**CRITICALITY REFERENCE BENCHMARK CALCULATIONS FOR
BURNUP CREDIT USING SPENT FUEL ISOTOPICS***

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Oak Ridge Gaseous Diffusion Plant Paducah Gaseous Diffusion Plant
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INTRODUCTION

To date, criticality analyses performed in support of the certification of spent fuel casks in the United States do not take credit for the reactivity reduction that results from burnup. By taking credit for the fuel burnup, commonly referred to as "burnup credit," the fuel loading capacity of these casks can be increased.

One of the difficulties in implementing burnup credit in criticality analyses is that there have been no critical experiments performed with spent fuel which can be used for computer code validation. In lieu of that, a reference problem set of fresh fuel critical experiments which model various conditions typical of light water reactor (LWR) transportation and storage casks has been identified and used in the validation of SCALE-4.^{1,2} This report documents the use of this same problem set to perform spent fuel criticality benchmark calculations by replacing the actual fresh fuel isotopics from the experiments with six different sets of calculated spent fuel isotopics. The SCALE-4 modules SAS2H³ and CSAS4⁴ were used to perform the analyses. These calculations do not model actual critical experiments. The calculated k-effectives are not supposed to equal unity and will vary depending on the initial enrichment and burnup of the calculated spent fuel isotopics.

GENERATION OF SPENT FUEL ISOTOPICS

LWR spent fuel isotopics were generated using the SAS2H module in SCALE-4. Three initial enrichments of 3.0, 3.75, and 4.5 weight percent (wt %) ²³⁵U and two burnups of 18,000 and 25,000 MWd/MTU were selected to give a total of six different enrichment/burnup combinations.

The initial isotopic distribution assumed for each enrichment is presented in Table 1. The wt % of ²³⁴U and ²³⁶U for the lowest enrichment (3.0 wt % ²³⁵U) were calculated using the following formulae:

$$\text{wt \% } ^{234}\text{U} = 0.007731 (\text{wt \% } ^{235}\text{U})^{1.08370}$$

$$\text{wt \% } ^{236}\text{U} = 0.0046 (\text{wt \% } ^{235}\text{U})$$

These formulae are empirical fits of measured data for LWR fuel over a range of 2.56 to 3.13 wt %. The values for the two higher enrichments (3.75 and 4.5 wt % ²³⁵U) are based on extrapolation of measured data for 3.8 and 4.0 wt % ²³⁵U fuel.

Table 1. Initial fuel isotopic distributions

wt % ^{235}U	wt % ^{234}U	wt % ^{236}U	wt % ^{238}U
3.0	0.0254	0.0138	96.9608
3.75	0.0294	0.0233	96.1973
4.5	0.0358	0.0278	95.4364

The fuel assembly model used in SAS2H was a standard Westinghouse 17 x 17 design. The data used to model the assembly are given in Table 2. The spent fuel isotopes tracked in SAS2H are listed in Table 3. The input xenon concentration was 6.72×10^{-9} atoms/b-cm.

Table 2. Fuel assembly data

Parameter	Data
Assembly general data	
Designer	Westinghouse
Lattice	17 x 17
Water temperature, K	570
Water density, g-cm ⁻³	0.733
Soluble boron, cycle av, ppm (wt)	750
Number of fuel rods	264
Number of guide tubes	24
Number of instrument tubes	1
Assembly pitch cm (in.)	21.50364 (8.466)
Fuel rod data	
Type fuel pellet	UO ₂
Pellet stack density, % TD	95
Rod pitch, cm (in.)	1.25984 (0.496)
Rod OD, cm (in.)	0.94966 (0.374)
Rod ID, cm (in.)	0.83566 (0.329)
Pellet diameter, cm (in.)	0.81915 (0.3225)
Active fuel length, cm (in.)	365.76 (144)
Effective fuel temperature, K	811
Clad temperature, K	620
Clad material	Zircalloy
Guide tube data	
Inner radius, cm (in.)	0.5715 (0.45)
Outer radius, cm (in.)	0.61214 (0.482)
Tube material	Zircalloy

Table 3. Spent fuel isotopes tracked in SAS2H

Kr-85	Ag-109	Nd-143	U-236*
Sr-90	Sb-124	Nd-145	U-238*
Y-89	Xe-131	Pm-147	Np-237*
Mo-95	Xe-132	Nd-147	Pu-238*
Zr-93	Xe-135*	Sm-147	Pu-239*
Zr-94	Xe-136	Sm-149	Pu-240*
Zr-95	Cs-133*	Sm-150	Pu-241*
Nb-94	Cs-134	Sm-151	Pu-242*
Tc-99	Cs-135	Sm-152	Am-241*
Rh-103	Cs-137	Gd-155	Am-241m*
Rh-105	Ba-136	Eu-153	Am-243*
Ru-101	La-139	Eu-154	Cm-242*
Ru-106	Pr-141	Eu-155	Cm-243*
Pd-105	Pr-143	U-234*	Cm-244*
Pd-108	Ce-144	U-235*	

*Automatically included by SAS2H.

The lower burnup (18,000 MWd/MTU) cases were depleted for two cycles of 240 days. The higher burnup (25,000 MWd/MTU) cases were depleted for three cycles of 222.22 days. The specific power level for all cases was 17.514 MW per assembly. There was no downtime between cycles and a five-year downtime after the final cycle in all cases.

The resulting isotopics at the end of the five-year cooling period are listed in Tables 4—9. These were the values used in the criticality calculations described below. The SAS2H input decks are attached in Appendix A.

Table 4. Reference isotopic set 1
3.0 wt %, 18000 MWd/MTU*

Nuclide	Number density	Nuclide	Number density
U-234	4.5843E-06	Rh-103	1.5864E-05
U-235	3.3960E-04	Cs-133	2.8059E-05
U-236	6.6971E-05	Cs-135	7.7769E-06
U-238	2.2205E-02	Nd-143	2.0929E-05
Pu-238	8.8353E-07	Nd-145	1.5484E-05
Pu-239	1.1460E-04	Sm-147	5.3314E-06
Pu-240	2.8115E-05	Sm-149	1.5299E-07
Pu-241	1.3620E-05	Sm-150	6.1460E-06
Pu-242	2.7445E-06	Sm-151	4.2377E-07
Am-241	3.8661E-06	Sm-152	2.7537E-06
O	4.6455E-02	Eu-153	1.7946E-06
Mo-95	2.5875E-05	Gd-155	1.0026E-07
Tc-99	2.5634E-05		

*Megawatt days/metric ton initial uranium.

Table 5. Reference isotopic set 2
3.0 wt %, 25000 MWd/MTU*

Nuclide	Number density	Nuclide	Number density
U-234	4.1151E-06	Rh-103	2.1252E-05
U-235	2.4980E-04	Cs-133	3.7614E-05
U-236	8.0670E-05	Cs-135	1.0747E-05
U-238	2.2071E-02	Nd-143	2.6524E-05
Pu-238	1.9672E-06	Nd-145	2.0568E-05
Pu-239	1.2743E-04	Sm-147	6.4862E-06
Pu-240	3.9900E-05	Sm-149	1.5980E-07
Pu-241	2.0457E-05	Sm-150	8.9709E-06
Pu-242	6.2056E-06	Sm-151	4.9181E-07
Am-241	5.9277E-06	Sm-152	3.7235E-06
O	4.6455E-02	Eu-153	2.8184E-06
Mo-95	3.4760E-05	Gd-155	1.7613E-07
Tc-99	3.4462E-05		

*Megawatt days/metric ton initial uranium.

Table 6. Reference isotopic set 3
3.75 wt %, 18000 MWd/MTU*

Nuclide	Number density	Nuclide	Number density
U-234	5.4708E-06	Rh-103	1.5439E-05
U-235	4.8322E-04	Cs-133	2.8295E-05
U-236	7.6752E-05	Cs-135	9.1769E-06
U-238	2.2057E-02	Nd-143	2.1890E-05
Pu-238	8.0056E-07	Nd-145	1.5817E-05
Pu-239	1.1618E-04	Sm-147	5.5518E-06
Pu-240	2.4356E-05	Sm-149	1.7037E-07
Pu-241	1.1818E-05	Sm-150	6.0561E-06
Pu-242	1.9009E-06	Sm-151	4.8345E-07
Am-241	3.3564E-06	Sm-152	2.6548E-06
O	4.6458E-02	Eu-153	1.6704E-06
Mo-95	2.6362E-05	Gd-155	9.3242E-08
Tc-99	2.5850E-05		

*Megawatt days/metric ton initial uranium.

Table 7. Reference isotopic set 4
3.75 wt %, 25000 MWd/MTU*

Nuclide	Number density	Nuclide	Number density
U-234	4.9660E-06	Rh-103	2.0758E-05
U-235	3.7448E-04	Cs-133	3.8065E-05
U-236	9.4302E-05	Cs-135	1.2603E-05
U-238	2.1935E-02	Nd-143	2.8152E-05
Pu-238	1.8076E-06	Nd-145	2.1125E-05
Pu-239	1.3180E-04	Sm-147	6.8490E-06
Pu-240	3.5530E-05	Sm-149	1.7808E-07
Pu-241	1.8700E-05	Sm-150	8.8190E-06
Pu-242	4.5287E-06	Sm-151	5.5383E-07
Am-241	5.4293E-06	Sm-152	3.6210E-06
O	4.6458E-02	Eu-153	2.6441E-06
Mo-95	3.5562E-05	Gd-155	1.6162E-07
Tc-99	3.4863E-05		

*Megawatt days/metric ton initial uranium

Table 8. Reference isotopic set 5
4.5 wt %, 18000 MWd/MTU*

Nuclide	Number density	Nuclide	Number density
U-234	6.8134E-06	Rh-103	1.5141E-05
U-235	6.3569E-04	Cs-133	2.8480E-05
U-236	8.3957E-05	Cs-135	1.0523E-05
U-238	2.1901E-02	Nd-143	2.2600E-05
Pu-238	7.2349E-07	Nd-145	1.6059E-05
Pu-239	1.1687E-04	Sm-147	5.7241E-06
Pu-240	2.1413E-05	Sm-149	1.8366E-07
Pu-241	1.0316E-05	Sm-150	6.0269E-06
Pu-242	1.3715E-06	Sm-151	5.4511E-07
Am-241	2.9311E-06	Sm-152	2.5670E-06
O	4.6462E-02	Eu-153	1.5715E-06
Mo-95	2.6712E-05	Gd-155	8.8526E-08
Tc-99	2.6015E-05		

*Megawatt days/metric ton initial uranium.

