fuel - Upper PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414  0.0635 0.0
cylinder 2 1 0.7176  0.0635 0.0
cuboid   3 1 4p0.889 0.0635 0.0
'
unit 85
com='Reflector - Lower Moderator'
cuboid 3 1 4p0.889  0.3175 0.0
'
unit 86
com='Reflector - Lower Moderator + Lattice Grid'
cuboid   3 1 4p0.73025 2.54 0.0
cuboid   4 1 4p0.889   2.54 0.0
'
unit 87
com='Reflector - Upper Moderator + Lattice Grid'
cuboid   3 1 4p0.73025 2.54 0.0
cuboid   4 1 4p0.889   2.54 0.0
'
unit 88
com='Reflector - Upper Moderator'
cuboid   3 1 4p0.889 0.0635 0.0
'
unit 90
com='Reflector'
cuboid 3 1 4p0.889 86.6775 0.0
'
global unit 100
com='Cells in assembly'
array 1 -20.447 -20.447 0
cuboid 6 1 4p20.447  92.9640  -2.8575
cuboid 7 1 4p20.447  93.9165  -2.8575
replicate 3 2 6*3.0          4
replicate 3 6 4*3.0 1.462 3.0 1
replicate 3 7 4*3.0 0.0   3.0 5
end geometry
read array
ara=1 nux=23 nuy=23 nuz=5
fill
'Lower Cladding and Moderator
85 85 85 85 85 81 81 81 81 81 81 81 1b11
85 85 85 85 81 81 81 81 81 81 81 81 1b11
85 85 85 81 81 81 81 81 81 81 81 81 1b11
85 85 81 81 81 81 81 81 81 81 81 81 1b11
85 81 81 81 81 81 81 81 81 81 81 81 1b11
81 81 81 81 81 81 81 81 81 81 81 81 1b11
81 81 81 81 81 81 81 81 81 81 81 81 1b11
81 81 81 81 81 81 81 81 81 81 81 81 1b11
```

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81 81 81 81 81 81 81 81 81 81 81 81 1b11
81 81 81 81 81 81 81 81 81 81 81 81 1b11
81 81 81 81 81 81 81 81 81 81 81 81 1b11
81 81 81 81 81 81 81 81 81 81 81 81 1b264
'Lower Lattice Grid
86 86 86 86 86 82 82 82 82 82 82 82 1b11
86 86 86 86 82 82 82 82 82 82 82 82 1b11
86 86 86 82 82 82 82 82 82 82 82 82 1b11
86 86 82 82 82 82 82 82 82 82 82 82 1b11
86 82 82 82 82 82 82 82 82 82 82 82 1b11
82 82 82 82 82 82 82 82 82 82 82 82 1b11
82 82 82 82 82 82 82 82 82 82 82 82 1b11
82 82 82 82 82 82 82 82 82 82 82 82 1b11
82 82 82 82 82 82 82 82 82 82 82 82 1b11
82 82 82 82 82 82 82 82 82 82 82 82 1b11
82 82 82 82 82 82 82 82 82 82 82 82 1b11
82 82 82 82 82 82 82 82 82 82 82 82 1b264
'Fuel and Reflector
90 90 90 90 90  1  2  3  4  5  6  7 1b11
90 90 90 90  8  9 10 11 12 13 14 15 1b11
90 90 90 16 17 18 19 20 21 22 23 24 1b11
90 90 16 25 26 27 28 29 30 31 32 33 1b11
90  8 17 26 34 35 36 37 38 39 40 41 1b11
 1  9 18 27 35 42 43 44 45 46 47 48 1b11
 2 10 19 28 36 43 49 50 51 52 53 54 1b11
 3 11 20 29 37 44 50 55 56 57 58 59 1b11
 4 12 21 30 38 45 51 56 60 61 62 63 1b11
 5 13 22 31 39 46 52 57 61 64 65 66 1b11
 6 14 23 32 40 47 53 58 62 65 67 68 1b11
 7 15 24 33 41 48 54 59 63 66 68 69 1b264
'Upper Lattice Grid
87 87 87 87 87 83 83 83 83 83 83 83 1b11
87 87 87 87 83 83 83 83 83 83 83 83 1b11
87 87 87 83 83 83 83 83 83 83 83 83 1b11
87 87 83 83 83 83 83 83 83 83 83 83 1b11
87 83 83 83 83 83 83 83 83 83 83 83 1b11
83 83 83 83 83 83 83 83 83 83 83 83 1b11
83 83 83 83 83 83 83 83 83 83 83 83 1b11
83 83 83 83 83 83 83 83 83 83 83 83 1b11
83 83 83 83 83 83 83 83 83 83 83 83 1b11
83 83 83 83 83 83 83 83 83 83 83 83 1b11
83 83 83 83 83 83 83 83 83 83 83 83 1b11
83 83 83 83 83 83 83 83 83 83 83 83 1b264
'Upper Cladding and Moderator
88 88 88 88 88 84 84 84 84 84 84 84 1b11
88 88 88 88 84 84 84 84 84 84 84 84 1b11
88 88 88 84 84 84 84 84 84 84 84 84 1b11
88 88 84 84 84 84 84 84 84 84 84 84 1b11
88 84 84 84 84 84 84 84 84 84 84 84 1b11
84 84 84 84 84 84 84 84 84 84 84 84 1b11
84 84 84 84 84 84 84 84 84 84 84 84 1b11
84 84 84 84 84 84 84 84 84 84 84 84 1b11
84 84 84 84 84 84 84 84 84 84 84 84 1b11
84 84 84 84 84 84 84 84 84 84 84 84 1b11
84 84 84 84 84 84 84 84 84 84 84 84 1b11
84 84 84 84 84 84 84 84 84 84 84 84 1b264
end fill
end array
read bias  id=500 2 11  end bias
read plot
ttl='x-z plot at y=0.0'
xul=-50.0 yul=0.  zul=110
xlr=50.0  ylr=0.  zlr=-10.
uax=1.0 wdn=-1.0
nax=600 end plt0
ttl='x-y plot at z=25.0'
pic=mix
xul=-30.0 yul=30.  zul=25.
xlr=30.0  ylr=-30. zlr=25.
uax=1.0 vdn=-1.0
nax=600 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/pnl30.xs04
cp ft64f001  $RTNDIR/pnl30.rs64
end
=kmart
read initial   kunit=64
xunit=4
actbygrp
rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92236 27 92236 18  92236  1452
92238 27 92238 18  92238  1452
94238 27 94238 18  94238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
40000 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
28000 27
24000 27
26000 27
5010 27
5011 27
8016 27
1001 27
end activity
```

```
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end


=csasc5          parm=(size=2000000)
pnl-31 fuel
238group latticecell
'MOX fuel
u-235   1  0  1.4886-4  295  end
u-238   1  0  2.0611-2  295  end
o       1  0  4.3779-2  295  end
u-234   1  0  1.2458-6  295  end
u-236   1  0  2.0936-9  295  end
pu-238  1  0  3.8836-8  295  end
pu-239  1  0  3.9262-4  295  end
pu-240  1  0  3.3206-5  295  end
pu-241  1  0  1.6081-6  295  end
pu-242  1  0  1.1882-7  295  end
am-241  1  0  1.4891-6  295  end
'clad (ZR-2)
zr      2  0  4.2621-2  295  end
sn      2  0  4.8328-4  295  end
ni      2  0  3.0336-5  295  end
cr      2  0  7.6093-5  295  end
fe      2  0  9.5642-5  295  end
'water(Refletor)
h       3  0  6.6685-2  295  end
o       3  0  3.3400-2  295  end
b-10    3  0  7.5838-6  295  end
b-11    3  0  3.0718-5  295  end
'Lattice Grid
si      4  0  3.4607-4  295  end
fe      4  0  1.0152-4  295  end
cu      4  0  6.3731-5  295  end
mn      4  0  2.2115-5  295  end
mg      4  0  6.6651-4  295  end
cr      4  0  6.2310-5  295  end
ti      4  0  2.5375-5  295  end
al      4  0  5.8433-2  295  end
'UO2
u-234   5  0  1.2406-6  295  end
u-235   5  0  1.4824-4  295  end
u-236   5  0  2.0848-9  295  end
u-238   5  0  2.0525-2  295  end
o       5  0  4.1943-2  295  end
'Aluminum
si      6  0  3.4607-4  295  end
fe      6  0  1.0152-4  295  end
cu      6  0  6.3731-5  295  end
mn      6  0  2.2115-5  295  end
mg      6  0  6.6651-4  295  end
cr      6  0  6.2310-5  295  end
ti      6  0  2.5375-5  295  end
al      6  0  5.8433-2  295  end
'lead
pb      7  0  3.2174-2  295  end
end comp
squarepitch  1.778  1.2827  1 2  1.4351  3  end
more data
limcen=20000000
end more
PNL-31
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
plt=no lng=2000000
end param
read geometry
'
unit 1
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 2
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 3
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 4
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 5
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 6
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 7
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
```

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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 8
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 9
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 10
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 11
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 12
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 13
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 14
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 15
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 16
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 17
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 18
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 19
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 20
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 21
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 22
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 23
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 24
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 25
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 26
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
```

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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 27
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 28
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 29
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 30
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 31
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 32
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 33
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 34
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 35
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 36
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 37
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 38
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 39
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 40
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 41
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 42
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 43
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 44
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 45
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
```

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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 46
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 47
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 48
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 49
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 50
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 51
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 52
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 53
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 54
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 55
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 56
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 57
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 58
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 59
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 60
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 61
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 62
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 63
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 64
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
```

```
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 65
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 66
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 67
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 68
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 69
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 70
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 71
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 72
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 73
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 74
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 75
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 76
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 77
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 78
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 79
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 80
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 81
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 82
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 83
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
```

```
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 84
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 85
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 86
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 87
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 88
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 89
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 90
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 91
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 92
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 93
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 94
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 95
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 96
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 97
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 98
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 99
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 100
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 101
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 102
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
```

```
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 103
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 104
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 105
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 106
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 107
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 108
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 109
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p0.889  86.6775 0.0
'
unit 111
com='Fuel - Lower Clad + Moderator'
cylinder 2 1 0.7176 0.3175 0.0
cuboid 3 1 4p0.889  0.3175 0.0
'
unit 112
com='Fuel - Lower PuO2/UO2 + UO2 + Clad + Moderator
+ Lattice Grid'
cylinder 1 1 0.6414    2.54 0.881
cylinder 5 1 0.6414    2.54 0.381
cylinder 2 1 0.7176    2.54 0.0
cuboid   3 1 4p0.73025 2.54 0.0
cuboid   4 1 4p0.889   2.54 0.0
'
unit 113
com='Fuel - Upper PuO2/UO2 + Clad + Moderator +
Lattice Grid'
cylinder 1 1 0.6414    2.54 0.0
cylinder 2 1 0.7176    2.54 0.0
cuboid   3 1 4p0.73025 2.54 0.0
cuboid   4 1 4p0.889   2.54 0.0
'
unit 114
com='Fuel - Upper PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414  0.0635 0.0
cylinder 2 1 0.7176  0.0635 0.0
cuboid   3 1 4p0.889 0.0635 0.0
'
unit 115
com='Reflector - Lower Moderator'
cuboid 3 1 4p0.889  0.3175 0.0
'
unit 116
com='Reflector - Lower Moderator + Lattice Grid'
cuboid   3 1 4p0.73025 2.54 0.0
cuboid   4 1 4p0.889   2.54 0.0
'
unit 117
com='Reflector - Upper Moderator + Lattice Grid'
cuboid   3 1 4p0.73025 2.54 0.0
cuboid   4 1 4p0.889   2.54 0.0
'
unit 118
com='Reflector - Upper Moderator'
cuboid   3 1 4p0.889 0.0635 0.0
'
unit 120
com='Moderator'
cuboid 3 1 4p0.889 86.6775 0.0
'
global unit 130
com='Cells in assembly'
array 1 -27.559 -27.559 0
cuboid 6 1 4p27.559  92.9640  -2.8575
cuboid 7 1 4p27.559  93.9165  -2.8575
replicate 3 2 6*3.0 4
replicate 3 6 4*3.0 1.462 3.0 1
replicate 3 7 4*3.0 0.0   3.0 5
end geometry
read array
ara=1 nux=31 nuy=31 nuz=5
fill
'Lower Cladding and Moderator
115 115 115 115 115 115 115 115 115 115 115 115 111
111 111 111 1b15
115 115 115 115 115 115 115 115 115 111 111 111 111
111 111 111 1b15
115 115 115 115 115 115 115 111 111 111 111 111 111
111 111 111 1b15
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115 115 115 115 115 111 111 111 111 111 111 111 111
111 111 111 1b15
115 115 115 115 111 111 111 111 111 111 111 111 111
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111 111 111 1b15
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111 111 111 1b15
111 111 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
111 111 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b480
'Lower Lattice Grid
116 116 116 116 116 116 116 116 116 116 116 116 112
112 112 112 1b15
116 116 116 116 116 116 116 116 116 112 112 112 112
112 112 112 1b15
116 116 116 116 116 116 116 112 112 112 112 112 112
112 112 112 1b15
116 116 116 116 116 112 112 112 112 112 112 112 112
112 112 112 1b15
116 116 116 116 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 116 116 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 116 116 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 116 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 116 112 112 112 112 112 112 112 112 112 112 112
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112 112 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
112 112 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
112 112 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b480
'Fuel and Reflector
120 120 120 120 120 120 120 120 120 120 120 120 1 2
3 4 1b15
120 120 120 120 120 120 120 120 120 5 6 7 8 9 10
11 1b15
120 120 120 120 120 120 120 12 13 14 15 16 17 18
19 20 1b15
120 120 120 120 120 21 22 23 24 25 26 27 28 29 30
31 1b15
120 120 120 120 32 33 34 35 36 37 38 39 40 41 42
43 1b15
120 120 120 21 33 44 45 46 47 48 49 50 51 52 53
54 1b15
120 120 120 22 34 45 55 56 57 58 59 60 61 62 63
64 1b15
120 120 12 23 35 46 56 65 66 67 68 69 70 71 72
73 1b15
120 120 13 24 36 47 57 66 74 75 76 77 78 79 80
81 1b15
120 5 14 25 37 48 58 67 75 82 83 84 85 86 87 88
1b15
120 6 15 26 38 49 59 68 76 83 89 90 91 92 93 94
1b15
120 7 16 27 39 50 60 69 77 84 90 95 96 97 98 99
1b15
1 8 17 28 40 51 61 70 78 85 91 96 100 101 102
103 1b15
2 9 18 29 41 52 62 71 79 86 92 97 101 104 105
106 1b15
3 10 19 30 42 53 63 72 80 87 93 98 102 105 107
108 1b15
4 11 20 31 43 54 64 73 81 88 94 99 103 106 108
109 1b480
'Upper Lattice Grid
117 117 117 117 117 117 117 117 117 117 117 117 113
113 113 113 1b15
117 117 117 117 117 117 117 117 117 113 113 113 113
113 113 113 1b15
117 117 117 117 117 117 117 113 113 113 113 113 113
113 113 113 1b15
117 117 117 117 117 113 113 113 113 113 113 113 113
113 113 113 1b15
117 117 117 117 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 117 117 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 117 117 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 117 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 117 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 113 113 113 113 113 113 113 113 113 113 113 113

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113 113 113 1b15
117 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
113 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
113 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
113 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
113 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b480
'Upper Cladding and Moderator
114 114 114 114 114 114 114 114 114 114 114 114 118
118 118 118 1b15
114 114 114 114 114 114 114 114 114 118 118 118 118
118 118 118 1b15
114 114 114 114 114 114 114 118 118 118 118 118 118
118 118 118 1b15
114 114 114 114 114 118 118 118 118 118 118 118 118
118 118 118 1b15
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118 118 118 118 118 118 118 118 118 118 118 118 118
118 118 118 1b15
118 118 118 118 118 118 118 118 118 118 118 118 118
118 118 118 1b15
118 118 118 118 118 118 118 118 118 118 118 118 118
118 118 118 1b480
end fill
end array
read bias  id=500 2 11  end bias
read plot
ttl='x-z plot at y=0.0'
xul=-50.0 yul=0.  zul=110
xlr=50.0  ylr=0.  zlr=-10.
uax=1.0 wdn=-1.0
nax=600 end plt0
ttl='x-y plot at z=25.0'
pic=mix
xul=-30.0 yul=30.  zul=25.
xlr=30.0  ylr=-30. zlr=25.
uax=1.0 vdn=-1.0
nax=600 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/pnl31.xs04
cp ft64f001  $RTNDIR/pnl31.rs64
end
=kmart
read initial   kunit=64
xunit=4
actbygrp
rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92236 27 92236 18  92236  1452
92238 27 92238 18  92238  1452
94238 27 94238 18  94238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
40000 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
28000 27
24000 27
26000 27
5010 27
5011 27
8016 27
1001 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end

=csasc5          parm=(size=1000000)
pnl-32 fuel
```

```
238group latticecell
'MOX fuel
u-235   1  0  1.4886-4  295  end
u-238   1  0  2.0611-2  295  end
o       1  0  4.3779-2  295  end
u-234   1  0  1.2458-6  295  end
u-236   1  0  2.0936-9  295  end
pu-238  1  0  3.8836-8  295  end
pu-239  1  0  3.9262-4  295  end
pu-240  1  0  3.3206-5  295  end
pu-241  1  0  1.6081-6  295  end
pu-242  1  0  1.1882-7  295  end
am-241  1  0  1.4891-6  295  end
'clad (ZR-2)
zr      2  0  4.2621-2  295  end
sn      2  0  4.8328-4  295  end
ni      2  0  3.0336-5  295  end
cr      2  0  7.6093-5  295  end
fe      2  0  9.5642-5  295  end
'water(Refletor)
h       3  0  6.6706-2  295  end
o       3  0  3.3353-2  295  end
b-10    3  0  9.9034-9  295  end
b-11    3  0  4.0114-8  295  end
'Lattice Grid
si      4  0  3.4607-4  295  end
fe      4  0  1.0152-4  295  end
cu      4  0  6.3731-5  295  end
mn      4  0  2.2115-5  295  end
mg      4  0  6.6651-4  295  end
cr      4  0  6.2310-5  295  end
ti      4  0  2.5375-5  295  end
al      4  0  5.8433-2  295  end
'UO2
u-234   5  0  1.2406-6  295  end
u-235   5  0  1.4824-4  295  end
u-236   5  0  2.0848-9  295  end
u-238   5  0  2.0525-2  295  end
o       5  0  4.1943-2  295  end
'Aluminum
si      6  0  3.4607-4  295  end
fe      6  0  1.0152-4  295  end
cu      6  0  6.3731-5  295  end
mn      6  0  2.2115-5  295  end
mg      6  0  6.6651-4  295  end
cr      6  0  6.2310-5  295  end
ti      6  0  2.5375-5  295  end
al      6  0  5.8433-2  295  end
'lead
pb      7  0  3.2174-2  295  end
end comp
squarepitch  2.20914  1.2827  1 2  1.4351  3  end
more data
limcen=20000000
end more
PNL-32
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
plt=no lng=2000000
end param
read geometry
'
unit 1
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 2
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 3
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 4
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 5
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 6
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 7
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 8
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 9
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
```

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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 10
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 11
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 12
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 13
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 14
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 15
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 16
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 17
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 18
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 19
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 20
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 21
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 22
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 23
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 24
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 25
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 26
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 27
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 28
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 29
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 30
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 31
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 32
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 33
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 34
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 35
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 36
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 37
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 38
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 39
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 40
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 41
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 42
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 43
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 44
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 45
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 46
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 47
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 48
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 49
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 50
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 51
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 52
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 53
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 54
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 55
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 56
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 57
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 58
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 59
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 60
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 61
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 62
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 63
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 64
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 65
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 66
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
```