Table 9. Reference isotopic set 6
4.5 wt %, 25000 MWd/MTU*

Nuclide	Number density	Nuclide	Number density
U-234	6.2365E-06	Rh-103	2.0397E-05
U-235	5.1213E-04	Cs-133	3.8420E-05
U-236	1.0479E-04	Cs-135	1.4418E-05
U-238	2.1790E-02	Nd-143	2.9402E-05
Pu-238	1.6481E-06	Nd-145	2.1543E-05
Pu-239	1.3503E-04	Sm-147	7.1435E-06
Pu-240	3.1871E-05	Sm-149	1.9093E-07
Pu-241	1.7023E-05	Sm-150	8.8363E-06
Pu-242	3.3969E-06	Sm-151	6.2147E-07
Am-241	4.9501E-06	Sm-152	3.5323E-06
O	4.6462E-02	Eu-153	2.4987E-06
Mo-95	3.6158E-05	Gd-155	1.5066E-07
Tc-99	3.5176E-05		

*Megawatt days/metric ton initial uranium.

CRITICALITY BENCHMARK CALCULATIONS

The reference problem set of fresh fuel critical experiments from ref. 1 is listed and briefly described in Table 10. More complete descriptions may be found in the individual references listed in the table. The last experiment listed in the table was not used since it was a mixed-oxide experiment intended to simulate an assembly with 20,000 MWd/MTU burnup. The other 15 problems were analyzed with each of the 6 sets of spent fuel isotopics for a total of 90 cases. The CSAS4 input decks used to model the experiments in ref. 1 were modified by commenting out the actual fresh fuel isotopics and inserting one set of the spent fuel isotopics shown in Tables 4 through 9. Copies of the input decks for the 15 benchmark problems are provided in Appendix B. Note that the fresh fuel isotopics are commented out, and comments show where the spent fuel isotopics are to be inserted and what mixture number should be assigned. The results for all 90 cases are presented in Table 11. Each case used 600 neutrons per generation for 205 generations, except as noted otherwise in the table.

Table 10. Fresh fuel critical experiments for burnup credit calculations

Experimental assembly	Experiment reference numbers	Data source
2 x 2 rectangular array of water-moderated and reflected fuel units separated by neutron flux traps	214R	S. R. Bierman, PNL-7167, 1990 (ref. 5)
2 x 2 rectangular array of water-moderated and reflected fuel units separated by neutron flux traps containing voids	214V3	S. R. Bierman, PNL-7167, 1990 (ref. 5)
Three rectangular water-moderated and reflected fuel units in a row separated by water gaps containing plates of either boral, steel, or aluminum	005 017 028 024	S. R. Bierman et al., PNL-2438, 1977 (ref. 6)
Three separate water-moderated and reflected rectangular fuel units in a row with lead, depleted uranium, or steel walls on either side	^a	S. R. Bierman et al., PNL-3926, 1981 (ref. 7) S. R. Bierman et al., PNL-3602, 1981 (ref. 8)
3 x 3 rectangular array of water-moderated and reflected fuel units separated by water gaps containing equally spaced B ₄ C rods	2282	M. N. Baldwin et al., BAW-1484-7, 1979 (ref. 9)
Slightly undermoderated assemblies of fuel rods moderated with water containing identical concentrations of dissolved boron ^b	173 177 178 181	B. M. Durst et al., PNL-4267, 1982 (ref. 10)
Seven rectangular units of fuel rods encased in AIB ₂ alloy sleeves arranged in a subcritical shipping cask geometry, water-moderated and reflected	TTC-5 ^c	S. R. Bierman, PNL-6838, 1989 (ref. 11)
A water-moderated and reflected assembly of PuO ₂ -UO ₂ fuel rods and UO ₂ fuel rods arranged in a uniform pattern to approximate an assembly Pu/ ²³⁵ U ratio characteristic of 20,000 MWd/MTU burnup ^d	196	S. R. Bierman et al., PNL-4976, 1982 (ref. 12)

^a No reference number given. Assembly with 19.56 mm between fuel and reflecting walls.

^b Boron concentration such that assembly with closer-spaced fuel rods has the smaller critical mass.

^c 1264 fuel rods and k_{eff} of 0.92.

^d Measured subcritical k_{eff} values also provided as function of Gd concentration in the moderator.

Table 11. Reference benchmark results using spent fuel isotopics

Experiment	3.0 wt %	3.0 wt %	3.75 wt %	3.75 wt %	4.5 wt %	4.5 wt %
	18 GWd/MTU	25 GWd/MTU	18 GWd/MTU	25 GWd/MTU	18 GWd/MTU	25 GWd/MTU
214R	0.79706(203) ^a	0.73890(196)	0.83495(195)	0.79795(174)	0.87645(194)	0.83557(188)
214V3	0.79061(182)	0.74729(174)	0.83900(183)	0.79622(183)	0.87667(193)	0.83357(183)
2282	0.88796(199)	0.83402(166)	0.93683(188)	0.89251(200)	0.98586(198)	0.93913(187)
005	0.91760(188)	0.86904(177)	0.98218(202)	0.93404(186)	1.03204(189)	0.98566(207)
017	0.92196(187)	0.86654(167)	0.97958(191)	0.92877(179)	1.03066(161)	0.98659(194)
024	0.92029(184)	0.86868(160)	0.98184(180)	0.93327(179)	1.02766(182)	0.98474(192)
028	0.92392(172)	0.86934(172)	0.98338(195)	0.93203(192)	1.03011(196)	0.98298(193)
PNL-3602 (steel walls)	0.79743(193)	0.75216(167)	0.84587(183)	0.80181(184)	0.88688(210)	0.84010(185)
PNL-3926 (U walls)	0.80602(174)	0.76228(190)	0.84818(188)	0.80746(166)	0.88562(173)	0.84502(176)
PNL-3926 (lead walls)	0.79899(187)	0.75539(164)	0.84455(184)	0.80299(200)	0.88064(194)	0.84121(187)
173	0.79132(249) ^b	0.74769(276) ^b	0.83815(288) ^b	0.79589(261) ^b	0.87589(259) ^b	0.84068(313) ^b
177	0.77227(123)	0.72487(135)	0.83253(142)	0.78994(160)	0.88162(144)	0.84069(147)
178	0.78905(278) ^b	0.74583(273) ^b	0.83043(278) ^b	0.78859(240) ^b	0.86806(249) ^b	0.82301(282) ^b
181	0.76397(148)	0.71668(145)	0.81956(159)	0.77561(144)	0.86763(165)	0.82120(162)
TTC-5	0.71351(189)	0.67805(172)	0.76147(192)	0.72137(180)	0.80058(211)	0.76501(217)

^a Read as 0.79706 ± 0.00203.^b 600 neutrons per generation for 105 generations.

CONCLUSIONS

The reference benchmark calculations in Table 11 provide a means for benchmarking different calculational methods and provides users with a reference set of criticality problems at six different enrichment/burnup combinations. This should aid in addressing some of the computer code validation concerns regarding burnup credit.

REFERENCES

1. S. M. Bowman, *Validation of SCALE-4 for a Reference Problem Set*, ORNL/M-1332, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab. (November 1990).
2. C. V. Parks, Ed., *SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation*, NUREG/CR-0200, Rev. 4 (ORNL/NUREG/CSD-2/R4), Vols. I, II, and III (Draft February 1990).
3. O. W. Hermann et al., "SAS2H: A Coupled One-Dimensional Depletion and Shielding Analysis Code," Sect. S2 of NUREG/CR-0200, Rev. 4 (ORNL/NUREG/CSD-2/R4), Vol. I (Draft February 1990).
4. N. F. Landers et al., "CSAS4: An Enhanced Criticality Safety Analysis Module with an Optimum Pitch Search Option," Sect. C4 of NUREG/CR-0200, Rev. 4, Vol. 1 (Draft February 1990).
5. S. R. Bierman, *Criticality Experiments With Neutron Flux Traps Containing Voids*, PNL-7167, Battelle Pacific Northwest Laboratory (April 1990).
6. S. R. Bierman et al., *Critical Separation Between Subcritical Clusters of 2.35 Wt% ^{235}U Enriched UO_2 Rods in Water With Fixed Neutron Poisons*, PNL-2438, Battelle Pacific Northwest Laboratory (October 1977).
7. S. R. Bierman et al., *Criticality Experiments with Subcritical Clusters of 2.35 Wt% and 4.31 Wt% ^{235}U Enriched UO_2 Rods in Water with Uranium or Lead Reflecting Walls*, PNL-3926, Battelle Pacific Northwest Laboratory (December 1981).
8. S. R. Bierman and E. D. Clayton, *Criticality Experiments with Subcritical Clusters of 2.35 Wt% and 4.31 Wt% ^{235}U Enriched UO_2 Rods in Water with Steel Reflecting Walls*, PNL-3602, Battelle Pacific Northwest Laboratory (April 1981).
9. M. N. Baldwin et al., *Critical Experiments Supporting Close Proximity Water Storage of Power Reactor Fuel*, BAW-1484-7, Babcock and Wilcox (July 1979).

10. B. M. Durst et al., *Critical Experiments with 4.31 Wt% ^{235}U Enriched UO_2 Rods in Highly Borated Water Lattices*, PNL-4267, Battelle Pacific Northwest Laboratory (August 1982).
11. S. R. Bierman, *Reactivity Measurements on an Experimental Assembly of 4.31 Wt% ^{235}U Enriched UO_2 Fuel Rods Arranged in a Shipping Cask Geometry*, PNL-6838, Battelle Pacific Northwest Laboratory (October 1989).
12. S. R. Bierman et al., *Criticality Experiments with Low Enriched UO_2 Fuel Rods in Water Containing Dissolved Gadolinium*, PNL-4976, Battelle Pacific Northwest Laboratory (February 1984).

APPENDIX A

SAS2H INPUT DECK FOR 3.00 WT% 18000 MWD/T DEPLETION

```
=SAS2H      PARM=(HALT02,SKIPSHIPDATA)
BURNUP CREDIT - 3.00 WT% 18GWD/T DEPLETION
27BURNUPLIB LATTICECELL
UO2      1 .95 811 92234 .0254 92235 3.0 92236 .0138 92238
96.9608  END
KR-85    1 0 1-20 811 END
SR-90    1 0 1-20 811 END
Y-89     1 0 1-20 811 END
MO-95    1 0 1-20 811 END
ZR-93    1 0 1-20 811 END
ZR-94    1 0 1-20 811 END
ZR-95    1 0 1-20 811 END
NB-94    1 0 1-20 811 END
TC-99    1 0 1-20 811 END
RH-103   1 0 1-20 811 END
RH-105   1 0 1-20 811 END
RU-101   1 0 1-20 811 END
RU-106   1 0 1-20 811 END
PD-105   1 0 1-20 811 END
PD-108   1 0 1-20 811 END
AG-109   1 0 1-20 811 END
SB-124   1 0 1-20 811 END
XE-131   1 0 1-20 811 END
YE-132   1 0 1-20 811 END
XE-135   1 0 6.72-9 811 END
XE-136   1 0 1-20 811 END
CS-134   1 0 1-20 811 END
CS-135   1 0 1-20 811 END
CS-137   1 0 1-20 811 END
BA-136   1 0 1-20 811 END
LA-139   1 0 1-20 811 END
PR-141   1 0 1-20 811 END
PR-143   1 0 1-20 811 END
CE-144   1 0 1-20 811 END
ND-143   1 0 1-20 811 END
ND-145   1 0 1-20 811 END
PM-147   1 0 1-20 811 END
ND-147   1 0 1-20 811 END
SM-147   1 0 1-20 811 END
SM-149   1 0 1-20 811 END
SM-150   1 0 1-20 811 END
SM-151   1 0 1-20 811 END
SM-152   1 0 1-20 811 END
GD-155   1 0 1-20 811 END
EU-153   1 0 1-20 811 END
EU-154   1 0 1-20 811 END
EU-155   1 0 1-20 811 END
ZIRCALLOY 2 1 620 END
H2O      3 DEN=.733 1 570 END
```

BORON 3 DEN=.733 750.E-6 570 END
END COMP
SQUAREPITCH 1.25984 0.81915 1 3 0.94966 2 0.83566 0 END
NPIN/ASSM=264 FUELENGTH=365.76 NCYCLES=2 NLIB/CYC=1
INPLEVEL=1 NUMHOLES=24 ASMPITCH=21.50364
ORTUBE=.61214 SRTUBE=.5715 END
POWER=17.514 BURN=240 DOWN=0 END
POWER=17.514 BURN=240 DOWN=1825 END
END

SAS2H INPUT DECK FOR 3.00 WT% 25000 MWD/T DEPLETION

```

=SAS2H      PARM=(HALT03,SKIPSHIPDATA)
BURNUP CREDIT - 3.00 WT% 25GWD/T DEPLETION
27BURNUPLIB LATTICECELL
UO2      1 .95 811 92234 .0254 92235 3.0 92236 .0138 92238
96.9608  END
KR-85    1 0 1-20 811  END
SR-90    1 0 1-20 811  END
Y-89     1 0 1-20 811  END
MO-95    1 0 1-20 811  END
ZR-93    1 0 1-20 811  END
ZR-94    1 0 1-20 811  END
ZR-95    1 0 1-20 811  END
NB-94    1 0 1-20 811  END
TC-99    1 0 1-20 811  END
RH-103   1 0 1-20 811  END
RH-105   1 0 1-20 811  END
RU-101   1 0 1-20 811  END
RU-106   1 0 1-20 811  END
PD-105   1 0 1-20 811  END
PD-108   1 0 1-20 811  END
AG-109   1 0 1-20 811  END
SB-124   1 0 1-20 811  END
XE-131   1 0 1-20 811  END
XE-132   1 0 1-20 811  END
XE-135   1 0 6.72-9 811  END
XE-136   1 0 1-20 811  END
CS-134   1 0 1-20 811  END
CS-135   1 0 1-20 811  END
CS-137   1 0 1-20 811  END
BA-136   1 0 1-20 811  END
LA-139   1 0 1-20 811  END
PR-141   1 0 1-20 811  END
PR-143   1 0 1-20 811  END
CE-144   1 0 1-20 811  END
ND-143   1 0 1-20 811  END
ND-145   1 0 1-20 811  END
PM-147   1 0 1-20 811  END
ND-147   1 0 1-20 811  END
SM-147   1 0 1-20 811  END
SM-149   1 0 1-20 811  END
SM-150   1 0 1-20 811  END
SM-151   1 0 1-20 811  END
SM-152   1 0 1-20 811  END
GD-155   1 0 1-20 811  END
EU-153   1 0 1-20 811  END
EU-154   1 0 1-20 811  END
EU-155   1 0 1-20 811  END
ZIRCALLOY 2 1 620  END
H2O      3 DEN=.733 1
570  END

```


BORON 3 DEN=.733 750.E-6 570 END
END COMP
SQUAREPITCH 1.25984 0.81915 1 3 0.94966 2 0.83566 0 END
NPIN/ASSM=264 FUELENGTH=365.76 NCYCLES=3 NLIB/CYC=1
INPLEVEL=1 NUMHOLES=24 ASMPITCH=21.50364
ORTU_LE=.61214 SRTUBE=.5715 END
POWER=17.514 BURN=222.22 DOWN=0 END
POWER=17.514 BURN=222.22 DOWN=0 END
POWER=17.514 BURN=222.22 DOWN=1825 END
END

SAS2H INPUT DECK FOR 3.75 WT% 18000 MWD/T DEPLETION

```
=SAS2H      PARM=(HALT02,SKIPSHIPDATA)
BURNUP CREDIT - 3.75 WT% 18GWD/T DEPLETION
27BURNUPLIB LATTICECELL
UO2      1 .95 811 92234 .0294 92235 3.75 92236 .0233 92238
96.1973  END
KR-85    1 0 1-20 811  END
SR-90    1 0 1-20 811  END
Y-89     1 0 1-20 811  END
MO-95    1 0 1-20 811  END
ZR-93    1 0 1-20 811  END
ZR-94    1 0 1-20 811  END
ZR-95    1 0 1-20 811  END
NB-94    1 0 1-20 811  END
TC-99    1 0 1-20 811  END
RH-103   1 0 1-20 811  END
RH-105   1 0 1-20 811  END
RU-101   1 0 1-20 811  END
RU-106   1 0 1-20 811  END
PD-105   1 0 1-20 811  END
PD-108   1 0 1-20 811  END
AG-109   1 0 1-20 811  END
SB-124   1 0 1-20 811  END
XE-131   1 0 1-20 811  END
XE-132   1 0 1-20 811  END
XE-135   1 0 6.72-9 811  END
XE-136   1 0 1-20 811  END
CS-134   1 0 1-20 811  END
CS-135   1 0 1-20 811  END
CS-137   1 0 1-20 811  END
BA-136   1 0 1-20 811  END
LA-139   1 0 1-20 811  END
PR-141   1 0 1-20 811  END
PR-143   1 0 1-20 811  END
CE-144   1 0 1-20 811  END
ND-143   1 0 1-20 811  END
ND-145   1 0 1-20 811  END
PM-147   1 0 1-20 811  END
ND-147   1 0 1-20 811  END
SM-147   1 0 1-20 811  END
SM-149   1 0 1-20 811  END
SM-150   1 0 1-20 811  END
SM-151   1 0 1-20 811  END
SM-152   1 0 1-20 811  END
GD-155   1 0 1-20 811  END
EU-153   1 0 1-20 811  END
EU-154   1 0 1-20 811  END
EU-155   1 0 1-20 811  END
ZIRCALLOY 2 1 620  END
H2O      3 DEN=.733 1 570 END
```

BORON 3 DEN=.733 750.E-6 570 END
END COMP
SQUAREPITCH 1.25984 0.81915 1 3 0.94966 2 0.83566 0 END
NPIN/ASSM=264 FUELENGTH=365.76 NCYCLES=2 NLIB/CYC=1
INPLEVEL=1 NUMHOLES=24 ASMPITCH=21.50364
ORTUBE=.61214 SRTUBE=.5715 END
POWER=17.514 BURN=240 DOWN=0 END
POWER=17.514 BURN=240 DOWN=1825 END
END