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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 67
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 68
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 69
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 70
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 71
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 72
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 73
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 74
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 75
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 76
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 77
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 78
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 79
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 80
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 81
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 82
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 83
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 84
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 85
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
```

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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 86
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 87
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 88
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 89
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 90
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 91
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 92
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 93
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 94
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 95
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 96
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 97
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 98
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 99
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 100
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 101
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 102
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 103
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 104
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 105
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 106
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 107
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 108
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 109
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 110
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 111
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 112
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 113
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 114
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 115
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 116
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 117
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 118
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 119
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 120
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 121
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 122
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457 86.6775 0.0
'
unit 123
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0

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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 124
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 125
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 126
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 127
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 128
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 129
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 130
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 131
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 132
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 133
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 134
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 135
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 136
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 137
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 138
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 139
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 140
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 141
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 142
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 143
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 144
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 145
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 146
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 147
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 148
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 149
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 150
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 151
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 152
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 153
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 154
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 155
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 156
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 157
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 158
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 159
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 160
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 161
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 162
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 163
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 164
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 165
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 166
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 167
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 168
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 169
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 170
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 171
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 172
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 173
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 174
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 175
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 176
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 177
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 178
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 179
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 180
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
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cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 181
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 182
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 183
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 184
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 185
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 186
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 187
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 188
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 189
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 190
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 191
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 192
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 193
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 194
com='1PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 195
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.10457  86.6775 0.0
'
unit 201
com='Fuel - Lower Clad + Moderator'
cylinder 2 1 0.7176 0.3175 0.0
cuboid 3 1 4p1.10457  0.3175 0.0
'
unit 202
com='Fuel - Lower PuO2/UO2 + UO2 + Clad + Moderator
+ Lattice Grid'
cylinder 1 1 0.6414    2.54 0.881
cylinder 5 1 0.6414    2.54 0.381
cylinder 2 1 0.7176    2.54 0.0
cuboid   3 1 4p1.02329 2.54 0.0
cuboid   4 1 4p1.10457   2.54 0.0
'
unit 203
com='Fuel - Upper PuO2/UO2 + Clad + Moderator +
Lattice Grid'
cylinder 1 1 0.6414    2.54 0.0
cylinder 2 1 0.7176    2.54 0.0
cuboid   3 1 4p1.02329 2.54 0.0
cuboid   4 1 4p1.10457   2.54 0.0
```

```
'
unit 204
com='Fuel - Upper PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414  0.0635 0.0
cylinder 2 1 0.7176  0.0635 0.0
cuboid   3 1 4p1.10457 0.0635 0.0
'
unit 205
com='Reflector - Lower Moderator'
cuboid 3 1 4p1.10457  0.3175 0.0
'
unit 206
com='Reflector - Lower Moderator + Lattice Grid'
cuboid   3 1 4p1.02329 2.54 0.0
cuboid   4 1 4p1.10457   2.54 0.0
'
unit 207
com='Reflector - Upper Moderator + Lattice Grid'
cuboid   3 1 4p1.02329 2.54 0.0
cuboid   4 1 4p1.10457   2.54 0.0
'
unit 208
com='Reflector - Upper Moderator'
cuboid   3 1 4p1.10457 0.0635 0.0
'
unit 210
com='Moderator'
cuboid 3 1 4p1.10457 86.6775 0.0
'
global unit 220
com='Cells in assembly'
array 1 -18.77769 -18.77769 0
cuboid 6 1 4p18.77769  92.9640  -2.8575
cuboid 7 1 4p18.77769  93.9165  -2.8575
replicate 3 2 4*3.0 3.937 3.0 1
replicate 3 3 4*3.0 0.0   3.0 9
cuboid 3 1 4p48.77769  97.8535 -32.8575
end geometry
read array
ara=1 nux=17 nuy=17 nuz=5
fill
'Lower Cladding and Moderator
205 205 205 205 205 205 205 201 201 201 205 205 205
205 205 205 205
205 205 205 205 205 205 201 201 201 201 201 201 205
205 205 205 205
205 205 205 205 201 201 201 201 201 201 201 201 201
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205 205 205 205
'Lower Lattice Grid
206 206 206 206 206 206 206 202 202 202 206 206 206
206 206 206 206
206 206 206 206 206 206 202 202 202 202 202 202 206
206 206 206 206
206 206 206 206 202 202 202 202 202 202 202 202 202
206 206 206 206
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206 206 206 206
206 206 206 206 206 202 202 202 202 202 202 206 206
206 206 206 206
206 206 206 206 206 206 206 202 202 202 206 206 206
206 206 206 206
'Fuel and Reflector
210 210 210 210 210 210 210 193 194 195 210 210 210
210 210 210 210
```

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210 210 210 210 210 210 187 188 189 190 191 192 210
210 210 210 210
210 210 210 210 178 179 180 181 182 183 184 185 186
210 210 210 210
210 210 210 167 168 169 170 171 172 173 174 175 176
177 210 210 210
210 210 154 155 156 157 158 159 160 161 162 163 164
165 166 210 210
210 139 140 141 142 143 144 145 146 147 148 149 150
151 152 153 210
210 124 125 126 127 128 129 130 131 132 133 134 135
136 137 138 210
107 108 109 110 111 112 113 114 115 116 117 118 119
120 121 122 123
90  91  92  93  94  95  96  97  98  99 100 101 102 103 104
105 106
73  74  75  76  77  78  79  80  81  82  83  84  85  86  87  88
89
210  58  59  60  61  62  63  64  65  66  67  68  69  70  71
72 210
210  43  44  45  46  47  48  49  50  51  52  53  54  55  56
57 210
210 210  30  31  32  33  34  35  36  37  38  39  40  41  42
210 210
210 210 210  19  20  21  22  23  24  25  26  27  28  29 210
210 210
210 210 210 210  10  11  12  13  14  15  16  17  18 210 210
210 210
210 210 210 210 210   4   5   6   7   8   9 210 210 210 210
210 210
210 210 210 210 210 210 210   1   2   3 210 210 210 210
210 210 210
'Upper Lattice Grid
207 207 207 207 207 207 207 203 203 203 207 207 207
207 207 207 207
207 207 207 207 207 207 203 203 203 203 203 203 207
207 207 207 207
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207 207 207 207
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207 207 207 207
207 207 207 207 207 207 207 203 203 203 207 207 207
207 207 207 207
'Upper Cladding and Moderator
208 208 208 208 208 208 208 204 204 204 208 208 208
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208 208 208 208
end fill
end array
read bias  id=500 2 11  end bias
read plot
ttl='x-z plot at y=0.0'
xul=-30.0 yul=0.  zul=110
xlr=30.0  ylr=0.  zlr=-10.
uax=1.0 wdn=-1.0
nax=600 end plt0
ttl='x-y plot at z=25.0'
pic=mix
xul=-30.0 yul=30.  zul=25.
```

```
xlr=30.0  ylr=-30. zlr=25.
uax=1.0 vdn=-1.0
nax=600 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/pnl32.xs04
cp ft64f001  $RTNDIR/pnl32.rs64
end
=kmart
read initial   kunit=64
xunit=4
actbygrp
rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92236 27 92236 18  92236  1452
92238 27 92238 18  92238  1452
94238 27 94238 18  94238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
40000 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
28000 27
24000 27
26000 27
5010 27
5011 27
8016 27
1001 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end

=csasc5          parm=(size=1000000)
pnl-33 fuel
238group latticecell
'MOX fuel
u-235   1  0  1.4886-4  295  end
u-238   1  0  2.0611-2  295  end
o       1  0  4.3779-2  295  end
u-234   1  0  1.2458-6  295  end
u-236   1  0  2.0936-9  295  end
pu-238  1  0  3.8836-8  295  end
pu-239  1  0  3.9262-4  295  end
pu-240  1  0  3.3206-5  295  end
pu-241  1  0  1.6081-6  295  end
pu-242  1  0  1.1882-7  295  end
am-241  1  0  1.4891-6  295  end
'clad (ZR-2)
zr      2  0  4.2621-2  295  end
sn      2  0  4.8328-4  295  end
ni      2  0  3.0336-5  295  end
cr      2  0  7.6093-5  295  end
fe      2  0  9.5642-5  295  end
'water(Refletor)
h     3  0  6.6672-2  295  end
o     3  0  3.3427-2  295  end
b-10  3  0  1.2034-5  295  end
b-11  3  0  4.8746-5  295  end
'Lattice Grid
si      4  0  3.4607-4  295  end
fe      4  0  1.0152-4  295  end
cu      4  0  6.3731-5  295  end
mn      4  0  2.2115-5  295  end
mg      4  0  6.6651-4  295  end
cr      4  0  6.2310-5  295  end
ti      4  0  2.5375-5  295  end
al      4  0  5.8433-2  295  end
'UO2
u-234   5  0  1.2406-6  295  end
u-235   5  0  1.4824-4  295  end
u-236   5  0  2.0848-9  295  end
u-238   5  0  2.0525-2  295  end
o       5  0  4.1943-2  295  end
'Aluminum
si      6  0  3.4607-4  295  end
fe      6  0  1.0152-4  295  end
cu      6  0  6.3731-5  295  end
mn      6  0  2.2115-5  295  end
mg      6  0  6.6651-4  295  end
cr      6  0  6.2310-5  295  end
ti      6  0  2.5375-5  295  end
al      6  0  5.8433-2  295  end
'lead
pb      7  0  3.2174-2  295  end
end comp
squarepitch  2.20914  1.2827  1 2  1.4351  3  end
more data
limcen=20000000
end more
PNL-33
```

```
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
plt=no lng=2000000
end param
read geometry
'
unit 1
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 2
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 3
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 4
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 5
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 6
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 7
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 8
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 9
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 10
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 11
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 12
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 13
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 14
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 15
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 16
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 17
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 18
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
```

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'
unit 19
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 20
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 21
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 22
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 23
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 24
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 25
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 26
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 27
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 28
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 29
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 30
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 31
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 32
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 33
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 34
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 35
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 36
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 37
com='PuO2/UO2 + Clad + Moderator'
 cylinder 1 1 0.6414 86.6775 0.0
 cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.1046  86.6775 0.0
```

```
'
unit 38
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 39
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 40
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 41
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 42
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 43
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 44
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 45
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 46
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 47
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 48
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 49
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 50
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 51
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 52
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 53
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 54
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 55
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 56
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
```

```
'
unit 57
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 58
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 59
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 60
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 61
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 62
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 63
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 64
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 65
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 66
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 67
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 68
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 69
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 70
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 71
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 72
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 73
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 74
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 75
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
```

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'
unit 76
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 77
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 78
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 79
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 80
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 81
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 82
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 83
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 84
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 85
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 86
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 87
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 88
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 89
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 90
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 91
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 92
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 93
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 94
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
```

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'
unit 95
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 96
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 97
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 98
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 99
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 100
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 101
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 102
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 103
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 104
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 105
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 106
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 107
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 108
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 109
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.1046  86.6775 0.0
'
unit 111
com='Fuel - Lower Clad + Moderator'
cylinder 2 1 0.7176 0.3175 0.0
cuboid 3 1 4p1.1046  0.3175 0.0
'
unit 112
com='Fuel - Lower PuO2/UO2 + UO2 + Clad + Moderator
+ Lattice Grid'
cylinder 1 1 0.6414    2.54 0.881
cylinder 5 1 0.6414    2.54 0.381
cylinder 2 1 0.7176    2.54 0.0
cuboid   3 1 4p1.02329 2.54 0.0
cuboid   4 1 4p1.1046 2.54 0.0
'
unit 113
com='Fuel - Upper PuO2/UO2 + Clad + Moderator +
Lattice Grid'
cylinder 1 1 0.6414    2.54 0.0
cylinder 2 1 0.7176    2.54 0.0
cuboid   3 1 4p1.02329 2.54 0.0
cuboid   4 1 4p1.1046 2.54 0.0
'
unit 114
```

```
com='Fuel - Upper PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414    0.0635 0.0
cylinder 2 1 0.7176    0.0635 0.0
cuboid   3 1 4p1.1046 0.0635 0.0
'
unit 115
com='Reflector - Lower Moderator'
cuboid 3 1 4p1.1046   0.3175 0.0
'
unit 116
com='Reflector - Lower Moderator + Lattice Grid'
cuboid   3 1 4p1.02329 2.54 0.0
cuboid   4 1 4p1.1046 2.54 0.0
'
unit 117
com='Reflector - Upper Moderator + Lattice Grid'
cuboid   3 1 4p1.02329 2.54 0.0
cuboid   4 1 4p1.1046 2.54 0.0
'
unit 118
com='Reflector - Upper Moderator'
cuboid   3 1 4p1.1046 0.0635 0.0
'
unit 120
com='Moderator'
cuboid 3 1 4p1.1046 86.6775 0.0
'
global unit 130
com='Cells in assembly'
array 1 -34.2426 -34.2426 0
cuboid 6 1 4p34.2426  92.9640  -2.8575
cuboid 7 1 4p34.2426  93.9165  -2.8575
replicate 3 2 6*3.0           4
replicate 3 6 4*3.0 1.462 3.0 1
replicate 3 7 4*3.0 0.0   3.0 5
end geometry
read array
ara=1 nux=31 nuy=31 nuz=5
fill
'Lower Cladding and Moderator
115 115 115 115 115 115 115 115 115 115 115 115 111
111 111 111 1b15
115 115 115 115 115 115 115 115 115 111 111 111 111
111 111 111 1b15
115 115 115 115 115 115 115 111 111 111 111 111 111
111 111 111 1b15
115 115 115 115 115 111 111 111 111 111 111 111 111
111 111 111 1b15
115 115 115 115 111 111 111 111 111 111 111 111 111
111 111 111 1b15
115 115 115 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
115 115 115 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
115 115 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
115 115 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
115 111 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
115 111 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
115 111 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
111 111 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
111 111 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
111 111 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b15
111 111 111 111 111 111 111 111 111 111 111 111 111
111 111 111 1b480
'Lower Lattice Grid
116 116 116 116 116 116 116 116 116 116 116 116 112
112 112 112 1b15
116 116 116 116 116 116 116 116 116 112 112 112 112
112 112 112 1b15
116 116 116 116 116 116 116 112 112 112 112 112 112
112 112 112 1b15
116 116 116 116 116 112 112 112 112 112 112 112 112
112 112 112 1b15
116 116 116 116 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 116 116 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 116 116 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 116 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 116 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 112 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 112 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
116 112 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
112 112 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
112 112 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
112 112 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b15
112 112 112 112 112 112 112 112 112 112 112 112 112
112 112 112 1b480
'Fuel and Reflector
120 120 120 120 120 120 120 120 120 120 120 120   1   2
3   4 1b15
120 120 120 120 120 120 120 120 120   5   6   7   8   9  10
11 1b15
120 120 120 120 120 120 120  12  13  14  15  16  17  18
19  20 1b15
120 120 120 120 120  21  22  23  24  25  26  27  28  29  30
31 1b15
```

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120 120 120 120  32  33  34  35  36  37  38  39  40  41  42
43 1b15
120 120 120  21  33  44  45  46  47  48  49  50  51  52  53
54 1b15
120 120 120  22  34  45  55  56  57  58  59  60  61  62  63
64 1b15
120 120  12  23  35  46  56  65  66  67  68  69  70  71  72
73 1b15
120 120  13  24  36  47  57  66  74  75  76  77  78  79  80
81 1b15
120   5  14  25  37  48  58  67  75  82  83  84  85  86  87  88
1b15
120   6  15  26  38  49  59  68  76  83  89  90  91  92  93  94
1b15
120   7  16  27  39  50  60  69  77  84  90  95  96  97  98  99
1b15
1   8  17  28  40  51  61  70  78  85  91  96 100 101 102
103 1b15
2   9  18  29  41  52  62  71  79  86  92  97 101 104 105
106 1b15
3  10  19  30  42  53  63  72  80  87  93  98 102 105 107
108 1b15
4  11  20  31  43  54  64  73  81  88  94  99 103 106 108
109 1b480
'Upper Lattice Grid
117 117 117 117 117 117 117 117 117 117 117 117 113
113 113 113 1b15
117 117 117 117 117 117 117 117 117 113 113 113 113
113 113 113 1b15
117 117 117 117 117 117 117 113 113 113 113 113 113
113 113 113 1b15
117 117 117 117 117 113 113 113 113 113 113 113 113
113 113 113 1b15
117 117 117 117 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 117 117 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 117 117 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 117 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 117 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
117 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
113 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
113 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
113 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b15
113 113 113 113 113 113 113 113 113 113 113 113 113
113 113 113 1b480
'Upper Cladding and Moderator
114 114 114 114 114 114 114 114 114 114 114 114 118
118 118 118 1b15
114 114 114 114 114 114 114 114 114 118 118 118 118
118 118 118 1b15
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118 118 118 118 118 118 118 118 118 118 118 118 118
118 118 118 1b15
118 118 118 118 118 118 118 118 118 118 118 118 118
118 118 118 1b480
end fill
end array
read bias  id=500 2 11  end bias
read plot
ttl='x-z plot at y=0.0'
xul=-50.0 yul=0.  zul=110
xlr=50.0  ylr=0.  zlr=-10.
uax=1.0 wdn=-1.0
nax=600 end plt0
ttl='x-y plot at z=25.0'
pic=mix
xul=-30.0 yul=30.  zul=25.
xlr=30.0  ylr=-30. zlr=25.
uax=1.0 vdn=-1.0
nax=600 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/pnl33.xs04
cp ft64f001  $RTNDIR/pnl33.rs64
end
=kmart
read initial   kunit=64
```

```
xunit=4
actbygrp
rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92236 27 92236 18  92236  1452
92238 27 92238 18  92238  1452
94238 27 94238 18  94238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
40000 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
28000 27
24000 27
26000 27
5010 27
5011 27
8016 27
1001 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end


=csasc5           parm=(size=1000000)
pnl-34 fuel
238group latticecell
'MOX fuel
u-235   1  0  1.4886-4  295  end
u-238   1  0  2.0611-2  295  end
o       1  0  4.3779-2  295  end
u-234   1  0  1.2458-6  295  end
u-236   1  0  2.0936-9  295  end
pu-238  1  0  3.8836-8  295  end
pu-239  1  0  3.9262-4  295  end
pu-240  1  0  3.3206-5  295  end
pu-241  1  0  1.6081-6  295  end
pu-242  1  0  1.1882-7  295  end
am-241  1  0  1.4891-6  295  end
'clad (ZR-2)
zr      2  0  4.2621-2  295  end
sn      2  0  4.8328-4  295  end
ni      2  0  3.0336-5  295  end
cr      2  0  7.6093-5  295  end
fe      2  0  9.5642-5  295  end
'water(Refletor)
h     3  0  6.6706-2  295  end
o     3  0  3.3353-2  295  end
b-10  3  0  1.7606-8  295  end
b-11  3  0  7.1313-8  295  end
'Lattice Grid
si      4  0  3.4607-4  295  end
fe      4  0  1.0152-4  295  end
cu      4  0  6.3731-5  295  end
mn      4  0  2.2115-5  295  end
mg      4  0  6.6651-4  295  end
cr      4  0  6.2310-5  295  end
ti      4  0  2.5375-5  295  end
al      4  0  5.8433-2  295  end
'UO2
u-234   5  0  1.2406-6  295  end
u-235   5  0  1.4824-4  295  end
u-236   5  0  2.0848-9  295  end
u-238   5  0  2.0525-2  295  end
o       5  0  4.1943-2  295  end
'Aluminum
si      6  0  3.4607-4  295  end
fe      6  0  1.0152-4  295  end
cu      6  0  6.3731-5  295  end
mn      6  0  2.2115-5  295  end
mg      6  0  6.6651-4  295  end
cr      6  0  6.2310-5  295  end
ti      6  0  2.5375-5  295  end
al      6  0  5.8433-2  295  end
'lead
pb      7  0  3.2174-2  295  end
end comp
squarepitch  2.51447  1.2827  1 2  1.4351  3  end
more data
limcen=20000000
end more
PNL-34
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
plt=no lng=2000000
end param
read geometry
'
unit 1
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
```

```
'
unit 2
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 3
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 4
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 5
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 6
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 7
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 8
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 9
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 10
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 11
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 12
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 13
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 14
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 15
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 16
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 17
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 18
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 19
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 20
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
```

```
'
unit 21
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 22
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 23
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 24
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 25
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 26
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 27
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 31
com='Fuel - Lower Clad + Moderator'
cylinder 2 1 0.7176 0.3175 0.0
cuboid 3 1 4p1.257235  0.3175 0.0
'
unit 32
com='Fuel - Lower PuO2/UO2 + UO2 + Clad + Moderator
+ Lattice Grid'
cylinder 1 1 0.6414    2.54 0.881
cylinder 5 1 0.6414    2.54 0.381
cylinder 2 1 0.7176    2.54 0.0
cuboid   3 1 4p0.939735 2.54 0.0
cuboid   4 1 4p1.257235   2.54 0.0
'
unit 33
com='Fuel - Upper PuO2/UO2 + Clad + Moderator +
Lattice Grid'
cylinder 1 1 0.6414    2.54 0.0
cylinder 2 1 0.7176    2.54 0.0
cuboid   3 1 4p0.939735 2.54 0.0
cuboid   4 1 4p1.257235   2.54 0.0
'
unit 34
com='Fuel - Upper PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414  0.0635 0.0
cylinder 2 1 0.7176  0.0635 0.0
cuboid   3 1 4p1.257235 0.0635 0.0
'
unit 35
com='Reflector - Lower Moderator'
cuboid 3 1 4p1.257235  0.3175 0.0
'
unit 36
com='Reflector - Lower Moderator + Lattice Grid'
cuboid   3 1 4p0.939735 2.54 0.0
cuboid   4 1 4p1.257235   2.54 0.0
'
unit 37
com='Reflector - Upper Moderator + Lattice Grid'
cuboid   3 1 4p0.939735 2.54 0.0
cuboid   4 1 4p1.257235   2.54 0.0
'
unit 38
com='Reflector - Upper Moderator'
cuboid   3 1 4p1.257235 0.0635 0.0
'
unit 40
com='Moderator'
cuboid 3 1 4p1.257235 86.6775 0.0
'
global unit 50
com='Cells in assembly'
array 1 -21.372995 -21.372995 0
cuboid 6 1 4p21.372995  92.9640  -2.8575
cuboid 7 1 4p21.372995  93.9165  -2.8575
replicate 3 2 4*3.0 0.508 3.0 1
replicate 3 3 4*3.0 0.0   3.0 9
end geometry
read array
ara=1 nux=17 nuy=17 nuz=5
fill
'Lower Cladding and Moderator
35 35 35 35 35 35 35 35 31 1b8
35 35 35 35 35 35 35 31 31 1b8
35 35 35 35 35 31 31 31 31 1b8
35 35 35 35 31 31 31 31 31 1b8
35 35 35 31 31 31 31 31 31 1b8
35 35 31 31 31 31 31 31 31 1b8
35 35 31 31 31 31 31 31 31 1b8
35 31 31 31 31 31 31 31 31 1b8
31 31 31 31 31 31 31 31 31 1b144
```