SAS2H INPUT DECK FOR 3.75 WT% 25000 MWD/T DEPLETION

```

=SAS2H      PARM=(HALT03,SKIPSHIPDATA)
BURNUP CREDIT - 3.75 WT% 25GWD/T DEPLETION
27BURNUPLIB LATTICECELL
UO2      1 .95 811 92234 .0294 92235 3.75 92236 .0233 92238
96.1973  END
KR-85    1 0 1-20 811  END
SR-90    1 0 1-20 811  END
Y-89     1 0 1-20 811  END
MO-95    1 0 1-20 811  END
ZR-93    1 0 1-20 811  END
ZR-94    1 0 1-20 811  END
ZR-95    1 0 1-20 811  END
NB-94    1 0 1-20 811  END
TC-99    1 0 1-20 811  END
RH-103   1 0 1-20 811  END
RH-105   1 0 1-20 811  END
RU-101   1 0 1-20 811  END
RU-106   1 0 1-20 811  END
PD-105   1 0 1-20 811  END
PD-108   1 0 1-20 811  END
AG-109   1 0 1-20 811  END
SB-124   1 0 1-20 811  END
XE-131   1 0 1-20 811  END
XE-132   1 0 1-20 811  END
XE-135   1 0 6.72-9 811  END
XE-136   1 0 1-20 811  END
CS-134   1 0 1-20 811  END
CS-135   1 0 1-20 811  END
CS-137   1 0 1-20 811  END
BA-136   1 0 1-20 811  END
LA-139   1 0 1-20 811  END
PR-141   1 0 1-20 811  END
PR-143   1 0 1-20 811  END
CE-144   1 0 1-20 811  END
ND-143   1 0 1-20 811  END
ND-145   1 0 1-20 811  END
PM-147   1 0 1-20 811  END
ND-147   1 0 1-20 811  END
SM-147   1 0 1-20 811  END
SM-149   1 0 1-20 811  END
SM-150   1 0 1-20 811  END
SM-151   1 0 1-20 811  END
SM-152   1 0 1-20 811  END
GD-155   1 0 1-20 811  END
EU-153   1 0 1-20 811  END
EU-154   1 0 1-20 811  END
EU-155   1 0 1-20 811  END
ZIRCALLOY 2 1 620  END
H2O      3 DEN=.733 1
570 END

```

BCRON 3 DEN=.733 750.E-6 570 END
END COMP
SQUAREPITCH 1.25984 0.81915 1 3 0.94966 2 0.83566 0 END
NPIN/ASSM=264 FUELENGTH=365.76 NCYCLES=3 NLIB/CYC=1
INPLEVEL=1 NUMHOLES=24 ASMPITCH=21.50364
ORTUBE=.61214 SRTUBE=.5715 END
POWER=17.514 BURN=222.22 DOWN=0 END
POWER=17.514 BURN=222.22 DOWN=0 END
POWER=17.514 BURN=222.22 DOWN=1825 END
END

SAS2H INPUT DECK FOR 4.50 WT% 18000 MWD/T DEPLETION

```
=SAS2H      PARM=(HALT02,SKIPSHIPDATA)
BURNUP CREDIT - 4.5 WT% 18GWD/T DEPLETION
27BURNUPLIB LATTICECELL
UO2      1 .95 811 92234 .0358  92235 4.5  92236 .0278 92238
95.4364  END
KR-85    1  0  1-20  811  END
SR-90    1  0  1-20  811  END
Y-89     1  0  1-20  811  END
MO-95    1  0  1-20  811  END
ZR-93    1  0  1-20  811  END
ZR-94    1  0  1-20  811  END
ZR-95    1  0  1-20  811  END
NB-94    1  0  1-20  811  END
TC-99    1  0  1-20  811  END
RK-103   1  0  1-20  811  END
RH-105   1  0  1-20  811  END
RU-101   1  0  1-20  811  END
RU-106   1  0  1-20  811  END
PD-105   1  0  1-20  811  END
PD-108   1  0  1-20  811  END
AG-109   1  0  1-20  811  END
SB-124   1  0  1-20  811  END
XE-131   1  0  1-20  811  END
XE-132   1  0  1-20  811  END
XE-135   1  0  6.72-9 811  END
XE-136   1  0  1-20  811  END
CS-134   1  0  1-20  811  END
CS-135   1  0  1-20  811  END
CS-137   1  0  1-20  811  END
BA-136   1  0  1-20  811  END
LA-139   1  0  1-20  811  END
PR-141   1  0  1-20  811  END
PR-143   1  0  1-20  811  END
CE-144   1  0  1-20  811  END
ND-143   1  0  1-20  811  END
ND-145   1  0  1-20  811  END
PM-147   1  0  1-20  811  END
ND-147   1  0  1-20  811  END
SM-147   1  0  1-20  811  END
SM-149   1  0  1-20  811  END
SM-150   1  0  1-20  811  END
SM-151   1  0  1-20  811  END
SM-152   1  0  1-20  811  END
GD-155   1  0  1-20  811  END
EU-153   1  0  1-20  811  END
EU-154   1  0  1-20  811  END
EU-155   1  0  1-20  811  END
ZIRCALLOY 2 1 620  END
H2O      3 DEN=.733 1      570 END
```

BORON 3 DEN=.733 750.E-6 570 END
END COMP
SQUAREPITCH 1.25984 0.81915 1 3 0.94966 2 0.83566 0 END
NPIN/ASSM=264 FUELENGTH=365.76 NCYCLES=2 NLIB/CYC=1
INPLEVEL=1 NUMHOLES=24 ASMPITCH=21.50364
ORTUBE=.61214 SRTUBE=.5715 END
POWER=17.514 BURN=240 DOWN=0 END
POWER=17.514 BURN=240 DOWN=1825 END
END

SAS2H INPUT DECK FOR 4.50 WT% 25000 MWD/T DEPLETION

```
=SAS2H      PARM=(HALT03,SKIPSHIPDATA)
BURNUP CREDIT - 4.5 WT% 25GWD/T DEPLETION
27BURNUPLIB LATTICECELL
UO2      1 .95 811 92234 .0358 92235 4.5 92236 .0278 92238
95.4364 END
KR-85    1 0 1-20 811 END
SR-90    1 0 1-20 811 END
Y-89     1 0 1-20 811 END
MO-95    1 0 1-20 811 END
ZR-93    1 0 1-20 811 END
ZR-94    1 0 1-20 811 END
ZR-95    1 0 1-20 811 END
NB-94    1 0 1-20 811 END
TC-99    1 0 1-20 811 END
RH-103   1 0 1-20 811 END
RH-105   1 0 1-20 811 END
RU-101   1 0 1-20 811 END
RU-106   1 0 1-20 811 END
PD-105   1 0 1-20 811 END
PD-108   1 0 1-20 811 END
AG-109   1 0 1-20 811 END
SB-124   1 0 1-20 811 END
XE-131   1 0 1-20 811 END
XE-132   1 0 1-20 811 END
XE-135   1 0 6.72-9 811 END
XE-136   1 0 1-20 811 END
CS-134   1 0 1-20 811 END
CS-135   1 0 1-20 811 END
CS-137   1 0 1-20 811 END
BA-136   1 0 1-20 811 END
LA-139   1 0 1-20 811 END
PR-141   1 0 1-20 811 END
PR-143   1 0 1-20 811 END
CE-144   1 0 1-20 811 END
ND-143   1 0 1-20 811 END
ND-145   1 0 1-20 811 END
PM-147   1 0 1-20 811 END
ND-147   1 0 1-20 811 END
SM-147   1 0 1-20 811 END
SM-149   1 0 1-20 811 END
SM-150   1 0 1-20 811 END
SM-151   1 0 1-20 811 END
SM-152   1 0 1-20 811 END
GD-155   1 0 1-20 811 END
EU-153   1 0 1-20 811 END
EU-154   1 0 1-20 811 END
EU-155   1 0 1-20 811 END
ZIRCALLOY 2 1 620 END
H2O      3 DEN=.733 1 570 END
```


BORON 3 DEN=.733 750.E-6 570 END
END COMP
SQUAREPITCH 1.25984 0.81915 1 3 0.94966 2 0.83566 0 END
NPIN/ASSM=264 FUELENGTH=365.76 NCYCLES=3 NLIB/CYC=1
INPLEVEL=1 NUMHOLES=24 ASMPITCH=21.50364
ORTUBE=.61214 SRTUBE=.5715 END
POWER=17.514 BURN=222.22 DOWN=0 END
POWER=17.514 BURN=222.22 DOWN=0 END
POWER=17.514 BURN=222.22 DOWN=1825 END
END

APPENDIX B

SCALE INPUT DECK FOR BAW-1484-7 EXPERIMENT 2282 (CORE IV)

=CSAS25

' PROBLEM ID BAW 1484-7 EXP 2282 (CORE IV)

' 2.46% U-235 ENRICHED UO2 RODS, 1.206 CM DIAM. AL CLAD, 1.044 CM ID,

' 1.030 CM OD. UO2 91.44 CM LONG, H2O MODERATED AND REFLECTED.

' CRITICAL H2O HEIGHT = 145.68 CM

' 9 14X14 CLUSTERS, SEPARATED BY 1 PIN PITCH WITH 84 B4C RODS

' REFERENCE: BAW-1484-7

' SCALE MODULE: CSAS25

BAW 1484-7 CORE IV LATTICE PITCH=1.636 CM FUEL=?.? WT% ??000 MWD/T IN MOX

27BURNUPLIB LATTICECELL

'U-235 1 0 5.67505-4 END

'U-238 1 0 2.22265-2 END

'O 1 0 4.55881-2 END

INSERT MIX 1 HERE

MG 2 0 5.34873-4 END

AL 2 0 5.80754-2 END

SI 2 0 4.63000-4 END

CR 2 0 1.09416-4 END

MN 2 0 4.43813-5 END

FE 2 0 2.03741-4 END

CU 2 0 1.02328-4 END

H 3 0 6.67755-2 END

O 3 0 3.33877-2 END

B4C 4 DEN=1.28 0.9945 END

O 4 0 3.32183-5 END

MG 5 0 5.34873-4 END

AL 5 0 5.80754-2 END

SI 5 0 4.63000-4 END

CR 5 0 1.09416-4 END

MN 5 0 4.43813-5 END

FE 5 0 2.03741-4 END

CU 5 0 1.02328-4 END

H 6 0 6.67755-2 END

O 6 0 3.33877-2 END

END COMP

SQUAREPITCH 1.636 1.030 1 3 1.206 2 1.044 0 END

BAW-1484-7 CORE IV EXP 2282 ?.? WT% ??000 MWD/T 9 ASSYS 14X14 W/ 84 B4C PINS

READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30

WRS=34 RES=205 END PARM

READ GEOM

UNIT 1

COM='BOTTOM PLUG OF FUEL ROD'

CYLINDER	2	1	.603	.3175	0.0
CUBOID	3	1	4P.818	.3175	0.0

UNIT 2

COM='BOTTOM PLUG OF B4C ROD'

CYLINDER	2	1	.5565	.3175	0.0
CUBOID	3	1	4P.818	.3175	0.0

UNIT 3

COM='BOTTOM OF WATER HOLE'

CUBOID	3	1	4P.818	.3175	0.0
--------	---	---	--------	-------	-----

UNIT 4

COM='FUEL ROD IN GRID'

CYLINDER	1	1	.515	2.54	0.0
CYLINDER	0	1	.522	2.54	0.0
CYLINDER	2	1	.603	2.54	0.0
CUBOID	3	1	4P.615	2.54	0.0
CUBOID	5	1	4P.818	2.54	0.0

UNIT 5

COM='B4C ROD IN GRID'

CYLINDER	4	1	.4675	2.54	0.0
CYLINDER	2	1	.5565	2.54	0.0
CUBOID	3	1	4P.615	2.54	0.0
CUBOID	5	1	4P.818	2.54	0.0

UNIT 6

COM='WATER HOLE IN GRID'

CUBOID	3	1	4P.615	2.54	0.0
CUBOID	5	1	4P.818	2.54	0.0

UNIT 7

COM='FUEL ROD'

CYLINDER	1	1	.515	142.8225	0.0
CYLINDER	0	1	.522	142.8225	0.0
CYLINDER	2	1	.603	142.8225	0.0
CUBOID	3	1	4P.818	142.8225	0.0

UNIT 8

COM='B4C ROD '

CYLINDER	4	1	.4675	142.8225	0.0
CYLINDER	2	1	.5565	142.8225	0.0
CUBOID	3	1	4P.818	142.8225	0.0

UNIT 9

COM='WATER HOLE'

CUBOID	3	1	4P.818	142.8225	0.0
--------	---	---	--------	----------	-----

UNIT 11

```

COM='FUEL ROD'
ARRAY 1 3*0.0
UNIT 12
COM='B4C PIN'
ARRAY 2 3*0.0
UNIT 13
COM='WATER HOLE'
ARRAY 3 3*0.0
UNIT 14
COM='FUEL ASSY'
ARRAY 4 3*0.0
UNIT 15
COM='BOTTOM VERTICAL ROW OF B4C PINS'
ARRAY 5 3*0.0
UNIT 16
COM='MIDDLE VERTICAL ROW OF B4C PINS'
ARRAY 6 3*0.0
UNIT 17
COM='TOP VERTICAL ROW OF B4C PINS'
ARRAY 7 3*0.0

UNIT 18
COM='BOTTOM ROW OF ASSEMBLIES '
ARRAY 8 3*0.0

UNIT 19
COM='MIDDLE ROW OF ASSEMBLIES'
ARRAY 9 3*0.0

UNIT 20
COM='TOP ROW OF ASSEMBLIES '
ARRAY 10 3*0.0

UNIT 21
COM='HORIZONTAL ROW OF B4C PINS'
ARRAY 11 3*0.0

GLOBAL UNIT 22
ARRAY 12 3*0.0
CUBOID 5 1 71.984 0.0 71.984 0.0 145.68 -5.08
CUBOID 6 1 71.984 0.0 71.984 0.0 145.68 -7.62
REFLECTOR 6 2 4R3 2R0 8

END GEOM

READ BIAS ID=500 2 9 END BIAS

READ ARRAY
COM='FUEL ROD' ARA=1 NUX=1 NUY=1 NUZ=3 FILL 1 4 7
END FILL
COM='B4C PIN' ARA=2 NUX=1 NUY=1 NUZ=3 FILL 2 5 8

```

```

END FILL
COM='WATER HOLE' ARA=3 NUX=1 NUY=1 NUZ=3 FILL 3 6 9
END FILL
COM='FUEL ASSY' ARA=4 NUX=14 NUY=14 NUZ=1 FILL F11
END FILL
ARA=5 NUX=1 NUY=14 NUZ=1 FILL 12 13 6Q2 END FILL
ARA=6 NUX=1 NUY=14 NUZ=1 FILL 13 12 2Q2 13 13 12 13 2Q2 END
FILL
ARA=7 NUX=1 NUY=14 NUZ=1 FILL 13 12 6Q2 END FILL
ARA=8 NUX=5 NUY=1 NUZ=1 FILL 14 15 14 15 14 END FILL
ARA=9 NUX=5 NUY=1 NUZ=1 FILL 14 16 14 16 14 END FILL
ARA=10 NUX=5 NUY=1 NUZ=1 FILL 14 17 14 17 14 END FILL
ARA=11 NUX=44 NUY=1 NUZ=1
FILL 13 13 12 13Q2 12 12 13 6Q2 END FILL
ARA=12 NUX=1 NUY=5 NUZ=1 FILL 18 21 19 21 20 END FILL
END ARRAY
READ PLOT
TTL='X-Y SLICE BELOW GRID PLATE'
XUL=-0.5 YUL=72.5 ZUL=0.2
XLR=72.5 YLR=-6.5 ZLR=0.2
UAX=1 VDN=-1 NAX=260 NCH=' 12 456789' END
TTL='X-Y SLICE OF GRID PLATE'
XUL=-0.5 YUL=72.5 ZUL=2.
XLR=72.5 YLR=-0.5 ZLR=2.
UAX=1 VDN=-1 NAX=260 NCH=' 12 456789' END
TTL='X-Y SLICE ABOVE GRID PLATE'
XUL=-0.5 YUL=72.5 ZUL=50.
XLR=72.5 YLR=-0.5 ZLR=50.
UAX=1 VDN=-1 NAX=260 NCH=' 12 456789' END
END PLOT
END DATA
END

```

SCALE INPUT DECK FOR PNL-7167 FLUX TRAP EXPERIMENT 214R

```
=CSAS2X
' 952 FUEL RODS
' 4.31% U-235 ENRICHED UO2 RODS, 1.265 CM DIAM.; AL CLAD,
1.283 CM ID,
' 1.415 CM OD. UO2 91.44 CM LONG, ROD 96.52 CM LONG. H2O
MODERATED AND
' REFLECTED, 2 X 2 ARRAY OF FUEL CLUSTERS, 1.891 CM SQUARE
PITCH.
' 0.295 CM BETWEEN CLUSTERS AND POISON PLATES, 3.73 CM FLUX
TRAP WIDTH.
' REFERENCE: PNL-7167
' SCALE MODULE: CSAS2X
,
1.891 CM PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000
MWD/T
27BURNUPLIB LATTICECELL
'UO2 1 0.9489 293 92234 0.022 92235 4.306 92236 0.022 92238
95.650 END
INSERT MIX 1 HERE
AL 2 END
H2O 3 END
'UO2 8 0.9489 293 92234 0.022 92235 4.306 92236 0.022 92238
95.650 END
INSERT MIX 8 HERE
AL 9 END
H2O 10 END
AL 4 END
ARBMBORAL 2.64 5 1 0 0 5000 29.22 6012 8.16 13027 62.54
8016 0.06 26000 0.02 5 END
ARBMRUBBER 1.321 6 0 0 0 6012 58. 1001 6.5 20000 11.4
16000 1.7 8016 22.1 14000 0.3 6 END
H2O 7 END
END COMP
SQUAREPITCH 1.891 1.265 1 3 1.415 2 1.283 0 END
MORE DATA
RES=8 CYLINDER .6325 DAN(8)=.173084
END MORE
FLUX TRAP ASSEMBLY NO. 214R W/ ?? WT% UO2 ??000 MWD/T
READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30
WRS=34 RES=205 END PARM
READ GEOMETRY
UNIT 1
CYLINDER 8 1 .6325 2P45.72
CYLINDER 0 1 .6415 2P45.72
CYLINDER 6 1 .6415 2P48.26
CYLINDER 9 1 .7075 2P48.26
CUBOID 10 1 4P.9. 5 2P48.26
UNIT 2
ARRAY 1 3*0.0
```

```

'16X15 CLUSTER
CUBOID 7 1 30.313 -14.013 44.269 -.057 96.52 0.0
CUBOID 4 1 30.415 -14.013 44.269 -.159 96.52 0.0
CUBOID 5 1 30.885 -14.013 44.269 -.629 96.52 0.0
CUBOID 4 1 30.987 -14.013 44.269 -.731 96.52 0.0
UNIT 3
ARRAY 1 3*0.0
'16X15 CLUSTER
CUBOID 7 1 44.269 -0.057 44.269 -0.057 96.52 0.0
CUBOID 4 1 44.269 -0.159 44.269 -0.159 96.52 0.0
CUBOID 5 1 44.269 -0.629 44.269 -0.629 96.52 0.0
CUBOID 4 1 44.269 -0.731 44.269 -0.731 96.52 0.0
UNIT 4
ARRAY 1 3*0.0
'16X15 CLUSTER
CUBOID 7 1 30.313 -14.013 28.422 -15.905 96.52 0.0
CUBOID 4 1 30.415 -14.013 28.5235 -15.905 96.52 0.0
CUBOID 5 1 30.885 -14.013 28.9935 -15.905 96.52 0.0
CUBOID 4 1 30.987 -14.013 29.095 -15.905 96.52 0.0
UNIT 5
ARRAY 2 3*0.0
'15X15 CLUSTER
CUBOID 7 1 44.269 -0.057 28.422 -15.905 96.52 0.0
CUBOID 4 1 44.269 -0.159 28.5235 -15.905 96.52 0.0
CUBOID 5 1 44.269 -0.629 28.9935 -15.905 96.52 0.0
CUBOID 4 1 44.269 -0.731 29.095 -15.905 96.52 0.0
UNIT 6
CUBOID 7 1 2.18 -1.55 45.0 0.0 96.52 0.0
'FLUX TRAP
UNIT 7
CUBOID 7 1 45.0 0.0 2.18 -1.55 96.52 0.0
'FLUX TRAP
UNIT 8
CUBOID 7 1 2.18 -1.55 2.18 -1.55 96.52 0.0
'CENTRAL MODERATOR
UNIT 9
COM='7 RODS SMEARED OVER A ROW OF 15'
CUBOID 500 1 .8825 0 1.891 0 2P45.72
CUBOID 6 1 .8825 0 1.891 0 2P48.26
CUBOID 7 1 1.891 0 1.891 0 2P48.26
GLOBAL UNIT 10
ARRAY 3 3*0.0
'3X3 ARRAY
REFLECTOR 7 2 6R3 5
END GEOM

READ BIAS ID=500 2 6 END BIAS

READ ARRAY
ARA=1 NUX=16 NUY=15 FILL F1 END FILL
ARA=2 NUX=16 NUY=15 FILL 15R1 9 14Q16 END FILL