```
'Lower Lattice Grid
36 36 36 36 36 36 36 36 32 1b8
36 36 36 36 36 36 36 32 32 1b8
36 36 36 36 36 32 32 32 32 1b8
36 36 36 36 32 32 32 32 32 1b8
36 36 36 32 32 32 32 32 32 1b8
36 36 32 32 32 32 32 32 32 1b8
36 36 32 32 32 32 32 32 32 1b8
36 32 32 32 32 32 32 32 32 1b8
32 32 32 32 32 32 32 32 32 1b144
'Fuel and Reflector
40 40 40 40 40 40 40 40  1 1b8
40 40 40 40 40 40 40  2  3 1b8
40 40 40 40 40  4  5  6  7 1b8
40 40 40 40  8  9 10 11 12 1b8
40 40 40  8 13 14 15 16 17 1b8
40 40  4  9 14 18 19 20 21 1b8
40 40  5 10 15 19 22 23 24 1b8
40  2  6 11 16 20 23 25 26 1b8
 1  3  7 12 17 21 24 26 27 1b144
'Upper Lattice Grid
37 37 37 37 37 37 37 37 33 1b8
37 37 37 37 37 37 37 33 33 1b8
37 37 37 37 37 33 33 33 33 1b8
37 37 37 37 33 33 33 33 33 1b8
37 37 37 33 33 33 33 33 33 1b8
37 37 33 33 33 33 33 33 33 1b8
37 37 33 33 33 33 33 33 33 1b8
37 33 33 33 33 33 33 33 33 1b8
33 33 33 33 33 33 33 33 33 1b144
'Upper Cladding and Moderator
38 38 38 38 38 38 38 38 34 1b8
38 38 38 38 38 38 38 34 34 1b8
38 38 38 38 38 34 34 34 34 1b8
38 38 38 38 34 34 34 34 34 1b8
38 38 38 34 34 34 34 34 34 1b8
38 38 34 34 34 34 34 34 34 1b8
38 38 34 34 34 34 34 34 34 1b8
38 34 34 34 34 34 34 34 34 1b8
34 34 34 34 34 34 34 34 34 1b144
end fill
end array
read bias  id=500 2 11  end bias
read plot
ttl='x-z plot at y=0.0'
xul=-30.0 yul=0.  zul=110
xlr=30.0  ylr=0.  zlr=-10.
uax=1.0 wdn=-1.0
nax=600 end plt0
ttl='x-y plot at z=25.0'
pic=mix
xul=-30.0 yul=30.  zul=25.
xlr=30.0  ylr=-30. zlr=25.
uax=1.0 vdn=-1.0
nax=600 end plt1
end plot
end data
```

```
end
=shell
cp ft04f001  $RTNDIR/pnl34.xs04
cp ft64f001  $RTNDIR/pnl34.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92236 27 92236 18  92236  1452
92238 27 92238 18  92238  1452
94238 27 94238 18  94238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
40000 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
28000 27
24000 27
26000 27
5010 27
5011 27
8016 27
1001 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end


=csasc5          parm=(size=1000000)
pnl-35 fuel
238group latticecell
'MOX fuel
u-235   1  0  1.4886-4  295  end
u-238   1  0  2.0611-2  295  end
```

```
o       1  0  4.3779-2  295  end
u-234   1  0  1.2458-6  295  end
u-236   1  0  2.0936-9  295  end
pu-238  1  0  3.8836-8  295  end
pu-239  1  0  3.9262-4  295  end
pu-240  1  0  3.3206-5  295  end
pu-241  1  0  1.6081-6  295  end
pu-242  1  0  1.1882-7  295  end
am-241  1  0  1.4891-6  295  end
'clad (ZR-2)
zr      2  0  4.2621-2  295  end
sn      2  0  4.8328-4  295  end
ni      2  0  3.0336-5  295  end
cr      2  0  7.6093-5  295  end
fe      2  0  9.5642-5  295  end
'water(Refletor)
h       3  0  6.6682-2  295  end
o       3  0  3.3405-2  295  end
b-10    3  0  8.4597-6  295  end
b-11    3  0  3.4266-5  295  end
'Lattice Grid
si      4  0  3.4607-4  295  end
fe      4  0  1.0152-4  295  end
cu      4  0  6.3731-5  295  end
mn      4  0  2.2115-5  295  end
mg      4  0  6.6651-4  295  end
cr      4  0  6.2310-5  295  end
ti      4  0  2.5375-5  295  end
al      4  0  5.8433-2  295  end
'UO2
u-234   5  0  1.2406-6  295  end
u-235   5  0  1.4824-4  295  end
u-236   5  0  2.0848-9  295  end
u-238   5  0  2.0525-2  295  end
o       5  0  4.1943-2  295  end
'Aluminum
si      6  0  3.4607-4  295  end
fe      6  0  1.0152-4  295  end
cu      6  0  6.3731-5  295  end
mn      6  0  2.2115-5  295  end
mg      6  0  6.6651-4  295  end
cr      6  0  6.2310-5  295  end
ti      6  0  2.5375-5  295  end
al      6  0  5.8433-2  295  end
'lead
pb      7  0  3.2174-2  295  end
end comp
squarepitch  2.51447  1.2827  1 2  1.4351  3  end
more data
limcen=20000000
end more
PNL-35
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
plt=no lng=2000000
end param
read geometry
'
unit 1
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 2
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 3
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 4
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 5
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 6
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 7
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 8
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 9
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 10
```

```
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 11
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 12
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 13
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 14
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 15
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 16
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 17
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 18
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 19
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 20
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 21
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 22
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 23
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 24
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 25
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 26
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 27
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 28
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 29
```

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com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 30
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 31
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 32
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 33
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 34
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 35
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 36
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 37
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 38
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 39
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 40
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 41
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 42
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 43
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 44
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 45
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 46
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 47
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 48
```

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com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 49
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 50
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 51
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 52
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 53
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 54
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 55
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 56
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 57
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 58
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 59
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 60
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 61
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 62
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 63
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 64
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 65
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 66
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 67
```

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com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 68
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 69
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 70
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 71
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 72
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 73
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 74
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 75
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 76
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 77
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 78
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 79
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 80
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 81
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 82
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 83
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 84
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 85
com='PuO2/UO2 + Clad + Moderator'
cylinder 1 1 0.6414 86.6775 0.0
cylinder 2 1 0.7176 86.6775 0.0
cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 86
```

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com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 87
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 88
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 89
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 90
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 91
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 92
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 93
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 94
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 95
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 96
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 97
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 98
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.0
'
unit 99
com='PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414 86.6775 0.0
  cylinder 2 1 0.7176 86.6775 0.0
 cuboid 3 1 4p1.257235  86.6775 0.
'
unit 101
com='Fuel - Lower Clad + Moderator'
  cylinder 2 1 0.7176 0.3175 0.0
 cuboid 3 1 4p1.257235  0.3175 0.0
'
unit 102
com='Fuel - Lower PuO2/UO2 + UO2 + Clad + Moderator
 + Lattice Grid'
  cylinder 1 1 0.6414    2.54 0.881
  cylinder 5 1 0.6414    2.54 0.381
  cylinder 2 1 0.7176    2.54 0.0
  cuboid   3 1 4p0.939735 2.54 0.0
  cuboid   4 1 4p1.257235 2.54 0.0
'
unit 103
com='Fuel - Upper PuO2/UO2 + Clad + Moderator +
 Lattice Grid'
  cylinder 1 1 0.6414    2.54 0.0
  cylinder 2 1 0.7176    2.54 0.0
  cuboid   3 1 4p0.939735 2.54 0.0
  cuboid   4 1 4p1.257235 2.54 0.0
'
unit 104
com='Fuel - Upper PuO2/UO2 + Clad + Moderator'
  cylinder 1 1 0.6414    0.0635 0.0
  cylinder 2 1 0.7176    0.0635 0.0
  cuboid   3 1 4p1.257235 0.0635 0.0
'
unit 105
com='Reflector - Lower Moderator'
 cuboid 3 1 4p1.257235   0.3175 0.0
```

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'
unit 106
com='Reflector - Lower Moderator + Lattice Grid'
cuboid   3 1 4p0.939735 2.54 0.0
cuboid   4 1 4p1.257235 2.54 0.0
'
unit 107
com='Reflector - Upper Moderator + Lattice Grid'
cuboid   3 1 4p0.939735 2.54 0.0
cuboid   4 1 4p1.257235 2.54 0.0
'
unit 108
com='Reflector - Upper Moderator'
cuboid   3 1 4p1.257235 0.0635 0.0
'
unit 110
com='Moderator'
cuboid 3 1 4p1.257235 86.6775 0.0
'
global unit 120
com='Cells in assembly'
array 1 -36.459815 -36.459815 0
cuboid 6 1 4p36.459815  92.9640  -2.8575
cuboid 7 1 4p36.459815  93.9165  -2.8575
replicate 3 2 6*3.0           4
replicate 3 6 4*3.0 1.462 3.0 1
replicate 3 7 4*3.0 0.0   3.0 5
end geometry
read array
ara=1 nux=29 nuy=29 nuz=5
fill
'Lower Cladding and Moderator
105 105 105 105 105 105 105 105 105 101 101 101 101
101 101 1b14
105 105 105 105 105 105 105 101 101 101 101 101 101
101 101 1b14
105 105 105 105 105 105 101 101 101 101 101 101 101
101 101 1b14
105 105 105 105 105 101 101 101 101 101 101 101 101
101 101 1b14
105 105 105 105 101 101 101 101 101 101 101 101 101
101 101 1b14
105 105 105 101 101 101 101 101 101 101 101 101 101
101 101 1b14
105 105 101 101 101 101 101 101 101 101 101 101 101
101 101 1b14
105 101 101 101 101 101 101 101 101 101 101 101 101
101 101 1b14
105 101 101 101 101 101 101 101 101 101 101 101 101
101 101 1b14
101 101 101 101 101 101 101 101 101 101 101 101 101
101 101 1b14
101 101 101 101 101 101 101 101 101 101 101 101 101
101 101 1b14
101 101 101 101 101 101 101 101 101 101 101 101 101
101 101 1b14
101 101 101 101 101 101 101 101 101 101 101 101 101
101 101 1b14
101 101 101 101 101 101 101 101 101 101 101 101 101
101 101 1b14
101 101 101 101 101 101 101 101 101 101 101 101 101
101 101 1b420
'Lower Lattice Grid
106 106 106 106 106 106 106 106 106 102 102 102 102
102 102 1b14
106 106 106 106 106 106 106 102 102 102 102 102 102
102 102 1b14
106 106 106 106 106 106 102 102 102 102 102 102 102
102 102 1b14
106 106 106 106 106 102 102 102 102 102 102 102 102
102 102 1b14
106 106 106 106 102 102 102 102 102 102 102 102 102
102 102 1b14
106 106 106 102 102 102 102 102 102 102 102 102 102
102 102 1b14
106 106 102 102 102 102 102 102 102 102 102 102 102
102 102 1b14
106 102 102 102 102 102 102 102 102 102 102 102 102
102 102 1b14
106 102 102 102 102 102 102 102 102 102 102 102 102
102 102 1b14
102 102 102 102 102 102 102 102 102 102 102 102 102
102 102 1b14
102 102 102 102 102 102 102 102 102 102 102 102 102
102 102 1b14
102 102 102 102 102 102 102 102 102 102 102 102 102
102 102 1b14
102 102 102 102 102 102 102 102 102 102 102 102 102
102 102 1b14
102 102 102 102 102 102 102 102 102 102 102 102 102
102 102 1b14
102 102 102 102 102 102 102 102 102 102 102 102 102
102 102 1b420
'Fuel and Reflector
110 110 110 110 110 110 110 110 110   1   2   3   4   5   6
1b14
110 110 110 110 110 110 110   7   8   9  10  11  12  13  14
1b14
110 110 110 110 110 110  15  16  17  18  19  20  21  22  23
1b14
110 110 110 110 110  24  25  26  27  28  29  30  31  32  33
1b14
110 110 110 110  34  35  36  37  38  39  40  41  42  43  44
1b14
110 110 110  24  35  45  46  47  48  49  50  51  52  53  54
1b14
110 110  15  25  36  46  55  56  57  58  59  60  61  62  63
1b14
110   7  16  26  37  47  56  64  65  66  67  68  69  70  71
1b14
110   8  17  27  38  48  57  65  72  73  74  75  76  77  78
1b14
  1   9  18  28  39  49  58  66  73  79  80  81  82  83  84
1b14
```

```
2 10 19 29 40 50 59 67 74 80 85 86 87 88 89
1b14
3 11 20 30 41 51 60 68 75 81 86 90 91 92 93
1b14
4 12 21 31 42 52 61 69 76 82 87 91 94 95 96
1b14
5 13 22 32 43 53 62 70 77 83 88 92 95 97 98
1b14
6 14 23 33 44 54 63 71 78 84 89 93 96 98 99
1b420
'Upper Lattice Grid
107 107 107 107 107 107 107 107 107 103 103 103 103
103 103 1b14
107 107 107 107 107 107 107 103 103 103 103 103 103
103 103 1b14
107 107 107 107 107 107 103 103 103 103 103 103 103
103 103 1b14
107 107 107 107 107 103 103 103 103 103 103 103 103
103 103 1b14
107 107 107 107 103 103 103 103 103 103 103 103 103
103 103 1b14
107 107 107 103 103 103 103 103 103 103 103 103 103
103 103 1b14
107 107 103 103 103 103 103 103 103 103 103 103 103
103 103 1b14
107 103 103 103 103 103 103 103 103 103 103 103 103
103 103 1b14
107 103 103 103 103 103 103 103 103 103 103 103 103
103 103 1b14
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103 103 1b14
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103 103 1b14
103 103 103 103 103 103 103 103 103 103 103 103 103
103 103 1b14
103 103 103 103 103 103 103 103 103 103 103 103 103
103 103 1b14
103 103 103 103 103 103 103 103 103 103 103 103 103
103 103 1b420
'Upper Cladding and Moderator
108 108 108 108 108 108 108 108 108 104 104 104 104
104 104 1b14
108 108 108 108 108 108 108 104 104 104 104 104 104
104 104 1b14
108 108 108 108 108 108 104 104 104 104 104 104 104
104 104 1b14
108 108 108 108 108 104 104 104 104 104 104 104 104
104 104 1b14
108 108 108 108 104 104 104 104 104 104 104 104 104
104 104 1b14
108 108 108 104 104 104 104 104 104 104 104 104 104
104 104 1b14
108 108 104 104 104 104 104 104 104 104 104 104 104
104 104 1b14
108 104 104 104 104 104 104 104 104 104 104 104 104
104 104 1b14
108 104 104 104 104 104 104 104 104 104 104 104 104
104 104 1b14
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104 104 104 104 104 104 104 104 104 104 104 104 104
104 104 1b14
104 104 104 104 104 104 104 104 104 104 104 104 104
104 104 1b14
104 104 104 104 104 104 104 104 104 104 104 104 104
104 104 1b14
104 104 104 104 104 104 104 104 104 104 104 104 104
104 104 1b420
end fill
end array
read bias  id=500 2 11  end bias
read plot
ttl='x-z plot at y=0.0'
xul=-50.0 yul=0.  zul=110
xlr=50.0  ylr=0.  zlr=-10.
uax=1.0 wdn=-1.0
nax=600 end plt0
ttl='x-y plot at z=25.0'
pic=mix
xul=-30.0 yul=30.  zul=25.
xlr=30.0  ylr=-30. zlr=25.
uax=1.0 vdn=-1.0
nax=600 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/pnl35.xs04
cp ft64f001  $RTNDIR/pnl35.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92236 27 92236 18  92236  1452
92238 27 92238 18  92238  1452
94238 27 94238 18  94238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
40000 27
50112 27
50114 27
```

```
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
28000 27
24000 27
26000 27
5010 27
5011 27
8016 27
1001 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end
```

APPENDIX B

SCALE INPUT OF MIX-COMP-THERM-3 PROBLEM SET

APPENDIX B
SCALE INPUT OF MIX-COMP-THERM-3 PROBLEM SET

This appendix contains the CENTRM inputs for the six MIX-COMP-THERM-03 cases, SAXTON01 , SAXTON02, SAXTON03, SAXTON04, SAXTON05, and SAXTON06. The inputs can be changed to standard CSAS cases by replacing the =CSASC5 record with =CSAS25. The input for the cases are listed below.

```
=csasc5          parm=size=1000000
saxton 1 fuel
238group latticecell
'MOX fuel
pu-239  1  0  1.3526-3  299  end
pu-240  1  0  1.2759-4  299  end
pu-241  1  0  1.1407-5  299  end
pu-242  1  0  6.0318-7  299  end
am-241  1  0  1.7783-6  299  end
u-234   1  0  1.1688-6  299  end
u-235   1  0  1.5301-4  299  end
u-238   1  0  2.1097-2  299  end
o       1  0  4.5155-2  299  end
'clad (ZR-2)
zr      2  0  4.2517-2  299  end
sn      2  0  4.6590-4  299  end
cr      2  0  7.5977-5  299  end
fe      2  0  1.4148-4  299  end
o       2  0  2.9630-4  299  end
'water(Refletor)
h       3  0  6.6643-2  299  end
o       3  0  3.3322-2  299  end
'b-10   3  0  1.7606-8  299  end
'b-11   3  0  7.1313-8  299  end
'Middle Grid and H2O
al      4  .8004  299  end
h2o     4  .1996  299  end
'Aluminum
al      5  0  6.0039-2  295  end
end comp
squarepitch  1.3208  .856996  1 2 .99314  3  .87503  0   end
more data
limcen=20000000
end more
saxton 1
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
'
unit 1
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 2
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 3
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 4
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 5
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 6
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 7
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 8
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
```

```
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 9
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 10
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 11
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 12
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 13
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 14
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 15
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 16
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 17
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 18
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 19
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 20
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 21
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 22
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 23
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 24
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
```

```
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 25
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 26
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 27
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 28
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 29
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 30
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 31
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 32
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 33
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 34
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 35
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 36
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 37
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 38
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 39
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 40
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
```

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unit 41
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 42
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 43
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 44
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 45
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 46
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 47
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 48
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 49
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 50
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 51
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 52
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 53
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 54
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 55
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 56
com='Fuel + Gap + Clad + Moderator'
cylinder 1 1 0.428498 82.90 0.00
cylinder 0 1 0.437515 82.90 0.00
cylinder 2 1 0.49657 82.90 0.00
cylinder 2 1 0.49657 82.90 -1.27
cuboid 3 1 4p.6604 82.90 -1.27
unit 57
com='Fuel + Gap + Clad + Moderator'
```

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cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 58
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 59
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 60
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 61
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 62
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 63
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 64
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 65
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 66
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 67
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 68
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 69
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 70
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 71
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 72
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
                 unit 73
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
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cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 74
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 75
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 76
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 77
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 78
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 79
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 80
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 81
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 82
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 83
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 84
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 85
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 86
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 87
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 88
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
               unit 89
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
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cuboid     3  1  4p.6604   82.90 -1.27
unit 90
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 91
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 92
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 93
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 94
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 95
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 96
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 97
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 98
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 99
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 100
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 101
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 102
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 103
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 104
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 105
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 106
```

```
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 107
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 108
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 109
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 110
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 111
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 112
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 113
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 114
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 115
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 116
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 117
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 118
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 119
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 120
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 121
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 122
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
```

```
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 123
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 124
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 125
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 126
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 127
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 128
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 129
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 130
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 131
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
unit 132
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  82.90  0.00
cylinder   0  1  0.437515  82.90  0.00
cylinder   2  1  0.49657   82.90  0.00
cylinder   2  1  0.49657   82.90 -1.27
cuboid     3  1  4p.6604   82.90 -1.27
'
unit  141
com='Clad + Mod + AL Grid'
cylinder  2  1  0.49657   0.635  0.0
cylinder  3  1  0.50419   0.635  0.0
cuboid    5  1  4p.6604   0.635  0.0

unit 143
com='Fuel + Gap + Clad + Air'
cylinder  1  1  0.428498  10.064  0.0
cylinder  0  1  0.437515  10.064  0.0
cylinder  2  1  0.49657   10.064  0.0
cuboid    0  1  4p.6604   10.064  0.0
'
unit 144
com='Top Clad + Void'
cylinder  2  1  0.49657  1.016  0.0
cuboid    0  1  4p.6604  1.016  0.0
'
unit 145
com='Top Clad + Void + AL grid'
cylinder 2 1 0.49657  1.27  0.0
cylinder 0 1 0.50419  1.27  0.0
cuboid   5 1 4p.6604  1.27  0.0
'
unit 151
com='array of Clad + Mod + AL Grid + Reflector'
array  1  -15.1892 -14.5288 0.0
cuboid 4 1  2p45.1892  2p44.5288 0.635  0.0
'
unit 152
com='array of Fuel + Gap + Clad + Moderator + Reflector'
array  2  -15.1892 -14.5288 -1.27
cuboid 3 1  2p45.1892  2p44.5288 82.90  -1.27
'
unit 153
com='array of Fuel + Gap + Clad + Air'
array  3  -15.1892 -14.5288 0.0
cuboid 0 1  2p45.1892  2p44.5288 10.064  0.0
'
```

```
unit 154
com='array of Top Clad + Void'
array  4  -15.1892 -14.5288 0.0
cuboid 0 1  2p45.1892  2p44.5288 1.016  0.0
'
unit 155
com='array of Top Clad + Void + AL grid'
array  5  -15.1892 -14.5288 0.0
cuboid 4 1  2p45.1892  2p44.5288 1.27  0.0
'
global unit 160
com='array of arrays of fuel element sections + reflector'
array  6  -45.1892  -44.5288  0.0
cuboid  5  1  2p45.1892  2p44.5288  97.155   -2.54
cuboid  3  1  2p45.1892  2p44.5288  97.155   -8.89
cuboid  5  1  2p45.1892  2p44.5288  97.155  -13.97
cuboid  3  1  2p45.1892  2p44.5288  97.155  -43.97
end geom
'
read array
ara=1 nux=23 nuy=22 nuz=1
fill  f141  end fill
ara=2 nux=23 nuy=22 nuz=1
fill
1   2   3   4   5   6   7   8   9  10  11  12 1b11
13  14  15  16  17  18  19  20  21  22  23  24 1b11
25  26  27  28  29  30  31  32  33  34  35  36 1b11
37  38  39  40  41  42  43  44  45  46  47  48 1b11
49  50  51  52  53  54  55  56  57  58  59  60 1b11
61  62  63  64  65  66  67  68  69  70  71  72 1b11
73  74  75  76  77  78  79  80  81  82  83  84 1b11
85  86  87  88  89  90  91  92  93  94  95  96 1b11
97  98  99 100 101 102 103 104 105 106 107 108 1b11
109 110 111 112 113 114 115 116 117 118 119 120 1b11
121 122 123 124 125 126 127 128 129 130 131 132 1b11
1n253
end fill
ara=3 nux=23 nuy=22 nuz=1
fill f143 end fill
ara=4 nux=23 nuy=22 nuz=1
fill f144 end fill
ara=5 nux=23 nuy=22 nuz=1
fill f145 end fill
ara=6 nux=1  nuy=1  nuz=5
fill 151 152 153 154 155 end fill
end array
read plot
ttl='simple plot 1'
lpi=10 scr=yes pic=mix nax=400
xul= -20.0  yul= 0.6   zul= 100
xlr= 20.0  ylr= 0.6   zlr= -10
uax=1.0 wdn=-1.0 end plt0
ttl='simple plot 2'
pic=mix nax=400
xul= -20.0  yul= 20.   zul= 25.
xlr= 20.0  ylr= -20.  zlr= 25.
uax=1.0 vdn=-1.0 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/sax01.xs04
cp ft64f001  $RTNDIR/sax01.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92238 27 92238 18  92238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
5010 27
5011 27
8016 27
40000 27
24000 27
26000 27
1001 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end


=csasc5           parm=size=1000000
saxton 2 fuel
238group latticecell
'MOX fuel
pu-239  1  0  1.3526-3  290  end
pu-240  1  0  1.2759-4  290  end
pu-241  1  0  1.1407-5  290  end
```

```
pu-242  1  0  6.0318-7  290  end
am-241  1  0  1.7783-6  290  end
u-234   1  0  1.1688-6  290  end
u-235   1  0  1.5301-4  290  end
u-238   1  0  2.1097-2  290  end
o       1  0  4.5155-2  290  end
'clad (ZR-2)
zr      2  0  4.2517-2  290  end
sn      2  0  4.6590-4  290  end
cr      2  0  7.5977-5  290  end
fe      2  0  1.4148-4  290  end
o       2  0  2.9630-4  290  end
'water(Refletor)
h       3  0  6.6781-2  290  end
o       3  0  3.3390-2  290  end
'b-10   3  0  1.7606-8  290  end
'b-11   3  0  7.1313-8  290  end
'Middle Grid and H2O
al      4  .8458        290  end
h2o     4  .1542        290  end
'Aluminum
al      5  0  6.0039-2  290  end
end comp
squarepitch  1.4224  .856996  1 2 .99314  3  .87503  0   end
more data
limcen=20000000
end more
saxton 2
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
'
unit 1
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 2
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 3
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 4
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 5
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 6
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 7
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 8
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 9
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 10
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 11
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 12
com='Fuel + Gap + Clad + Moderator'
```

```
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 13
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 14
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 15
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 16
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 17
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 18
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 19
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 20
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 21
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 22
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 23
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 24
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 25
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 26
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 27
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                 unit 28
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
```

```
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 29
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 30
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 31
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 32
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 33
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 34
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 35
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 36
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 37
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 38
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 39
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 40
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 41
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 42
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 43
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
                unit 44
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
```

```
cuboid     3  1  4p.7112   80.80 -1.27
unit 45
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 46
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 47
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 48
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 49
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 50
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 51
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 52
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 53
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 54
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
unit 55
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  80.80  0.00
cylinder   0  1  0.437515  80.80  0.00
cylinder   2  1  0.49657   80.80  0.00
cylinder   2  1  0.49657   80.80 -1.27
cuboid     3  1  4p.7112   80.80 -1.27
'
unit  71
com='Clad + Mod + AL Grid'
cylinder  2  1  0.49657   0.635  0.0
cylinder  3  1  0.50419   0.635  0.0
cuboid    5  1  4p.7112   0.635  0.0
'
unit 73
com='Fuel + Gap + Clad + Air'
cylinder  1  1  0.428498  12.164  0.0
cylinder  0  1  0.437515  12.164  0.0
cylinder  2  1  0.49657   12.164  0.0
cuboid    0  1  4p.7112   12.164  0.0
'
unit 74
com='Top Clad + Void'
cylinder  2  1  0.49657  1.016  0.0
cuboid    0  1  4p.7112  1.016  0.0
'
unit 75
com='Top Clad + Void + AL grid'
cylinder 2 1 0.49657  1.27  0.0
cylinder 0 1 0.50419  1.27  0.0
cuboid   5 1 4p.7112  1.27  0.0
'
unit 81
com='array of Clad + Mod + AL Grid + Reflector'
array  1  -13.5128 -13.5128 0.0
cuboid 4 1  4p43.5128 0.635  0.0
'
unit 82
com='array of Fuel + Gap + Clad + Moderator + Reflector'
array  2  -13.5128 -13.5128 -1.27
cuboid 3 1 4p43.5128  80.80  -1.27
'
unit 83
```

```
com='array of Fuel + Gap + Clad + Air'
array  3  -13.5128 -13.5128 0.0
cuboid 0 1  4p43.5128 12.164  0.0
'
unit 84
com='array of Top Clad + Void'
array  4  -13.5128 -13.5128 0.0
cuboid 0 1  4p43.5128 1.016  0.0
'
unit 85
com='array of Top Clad + Void + AL grid'
array  5  -13.5128 -13.5128 0.0
cuboid 4 1  4p43.5128 1.27  0.0
'
global unit 100
com='array of arrays of fuel element sections + reflector'
array  6  -43.5128  -43.5128  0.0
cuboid  5  1  4p43.5128  97.155   -2.54
cuboid  3  1  4p43.5128  97.155   -8.89
cuboid  5  1  4p43.5128  97.155  -13.97
cuboid  3  1  4p43.5128  97.155  -43.97
end geom
'
read array
ara=1 nux=19 nuy=19 nuz=1
fill  f71  end fill
ara=2 nux=19 nuy=19 nuz=1
fill
1  2  3  4  5  6  7  8  9 10  1b9
2 11 12 13 14 15 16 17 18 19  1b9
3 12 20 21 22 23 24 25 26 27  1b9
4 13 21 28 29 30 31 32 33 34  1b9
5 14 22 29 35 36 37 38 39 40  1b9
6 15 23 30 36 41 42 43 44 45  1b9
7 16 24 31 37 42 46 47 48 49  1b9
8 17 25 32 38 43 47 50 51 52  1b9
9 18 26 33 39 44 48 51 53 54  1b9
10 19 27 34 40 45 49 52 54 55  1b180
end fill
ara=3 nux=19 nuy=19 nuz=1
fill f73 end fill
ara=4 nux=19 nuy=19 nuz=1
fill f74 end fill
ara=5 nux=19 nuy=19 nuz=1
fill f75 end fill
ara=6 nux=1  nuy=1  nuz=5
fill 81 82 83 84 85 end fill
end array
read plot
ttl='simple plot 1'
lpi=10 scr=yes pic=mix nax=400
xul= -20.0  yul= 0.0  zul= 100
xlr= 20.0  ylr= 0.0  zlr= -10
uax=1.0 wdn=-1.0 end plt0
ttl='simple plot 2'
pic=mix nax=400
xul= -20.0  yul= 20.   zul= 25.
xlr= 20.0  ylr= -20.  zlr= 25.
uax=1.0 vdn=-1.0 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/sax02.xs04
cp ft64f001  $RTNDIR/sax02.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92238 27 92238 18  92238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
5010 27
5011 27
8016 27
40000 27
24000 27
26000 27
1001 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end


=csasc5          parm=size=1000000
saxton 3 fuel
238group latticecell
'MOX fuel
pu-239  1  0  1.3526-3  291  end
```

```
pu-240  1  0  1.2759-4  291  end
pu-241  1  0  1.1407-5  291  end
pu-242  1  0  6.0318-7  291  end
am-241  1  0  1.7783-6  291  end
u-234   1  0  1.1688-6  291  end
u-235   1  0  1.5301-4  291  end
u-238   1  0  2.1097-2  291  end
o       1  0  4.5155-2  291  end
'clad (ZR-2)
zr      2  0  4.2517-2  291  end
sn      2  0  4.6590-4  291  end
cr      2  0  7.5977-5  291  end
fe      2  0  1.4148-4  291  end
o       2  0  2.9630-4  291  end
'water(Refletor)
h       3  0  6.6751-2  291  end
o       3  0  3.3404-2  291  end
b-10    3  0  3.7338-6  291  end
b-11    3  0  1.5029-5  291  end
'Middle Grid and H2O
al      4  .8458        291  end
h2o     4  .1542        291  end
'Aluminum
al      5  0  6.0039-2  291  end
end comp
squarepitch  1.4224  .856996  1 2 .99314  3  .87503  0   end
more data
limcen=20000000
end more
saxton 3
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 2
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 3
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 4
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 5
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 6
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 7
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 8
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 9
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 10
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 11
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 12
```

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com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 13
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 14
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 15
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 16
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 17
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 18
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 19
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 20
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 21
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 22
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 23
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 24
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 25
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 26
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 27
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 28
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
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cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 29
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 30
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 31
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 32
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 33
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 34
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 35
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 36
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 37
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 38
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 39
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 40
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 41
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 42
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 43
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                 unit 44
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
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cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 45
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 46
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 47
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 48
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 49
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 50
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 51
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 52
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 53
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 54
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 55
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 56
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 57
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 58
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 59
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
                unit 60
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
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unit 61
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 62
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 63
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 64
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 65
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
unit 66
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  88.06  0.00
cylinder   0  1  0.437515  88.06  0.00
cylinder   2  1  0.49657   88.06  0.00
cylinder   2  1  0.49657   88.06 -1.27
cuboid     3  1  4p.7112   88.06 -1.27
'
unit  71
com='Clad + Mod + AL Grid'
cylinder  2  1  0.49657   0.635  0.0
cylinder  3  1  0.50419   0.635  0.0
cuboid    5  1  4p.7112   0.635  0.0
'
unit 73
com='Fuel + Gap + Clad + Air'
cylinder  1  1  0.428498   4.904  0.0
cylinder  0  1  0.437515   4.904  0.0
cylinder  2  1  0.49657    4.904  0.0
cuboid    0  1  4p.7112    4.904  0.0
'
unit 74
com='Top Clad + Void'
cylinder  2  1  0.49657  1.016  0.0
cuboid    0  1  4p.7112  1.016  0.0
'
unit 75
com='Top Clad + Void + AL grid'
cylinder 2 1 0.49657  1.27  0.0
cylinder 0 1 0.50419  1.27  0.0
cuboid   5 1 4p.7112  1.27  0.0
'
unit 81
com='array of Clad + Mod + AL Grid + Reflector'
array  1  -14.9499 -14.9499 0.0
cuboid 4 1  4p44.9499 0.635  0.0
'
unit 82
com='array of Fuel + Gap + Clad + Moderator + Reflector'
array  2  -14.9499 -14.9499 -1.27
cuboid 3 1 4p44.9499  88.06  -1.27
'
unit 83
com='array of Fuel + Gap + Clad + Air'
array  3  -14.9499 -14.9499 0.0
cuboid 0 1  4p44.9499 4.904  0.0
'
unit 84
com='array of Top Clad + Void'
array  4  -14.9499 -14.9499 0.0
cuboid 0 1  4p44.9499 1.016  0.0
'
unit 85
com='array of Top Clad + Void + AL grid'
array  5  -14.9499 -14.9499 0.0
cuboid 4 1  4p44.9499 1.27  0.0
'
global unit 100
com='array of arrays of fuel element sections + reflector'
array  6  -44.9499 -44.9499  0.0
cuboid  5  1  4p44.9499  97.155   -2.54
cuboid  3  1  4p44.9499  97.155   -8.89
cuboid  5  1  4p44.9499  97.155  -13.97
cuboid  3  1  4p44.9499  97.155  -43.97
end geom
'
read array
ara=1 nux=21 nuy=21 nuz=1
fill  f71  end fill
ara=2 nux=21 nuy=21 nuz=1
fill
1  2  3  4  5  6  7  8  9 10 11  1b 10
2 12 13 14 15 16 17 18 19 20 21  1b 10
3 13 22 23 24 25 26 27 28 29 30  1b 10
4 14 23 31 32 33 34 35 36 37 38  1b 10
5 15 24 32 39 40 41 42 43 44 45  1b 10
6 16 25 33 40 46 47 48 49 50 51  1b 10
7 17 26 34 41 47 52 53 54 55 56  1b 10
8 18 27 35 42 48 53 57 58 59 60  1b 10
```

```
9 19 28 36 43 49 54 58 61 62 63  1b 10
10 20 29 37 44 50 55 59 62 64 65  1b 10
11 21 30 38 45 51 56 60 63 65 66  1b 220
end fill
ara=3 nux=21 nuy=21 nuz=1
fill f73 end fill
ara=4 nux=21 nuy=21 nuz=1
fill f74 end fill
ara=5 nux=21 nuy=21 nuz=1
fill f75 end fill
ara=6 nux=1  nuy=1  nuz=5
fill 81 82 83 84 85 end fill
end array
read plot
ttl='simple plot 1'
lpi=10 scr=yes pic=mix nax=400
xul= -20.0  yul= 0.0  zul= 100
xlr= 20.0  ylr= 0.0   zlr= -10
uax=1.0 wdn=-1.0 end plt0
ttl='simple plot 2'
pic=mix nax=400
xul= -20.0  yul= 20.   zul= 25.
xlr= 20.0  ylr= -20.  zlr= 25.
uax=1.0 vdn=-1.0 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/sax03.xs04
cp ft64f001  $RTNDIR/sax03.rs64
end
=kmart
read initial   kunit=64
xunit=4
actbygrp
rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92238 27 92238 18  92238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
5010 27
5011 27
8016 27
40000 27
24000 27
26000 27
1001 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end

=csasc5           parm=size=1000000
saxton 4 fuel
238group latticecell
'MOX fuel
pu-239  1  0  1.3526-3  297  end
pu-240  1  0  1.2759-4  297  end
pu-241  1  0  1.1407-5  297  end
pu-242  1  0  6.0318-7  297  end
am-241  1  0  1.7783-6  297  end
u-234   1  0  1.1688-6  297  end
u-235   1  0  1.5301-4  297  end
u-238   1  0  2.1097-2  297  end
o       1  0  4.5155-2  297  end
'clad (ZR-2)
zr      2  0  4.2517-2  297  end
sn      2  0  4.6590-4  297  end
cr      2  0  7.5977-5  297  end
fe      2  0  1.4148-4  297  end
o       2  0  2.9630-4  297  end
'water(Refletor)
h       3  0  6.6673-2  297  end
o       3  0  3.3336-2  297  end
'b-10   3  0  3.7338-6  297  end
'b-11   3  0  1.5029-5  297  end
'Middle Grid and H2O
al      4  .93          297  end
h2o     4  .07          297  end
'Aluminum
al      5  0  6.0039-2  297  end
end comp
squarepitch  1.8679  .856996  1 2 .99314  3  .87503  0   end
more data
limcen=20000000
end more
saxton 4
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
```

```
read geometry
'
unit 1
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 2
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 3
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 4
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 5
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 6
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 7
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 8
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 9
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 10
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 11
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 12
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 13
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 14
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 15
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 16
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
```

```
unit 17
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 18
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 19
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 20
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 21
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 22
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 23
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 24
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 25
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 26
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 27
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
unit 28
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  68.41  0.00
cylinder   0  1  0.437515  68.41  0.00
cylinder   2  1  0.49657   68.41  0.00
cylinder   2  1  0.49657   68.41 -1.27
cuboid     3  1  4p.93395  68.41 -1.27
'
unit  71
com='Clad + Mod + AL Grid'
cylinder  2  1  0.49657   0.635  0.0
cylinder  3  1  0.50419   0.635  0.0
cuboid    5  1  4p.93395  0.635  0.0
'
unit 73
com='Fuel + Gap + Clad + Air'
cylinder  1  1  0.428498  24.554  0.0
cylinder  0  1  0.437515  24.554  0.0
cylinder  2  1  0.49657   24.554  0.0
cuboid    0  1  4p.93395  24.554  0.0
'
unit 74
com='Top Clad + Void'
cylinder  2  1  0.49657  1.016  0.0
cuboid    0  1  4p.93395 1.016  0.0
'
unit 75
com='Top Clad + Void + AL grid'
cylinder 2 1 0.49657  1.27  0.0
cylinder 0 1 0.50419  1.27  0.0
cuboid   5 1 4p.93395 1.27  0.0
'
unit 81
com='array of Clad + Mod + AL Grid + Reflector'
array  1  -12.14135 -12.14135 0.0
cuboid 4 1  4p42.14135 0.635  0.0
'
```

```
unit 82
com='array of Fuel + Gap + Clad + Moderator + Reflector'
array  2  -12.14135 -12.14135 -1.27
cuboid 3 1 4p42.14135  68.41  -1.27
'
unit 83
com='array of Fuel + Gap + Clad + Air'
array  3  -12.14135 -12.14135 0.0
cuboid 0 1  4p42.14135 24.554  0.0
'
unit 84
com='array of Top Clad + Void'
array  4  -12.14135 -12.14135 0.0
cuboid 0 1  4p42.14135 1.016  0.0
'
unit 85
com='array of Top Clad + Void + AL grid'
array  5  -12.14135 -12.14135 0.0
cuboid 4 1  4p42.14135 1.27  0.0
'
global unit 100
com='array of arrays of fuel element sections + reflector'
array  6  -42.14135 -42.14135  0.0
cuboid  0  1  4p42.14135  97.15501    0.00
cuboid  5  1  4p42.14135  97.15501   -2.54
cuboid  3  1  4p42.14135  97.15501   -8.89
cuboid  5  1  4p42.14135  97.15501  -13.97
cuboid  3  1  4p42.14135  97.15501  -43.97
end geom
'
read array
ara=1 nux=13 nuy=13 nuz=1
fill  f71  end fill
ara=2 nux=13 nuy=13 nuz=1
fill
1  2  3  4  5  6  7  1b6
2  8  9 10 11 12 13  1b6
3  9 14 15 16 17 18  1b6
4 10 15 19 20 21 22  1b6
5 11 16 20 23 24 25  1b6
6 12 17 21 24 26 27  1b6
7 13 18 22 25 27 28  1b84
end fill
ara=3 nux=13 nuy=13 nuz=1
fill f73 end fill
ara=4 nux=13 nuy=13 nuz=1
fill f74 end fill
ara=5 nux=13 nuy=13 nuz=1
fill f75 end fill
ara=6 nux=1  nuy=1  nuz=5
fill 81 82 83 84 85 end fill
end array
read plot
ttl='simple plot 1'
lpi=10 scr=yes pic=mix nax=400
xul= -20.0  yul= 0.0  zul= 100
xlr= 20.0  ylr= 0.0  zlr= -10
```

```
uax=1.0 wdn=-1.0 end plt0
ttl='simple plot 2'
pic=mix nax=400
xul= -20.0  yul= 20.   zul= 25.
xlr= 20.0  ylr= -20.  zlr= 25.
uax=1.0 vdn=-1.0 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/sax04.xs04
cp ft64f001  $RTNDIR/sax04.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92238 27 92238 18  92238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
5010 27
5011 27
8016 27
40000 27
24000 27
26000 27
1001 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end


=csasc5          parm=size=1000000
```

```
saxton 5 fuel
238group latticecell
'MOX fuel
pu-239  1  0  1.3526-3  289  end
pu-240  1  0  1.2759-4  289  end
pu-241  1  0  1.1407-5  289  end
pu-242  1  0  6.0318-7  289  end
am-241  1  0  1.7783-6  289  end
u-234   1  0  1.1688-6  289  end
u-235   1  0  1.5301-4  289  end
u-238   1  0  2.1097-2  289  end
o       1  0  4.5155-2  289  end
'clad (ZR-2)
zr      2  0  4.2517-2  289  end
sn      2  0  4.6590-4  298  end
cr      2  0  7.5977-5  289  end
fe      2  0  1.4148-4  289  end
o       2  0  2.9630-4  289  end
'water(Refletor)
h       3  0  6.6783-2  289  end
o       3  0  3.3392-2  289  end
'Middle Grid and H2O
al      4  .942        289  end
h2o     4  .058        289  end
'Aluminum
al      5  0  6.0039-2  289  end
end comp
squarepitch  2.01158  .856996  1 2 .99314  3  .87503  0
end
more data
limcen=20000000
end more
saxton 5
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
'
unit 1
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 2
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 3
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 4
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 5
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 6
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 7
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 8
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 9
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 10
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 11
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
```