```


ARA=3 NUX=3 NUY=3 FILL 4 6 5 7 8 7 2 6 3 END FILL
END ARRAY
READ PLOT
TTL='X-Y SLICE OF 214R '
XUL=39 YUL=54.7 ZUL=63.26
XLR=54.7 YLR=39 ZLR=63.26
UAX=1 VDN=-1 NAX=130 NCH=' 456 89 S' END
TTL='X-Y SLICE OF 214R '
XUL=-15 YUL=108 ZUL=63.26
XLR=108 YLR=-15 ZLR=63.26
UAX=1 VDN=-1 NAX=260 NCH=' 456 89 S' END
END PLOT
END DATA
END

SCALE INPUT DECK FOR PNL-7167 FLUX TRAP EXPERIMENT 214V3

```
=CSAS2X
' 862.1 FUEL RODS
' 4.31% U-235 ENRICHED UO2 RODS, 1.265 CM DIAM.; AL CLAD,
1.283 CM ID,
' 1.415 CM OD. UO2 91.44 CM LONG, ROD 96.52 CM LONG. H2O
MODERATED AND
' REFLECTED, 2 X 2 ARRAY OF FUEL CLUSTERS, 1.891 CM SQUARE
PITCH.
' 0.295 CM BETWEEN CLUSTERS AND POISON PLATES, 3.73 CM FLUX
TRAP WIDTH.
' THREE 0.63 CM X 45.0 CM X 96 CM AL PLATES BETWEEN CLUSTERS.
' REFERENCE: PNL-7167
' SCALE MODULE: CSAS2X
,
1.891 CM PITCH LATTICE CELL, ?? WT% ENRICHED ??000 MWD/T
27BURNUPLIB LATTICECELL
'UO2 1 0.9489 293 92234 0.022 92235 4.306 92236 0.022 92238
95.650 END
INSERT MIX 1 HERE
AL 2 END
H2O 3 END
'UO2 8 0.9489 293 92234 0.022 92235 4.306 92236 0.022 92238
95.650 END
INSERT MIX 8 HERE
AL 9 END
H2O 10 END
AL 4 END
ARBMBORAL 2.64 5 1 0 0 5000 29.22 6012 8.16 13027 62.54
8016 0.06 26000 0.02 5 END
ARBMRUBBER 1.321 6 0 0 0 6012 58. 1001 6.5 20000 11.4
16000 1.7 8016 22.1 14000 0.3 6 END
H2O 7 END
END COMP
SQUAREPITCH 1.891 1.265 1 3 1.415 2 1.283 0 END
MORE DATA
RES=8 CYLINDER .6325 DAN(8)=.173084
END MORE
FLUX TRAP ASSEMBLY NO. 214V3 ?? WT% ??000 MWD/T
READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30
WRS=34 RES=205 END PARM
READ GEOMETRY
UNIT 1
CYLINDER 8 1 .6325 2P45.72
CYLINDER 0 1 .6415 2P45.72
CYLINDER 6 1 .6415 2P48.26
CYLINDER 9 1 .7075 2P48.26
CUBOID 10 1 4P.9455 2P48.26
UNIT 2
ARRAY 1 3*0.0
```

```

'14X15 CLUSTER
CUBOID 7 1 26.531 -17.795 44.269 -.057 96.52 0.0
CUBOID 4 1 26.633 -17.795 44.269 -.159 96.52 0.0
CUBOID 5 1 27.103 -17.795 44.269 -.629 96.52 0.0
CUBOID 4 1 27.205 -17.795 44.269 -.731 96.52 0.0
UNIT 3
ARRAY 2 3*0.0
'15X15 CLUSTER
CUBOID 7 1 44.269 -0.057 44.269 -0.057 96.52 0.0
CUBOID 4 1 44.269 -0.159 44.269 -0.159 96.52 0.0
CUBOID 5 1 44.269 -0.629 44.269 -0.629 96.52 0.0
CUBOID 4 1 44.269 -0.731 44.269 -0.731 96.52 0.0
UNIT 4
ARRAY 1 3*0.0
'14X15 CLUSTER
CUBOID 7 1 26.531 -17.795 28.422 -15.904 96.52 0.0
CUBOID 4 1 26.633 -17.795 28.524 -15.904 96.52 0.0
CUBOID 5 1 27.103 -17.795 28.994 -15.904 96.52 0.0
CUBOID 4 1 27.205 -17.795 29.096 -15.904 96.52 0.0
UNIT 5
ARRAY 4 3*0.0
'14X15 CLUSTER
CUBOID 7 1 44.269 -0.057 28.422 -15.904 96.52 0.0
CUBOID 4 1 44.269 -0.159 28.524 -15.904 96.52 0.0
CUBOID 5 1 44.269 -0.629 28.994 -15.904 96.52 0.0
CUBOID 4 1 44.269 -0.731 29.096 -15.904 96.52 0.0
UNIT 6
CUBOID 7 1 0.46 0.0 45.0 0.0 96.52 0.0
CUBOID 4 1 1.09 0.0 45.0 0.0 96.52 0.0
CUBOID 7 1 1.55 0.0 45.0 0.0 96.52 0.0
CUBOID 4 1 2.18 0.0 45.0 0.0 96.52 0.0
CUBOID 7 1 2.64 0.0 45.0 0.0 96.52 0.0
CUBOID 4 1 3.27 0.0 45.0 0.0 96.52 0.0
CUBOID 7 1 3.73 0.0 45.0 0.0 96.52 0.0
'FLUX TRAP
UNIT 7
CUBOID 7 1 45.0 0.0 0.46 0.0 96.52 0.0
CUBOID 4 1 45.0 0.0 1.09 0.0 96.52 0.0
CUBOID 7 1 45.0 0.0 1.55 0.0 96.52 0.0
CUBOID 4 1 45.0 0.0 2.18 0.0 96.52 0.0
CUBOID 7 1 45.0 0.0 2.64 0.0 96.52 0.0
CUBOID 4 1 45.0 0.0 3.27 0.0 96.52 0.0
CUBOID 7 1 45.0 0.0 3.73 0.0 96.52 0.0
'FLUX TRAP
UNIT 8
CUBOID 7 1 2.18 -1.55 2.18 -1.55 96.52 0.0
'CENTRAL MODERATOR
UNIT 9
COM='7.1 RODS SMEARED OVER A ROW OF 15'
CUBOID 500 1 .8951 0 1.891 0 2P45.72
CUBOID 6 1 .8951 0 1.891 0 2P48.26

```

```

CUBOID      7 1 1.891 0 1.891 0 2P48.26
GLOBAL
UNIT 10
ARRAY 3 3*0.0
'3X3 ARRAY
REFLECTOR 7 2 6R3 5
END GEOM
READ ARRAY
ARA=1 NUX=14 NUY=15 FILL F1 END FILL
ARA=2 NUX=15 NUY=15 FILL F1 END FILL
ARA=3 NUX=3 NUY=3 FILL 4 6 5 7 8 7 2 6 3 END FILL
ARA=4 NUX=15 NUY=15 FILL 14R1 9 14Q15 END FILL
END ARRAY

READ BIAS ID=500 2 6 END BIAS

READ PLOT
TTL='X-Y SLICE OF 214RV3 '
XUL=39 YUL=54.7 ZUL=63.26
XLR=54.7 YLR=39 ZLR=63.26
UAX=1 VDN=-1 NAX=130 NCH=' 456 89 S' END
TTL='X-Y SLICE OF 214V3 '
XUL=-15 YUL=108 ZUL=63.26
XLR=108 YLR=-15 ZLR=63.26
UAX=1 VDN=-1 NAX=260 NCH=' 456 89 S' END
END PLOT
END DATA
END