```
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 12
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 13
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 14
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 15
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 16
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 17
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 18
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 19
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 20
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
unit 21
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498  76.76  0.00
cylinder   0  1  0.437515  76.76  0.00
cylinder   2  1  0.49657   76.76  0.00
cylinder   2  1  0.49657   76.76 -1.27
cuboid     3  1  4p1.00579  76.76 -1.27
'
unit  71
com='Clad + Mod + AL Grid'
cylinder  2  1  0.49657   0.635  0.0
cylinder  3  1  0.50419   0.635  0.0
cuboid    5  1  4p1.00579 0.635  0.0
'
unit 73
com='Fuel + Gap + Clad + Air'
cylinder  1  1  0.428498  16.204  0.0
cylinder  0  1  0.437515  16.204  0.0
cylinder  2  1  0.49657   16.204  0.0
cuboid    0  1  4p1.00579 16.204  0.0
'
unit 74
com='Top Clad + Void'
cylinder  2  1  0.49657  1.016  0.0
cuboid    0  1  4p1.00579 1.016  0.0
'
unit 75
com='Top Clad + Void + AL grid'
cylinder 2 1 0.49657  1.27  0.0
cylinder 0 1 0.50419  1.27  0.0
cuboid   5 1 4p1.00579 1.27  0.0
'
unit 81
com='array of Clad + Mod + AL Grid + Reflector'
array  1  -12.06948 -12.06948 0.0
cuboid 4 1  4p42.06948 0.635  0.0
'
unit 82
com='array of Fuel + Gap + Clad + Moderator + Reflector'
array  2  -12.06948 -12.06948 -1.27
cuboid 3 1 4p42.06948  76.76  -1.27
'
unit 83
com='array of Fuel + Gap + Clad + Air'
array  3  -12.06948 -12.06948 0.0
cuboid 0 1  4p42.06948 16.204  0.0
'
unit 84
```

```
com='array of Top Clad + Void'
array  4  -12.06948 -12.06948 0.0
cuboid 0 1  4p42.06948 1.016  0.0
'
unit 85
com='array of Top Clad + Void + AL grid'
array  5  -12.06948 -12.06948 0.0
cuboid 4 1  4p42.06948 1.27  0.0
'
global unit 100
com='array of arrays of fuel element sections + reflector'
array  6  -42.06948 -42.06948  0.0
cuboid  5  1  4p42.06948  97.15500   -2.54
cuboid  3  1  4p42.06948  97.15500   -8.89
cuboid  5  1  4p42.06948  97.15500  -13.97
cuboid  3  1  4p42.06948  97.15500  -43.97
end geom
'
read array
ara=1 nux=12 nuy=12 nuz=1
fill  f71  end fill
ara=2 nux=12 nuy=12 nuz=1
fill
1  2  3  4  5  6  n6
2  7  8  9 10 11  n6
3  8 12 13 14 15  n6
4  9 13 16 17 18  n6
5 10 14 17 19 20  n6
6 11 15 18 20 21  n6
n72
end fill
ara=3 nux=12 nuy=12 nuz=1
fill f73 end fill
ara=4 nux=12 nuy=12 nuz=1
fill f74 end fill
ara=5 nux=12 nuy=12 nuz=1
fill f75 end fill
ara=6 nux=1  nuy=1  nuz=5
fill 81 82 83 84 85 end fill
end array
read plot
ttl='simple plot 1'
lpi=10 scr=yes pic=mix nax=400
xul= -20.0  yul= 1.006  zul= 100
xlr= 20.0  ylr= 1.006  zlr= -10
uax=1.0 wdn=-1.0 end plt0
ttl='simple plot 2'
pic=mix nax=400
xul= -20.0  yul= 20.   zul= 25.
xlr= 20.0  ylr= -20.  zlr= 25.
uax=1.0 vdn=-1.0 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/sax05.xs04
cp ft64f001  $RTNDIR/sax05.rs64
end
=kmart
read initial   kunit=64
xunit=4
actbygrp
rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92238 27 92238 18  92238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
5010 27
5011 27
8016 27
40000 27
24000 27
26000 27
1001 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end

=csasc5           parm=size=1000000
saxton 6 fuel
238group latticecell
'MOX fuel
pu-239  1  0  1.3526-3  293  end
pu-240  1  0  1.2759-4  293  end
pu-241  1  0  1.1407-5  293  end
pu-242  1  0  6.0318-7  293  end
am-241  1  0  1.7783-6  293  end
u-234   1  0  1.1688-6  293  end
u-235   1  0  1.5301-4  293  end
u-238   1  0  2.1097-2  293  end
o       1  0  4.5155-2  293  end
```

```
'clad (ZR-2)
zr      2  0  4.2517-2  293  end
sn      2  0  4.6590-4  293  end
cr      2  0  7.5977-5  293  end
fe      2  0  1.4148-4  293  end
o       2  0  2.9630-4  293  end
'water(Refletor)
h       3  0  6.6737-2  293  end
o       3  0  3.3368-2  293  end
'Middle Grid and H2O
al      4  .969         293  end
h2o     4  .031         293  end
'Aluminum
al      5  0  6.0039-2  293  end
end comp
squarepitch  2.6416  .856996  1 2 .99314  3  .87503  0   end
more data
limcen=20000000
end more
saxton 6
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
'
unit 1
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 2
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 3
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 4
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 5
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 6
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 7
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 8
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 9
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 10
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 11
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 12
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
cylinder   0  1  0.437515 79.50  0.00
cylinder   2  1  0.49657  79.50  0.00
cylinder   2  1  0.49657  79.50 -1.27
cuboid     3  1  4p1.3208 79.50 -1.27
unit 13
com='Fuel + Gap + Clad + Moderator'
cylinder   1  1  0.428498 79.50  0.00
```

```
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 14
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 15
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 16
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 17
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 18
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 19
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 20
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 21
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 22
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 23
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 24
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 25
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 26
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 27
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                unit 28
com='Fuel + Gap + Clad + Moderator'
 cylinder   1  1  0.428498 79.50  0.00
 cylinder   0  1  0.437515 79.50  0.00
 cylinder   2  1  0.49657  79.50  0.00
 cylinder   2  1  0.49657  79.50 -1.27
 cuboid     3  1  4p1.3208 79.50 -1.27
                '
                unit  71
      com='Clad + Mod + AL Grid'
   cylinder  2  1  0.49657   0.635  0.0
   cylinder  3  1  0.50419   0.635  0.0
```

```
cuboid    5  1  4p1.3208  0.635  0.0
'
unit 73
com='Fuel + Gap + Clad + Air'
cylinder  1  1  0.428498  13.464  0.0
cylinder  0  1  0.437515  13.464  0.0
cylinder  2  1  0.49657   13.464  0.0
cuboid    0  1  4p1.3208  13.464  0.0
'
unit 74
com='Top Clad + Void'
cylinder  2  1  0.49657  1.016  0.0
cuboid    0  1  4p1.3208 1.016  0.0
'
unit 75
com='Top Clad + Void + AL grid'
cylinder 2 1 0.49657  1.27  0.0
cylinder 0 1 0.50419  1.27  0.0
cuboid   5 1 4p1.3208 1.27  0.0
'
unit 81
com='array of Clad + Mod + AL Grid + Reflector'
array  1  -14.5288 -14.5288 0.0
cuboid 4 1  4p44.5288 0.635  0.0
'
unit 82
com='array of Fuel + Gap + Clad + Moderator + Reflector'
array  2  -14.5288 -14.5288 -1.27
cuboid 3 1 4p44.5288 79.50  -1.27
'
unit 83
com='array of Fuel + Gap + Clad + Air'
array  3  -14.5288 -14.5288 0.0
cuboid 0 1  4p44.5288 13.464  0.0
'
unit 84
com='array of Top Clad + Void'
array  4  -14.5288 -14.5288 0.0
cuboid 0 1  4p44.5288 1.016  0.0
'
unit 85
com='array of Top Clad + Void + AL grid'
array  5  -14.5288 -14.5288 0.0
cuboid 4 1  4p44.5288 1.27  0.0
'
global unit 100
com='array of arrays of fuel element sections + reflector'
array  6  -44.5288 -44.5288  0.0
cuboid  5  1  4p44.5288  97.15500   -2.54
cuboid  3  1  4p44.5288  97.15500   -8.89
cuboid  5  1  4p44.5288  97.15500  -13.97
cuboid  3  1  4p44.5288  97.15500  -43.97
end geom
'
read array
ara=1 nux=11 nuy=11 nuz=1
fill  f71  end fill
ara=2 nux=11 nuy=11 nuz=1
fill
1  2  3  4  5  6  1b5
2  7  8  9 10 11  1b5
3  8 12 13 14 15  1b5
4  9 13 16 17 18  1b5
5 10 14 17 19 20  1b5
6 11 15 18 20 21  1b60
end fill
ara=3 nux=11 nuy=11 nuz=1
fill f73 end fill
ara=4 nux=11 nuy=11 nuz=1
fill f74 end fill
ara=5 nux=11 nuy=11 nuz=1
fill f75 end fill
ara=6 nux=1  nuy=1  nuz=5
fill 81 82 83 84 85 end fill
end array
read plot
ttl='simple plot 1'
lpi=10 scr=yes pic=mix nax=400
xul= -20.0  yul= 0.0  zul= 100
xlr= 20.0  ylr= 0.0  zlr= -10
uax=1.0 wdn=-1.0 end plt0
ttl='simple plot 2'
pic=mix nax=400
xul= -20.0  yul= 20.   zul= 25.
xlr= 20.0  ylr= -20.  zlr= 25.
uax=1.0 vdn=-1.0 end plt1
end plot
end data
end
=shell
cp ft04f001  $RTNDIR/sax06.xs04
cp ft64f001  $RTNDIR/sax06.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
92234 27 92234 18  92234  1452
92235 27 92235 18  92235  1452
92238 27 92238 18  92238  1452
94239 27 94239 18  94239  1452
94240 27 94240 18  94240  1452
94241 27 94241 18  94241  1452
94242 27 94242 18  94242  1452
95241 27 95241 18  95241  1452
5010 27
5011 27
8016 27
40000 27
24000 27
26000 27
```

```
1001 27
50112 27
50114 27
50115 27
50116 27
50117 27
50118 27
50119 27
50120 27
50122 27
50124 27
end activity
read collapse
factor=1.0
lastg=57
lastg=148
lastg=204
lastg=238
end collapse
end
```

APPENDIX C

SCALE INPUT OF MIX-COMP-THERM-4 PROBLEM SET

APPENDIX C
SCALE INPUT OF MIX-COMP-THERM-4 PROBLEM SET

This appendix contains the CENTRM inputs for the eleven MIX-COMP-THERM-04 cases, TCA01, TCA02, TCA03, TCA04, TCA05, TCA06, TCA07, TCA08, TCA09, TCA10, and TCA11. The inputs can be changed to standard CSAS cases by replacing the =CSASC5 record with =CSAS25.

```
=csasc5          parm=size=1000000
tca                      *****case 1 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.7923-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  1.3531-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h    3  0  6.6735-2  293  end
o    3  0  3.3368-2  293  end
'Al
Al   4  0  6.0224-2  293  end
'Stainless Steel
c    5  0  1.1928-4  293  end
si   5  0  1.7003-3  293  end
mn   5  0  1.7385-3  293  end
p    5  0  6.9381-5  293  end
s    5  0  4.4673-5  293  end
ni   5  0  8.9506-3  293  end
cr   5  0  1.7450-2  293  end
fe   5  0  5.7202-2  293  end
'ordinary concrete
h    6  0  1.3742-2  293  end
o    6  0  4.5919-2  293  end
c    6  0  1.1532-4  293  end
na   6  0  9.6395-4  293  end
mg   6  0  1.2388-4  293  end
al   6  0  1.7409-3  293  end
si   6  0  1.6617-2  293  end
k    6  0  4.6052-4  293  end
ca   6  0  1.5025-3  293  end
fe   6  0  3.4492-4  293  end
end comp
squarepitch  1.825    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-1
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 4
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
```

```
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 10
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 11
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 13
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 18
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 27
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 30
com='(Fuel+Clad+H2O)'
```

```
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 31
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 34
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 36
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 41
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 46
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 48
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 53
```

```
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 56
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 57
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 58
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 59
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 60
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 61
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 62
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 63
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 64
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 65
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 66
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 67
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 68
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 69
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 70
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 71
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 72
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 73
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 74
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 75
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
```

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unit 76
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 77
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit 78
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 59.55  0.0
cylinder  2  1  0.6115   59.55  0.0
cuboid    3  1  4p0.9125   59.55  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p.9125   4.445  0.0
unit 82
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p.9125  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  11.05  0.0
cylinder  2 1  .6115  11.05  0.0
cuboid    0 1  4p.9125 11.05  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p0.9125   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p50.9875 .601  0.0
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1  -20.9875 -20.9875 0.0
cuboid 3 1  4p50.9875  4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2  -20.9875 -20.9875 0.0
cuboid 3 1  4p50.9875  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3  -20.9875 -20.9875 0.0
cuboid 0 1  4p50.9875  11.05  0.0
unit 104
com='array of void+Clad+void'
array  4  -20.9875 -20.9875 0.0
cuboid 0 1  4p50.9875  9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  -20.9875 -20.9875 0.0
cuboid 3 1  4p50.9875  59.55  0.0
global unit 110
com='array of arrays of fuel element sections + reflector'
array  6  -50.9875  -50.9875  0
cuboid   4  1  4p50.9875  97.40   -1.27
cuboid   5  1  4p50.9875  97.40   -3.47
cuboid   3  1  4p50.9875  97.40  -17.27
cuboid   5  1  4p50.9875  97.40  -17.77
cuboid   6  1  4p50.9875  97.40  -54.77
end geometry
read array
ara=1  nux=23  nuy=23  nuz=1
fill  f81  end fill
ara=2  nux=23  nuy=23  nuz=1
fill  f82  end fill
ara=3  nux=23  nuy=23  nuz=1
fill  f83  end fill
ara=4  nux=23  nuy=23  nuz=1
fill  f84  end fill
ara=5 nux=23 nuy=23  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10 11 12  1b 11
  2 13 14 15 16 17 18 19 20 21 22 23  1b 11
  3 14 24 25 26 27 28 29 30 31 32 33  1b 11
  4 15 25 34 35 36 37 38 39 40 41 42  1b 11
  5 16 26 35 43 44 45 46 47 48 49 50  1b 11
  6 17 27 36 44 51 52 53 54 55 56 57  1b 11
  7 18 28 37 45 52 58 59 60 61 62 63  1b 11
  8 19 29 38 46 53 59 64 65 66 67 68  1b 11
  9 20 30 39 47 54 60 65 69 70 71 72  1b 11
 10 21 31 40 48 55 61 66 70 73 74 75  1b 11
 11 22 32 41 49 56 62 67 71 74 76 77  1b 11
 12 23 33 42 50 57 63 68 72 75 77 78  1b 264
 end fill
ara=6  nux=1  nuy=1  nuz=6
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca01.xs04
cp ft64f001  $RTNDIR/tca01.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
```

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 5010 27
 5011 27
 8016 27
 40000 27
 24000 27
 26000 27
 1001 27
 50112 27
 50114 27
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
 lastg=148
 lastg=204
 lastg=238
end collapse
end


=csasc5           parm=size=1000000
tca                        *****case 2 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.6701-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  2.5812-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h     3  0  6.6735-2  293  end
o     3  0  3.3368-2  293  end
'Al
Al    4  0  6.0224-2  293  end
'Stainless Steel
c     5  0  1.1928-4  293  end
si    5  0  1.7003-3  293  end
mn    5  0  1.7385-3  293  end
p     5  0  6.9381-5  293  end
s     5  0  4.4673-5  293  end
ni    5  0  8.9506-3  293  end
cr    5  0  1.7450-2  293  end
fe    5  0  5.7202-2  293  end
'ordinary concrete
h     6  0  1.3742-2  293  end
o     6  0  4.5919-2  293  end
c     6  0  1.1532-4  293  end
na    6  0  9.6395-4  293  end
mg    6  0  1.2388-4  293  end
al    6  0  1.7409-3  293  end
si    6  0  1.6617-2  293  end
k     6  0  4.6052-4  293  end
ca    6  0  1.5025-3  293  end
fe    6  0  3.4492-4  293  end
end comp
squarepitch  1.825    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-2
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 4
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
```

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unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 10
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 11
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 13
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 18
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 27
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
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cuboid    3  1  4p0.9125   61.90  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 30
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 31
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 34
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 36
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 41
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 46
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 48
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
```

```
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 53
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 56
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 57
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 58
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 59
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 60
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 61
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 62
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
```

```
unit 63
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 64
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 65
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 66
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 67
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 68
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 69
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 70
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 71
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 72
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 73
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 74
com='(Fuel+Clad+H2O)'
```

```
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 75
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 76
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 77
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit 78
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.90  0.0
cylinder  2  1  0.6115   61.90  0.0
cuboid    3  1  4p0.9125   61.90  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p.9125   4.445  0.0
unit 82
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p.9125  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  8.7  0.0
cylinder  2 1  .6115  8.7  0.0
cuboid    0 1  4p.9125 8.7  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p0.9125   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p50.9875 .601  0.0
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1   -20.9875 -20.9875 0.0
cuboid 3 1  4p50.9875  4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2   -20.9875 -20.9875 0.0
cuboid 3 1  4p50.9875  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3   -20.9875 -20.9875 0.0
cuboid 0 1  4p50.9875  8.7  0.0
unit 104
com='array of void+Clad+void'
array  4  -20.9875 -20.9875 0.0
cuboid 0 1  4p50.9875  9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  -20.9875 -20.9875 0.0
cuboid 3 1  4p50.9875  61.90  0.0
global unit 110
com='array of arrays of fuel element sections + reflector'
array  6  -50.9875  -50.9875  0.0
cuboid   4  1  4p50.9875  97.40   -1.27
cuboid   5  1  4p50.9875  97.40   -3.47
cuboid   3  1  4p50.9875  97.40  -17.27
cuboid   5  1  4p50.9875  97.40  -17.77
cuboid   6  1  4p50.9875  97.40  -54.77
end geometry
read array
ara=1  nux=23  nuy=23  nuz=1
fill  f81  end fill
ara=2  nux=23  nuy=23  nuz=1
fill  f82  end fill
ara=3  nux=23  nuy=23  nuz=1
fill  f83  end fill
ara=4  nux=23  nuy=23  nuz=1
fill  f84  end fill
ara=5 nux=23 nuy=23  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10 11 12  1b 11
  2 13 14 15 16 17 18 19 20 21 22 23  1b 11
  3 14 24 25 26 27 28 29 30 31 32 33  1b 11
  4 15 25 34 35 36 37 38 39 40 41 42  1b 11
  5 16 26 35 43 44 45 46 47 48 49 50  1b 11
  6 17 27 36 44 51 52 53 54 55 56 57  1b 11
  7 18 28 37 45 52 58 59 60 61 62 63  1b 11
  8 19 29 38 46 53 59 64 65 66 67 68  1b 11
  9 20 30 39 47 54 60 65 69 70 71 72  1b 11
 10 21 31 40 48 55 61 66 70 73 74 75  1b 11
 11 22 32 41 49 56 62 67 71 74 76 77  1b 11
 12 23 33 42 50 57 63 68 72 75 77 78  1b 264
 end fill
ara=6  nux=1  nuy=1  nuz=6
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca02.xs04
cp ft64f001  $RTNDIR/tca02.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
```

```
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
  5010 27
  5011 27
  8016 27
 40000 27
 24000 27
 26000 27
  1001 27
 50112 27
 50114 27
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
 lastg=148
 lastg=204
 lastg=238
end collapse
end


=csasc5        parm=size=1000000
tca                    *****case 3 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.5447-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  3.8361-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h     3  0  6.6735-2  293  end
o     3  0  3.3368-2  293  end
'Al
Al    4  0  6.0224-2  293  end
'Stainless Steel
c     5  0  1.1928-4  293  end
si    5  0  1.7003-3  293  end
mn    5  0  1.7385-3  293  end
p     5  0  6.9381-5  293  end
s     5  0  4.4673-5  293  end
ni    5  0  8.9506-3  293  end
cr    5  0  1.7450-2  293  end
fe    5  0  5.7202-2  293  end
'ordinary concrete
h     6  0  1.3742-2  293  end
o     6  0  4.5919-2  293  end
c     6  0  1.1532-4  293  end
na    6  0  9.6395-4  293  end
mg    6  0  1.2388-4  293  end
al    6  0  1.7409-3  293  end
si    6  0  1.6617-2  293  end
k     6  0  4.6052-4  293  end
ca    6  0  1.5025-3  293  end
fe    6  0  3.4492-4  293  end
end comp
squarepitch  1.825    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-3
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 4
com='(Fuel+Clad+H2O)'
```

```
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 10
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 11
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 13
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 18
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 27
```

```
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 30
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 31
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 34
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 36
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 41
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 46
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 48
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
```

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unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 53
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 56
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 57
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 58
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 59
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 60
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 61
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 62
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 63
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 64
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 65
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 66
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 67
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 68
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 69
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 70
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 71
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 72
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
```

```
cuboid    3  1  4p0.9125   64.06  0.0
unit 73
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 74
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 75
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 76
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 77
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit 78
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.06  0.0
cylinder  2  1  0.6115   64.06  0.0
cuboid    3  1  4p0.9125   64.06  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p.9125   4.445  0.0
unit 82
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p.9125  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  6.54  0.0
cylinder  2 1  .6115  6.54  0.0
cuboid    0 1  4p.9125 6.54  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p0.9125   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p50.9875 .601  0.0
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1  -20.9875 -20.9875 0.0
cuboid 3 1  4p50.9875  4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2  -20.9875 -20.9875 0.0
cuboid 3 1  4p50.9875  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3  -20.9875 -20.9875 0.0
cuboid 0 1  4p50.9875  6.54  0.0
unit 104
com='array of void+Clad+void'
array  4  -20.9875 -20.9875 0.0
cuboid 0 1  4p50.9875  9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  -20.9875 -20.9875 0.0
cuboid 3 1  4p50.9875  64.06  0.0
global unit 110
com='array of arrays of fuel element sections + reflector'
array  6  -50.9875  -50.9875  0.0
cuboid   4  1  4p50.9875  97.40   -1.27
cuboid   5  1  4p50.9875  97.40   -3.47
cuboid   3  1  4p50.9875  97.40  -17.27
cuboid   5  1  4p50.9875  97.40  -17.77
cuboid   6  1  4p50.9875  97.40  -54.77
end geometry
read array
ara=1  nux=23  nuy=23  nuz=1
fill  f81  end fill
ara=2  nux=23  nuy=23  nuz=1
fill  f82  end fill
ara=3  nux=23  nuy=23  nuz=1
fill  f83  end fill
ara=4  nux=23  nuy=23  nuz=1
fill  f84  end fill
ara=5 nux=23 nuy=23  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10 11 12  1b 11
  2 13 14 15 16 17 18 19 20 21 22 23  1b 11
  3 14 24 25 26 27 28 29 30 31 32 33  1b 11
  4 15 25 34 35 36 37 38 39 40 41 42  1b 11
  5 16 26 35 43 44 45 46 47 48 49 50  1b 11
  6 17 27 36 44 51 52 53 54 55 56 57  1b 11
  7 18 28 37 45 52 58 59 60 61 62 63  1b 11
  8 19 29 38 46 53 59 64 65 66 67 68  1b 11
  9 20 30 39 47 54 60 65 69 70 71 72  1b 11
 10 21 31 40 48 55 61 66 70 73 74 75  1b 11
 11 22 32 41 49 56 62 67 71 74 76 77  1b 11
 12 23 33 42 50 57 63 68 72 75 77 78  1b 264
 end fill
ara=6  nux=1  nuy=1  nuz=6
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca03.xs04
cp ft64f001  $RTNDIR/tca03.rs64
end
```

```
=kmart
read initial   kunit=64
              xunit=4
              actbygrp
              rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
  5010 27
  5011 27
  8016 27
 40000 27
 24000 27
 26000 27
  1001 27
 50112 27
 50114 27
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
 lastg=148
 lastg=204
 lastg=238
end collapse
end


=csasc5          parm=size=1000000
tca                         *****case 4 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.8003-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  1.2793-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h     3  0  6.6735-2  293  end
o     3  0  3.3368-2  293  end
'Al
Al    4  0  6.0224-2  293  end
'Stainless Steel
c     5  0  1.1928-4  293  end
si    5  0  1.7003-3  293  end
mn    5  0  1.7385-3  293  end
p     5  0  6.9381-5  293  end
s     5  0  4.4673-5  293  end
ni    5  0  8.9506-3  293  end
cr    5  0  1.7450-2  293  end
fe    5  0  5.7202-2  293  end
'ordinary concrete
h     6  0  1.3742-2  293  end
o     6  0  4.5919-2  293  end
c     6  0  1.1532-4  293  end
na    6  0  9.6395-4  293  end
mg    6  0  1.2388-4  293  end
al    6  0  1.7409-3  293  end
si    6  0  1.6617-2  293  end
k     6  0  4.6052-4  293  end
ca    6  0  1.5025-3  293  end
fe    6  0  3.4492-4  293  end
end comp
squarepitch  1.956    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-4
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
```

```
cuboid    3  1  4p0.978   61.50  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 4
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 10
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 11
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 13
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 18
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
```

```
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 27
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 30
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 31
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 34
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 36
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 41
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 46
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 48
com='(Fuel+Clad+H2O)'
```

```
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 53
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 56
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 57
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 58
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 59
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 60
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 61
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 62
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 63
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 64
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 65
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit 66
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 61.50  0.0
cylinder  2  1  0.6115   61.50  0.0
cuboid    3  1  4p0.978   61.50  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p.978   4.445  0.0
unit 82
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p.978  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  9.1  0.0
cylinder  2 1  .6115  9.1  0.0
cuboid    0 1  4p.978 9.1  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p0.978   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p50.538 .601  0.0
```

```
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1  -20.538  -20.538  0.0
cuboid    3  1  4p50.538   4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2  -20.538  -20.538  0.0
cuboid    3  1  4p50.538  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3  -20.538  -20.538  0.0
cuboid    0 1  4p50.538 9.1  0.0
unit 104
com='array of void+Clad+void'
array  4  -20.538  -20.538  0.0
cuboid    0  1  4p50.538   9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  -20.538  -20.538  0.0
cuboid    3  1  4p50.538   61.50  0.0
global unit 110
com='array of arrays of fuel element sections + reflector'
array  6  -50.538  -50.538  0.0
cuboid   4  1  4p50.538  97.40   -1.27
cuboid   5  1  4p50.538  97.40   -3.47
cuboid   3  1  4p50.538  97.40  -17.27
cuboid   5  1  4p50.538  97.40  -17.77
cuboid   6  1  4p50.538  97.40  -54.77
end geometry
read array
ara=1  nux=21  nuy=21  nuz=1
fill  f81  end fill
ara=2  nux=21  nuy=21  nuz=1
fill  f82  end fill
ara=3  nux=21  nuy=21  nuz=1
fill  f83  end fill
ara=4  nux=21  nuy=21  nuz=1
fill  f84  end fill
ara=5  nux=21  nuy=21  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10 11  1b 10
  2 12 13 14 15 16 17 18 19 20 21  1b 10
  3 13 22 23 24 25 26 27 28 29 30  1b 10
  4 14 23 31 32 33 34 35 36 37 38  1b 10
  5 15 24 32 39 40 41 42 43 44 45  1b 10
  6 16 25 33 40 46 47 48 49 50 51  1b 10
  7 17 26 34 41 47 52 53 54 55 56  1b 10
  8 18 27 35 42 48 53 57 58 59 60  1b 10
  9 19 28 36 43 49 54 58 61 62 63  1b 10
 10 20 29 37 44 50 55 59 62 64 65  1b 10
 11 21 30 38 45 51 56 60 63 65 66  1b 220
 end fill
ara=6  nux=1  nuy=1  nuz=6
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca04.xs04
cp ft64f001  $RTNDIR/tca04.rs64
end
=kmart
read initial   kunit=64
             xunit=4
             actbygrp
             rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
  5010 27
  5011 27
  8016 27
 40000 27
 24000 27
 26000 27
  1001 27
 50112 27
 50114 27
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
 lastg=148
 lastg=204
 lastg=238
end collapse
end


=csasc5          parm=size=1000000
tca                        *****case 5 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
```

```
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.6670-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  2.6129-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h    3  0  6.6735-2  293  end
o    3  0  3.3368-2  293  end
'Al
Al    4  0  6.0224-2  293  end
'Stainless Steel
c     5  0  1.1928-4  293  end
si    5  0  1.7003-3  293  end
mn    5  0  1.7385-3  293  end
p     5  0  6.9381-5  293  end
s     5  0  4.4673-5  293  end
ni    5  0  8.9506-3  293  end
cr    5  0  1.7450-2  293  end
fe    5  0  5.7202-2  293  end
'ordinary concrete
h     6  0  1.3742-2  293  end
o     6  0  4.5919-2  293  end
c     6  0  1.1532-4  293  end
na    6  0  9.6395-4  293  end
mg    6  0  1.2388-4  293  end
al    6  0  1.7409-3  293  end
si    6  0  1.6617-2  293  end
k     6  0  4.6052-4  293  end
ca    6  0  1.5025-3  293  end
fe    6  0  3.4492-4  293  end
end comp
squarepitch  1.956    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-5
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 4
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 10
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 11
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 13
com='(Fuel+Clad+H2O)'
```

```
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboad    3  1  4p0.978   64.40  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 18
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 27
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 30
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 31
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 34
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 36
```

```
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 41
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 46
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 48
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 53
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 56
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 57
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 58
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
```

```
unit 59
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 60
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 61
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 62
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 63
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 64
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 65
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit 66
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.40  0.0
cylinder  2  1  0.6115   64.40  0.0
cuboid    3  1  4p0.978   64.40  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p.978   4.445  0.0
unit 82
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p.978  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  6.2  0.0
cylinder  2 1  .6115  6.2  0.0
cuboid    0 1  4p.978 6.2  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p0.978   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p50.538 .601  0.0
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1  0 0 0
cuboid    3  1  4p50.538   4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2  0 0 0
cuboid    3  1  4p50.538  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3  0 0 0
cuboid    0 1  4p50.538 6.2  0.0
unit 104
com='array of void+Clad+void'
array  4  0 0 0
cuboid    0  1  4p50.538   9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  0 0 0
cuboid    3  1  4p50.538   64.40  0.0
global unit 110
com='array of arrays of fuel element sections + reflector'
array  6  -50.538  -50.538  0
cuboid   4  1  4p50.538  97.40   -1.27
cuboid   5  1  4p50.538  97.40   -3.47
cuboid   3  1  4p50.538  97.40  -17.27
cuboid   5  1  4p50.538  97.40  -17.77
cuboid   6  1  4p50.538  97.40  -54.77
end geometry
read array
ara=1  nux=21  nuy=21  nuz=1
fill  f81  end fill
ara=2  nux=21  nuy=21  nuz=1
fill  f82  end fill
ara=3  nux=21  nuy=21  nuz=1
fill  f83  end fill
ara=4  nux=21  nuy=21  nuz=1
fill  f84  end fill
ara=5  nux=21  nuy=21  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10 11  1b 10
  2 12 13 14 15 16 17 18 19 20 21  1b 10
  3 13 22 23 24 25 26 27 28 29 30  1b 10
  4 14 23 31 32 33 34 35 36 37 38  1b 10
  5 15 24 32 39 40 41 42 43 44 45  1b 10
  6 16 25 33 40 46 47 48 49 50 51  1b 10
  7 17 26 34 41 47 52 53 54 55 56  1b 10
  8 18 27 35 42 48 53 57 58 59 60  1b 10
  9 19 28 36 43 49 54 58 61 62 63  1b 10
 10 20 29 37 44 50 55 59 62 64 65  1b 10
 11 21 30 38 45 51 56 60 63 65 66  1b 220
 end fill
ara=6  nux=1  nuy=1  nuz=6
```

```
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca05.xs04
cp ft64f001  $RTNDIR/tca05.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
  5010 27
  5010 27
  5011 27
  8016 27
 40000 27
 24000 27
 26000 27
  1001 27
 50112 27
 50114 27
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
 lastg=148
 lastg=204
 lastg=238
end collapse
end


=csasc5            parm=size=1000000
tca                           *****case 6 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.4228-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  5.0543-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h     3  0  6.6735-2  293  end
o     3  0  3.3368-2  293  end
'Al
Al    4  0  6.0224-2  293  end
'Stainless Steel
c     5  0  1.1928-4  293  end
si    5  0  1.7003-3  293  end
mn    5  0  1.7385-3  293  end
p     5  0  6.9381-5  293  end
s     5  0  4.4673-5  293  end
ni    5  0  8.9506-3  293  end
cr    5  0  1.7450-2  293  end
fe    5  0  5.7202-2  293  end
'ordinary concrete
h     6  0  1.3742-2  293  end
o     6  0  4.5919-2  293  end
c     6  0  1.1532-4  293  end
na    6  0  9.6395-4  293  end
mg    6  0  1.2388-4  293  end
al    6  0  1.7409-3  293  end
si    6  0  1.6617-2  293  end
k     6  0  4.6052-4  293  end
ca    6  0  1.5025-3  293  end
fe    6  0  3.4492-4  293  end
end comp
squarepitch  1.956    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-6
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
```

```
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 4
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 10
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 11
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 13
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 18
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
```

```
cuboid   3  1  4p0.978   69.40  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 27
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 30
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 31
com='(Fuel+Clad+H2O)'

cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 34
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 36
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 41
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid   3  1  4p0.978   69.40  0.0
unit 46
com='(Fuel+Clad+H2O)'
```

```
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 48
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 53
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 56
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 57
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 58
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 59
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 60
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 61
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 62
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 63
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 64
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 65
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit 66
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 69.40  0.0
cylinder  2  1  0.6115   69.40  0.0
cuboid    3  1  4p0.978   69.40  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p.978   4.445  0.0
unit 82
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p.978  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  1.2  0.0
```

```
cylinder  2 1  .6115  1.2  0.0
cuboid    0 1  4p.978 1.2  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p0.978   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p50.538 .601  0.0
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1  0 0 0
cuboid    3  1  4p50.538   4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2  0 0 0
cuboid    3  1  4p50.538  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3  0 0 0
cuboid    0 1  4p50.538 1.2  0.0
unit 104
com='array of void+Clad+void'
array  4  0 0 0
cuboid    0  1  4p50.538   9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  0 0 0
cuboid    3  1  4p50.538   69.40  0.0
global unit 110
com='array of arrays of fuel element sections + reflector'
array  6  -50.538  -50.538  0
cuboid   4  1  4p50.538  97.40   -1.27
cuboid   5  1  4p50.538  97.40   -3.47
cuboid   3  1  4p50.538  97.40  -17.27
cuboid   5  1  4p50.538  97.40  -17.77
cuboid   6  1  4p50.538  97.40  -54.77
end geometry
read array
ara=1  nux=21  nuy=21  nuz=1
fill  f81  end fill
ara=2  nux=21  nuy=21  nuz=1
fill  f82  end fill
ara=3  nux=21  nuy=21  nuz=1
fill  f83  end fill
ara=4  nux=21  nuy=21  nuz=1
fill  f84  end fill
ara=5  nux=21  nuy=21  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10 11  1b 10
  2 12 13 14 15 16 17 18 19 20 21  1b 10
  3 13 22 23 24 25 26 27 28 29 30  1b 10
  4 14 23 31 32 33 34 35 36 37 38  1b 10
  5 15 24 32 39 40 41 42 43 44 45  1b 10
  6 16 25 33 40 46 47 48 49 50 51  1b 10
  7 17 26 34 41 47 52 53 54 55 56  1b 10
  8 18 27 35 42 48 53 57 58 59 60  1b 10
  9 19 28 36 43 49 54 58 61 62 63  1b 10
 10 20 29 37 44 50 55 59 62 64 65  1b 10
 11 21 30 38 45 51 56 60 63 65 66  1b 220
 end fill
ara=6  nux=1  nuy=1  nuz=6
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca06.xs04
cp ft64f001  $RTNDIR/tca06.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
  5010 27
  5010 27
  5011 27
  8016 27
 40000 27
 24000 27
 26000 27
  1001 27
 50112 27
 50114 27
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
 lastg=148
 lastg=204
 lastg=238
end collapse
end
```

```
=csasc5          parm=size=1000000
tca                          *****case 7 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.8133-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  1.1498-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h    3  0  6.6735-2  293  end
o    3  0  3.3368-2  293  end
'Al
Al   4  0  6.0224-2  293  end
'Stainless Steel
c    5  0  1.1928-4  293  end
si   5  0  1.7003-3  293  end
mn   5  0  1.7385-3  293  end
p    5  0  6.9381-5  293  end
s    5  0  4.4673-5  293  end
ni   5  0  8.9506-3  293  end
cr   5  0  1.7450-2  293  end
fe   5  0  5.7202-2  293  end
'ordinary concrete
h    6  0  1.3742-2  293  end
o    6  0  4.5919-2  293  end
c    6  0  1.1532-4  293  end
na   6  0  9.6395-4  293  end
mg   6  0  1.2388-4  293  end
al   6  0  1.7409-3  293  end
si   6  0  1.6617-2  293  end
k    6  0  4.6052-4  293  end
ca   6  0  1.5025-3  293  end
fe   6  0  3.4492-4  293  end
end comp
squarepitch  2.225    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-7
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 4
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 10
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 11
com='(Fuel+Clad+H2O)'
```

```
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 13
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 18
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 27
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 30
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 31
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 34
```

```
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 36
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 41
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 46
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 48
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 53
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 60.32  0.0
cylinder  2  1  0.6115   60.32  0.0
cuboid    3  1  4p1.1125   60.32  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p1.1125   4.445  0.0
unit 82
```

```
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p1.1125  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  10.28  0.0
cylinder  2 1  .6115  10.28  0.0
cuboid    0 1  4p1.1125 10.28  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p1.1125   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p52.25 .601  0.0
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1  -22.25  -22.25  0.0
cuboid    3  1  4p52.25   4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2  -22.25  -22.25  0.0
cuboid    3  1  4p52.25  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3  -22.25  -22.25  0.0
cuboid    0 1  4p52.25 10.28  0.0
unit 104
com='array of void+Clad+void'
array  4  -22.25  -22.25  0.0
cuboid    0  1  4p52.25   9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  -22.25  -22.25  0.0
cuboid    3  1  4p52.25   60.32  0.0
global unit 110
com='array of arrays of fuel element sections + reflector'
array  6  -52.25  -52.25  0.0
cuboid   4  1  4p52.25  97.40   -1.27
cuboid   5  1  4p52.25  97.40   -3.47
cuboid   3  1  4p52.25  97.40  -17.27
cuboid   5  1  4p52.25  97.40  -17.77
cuboid   6  1  4p52.25  97.40  -54.77
end geometry
read array
ara=1  nux=20  nuy=20  nuz=1
fill  f81  end fill
ara=2  nux=20  nuy=20  nuz=1
fill  f82  end fill
ara=3  nux=20  nuy=20  nuz=1
fill  f83  end fill
ara=4  nux=20  nuy=20  nuz=1
fill  f84  end fill
ara=5 nux=20 nuy=20  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10  n 10
  2 11 12 13 14 15 16 17 18 19  n 10
  3 12 20 21 22 23 24 25 26 27  n 10
  4 13 21 28 29 30 31 32 33 34  n 10
  5 14 22 29 35 36 37 38 39 40  n 10
  6 15 23 30 36 41 42 43 44 45  n 10
  7 16 24 31 37 42 46 47 48 49  n 10
  8 17 25 32 38 43 47 50 51 52  n 10
  9 18 26 33 39 44 48 51 53 54  n 10
 10 19 27 34 40 45 49 52 54 55  n 10
 n200
 end fill
ara=6  nux=1  nuy=1  nuz=6
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca07.xs04
cp ft64f001  $RTNDIR/tca07.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
  5010 27
  5011 27
  8016 27
 40000 27
 24000 27
 26000 27
  1001 27
 50112 27
 50114 27
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
```

```
 lastg=148
 lastg=204
 lastg=238
end collapse
end


=csasc5          parm=size=1000000
TCA                      *****case 8 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.6649-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  2.6340-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h     3  0  6.6735-2  293  end
o     3  0  3.3368-2  293  end
'Al
Al    4  0  6.0224-2  293  end
'Stainless Steel
c     5  0  1.1928-4  293  end
si    5  0  1.7003-3  293  end
mn    5  0  1.7385-3  293  end
p     5  0  6.9381-5  293  end
s     5  0  4.4673-5  293  end
ni    5  0  8.9506-3  293  end
cr    5  0  1.7450-2  293  end
fe    5  0  5.7202-2  293  end
'ordinary concrete
h     6  0  1.3742-2  293  end
o     6  0  4.5919-2  293  end
c     6  0  1.1532-4  293  end
na    6  0  9.6395-4  293  end
mg    6  0  1.2388-4  293  end
al    6  0  1.7409-3  293  end
si    6  0  1.6617-2  293  end
k     6  0  4.6052-4  293  end
ca    6  0  1.5025-3  293  end
fe    6  0  3.4492-4  293  end
end comp
squarepitch  2.225    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-8
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 4
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 10
```

```
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 11
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 13
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 18
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 27
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 30
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 31
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
```

```
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 34
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 36
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 41
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 46
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 48
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 53
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
cuboid    3  1  4p1.1125   62.99  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.99  0.0
cylinder  2  1  0.6115   62.99  0.0
```

```
cuboid    3  1  4p1.1125   62.99  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p1.1125   4.445  0.0
unit 82
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p1.1125  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  7.61  0.0
cylinder  2 1  .6115  7.61  0.0
cuboid    0 1  4p1.1125 7.61  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p1.1125   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p52.25 .601  0.0
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1  -22.25  -22.25  0.0
cuboid    3  1  4p52.25   4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2  -22.25  -22.25  0.0
cuboid    3  1  4p52.25  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3  -22.25  -22.25  0.0
cuboid    0 1  4p52.25 7.61  0.0
unit 104
com='array of void+Clad+void'
array  4  -22.25  -22.25  0.0
cuboid    0  1  4p52.25   9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  -22.25  -22.25  0.0
cuboid    3  1  4p52.25   62.99  0.0
global unit 110
com='array of arrays of fuel element sections + reflector'
array  6  -52.25  -52.25  0.0
cuboid   4  1  4p52.25  97.40   -1.27
cuboid   5  1  4p52.25  97.40   -3.47
cuboid   3  1  4p52.25  97.40  -17.27
cuboid   5  1  4p52.25  97.40  -17.77
cuboid   6  1  4p52.25  97.40  -54.77
end geometry
read array
ara=1  nux=20  nuy=20  nuz=1
fill  f81  end fill
ara=2  nux=20  nuy=20  nuz=1
fill  f82  end fill
ara=3  nux=20  nuy=20  nuz=1
fill  f83  end fill
ara=4  nux=20  nuy=20  nuz=1
fill  f84  end fill
ara=5 nux=20 nuy=20  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10  n 10
  2 11 12 13 14 15 16 17 18 19  n 10
  3 12 20 21 22 23 24 25 26 27  n 10
  4 13 21 28 29 30 31 32 33 34  n 10
  5 14 22 29 35 36 37 38 39 40  n 10
  6 15 23 30 36 41 42 43 44 45  n 10
  7 16 24 31 37 42 46 47 48 49  n 10
  8 17 25 32 38 43 47 50 51 52  n 10
  9 18 26 33 39 44 48 51 53 54  n 10
 10 19 27 34 40 45 49 52 54 55  n 10
 n200
 end fill
ara=6  nux=1  nuy=1  nuz=6
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca08.xs04
cp ft64f001  $RTNDIR/tca08.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
  5010 27
  5011 27
  8016 27
 40000 27
 24000 27
 26000 27
  1001 27
 50112 27
 50114 27
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
```