```

SCALE INPUT DECK FOR PNL-3602 CASE

=CSAS25

```

'
' PROBLEM ID --
' CITATION ID --      EXP. NO.  --
'
' 4.31% U-235 ENRICHED UO2 RODS, 1.4147 CM OD AL CLAD, 1.2827
CM ID,
' 1.2649 CM OD. UO2 91.44 CM LONG, ROD 96.52 CM LONG.
' STEEL WALLS (17.85 X 147.3 X 121.9) ON FLOOR REFLECTING IN
H2O.
' 3-12X16 CLUSTERS, 1.892 CM SQUARE PITCH. 15.84 CM SEPARATION
' BETWEEN CLUSTERS. 1.956 CM FROM FUEL CLUSTERS
' REFERENCE: PNL-3602 PG.16
' SCALE MODULE: CSAS25
'

```

1.892 CM PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000
MWD/T

27BURNUPLIB LATTICECELL

'UO2 1 0.949 293 92235 4.31 92238 95.69 END UO2

INSERT MIX 1 HERE

AL 2 1.0 END AL

H2O 3 1.0 END H2O

ARBM RUBBER 1.321 6 0 0 0 6012 58. 1001 6.5 20000 11.4
16000 1.7 8016 22.1 14000 0.3 4 END

ARBM STEEL 7.84 8 0 0 1 26304 96.78 6012 0.19 25055 1.28
14000 .22

28304 .79 42000 .49 24304 .12 29000 .13 5 END

H2O 6 END

END COMP

```

'          PITCH FOD F M COD C CID G
SQUAREPITCH 1.892 1.2649 1 3 1.4147 2 1.2827 0 END
15.84 CM H2O SEPARATES 3 12X16 ARRAYS W/ STEEL WALLS ?? WT%
??000 MWD/T

```

READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30

WRS=34 RES=205 END PARM

READ GEOM

UNIT 1

CYLINDER	1	1	0.63245			91.44	0.0
CYLINDER	0	1	0.64135			91.44	0.0
CYLINDER	4	1	0.64135			93.98	-2.54
CYLINDER	2	1	0.70735			93.98	-2.54
CUBOID	3	1	4P0.946			93.98	-5.08

UNIT 2

ARRAY 1 3*0.0

UNIT 3

CUBOID	6	1	15.3627	0.0	30.272	0.0	99.06	0.0
--------	---	---	---------	-----	--------	-----	-------	-----

GLOBAL

UNIT 4

ARRAY 2 3*0.0

CUBOID 6 1 123.0687 -24.2313 32.228 -1.956 106.6 -15.3
 CUBOID 5 1 123.0687 -24.2313 50.078 -19.806 106.6 -15.3
 REFLECTOR 6 2 5R3 0 2
 REFLECTOR 6 4 4R3 1.66 0 1
 REFLECTOR 6 5 2R3 2R1.694 0 0 1
 REFLECTOR 6 6 2R3.0833 4R0 6
 END GEOMETRY

READ BIAS ID=500 2 11 END BIAS
 READ START NST=1 END START
 READ ARRAY
 ARA=1 NUX=12 NUY=16 NUZ=1 FILL F1 END
 FILL
 ARA=2 NUX=5 NUY=1 NUZ=1 FILL 2 3 2 3 2 END
 FILL
 END ARRAY
 READ PLOT
 TTL='X-Y SLICE OF PNL3602 AT Z=50'
 XUL=-35. YUL=55.0 ZUL=50
 XLR=135. YLR=-25. ZLR=50
 UAX=1 VDN=-1 NAX=260 NCH=' 12 4567' END
 END PLOT
 END DATA
 END

SCALE INPUT DECK FOR PNL-3926 DEPLETED URANIUM WALLS CASE

=CSAS25

```

/
/ PROBLEM ID --
/ CITATION ID --      EXP. NO.  --
/
/ 4.31% U-235 ENRICHED UO2 RODS, 1.415 CM OD AL CLAD, 1.2827
CM ID,
/ 1.2649 CM OD UO2 91.44 CM LONG, ROD 96.52 CM LONG.
/ URANIUM WALLS (7.65 X 152.3 X 121.9) ON FLOOR REFLECTING IN
H2O.
/ 3-12X16 CLUSTERS, 1.892 CM SQUARE PITCH. 19.24 CM SEPARATION
/ BETWEEN CLUSTERS. , 1.956 CM FROM FUEL CLUSTERS
/ REFERENCE: PNL-3926 PG.13
/ SCALE MODULE: CSAS25
/
1.892 IN PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000
MWD/MTU
27BURNUPLIB LATTICECELL
INSERT MIX 1 HERE
AL  2 1.0  END AL
H2O  3 1.0  END H2O
ARBM RUBBER  1.321 6 0 0 0 6012 58. 1001 6.5 20000 11.4
              16000 1.7 8016 22.1 14000 0.3 4  END
URANIUM  5 0.9816  293 92235 0.199  92238  99.801  END
H2O      6              END
END COMP
/
          PITCH  FOD   F M  COD   C  CID   G
SQUAREPITCH 1.892 1.2649 1 3 1.4147 2 1.2827 0  END
PNL-3926 DEPL. U REFLECTING WALLS, ?? WT% UO2  ??000 MWD/MTU
READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30
WRS=34 RES=205  END PARM
READ GEOM
UNIT 1
CYLINDER  1 1 0.63245                      91.44  0.0
CYLINDER  0 1 0.64135                      91.44  0.0
CYLINDER  4 1 0.64135                      93.98 -2.54
CYLINDER  2 1 0.70735                      93.98 -2.54
CUBOID    3 1 4P0.946                      93.98 -5.08
UNIT 2
ARRAY  1 3*0.0
UNIT 3
CUBOID    6 1 18.7627      0.0      30.272  0.0  99.06  0.0
GLOBAL
UNIT 4
ARRAY  2 3*0.0
CUBOID    6 1 128.9687 -23.3313 32.228 -1.956 106.6 -15.3
CUBOID    5 1 128.9687 -23.3313 39.878 -9.606 106.6 -15.3
REFLECTOR 6 2 5R3 0 2
REFLECTOR 6 4 4R3 1.66 0 1

```

```

REFLECTOR 6 5 4R3 2R0 3
REFLECTOR 6 8 2R3 2R2.894 2R0 1
REFLECTOR 6 9 2R3.167 4R0 3
END GEOMETRY

READ BIAS ID=500 2 11  END BIAS
READ START NST=1  END START
READ ARRAY
ARA=1 NUX=12 NUY=16 NUZ=1  FILL F1  END
FILL
ARA=2 NUX=5  NUY=1  NUZ=1  FILL 2 3 2 3 2  END
FILL
END ARRAY
READ PLOT
TTL='X-Y SLICE OF PNL3926A AT Z=50'
XUL=-27.  YUL=45.0  ZUL=50
XLR=135.  YLR=-15  ZLR=50
UAX=1 VDN=-1 NAX=260 NCH=' 2 4567'  END
END PLOT
END DATA
END

```


SCALE INPUT DECK FOR PNL-3926 LEAD WALLS CASE

```
=CSAS25
/
/ PROBLEM ID --
/ CITATION ID --      EXP. NO.  --
/
/ 4.31% U-235 ENRICHED UO2 RODS, 1.4147CM OD AL CLAD, 1.2827
CM ID,
/ 1.2649 CM OD UO2 91.44 CM LONG, ROD 96.52 CM LONG.
/ LEAD WALLS (10.2 X 164.0 X 123.4) ON FLOOR REFLECTING IN
H2O.
/ 3-12X16 CLUSTERS, 1.892 CM SQUARE PITCH. 17.43 CM SEPARATION
/ BETWEEN CLUSTERS. 1.956 CM FROM FUEL CLUSTERS
/ REFERENCE: PNL-3926 PG.13
/ SCALE MODULE: CSAS25
/
1.892 IN PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000
MWD/T
27BURNUPLIB LATTICECELL
'UO2 1 0.949 293 92235 4.31 92238 95.69 END UO2
INSERT MIX 1 HERE
AL 2 1.0 END AL
H2O 3 1.0 END H2O
ARBM RUBBER 1.321 6 0 0 0 6012 58. 1001 6.5 20000 11.4
16000 1.7 8016 22.1 14000 0.3 4 END
PB 5 0.97533 END PB
H2O 6 END
END COMP
/
PITCH FOD F M COD C CID G
SQUAREPITCH 1.892 1.2649 1 3 1.4147 2 1.2827 0 END
17.43 CM H2O SEPARATING 3 12X16 ARRAYS ?? WT% ??000 MWD/T
READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30
WRS=34 RES=205 END PARM
READ GEOM
UNIT 1
CYLINDER 1 1 0.63245 91.44 0.0
CYLINDER 0 1 0.64135 91.44 0.0
CYLINDER 4 1 0.64135 93.98 -2.54
CYLINDER 2 1 0.70735 93.98 -2.54
CUBOID 3 1 4P0.946 93.98 -5.08
UNIT 2
ARRAY 1 3*0.0
UNIT 3
CUBOID 6 1 16.9527 0.0 30.272 0.0 99.06 0.0
GLOBAL
UNIT 4
ARRAY 2 3*0.0
CUBOID 6 1 133.0027 -30.9973 32.228 -1.956 108.1 -15.3
CUBOID 5 1 133.0027 -30.9973 42.428 -12.156 108.1 -15.3
REFLECTOR 6 2 5R3 0 2
```

```

REFLECTOR  6 4 4R3 0.16 0      1
REFLECTOR  6 5 4R3   0  0      3
REFLECTOR  6 8 2R3 2R.344  0 0  1
REFLECTOR  6 9 2R3.167 4R0      3
END GEOMETRY