```
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
 lastg=148
 lastg=204
 lastg=238
end collapse
end


=csasc5           parm=size=1000000
TCA                    *****case 9 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.5373-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  3.9098-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h     3  0  6.6735-2  293  end
o     3  0  3.3368-2  293  end
'Al
Al    4  0  6.0224-2  293  end
'Stainless Steel
c     5  0  1.1928-4  293  end
si    5  0  1.7003-3  293  end
mn    5  0  1.7385-3  293  end
p     5  0  6.9381-5  293  end
s     5  0  4.4673-5  293  end
ni    5  0  8.9506-3  293  end
cr    5  0  1.7450-2  293  end
fe    5  0  5.7202-2  293  end
'ordinary concrete
h     6  0  1.3742-2  293  end
o     6  0  4.5919-2  293  end
c     6  0  1.1532-4  293  end
na    6  0  9.6395-4  293  end
mg    6  0  1.2388-4  293  end
al    6  0  1.7409-3  293  end
si    6  0  1.6617-2  293  end
k     6  0  4.6052-4  293  end
ca    6  0  1.5025-3  293  end
fe    6  0  3.4492-4  293  end
end comp
squarepitch  2.225    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-9
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 4
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
```

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unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 10
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 11
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 13
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 18
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 27
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 30
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 31
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
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cuboid    3  1  4p1.1125   65.63  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 34
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 36
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 41
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 46
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 48
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 53
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
```

```
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 65.63  0.0
cylinder  2  1  0.6115   65.63  0.0
cuboid    3  1  4p1.1125   65.63  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p1.1125   4.445  0.0
unit 82
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p1.1125  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  4.97  0.0
cylinder  2 1  .6115  4.97  0.0
cuboid    0 1  4p1.1125 4.97  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p1.1125   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p52.25 .601  0.0
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1  -22.25  -22.25  0.0
cuboid    3  1  4p52.25   4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2  -22.25  -22.25  0.0
cuboid    3  1  4p52.25  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3  -22.25  -22.25  0.0
cuboid    0 1  4p52.25 4.97  0.0
unit 104
com='array of void+Clad+void'
array  4  -22.25  -22.25  0.0
cuboid    0  1  4p52.25   9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  -22.25  -22.25  0.0
cuboid    3  1  4p52.25   65.63  0.0
global unit 110
com='array of arrays of fuel element sections + reflector'
array  6  -52.25  -52.25  0.0
cuboid   4  1  4p52.25  97.40   -1.27
cuboid   5  1  4p52.25  97.40   -3.47
cuboid   3  1  4p52.25  97.40  -17.27
cuboid   5  1  4p52.25  97.40  -17.77
cuboid   6  1  4p52.25  97.40  -54.77
end geometry
```

```
read array
ara=1  nux=20  nuy=20  nuz=1
fill  f81  end fill
ara=2  nux=20  nuy=20  nuz=1
fill  f82  end fill
ara=3  nux=20  nuy=20  nuz=1
fill  f83  end fill
ara=4  nux=20  nuy=20  nuz=1
fill  f84  end fill
ara=5 nux=20 nuy=20  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10  n 10
  2 11 12 13 14 15 16 17 18 19  n 10
  3 12 20 21 22 23 24 25 26 27  n 10
  4 13 21 28 29 30 31 32 33 34  n 10
  5 14 22 29 35 36 37 38 39 40  n 10
  6 15 23 30 36 41 42 43 44 45  n 10
  7 16 24 31 37 42 46 47 48 49  n 10
  8 17 25 32 38 43 47 50 51 52  n 10
  9 18 26 33 39 44 48 51 53 54  n 10
 10 19 27 34 40 45 49 52 54 55  n 10
 n200
 end fill
ara=6  nux=1  nuy=1  nuz=6
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca09.xs04
cp ft64f001  $RTNDIR/tca09.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
  5010 27
  5011 27
  8016 27
 40000 27
 24000 27
 26000 27
  1001 27
 50112 27
 50114 27
```

```
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
 lastg=148
 lastg=204
 lastg=238
end collapse
end


=csasc5           parm=size=1000000
TCA                     *****case 10 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.8077-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  1.2053-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h    3  0  6.6735-2  293  end
o    3  0  3.3368-2  293  end
'Al
Al   4  0  6.0224-2  293  end
'Stainless Steel
c    5  0  1.1928-4  293  end
si   5  0  1.7003-3  293  end
mn   5  0  1.7385-3  293  end
p    5  0  6.9381-5  293  end
s    5  0  4.4673-5  293  end
ni   5  0  8.9506-3  293  end
cr   5  0  1.7450-2  293  end
fe   5  0  5.7202-2  293  end
'ordinary concrete
h    6  0  1.3742-2  293  end
o    6  0  4.5919-2  293  end
c    6  0  1.1532-4  293  end
na   6  0  9.6395-4  293  end
mg   6  0  1.2388-4  293  end
al   6  0  1.7409-3  293  end
si   6  0  1.6617-2  293  end
k    6  0  4.6052-4  293  end
ca   6  0  1.5025-3  293  end
fe   6  0  3.4492-4  293  end
end comp
squarepitch  2.474    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-10
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 4
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
```

```
cuboid    3  1  4p1.237   62.05  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 10
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 11
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 13
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 18
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 27
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 30
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
```

```
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 31
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 34
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 36
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 41
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 46
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 48
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 53
com='(Fuel+Clad+H2O)'
```

```
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 56
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 57
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 58
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 59
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 60
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 61
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 62
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 63
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 64
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 65
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit 66
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 62.05  0.0
cylinder  2  1  0.6115   62.05  0.0
cuboid    3  1  4p1.237   62.05  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p1.237   4.445  0.0
unit 82
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p1.237  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  8.55  0.0
cylinder  2 1  .6115  8.55  0.0
cuboid    0 1  4p1.237 8.55  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p1.237   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p55.977 .601  0.0
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1  -25.977  -25.977  0.0
cuboid    3  1  4p55.977    4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2  -25.977  -25.977  0.0
cuboid    3  1  4p55.977  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3  -25.977  -25.977  0.0
cuboid    0  1  4p55.977    8.55  0.0
unit 104
com='array of void+Clad+void'
array  4  -25.977  -25.977  0.0
cuboid    0  1  4p55.977    9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  -25.977  -25.977  0.0
cuboid    3  1  4p55.977   62.05  0.0
global unit 110
com='array of arrays of fuel element sections + reflector'
array  6  -55.977  -55.977  0.0
cuboid   4  1  4p55.977  97.40   -1.27
cuboid   5  1  4p55.977  97.40   -3.47
```

```
cuboid   3  1  4p55.977  97.40  -17.27
cuboid   5  1  4p55.977  97.40  -17.77
cuboid   6  1  4p55.977  97.40  -54.77
end geometry
read array
ara=1  nux=21  nuy=21  nuz=1
fill  f81  end fill
ara=2  nux=21  nuy=21  nuz=1
fill  f82  end fill
ara=3  nux=21  nuy=21  nuz=1
fill  f83  end fill
ara=4  nux=21  nuy=21  nuz=1
fill  f84  end fill
ara=5  nux=21  nuy=21  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10 11  1b 10
  2 12 13 14 15 16 17 18 19 20 21  1b 10
  3 13 22 23 24 25 26 27 28 29 30  1b 10
  4 14 23 31 32 33 34 35 36 37 38  1b 10
  5 15 24 32 39 40 41 42 43 44 45  1b 10
  6 16 25 33 40 46 47 48 49 50 51  1b 10
  7 17 26 34 41 47 52 53 54 55 56  1b 10
  8 18 27 35 42 48 53 57 58 59 60  1b 10
  9 19 28 36 43 49 54 58 61 62 63  1b 10
 10 20 29 37 44 50 55 59 62 64 65  1b 10
 11 21 30 38 45 51 56 60 63 65 66  1b 220
 end fill
ara=6  nux=1  nuy=1  nuz=6
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca10.xs04
cp ft64f001  $RTNDIR/tca10.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
  5010 27
  5011 27
  8016 27
 40000 27
 24000 27
 26000 27
  1001 27
 50112 27
 50114 27
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
 lastg=148
 lastg=204
 lastg=238
end collapse
end


=csasc5           parm=size=1000000
TCA                    *****case 11 *********
238group latticecell
'MOX fuel
u-234   1  0  7.1749-7  293  end
u-235   1  0  9.3926-5  293  end
u-238   1  0  1.2951-2  293  end
pu-238  1  0  2.0003-6  293  end
pu-239  1  0  2.7491-4  293  end
pu-240  1  0  8.8417-5  293  end
'***********  pu-241 varies ******************
pu-241  1  0  2.6617-5  293  end
pu-242  1  0  8.1234-6  293  end
'*****am-241 varies********
am-241  1  0  2.6656-6  293  end
o       1  0  2.7837-2  293  end
b-10    1  0  6.0418-8  293  end
b-11    1  0  2.4319-7  293  end
'clad (ZR-2)
zr      2  0  3.7772-2  293  end
sn      2  0  4.3737-4  293  end
cr      2  0  8.8570-5  293  end
fe      2  0  6.6119-5  293  end
o       2  0  3.5864-5  293  end
'water(Refletor)
h     3  0  6.6735-2  293  end
o     3  0  3.3368-2  293  end
'Al
Al    4  0  6.0224-2  293  end
'Stainless Steel
c     5  0  1.1928-4  293  end
si    5  0  1.7003-3  293  end
mn    5  0  1.7385-3  293  end
p     5  0  6.9381-5  293  end
```

```
s     5  0  4.4673-5  293  end
ni    5  0  8.9506-3  293  end
cr    5  0  1.7450-2  293  end
fe    5  0  5.7202-2  293  end
'ordinary concrete
h     6  0  1.3742-2  293  end
o     6  0  4.5919-2  293  end
c     6  0  1.1532-4  293  end
na    6  0  9.6395-4  293  end
mg    6  0  1.2388-4  293  end
al    6  0  1.7409-3  293  end
si    6  0  1.6617-2  293  end
k     6  0  4.6052-4  293  end
ca    6  0  1.5025-3  293  end
fe    6  0  3.4492-4  293  end
end comp
squarepitch  2.474    1.065  1 2  1.223  3  end
more data
limcen=17000000
end more
tca-11
read param
gen=225 nsk=25 npg=20000 fdn=yes flx=yes wrs=64
res=225
lng=2000000
end param
read geometry
unit 1
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 2
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 3
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 4
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 5
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 6
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 7
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 8
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 9
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 10
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 11
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 12
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 13
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 14
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 15
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 16
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 17
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 18
com='(Fuel+Clad+H2O)'
```

```
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 19
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 20
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 21
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 22
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 23
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 24
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 25
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 26
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 27
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 28
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 29
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 30
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 31
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 32
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 33
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 34
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 35
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 36
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 37
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 38
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 39
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 40
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 41
```

```
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 42
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 43
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 44
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 45
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 46
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 47
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 48
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 49
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 50
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 51
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 52
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 53
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 54
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 55
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 56
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 57
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 58
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 59
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 60
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 61
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 62
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 63
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
```

```
unit 64
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 65
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit 66
com='(Fuel+Clad+H2O)'
cylinder  1  1  0.5325 64.53  0.0
cylinder  2  1  0.6115   64.53  0.0
cuboid    3  1  4p1.237   64.53  0.0
unit  81
com='h2o and end plug below Al grid plate - fill array 1'
cylinder  4  1  0.6115    4.445  0.0
cuboid    3  1  4p1.237   4.445  0.0
unit 82
com='h2o and end plug above Al grid plate - fill array 2'
cylinder  4  1  0.6115   11.784   0.0
cuboid    3  1  4p1.237  11.784  0.0
unit  83
com='(Fuel+Clad+Void) - fill array 3'
cylinder  1 1  .5325  6.07  0.0
cylinder  2 1  .6115  6.07  0.0
cuboid    0 1  4p1.237 6.07  0.0
unit 84
com='(void+Clad+void)'
cylinder  0  1  0.5325 9.97  0.0
cylinder  2  1  0.6115   9.97  0.0
cuboid    0  1  4p1.237   9.97  0.0
unit 100
com='Lower Al grid plate'
cuboid   4 1 4p55.977 .601  0.0
unit 101
com='array of h2o and end plugs below Al grid plate'
array  1  -25.977  -25.977  0.0
cuboid    3  1  4p55.977   4.445  0.0
unit 102
com='array of h2o and end plugs above Al grid plate '
array  2  -25.977  -25.977  0.0
cuboid    3  1  4p55.977  11.784  0.0
unit 103
com='array of Fuel+Clad+Void'
array  3  -25.977  -25.977  0.0
cuboid    0  1  4p55.977   6.07  0.0
unit 104
com='array of void+Clad+void'
array  4  -25.977  -25.977  0.0
cuboid    0  1  4p55.977   9.97  0.0
unit 105
com='array of Fuel+Clad+H2O'
array  5  -25.977  -25.977  0.0
cuboid    3  1  4p55.977   64.53  0.0
global unit 110
```

```
com='array of arrays of fuel element sections + reflector'
array  6  -55.977  -55.977  0.0
cuboid   4  1  4p55.977  97.40   -1.27
cuboid   5  1  4p55.977  97.40   -3.47
cuboid   3  1  4p55.977  97.40  -17.27
cuboid   5  1  4p55.977  97.40  -17.77
cuboid   6  1  4p55.977  97.40  -54.77
end geometry
read array
ara=1  nux=21  nuy=21  nuz=1
fill  f81  end fill
ara=2  nux=21  nuy=21  nuz=1
fill  f82  end fill
ara=3  nux=21  nuy=21  nuz=1
fill  f83  end fill
ara=4  nux=21  nuy=21  nuz=1
fill  f84  end fill
ara=5  nux=21  nuy=21  nuz=1
fill
  1  2  3  4  5  6  7  8  9 10 11  1b 10
  2 12 13 14 15 16 17 18 19 20 21  1b 10
  3 13 22 23 24 25 26 27 28 29 30  1b 10
  4 14 23 31 32 33 34 35 36 37 38  1b 10
  5 15 24 32 39 40 41 42 43 44 45  1b 10
  6 16 25 33 40 46 47 48 49 50 51  1b 10
  7 17 26 34 41 47 52 53 54 55 56  1b 10
  8 18 27 35 42 48 53 57 58 59 60  1b 10
  9 19 28 36 43 49 54 58 61 62 63  1b 10
 10 20 29 37 44 50 55 59 62 64 65  1b 10
 11 21 30 38 45 51 56 60 63 65 66  1b 220
 end fill
ara=6  nux=1  nuy=1  nuz=6
fill  101 100 102 105 103 104  end fill
end array
end data
end
=shell
cp ft04f001  $RTNDIR/tca11.xs04
cp ft64f001  $RTNDIR/tca11.rs64
end
=kmart
read initial   kunit=64
               xunit=4
               actbygrp
               rrpvol
end initial
read activity
 92234 27 92234 18  92234  1452
 92235 27 92235 18  92235  1452
 92238 27 92238 18  92238  1452
 94238 27 94238 18  94238  1452
 94239 27 94239 18  94239  1452
 94240 27 94240 18  94240  1452
 94241 27 94241 18  94241  1452
 94242 27 94242 18  94242  1452
 95241 27 95241 18  95241  1452
  5010 27
```

```
  5011 27
  8016 27
 40000 27
 24000 27
 26000 27
  1001 27
 50112 27
 50114 27
 50115 27
 50116 27
 50117 27
 50118 27
 50119 27
 50120 27
 50122 27
 50124 27
end activity
read collapse
 factor=1.0
 lastg=57
 lastg=148
 lastg=204
 lastg=238
end collapse
end
```

APPENDIX D

SCALE INPUT OF VARIANTS PROBLEM SET

APPENDIX D
SCALE INPUT OF VARIANTS PROBLEM SET

This appendix contains the CENTRM inputs for the fourty variant/state computational benchmark cases. There are 8 variant groups: V1, V2, V3, V4, V7, V8, V9, and V10. In each variant group there are 5 states: S1, S3, S4, S5, and S6. Each combination of variant and state represents a case. The inputs can be changed to standard CSAS cases by replacing the =CSASC5 record with =CSAS25. The inputs for the cases are listed below.

```
=csasc1x       parm=size=1000000
FMDP  V10 S1 pin-cell case---
238group   latticecell
u-235  1  0  5.0-5    1027  end
u-238  1  0  2.2100-2  1027 end
o-16   1 0 4.63-2  1027  end
pu-238  1  0  3.0-5  1027  end
pu-239  1  0  1.1600-3    1027  end
pu-240  1  0  4.9-4  1027  end
pu-241  1  0  1.9-4  1027  end
pu-242  1  0  1.05-4  1027  end
am-241  1  0  2.5-5  1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V10 S3 pin-cell case---
238group   latticecell
u-235  1  0  5.0-5    1027  end
u-238  1  0  2.2100-2  1027 end
o-16   1 0 4.63-2  1027  end
pu-238  1  0  3.0-5  1027  end
pu-239  1  0  1.1600-3    1027  end
pu-240  1  0  4.9-4  1027  end
pu-241  1  0  1.9-4  1027  end
pu-242  1  0  1.05-4  1027  end
am-241  1  0  2.5-5  1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
'b-10  3  0  4.7344-6  579  end
'b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V10 S4 pin-cell case---
238group   latticecell
u-235  1  0  5.0-5    1027  end
u-238  1  0  2.2100-2  1027 end
o-16   1 0 4.63-2  1027  end
pu-238  1  0  3.0-5  1027  end
pu-239  1  0  1.1600-3    1027  end
pu-240  1  0  4.9-4  1027  end
pu-241  1  0  1.9-4  1027  end
pu-242  1  0  1.05-4  1027  end
am-241  1  0  2.5-5  1027  end
'xe-135  1  0  9.4581-9 1027  end
'sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V10 S5 pin-cell case---
238group   latticecell
u-235  1  0  5.0-5    579  end
u-238  1  0  2.2100-2  579 end
```

```
o-16   1 0 4.63-2  579  end
pu-238  1  0  3.0-5  579  end
pu-239  1  0  1.1600-3    579  end
pu-240  1  0  4.9-4  579  end
pu-241  1  0  1.9-4  579  end
pu-242  1  0  1.05-4  579  end
am-241  1  0  2.5-5  579  end
'xe-135  1  0  9.4581-9 579  end
'sm-149  1  0  7.3667-8  579  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V10 S6 pin-cell case---
238group   latticecell
u-235  1  0  5.0-5    300  end
u-238  1  0  2.2100-2  300 end
o-16   1 0 4.63-2  300  end
pu-238  1  0  3.0-5  300  end
pu-239  1  0  1.1600-3    300  end
pu-240  1  0  4.9-4  300  end
pu-241  1  0  1.9-4  300  end
pu-242  1  0  1.05-4  300  end
am-241  1  0  2.5-5  300  end
'xe-135  1  0  9.4581-9 300  end
'sm-149  1  0  7.3667-8  300  end
zr  2  0  4.23-2   300  end
h  3  0  6.694-2  300  end
o-16  3  0  3.347-2   300  end
b-10  3  0  6.6262-6  300  end
b-11  3  0  2.6839-5  300  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V1 S1 pin-cell case---
238group   latticecell
u-235  1  0  8.7370-4  1027  end
u-238  1  0  1.8744-2  1027  end
o-16   1 0 3.9235-2 1027  end
xe-135  1  0  9.4581-9  1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
iim=40 icm=50
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V1 S3 pin-cell case---
238group   latticecell
u-235  1  0  8.7370-4  1027  end
u-238  1  0  1.8744-2  1027  end
o-16   1 0 3.9235-2 1027  end
xe-135  1  0  9.4581-9  1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
'b-10  3  0  4.7344-6  579  end
'b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V1 S4 pin-cell case---
238group   latticecell
u-235  1  0  8.7370-4  1027  end
u-238  1  0  1.8744-2  1027  end
o-16   1 0 3.9235-2 1027  end
'xe-135  1  0  9.4581-9  1027  end
'sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
```

```
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V1 S5 pin-cell case---
238group   latticecell
u-235  1  0  8.7370-4  579  end
u-238  1  0  1.8744-2  579  end
o-16   1 0 3.9235-2 579  end
'xe-135  1  0  9.4581-9  579  end
'sm-149  1  0  7.3667-8  579  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V1 S6 pin-cell case---
238group   latticecell
u-235  1  0  8.7370-4  300  end
u-238  1  0  1.8744-2  300  end
o-16   1 0 3.9235-2 300  end
'xe-135  1  0  9.4581-9  300  end
'sm-149  1  0  7.3667-8  300  end
zr  2  0  4.23-2   300  end
h  3  0  6.694-2  300  end
o-16  3  0  3.347-2  300  end
b-10  3  0  6.6262-6  300  end
b-11  3  0  2.6839-5  300  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=8000000
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V2 S1 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  1027  end
u-238  1  0  1.8917-2  1027  end
pu-239  1  0  6.5875-4  1027  end
pu-240 1 0 4.2323-5  1027  end
pu-241 1 0 7.0246-6  1027  end
o-16   1 0 3.9235-2 1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V2 S3 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  1027  end
u-238  1  0  1.8917-2  1027  end
pu-239  1  0  6.5875-4  1027  end
pu-240 1 0 4.2323-5  1027  end
pu-241 1 0 7.0246-6  1027  end
o-16   1 0 3.9235-2 1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
'b-10  3  0  4.7344-6  579  end
'b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V2 S4 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  1027  end
u-238  1  0  1.8917-2  1027  end
pu-239  1  0  6.5875-4  1027  end
pu-240 1 0 4.2323-5  1027  end
pu-241 1 0 7.0246-6  1027  end
o-16   1 0 3.9235-2 1027  end
'xe-135  1  0  9.4581-9 1027  end
'sm-149  1  0  7.3667-8  1027  end
```

```
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=17000000
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
end more
end data
end

=csasc1x      parm=size=1000000
FMDP  V2 S5 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  579  end
u-238  1  0  1.8917-2  579  end
pu-239  1  0  6.5875-4  579  end
pu-240 1 0 4.2323-5  579  end
pu-241 1 0 7.0246-6  579  end
o-16   1 0 3.9235-2 579  end
'xe-135  1  0  9.4581-9 579  end
'sm-149  1  0  7.3667-8  579  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=17000000
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
end more
end data
end

=csasc1x      parm=size=1000000
FMDP  V2 S6 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  300  end
u-238  1  0  1.8917-2  300  end
pu-239  1  0  6.5875-4  300  end
pu-240 1 0 4.2323-5  300  end
pu-241 1 0 7.0246-6  300  end
o-16   1 0 3.9235-2 300  end
'xe-135  1  0  9.4581-9 300  end
'sm-149  1  0  7.3667-8  300  end
zr  2  0  4.23-2   300  end
h  3  0  6.694-2  300  end
o-16  3  0  3.347-2  300  end
b-10  3  0  6.6262-6  300  end
b-11  3  0  2.6839-5  300  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=17000000
ixtr3=3
szf=.75  isn=16  eps=.00001  ptc=.00001
end more
end data
end

=csasc1x      parm=size=1000000
FMDP  V3 S1 pin-cell case---
238group   latticecell
u-235  1  0  3.7843-4  1027  end
u-236  1  0  8.6365-5  1027  end
u-238  1  0  1.8327-2  1027  end
np-237   1  0  2.4823-5  1027  end
pu-238  1  0  6.7254-6  1027  end
'np-239  1  0  1.8332-6  1027  end
pu-239  1  0  1.3111-4   1027  end
pu-240 1 0 3.6233-5  1027  end
pu-241 1 0 2.1701-5  1027  end
pu-242  1  0  4.7576-6  1027  end
am-241  1  0  4.949-7  1027  end
am-242m  1  0  7.9194-9  1027  end
am-243  1  0  6.6925-7  1027  end
cm-242  1  0  1.2582-7  1027  end
cm-243  1  0  2.0629-9  1027  end
cm-244  1  0  1.2387-7  1027  end
o-16   1 0 3.9235-2 1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=16000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x      parm=size=1000000
FMDP  V3 S3 pin-cell case---
238group   latticecell
u-235  1  0  3.7843-4  1027  end
u-236  1  0  8.6365-5  1027  end
u-238  1  0  1.8327-2  1027  end
np-237   1  0  2.4823-5  1027  end
pu-238  1  0  6.7254-6  1027  end
'np-239  1  0  1.8332-6  1027  end
pu-239  1  0  1.3111-4   1027  end
```

```
pu-240 1 0 3.6233-5  1027  end
pu-241 1 0 2.1701-5  1027  end
pu-242  1  0  4.7576-6  1027  end
am-241  1  0  4.949-7  1027  end
am-242m  1  0  7.9194-9  1027  end
am-243  1  0  6.6925-7  1027  end
cm-242  1  0  1.2582-7  1027  end
cm-243  1  0  2.0629-9  1027  end
cm-244  1  0  1.2387-7  1027  end
o-16   1 0 3.9235-2 1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
'b-10  3  0  4.7344-6  579  end
'b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=16000000
ixtr3=3
szf=.75  isn=16   eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V3 S4 pin-cell case---
238group   latticecell
u-235  1  0  3.7843-4  1027  end
u-236  1  0  8.6365-5  1027  end
u-238  1  0  1.8327-2  1027  end
np-237   1  0  2.4823-5  1027  end
pu-238  1  0  6.7254-6  1027  end
'np-239  1  0  1.8332-6  1027  end
pu-239  1  0  1.3111-4   1027  end
pu-240 1 0 3.6233-5  1027  end
pu-241 1 0 2.1701-5  1027  end
pu-242  1  0  4.7576-6  1027  end
am-241  1  0  4.949-7  1027  end
am-242m  1  0  7.9194-9  1027  end
am-243  1  0  6.6925-7  1027  end
cm-242  1  0  1.2582-7  1027  end
cm-243  1  0  2.0629-9  1027  end
cm-244  1  0  1.2387-7  1027  end
o-16   1 0 3.9235-2 1027  end
'xe-135  1  0  9.4581-9 1027  end
'sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=16000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V3 S5 pin-cell case---
238group   latticecell
u-235  1  0  3.7843-4  579  end
u-236  1  0  8.6365-5  579  end
u-238  1  0  1.8327-2  579  end
np-237   1  0  2.4823-5  579  end
pu-238  1  0  6.7254-6  579  end
'np-239  1  0  1.8332-6  579  end
pu-239  1  0  1.3111-4   579  end
pu-240 1 0 3.6233-5  579  end
pu-241 1 0 2.1701-5  579  end
pu-242  1  0  4.7576-6  579  end
am-241  1  0  4.949-7  579  end
am-242m  1  0  7.9194-9  579  end
am-243  1  0  6.6925-7  579  end
cm-242  1  0  1.2582-7  579  end
cm-243  1  0  2.0629-9  579  end
cm-244  1  0  1.2387-7  579  end
o-16   1 0 3.9235-2 579  end
'xe-135  1  0  9.4581-9 579  end
'sm-149  1  0  7.3667-8  579  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=16000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V3 S6 pin-cell case---
238group   latticecell
u-235  1  0  3.7843-4  300  end
u-236  1  0  8.6365-5  300  end
u-238  1  0  1.8327-2  300  end
np-237   1  0  2.4823-5  300  end
pu-238  1  0  6.7254-6  300  end
'np-239  1  0  1.8332-6  300  end
pu-239  1  0  1.3111-4   300  end
pu-240 1 0 3.6233-5  300  end
pu-241 1 0 2.1701-5  300  end
pu-242  1  0  4.7576-6  300  end
```

```
am-241  1  0  4.949-7  300  end
am-242m  1  0  7.9194-9  300  end
am-243  1  0  6.6925-7  300  end
cm-242  1  0  1.2582-7  300  end
cm-243  1  0  2.0629-9  300  end
cm-244  1  0  1.2387-7  300  end
o-16   1 0 3.9235-2 300  end
'xe-135  1  0  9.4581-9 300  end
'sm-149  1  0  7.3667-8  300  end
zr  2  0  4.23-2   300  end
h  3  0  6.694-2  300  end
o-16  3  0  3.347-2  300  end
b-10  3  0  6.6262-6  300  end
b-11  3  0  2.6839-5  300  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=16000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V4 S1 pin-cell case---
238group   latticecell
u-235  1  0  3.7843-4  1027  end
u-236  1  0  8.6365-5  1027  end
u-238  1  0  1.8327-2  1027  end
np-237   1  0  2.4823-5  1027  end
pu-238  1  0  6.7254-6  1027  end
'np-239  1  0  1.8332-6  1027  end
pu-239  1  0  1.3111-4   1027  end
pu-240 1 0 3.6233-5  1027  end
pu-241 1 0 2.1701-5  1027  end
rh-103  1  0  1.8890-5  1027  end
xe-131  1  0  1.4255-5  1027  end
nd-143  1  0  2.6692-5  1027  end
pm-147  1  0  6.1574-6  1027  end
cs-133  1  0  3.5974-5  1027  end
tc-99  1  0  3.3320-5  1027  end
sm-152  1  0  2.6842-6  1027  end
sm-151  1  0  3.0757-7  1027  end
pu-242  1  0  4.7576-6  1027  end
am-241  1  0  4.9491-7  1027  end
am-242m  1  0  7.9194-9  1027  end
am-243  1  0  6.6925-7  1027  end
cm-242  1  0  1.2582-7  1027  end
cm-243  1  0  2.0629-9  1027  end
cm-244  1  0  1.2387-7  1027  end
o-16   1 0 3.9235-2 1027  end
nd-145  1  0  1.9975-5  1027  end
eu-153  1  0  2.4801-6  1027  end
ag-109  1  0  2.2037-6  1027  end
eu-155  1  0  9.6857-8  1027  end
mo-95  1  0  3.3720-5  1027  end
```

```
eu-154  1  0  5.1189-7  1027  end
ru-101  1  0  3.1134-5  1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=20000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V4 S3 pin-cell case---
238group   latticecell
u-235  1  0  3.7843-4  1027  end
u-236  1  0  8.6365-5  1027  end
u-238  1  0  1.8327-2  1027  end
np-237   1  0  2.4823-5  1027  end
pu-238  1  0  6.7254-6  1027  end
'np-239  1  0  1.8332-6  1027  end
pu-239  1  0  1.3111-4   1027  end
pu-240 1 0 3.6233-5  1027  end
pu-241 1 0 2.1701-5  1027  end
rh-103  1  0  1.8890-5  1027  end
xe-131  1  0  1.4255-5  1027  end
nd-143  1  0  2.6692-5  1027  end
pm-147  1  0  6.1574-6  1027  end
cs-133  1  0  3.5974-5  1027  end
tc-99  1  0  3.3320-5  1027  end
sm-152  1  0  2.6842-6  1027  end
sm-151  1  0  3.0757-7  1027  end
pu-242  1  0  4.7576-6  1027  end
am-241  1  0  4.9491-7  1027  end
am-242m  1  0  7.9194-9  1027  end
am-243  1  0  6.6925-7  1027  end
cm-242  1  0  1.2582-7  1027  end
cm-243  1  0  2.0629-9  1027  end
cm-244  1  0  1.2387-7  1027  end
o-16   1 0 3.9235-2 1027  end
nd-145  1  0  1.9975-5  1027  end
eu-153  1  0  2.4801-6  1027  end
ag-109  1  0  2.2037-6  1027  end
eu-155  1  0  9.6857-8  1027  end
mo-95  1  0  3.3720-5  1027  end
eu-154  1  0  5.1189-7  1027  end
ru-101  1  0  3.1134-5  1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
```

```
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
'b-10  3  0  4.7344-6  579  end
'b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=20000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V4 S4 pin-cell case---
238group   latticecell
u-235  1  0  3.7843-4  1027  end
u-236  1  0  8.6365-5  1027  end
u-238  1  0  1.8327-2  1027  end
np-237   1  0  2.4823-5  1027  end
pu-238  1  0  6.7254-6  1027  end
'np-239  1  0  1.8332-6  1027  end
pu-239  1  0  1.3111-4   1027  end
pu-240 1 0 3.6233-5  1027  end
pu-241 1 0 2.1701-5  1027  end
rh-103  1  0  1.8890-5  1027  end
xe-131  1  0  1.4255-5  1027  end
nd-143  1  0  2.6692-5  1027  end
pm-147  1  0  6.1574-6  1027  end
cs-133  1  0  3.5974-5  1027  end
tc-99  1  0  3.3320-5  1027  end
sm-152  1  0  2.6842-6  1027  end
sm-151  1  0  3.0757-7  1027  end
pu-242  1  0  4.7576-6  1027  end
am-241  1  0  4.9491-7  1027  end
am-242m  1  0  7.9194-9  1027  end
am-243  1  0  6.6925-7  1027  end
cm-242  1  0  1.2582-7  1027  end
cm-243  1  0  2.0629-9  1027  end
cm-244  1  0  1.2387-7  1027  end
o-16   1 0 3.9235-2 1027  end
nd-145  1  0  1.9975-5  1027  end
eu-153  1  0  2.4801-6  1027  end
ag-109  1  0  2.2037-6  1027  end
eu-155  1  0  9.6857-8  1027  end
mo-95  1  0  3.3720-5  1027  end
eu-154  1  0  5.1189-7  1027  end
ru-101  1  0  3.1134-5  1027  end
'xe-135  1  0  9.4581-9 1027  end
'sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=20000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V4 S5 pin-cell case---
238group   latticecell
u-235  1  0  3.7843-4  579  end
u-236  1  0  8.6365-5  579  end
u-238  1  0  1.8327-2  579  end
np-237   1  0  2.4823-5  579  end
pu-238  1  0  6.7254-6  579  end
'np-239  1  0  1.8332-6  579  end
pu-239  1  0  1.3111-4   579  end
pu-240 1 0 3.6233-5  579  end
pu-241 1 0 2.1701-5  579  end
rh-103  1  0  1.8890-5  579  end
xe-131  1  0  1.4255-5  579  end
nd-143  1  0  2.6692-5  579  end
pm-147  1  0  6.1574-6  579  end
cs-133  1  0  3.5974-5  579  end
tc-99  1  0  3.3320-5  579  end
sm-152  1  0  2.6842-6  579  end
sm-151  1  0  3.0757-7  579  end
pu-242  1  0  4.7576-6  579  end
am-241  1  0  4.9491-7  579  end
am-242m  1  0  7.9194-9  579  end
am-243  1  0  6.6925-7  579  end
cm-242  1  0  1.2582-7  579  end
cm-243  1  0  2.0629-9  579  end
cm-244  1  0  1.2387-7  579  end
o-16   1 0 3.9235-2 579  end
nd-145  1  0  1.9975-5  579  end
eu-153  1  0  2.4801-6  579  end
ag-109  1  0  2.2037-6  579  end
eu-155  1  0  9.6857-8  579  end
mo-95  1  0  3.3720-5  579  end
eu-154  1  0  5.1189-7  579  end
ru-101  1  0  3.1134-5  579  end
'xe-135  1  0  9.4581-9 579  end
'sm-149  1  0  7.3667-8  579  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2  579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=20000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
```

```
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V4 S6 pin-cell case---
238group   latticecell
u-235  1  0  3.7843-4  300  end
u-236  1  0  8.6365-5  300  end
u-238  1  0  1.8327-2  300  end
np-237   1  0  2.4823-5  300  end
pu-238  1  0  6.7254-6  300  end
'np-239  1  0  1.8332-6  300  end
pu-239  1  0  1.3111-4   300  end
pu-240 1 0 3.6233-5  300  end
pu-241 1 0 2.1701-5  300  end
rh-103  1  0  1.8890-5  300  end
xe-131  1  0  1.4255-5  300  end
nd-143  1  0  2.6692-5  300  end
pm-147  1  0  6.1574-6  300  end
cs-133  1  0  3.5974-5  300  end
tc-99  1  0  3.3320-5  300  end
sm-152  1  0  2.6842-6  300  end
sm-151  1  0  3.0757-7  300  end
pu-242  1  0  4.7576-6  300  end
am-241  1  0  4.9491-7  300  end
am-242m  1  0  7.9194-9  300  end
am-243  1  0  6.6925-7  300  end
cm-242  1  0  1.2582-7  300  end
cm-243  1  0  2.0629-9  300  end
cm-244  1  0  1.2387-7  300  end
o-16   1 0 3.9235-2 300  end
nd-145  1  0  1.9975-5  300  end
eu-153  1  0  2.4801-6  300  end
ag-109  1  0  2.2037-6  300  end
eu-155  1  0  9.6857-8  300  end
mo-95  1  0  3.3720-5  300  end
eu-154  1  0  5.1189-7  300  end
ru-101  1  0  3.1134-5  300  end
'xe-135  1  0  9.4581-9 300  end
'sm-149  1  0  7.3667-8  300  end
zr  2  0  4.23-2   300  end
h  3  0  6.694-2  300  end
o-16  3  0  3.347-2  300  end
b-10  3  0  6.6262-6  300  end
b-11  3  0  2.6839-5  300  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=20000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V4 S6 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  1027  end
u-238  1  0  1.8917-2  1027 end
pu-239  1  0 6.5875-4  1027  end
o-16   1 0 4.1707-2  1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=16000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V7 S3 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  1027  end
u-238  1  0  1.8917-2  1027 end
pu-239  1  0 6.5875-4  1027  end
o-16   1 0 4.1707-2  1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
'b-10  3  0  4.7344-6  579  end
'b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=16000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V7 S4 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  1027  end
u-238  1  0  1.8917-2  1027 end
pu-239  1  0 6.5875-4  1027  end
o-16   1 0 4.1707-2  1027  end
'xe-135  1  0  9.4581-9 1027  end
'sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
```

```
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=16000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V7 S5 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  579  end
u-238  1  0  1.8917-2  579 end
pu-239  1  0 6.5875-4  579  end
o-16   1 0 4.1707-2  579  end
'xe-135  1  0  9.4581-9 579  end
'sm-149  1  0  7.3667-8  579  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=16000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V7 S6 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  300  end
u-238  1  0  1.8917-2  300 end
pu-239  1  0 6.5875-4  300  end
o-16   1 0 4.1707-2  300  end
'xe-135  1  0  9.4581-9 300  end
'sm-149  1  0  7.3667-8  300  end
zr  2  0  4.23-2   300  end
h  3  0  6.694-2  300  end
o-16  3  0  3.347-2   300  end
b-10  3  0  6.6262-6  300  end
b-11  3  0  2.6839-5  300  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=16000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V8 S1 pin-cell case---
238group   latticecell
u-235  1  0  6.9714-4  1027  end
u-238  1  0  1.8917-2  1027 end
pu-240  1  0  4.2323-5  1027  end
o-16   1 0 4.1707-2  1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V8 S3 pin-cell case---
238group   latticecell
u-235  1  0  6.9714-4  1027  end
u-238  1  0  1.8917-2  1027 end
pu-240  1  0  4.2323-5  1027  end
o-16   1 0 4.1707-2  1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
'b-10  3  0  4.7344-6  579  end
'b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V8 S4 pin-cell case---
238group   latticecell
u-235  1  0  6.9714-4  1027  end
```

```
u-238  1  0  1.8917-2  1027 end
pu-240  1  0  4.2323-5  1027  end
o-16   1 0 4.1707-2  1027  end
'xe-135  1  0  9.4581-9 1027  end
'sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V8 S5 pin-cell case---
238group   latticecell
u-235  1  0  6.9714-4  579  end
u-238  1  0  1.8917-2  579 end
pu-240  1  0  4.2323-5  579  end
o-16   1 0 4.1707-2  579  end
'xe-135  1  0  9.4581-9 579  end
'sm-149  1  0  7.3667-8  579  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V8 S6 pin-cell case---
238group   latticecell
u-235  1  0  6.9714-4  300  end
u-238  1  0  1.8917-2  300 end
pu-240  1  0  4.2323-5  300  end
o-16   1 0 4.1707-2  300  end
'xe-135  1  0  9.4581-9 300  end
'sm-149  1  0  7.3667-8  300  end
zr  2  0  4.23-2   300  end
h  3  0  6.694-2  300  end
o-16  3  0  3.347-2   300  end
b-10  3  0  6.6262-6  300  end
b-11  3  0  2.6839-5  300  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V9 S1 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  1027  end
u-238  1  0  1.8917-2 1027 end
pu-241  1  0  6.6577-4  1027  end
o-16   1 0 4.1707-2  1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V9 S3 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  1027  end
u-238  1  0  1.8917-2 1027 end
pu-241  1  0  6.6577-4  1027  end
o-16   1 0 4.1707-2  1027  end
xe-135  1  0  9.4581-9 1027  end
sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
'b-10  3  0  4.7344-6  579  end
'b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
```

```
end

=csasc1x       parm=size=1000000
FMDP  V9 S5 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  1027  end
u-238  1  0  1.8917-2 1027 end
pu-241  1  0  6.6577-4  1027  end
o-16   1 0 4.1707-2  1027  end
'xe-135  1  0  9.4581-9 1027  end
'sm-149  1  0  7.3667-8  1027  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V9 S6 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  579  end
u-238  1  0  1.8917-2 579 end
pu-241  1  0  6.6577-4  579  end
o-16   1 0 4.1707-2  579  end
'xe-135  1  0  9.4581-9 579  end
'sm-149  1  0  7.3667-8  579  end
zr  2  0  4.23-2   579  end
h  3  0  4.783-2  579  end
o-16  3  0  2.391-2   579  end
b-10  3  0  4.7344-6  579  end
b-11  3  0  1.9177-5  579  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end

=csasc1x       parm=size=1000000
FMDP  V9 S6 pin-cell case---
238group   latticecell
u-235  1  0  3.8393-5  300  end
u-238  1  0  1.8917-2 300 end
pu-241  1  0  6.6577-4  300  end
o-16   1 0 4.1707-2  300  end
'xe-135  1  0  9.4581-9 300  end
'sm-149  1  0  7.3667-8  300  end
zr  2  0  4.23-2   300  end
h  3  0  6.694-2  300  end
o-16  3  0  3.347-2   300  end
b-10  3  0  6.6262-6  300  end
b-11  3  0  2.6839-5  300  end
end comp
triangpitch  1.27500  0.772  1  3  0.9164  2  end
more data
limcen=12000000
ixtr3=3
szf=.75  isn=16    eps=.00001  ptc=.00001
end more
end data
end
```

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