```

```

READ BIAS  ID=500  2  11  END BIAS
READ START NST=1  END START
READ ARRAY
ARA=1 NUX=12 NUY=16 NUZ=1  FILL F1      END
FILL
ARA=2 NUX=5  NUY=1  NUZ=1  FILL 2 3 2 3 2  END
FILL
END ARRAY
READ PLOT
TTL='X-Y SLICE OF PNL3926B AT Z=50'
XUL=-35.  YUL=45.0  ZUL=50
XLR=135.  YLR=-15.  ZLR=50
UAX=1 VDN=-1 NAX=260 NCH=' 12 4567'  END
END PLOT
END DATA
END

```

SCALE INPUT DECK FOR PNL-4267 EXPERIMENT 173

=CSAS2X

```
'
' PROBLEM ID -- PNL-4267
' CITATION ID -- EXP. NO. 173
'
' 4.31% U-235 ENRICHED UO2 RODS, 1.4147 CM OD AL CLAD, 1.2827
CM ID,
' 1.2649 CM OD. UO2 91.44 CM LONG, ROD 96.52 CM LONG.
' SINGLE ARRAY 40X8.92 RODS (357 TOTAL RODS), 1.890 CM SQUARE
PITCH.
' NO SOLUBLE BORON
' REFERENCE: PNL-4267 EXP. 173
' SCALE MODULE: CSAS2X
'
```

1.890 CM PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000 MWD/T

27BURNUPLIB LATTICECELL

'UO2 1 0.949 293 92235 4.31 92238 95.69 END UO2

INSERT MIX 1 HERE

AL 2 1.0 END AL

H2O 3 1.0 END H2O

ARBMURUBBER 1.321 6 0 0 0 6012 58. 1001 6.5 20000 11.4
16000 1.7 8016 22.1 14000 0.3 4 END

PLEXIGLASS 5 DEN=.904 END

H2O 6 END

BORON 7 DEN=.00255 1.0 END

H2O 7 END

PLEXIGLASS 8 1.0 END

'UO2 9 0.949 293 92235 4.31 92238 95.69 END UO2

INSERT MIX 9 HERE

AL 10 1.0 END AL

H2O 11 1.0 END H2O

END COMP

```
'
          PITCH FOD F M COD C CID G
SQUAREPITCH 1.890 1.2649 9 11 1.4147 10 1.2827 0 END
```

MCRE DATA

RES=1 CYLINDER .63245 DAN(1)=.173084

END MORE

PNL-4267 EXP.173 40X8.92 ARRAY(357 TOTAL RODS) BORON = 0 G/L
?.?WT% ??000 MWD/T

READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30

WRS=34 RES=205 END PARM

READ GEOM

UNIT 1

'BOTTOM OF FUEL - RUBBER CAP IN LOWER LATTICE SUPPORT FLATE

CYLINDER 4 1 0.64135 2.54 0.0

CYLINDER 2 1 0.70735 2.54 0.0

CUBOID 5 1 4P0.945 2.54 0.0

UNIT 2

```

'FUEL BETWEEN THE TWO LATTICE SUPPORT PLATES
CYLINDER 1 1 0.63245 67.29 0.0
CYLINDER 0 1 0.64135 67.29 0.0
CYLINDER 2 1 0.70735 67.29 0.0
CUBOID 3 1 4P0.945 67.29 0.0
UNIT 3
'FUEL IN UPPER LATTICE SUPPORT PLATE
CYLINDER 1 1 0.63245 1.27 0.0
CYLINDER 0 1 0.64135 1.27 0.0
CYLINDER 2 1 0.70735 1.27 0.0
CUBOID 5 1 4P0.945 1.27 0.0
UNIT 4
'FUEL ABOVE THE UPPER LATTICE SUPPORT PLATE
CYLINDER 1 1 0.63245 25.4 0.0
CYLINDER 0 1 0.64135 25.4 0.0
CYLINDER 2 1 0.70735 25.4 0.0
CUBOID 3 1 4P0.945 25.4 0.0
UNIT 5
'BOTTOM OF SMEARED FUEL
CUBOID 500 1 1.7483 0 2P0.945 2.54 0.0
CUBOID 3 1 1.890 0 2P0.945 2.54 0.0
UNIT 6
'SMEARED FUEL BETWEEN THE TWO LATTICE SUPPORT PLATES
CUBOID 500 1 1.7483 0 2P0.945 67.29 0.0
CUBOID 3 1 1.890 0 2P0.945 67.29 0.0
UNIT 7
'SMEARED FUEL IN UPPER LATTICE SUPPORT PLATE
CUBOID 500 1 1.7483 0 2P0.945 1.27 0.0
CUBOID 3 1 1.890 0 2P0.945 1.27 0.0
UNIT 8
'SMEARED FUEL ABOVE THE UPPER LATTICE SUPPORT PLATE
CUBOID 500 1 1.7483 0 2P0.945 25.4 0.0
CUBOID 3 1 1.890 0 2P0.945 25.4 0.0
GLOBAL
UNIT 9
ARRAY 1 -8.505 -37.80 0.0
CUBOID 3 1 2P39.80 2P37.94 111.7 0.0
CUBOID 8 1 2P41.705 2P39.845 111.7 -17.105
REFLECTOR 6 2 4R3 2R0 10
END GEOMETRY

```

```

READ BIAS ID=500 2 11 END BIAS

```

```

READ ARRAY

```

```

ARA=1 NUX=9 NUY=40 NUZ=4 FILL 8R1 5 39Q9 8R2 6 39Q9
8R3 7 39Q9 8R4 8 39Q9

```

```

END FILL

```

```

END ARRAY

```

```

READ PLOT

```

```

TTL='X-Y SLICE OF PNL4267A AT Z=50'

```

```

XUL=-45. YUL=45.0 ZUL=50

```

XLR= 45. YLR=-45. ZLR=50
UAX=1 VDN=-1 NAX=130 NCH=' 12 45 78&' END
END PLOT
END DATA
END

SCALE INPUT DECK FOR PNL-4267 EXPERIMENT 177

```
=CSAS2X
'
' PROBLEM ID -- PNL-4267
' CITATION ID -- EXP. NO. 177
'
' 4.31% U-235 ENRICHED UO2 RODS, 1.4147 CM OD AL CLAD, 1.2827
CM ID,
' 1.2649 CM OD. UO2 91.44 CM LONG, ROD 96.52 CM LONG.
' SINGLE ARRAY 40 X 30.92 RODS (1237 TOTAL RODS), 1.890 CM
SQUARE PITCH
' BORON CONC = 2.55 G/L
' REFERENCE: PNL-4267 EXP. 177
' SCALE MODULE: CSAS2X
'
1.890 CM PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000
MWD/T
27BURNUPLIB LATTICECELL
'UO2 1 0.949 293 92235 4.31 92238 95.69 END UO2
INSERT MIX 1 HERE
AL 2 1.0 END AL
H2O 3 1.0 END H2O
ARBMRUBBER 1.321 6 0 0 0 6012 58. 1001 6.5 20000 11.4
16000 1.7 8016 22.1 14000 0.3 4 END
PLEXIGLASS 5 DEN=.904 END
H2O 6 END
BORON 7 DEN=.00255 1.0 END
H2O 7 END
PLEXIGLASS 8 1.0 END
'UO2 9 0.949 293 92235 4.31 92238 95.69 END UO2
INSERT MIX 9 HERE
AL 10 1.0 END AL
H2O 11 1.0 END H2O
BORON 11 DEN=.00255 1.0 END
END COMP
'
PITCH FOD F M COD C CID G
SQUAREPITCH 1.890 1.2649 9 11 1.4147 10 1.2827 0 END
MORE DATA
RES=1 CYLINDER .63245 DAN(1)=.173084
END MORE
PNL-4267 EXP.177 40 X 30.92 ARRAY(1237 TOTAL RODS) BORON =
2.55 G/L
READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30
WRS=34 RES=205 END PARM
READ GEOM
UNIT 1
'BOTTOM OF FUEL - RUBBER CAP IN LOWER LATTICE SUPPORT PLATE
CYLINDER 4 1 0.64135 2.54 0.0
CYLINDER 2 1 0.70735 2.54 0.0
CUBOID 5 1 4P0.945 2.54 0.0
```

```

UNIT 2
'FUEL BETWEEN THE TWO LATTICE SUPPORT PLATES
CYLINDER 1 1 0.63245 67.29 0.0
CYLINDER 0 1 0.64135 67.29 0.0
CYLINDER 2 1 0.70735 67.29 0.0
CUBOID 7 1 4P0.945 67.29 0.0
UNIT 3
'FUEL IN UPPER LATTICE SUPPORT PLATE
CYLINDER 1 1 0.63245 1.27 0.0
CYLINDER 0 1 0.64135 1.27 0.0
CYLINDER 2 1 0.70735 1.27 0.0
CUBOID 5 1 4P0.945 1.27 0.0
UNIT 4
'FUEL ABOVE THE UPPER LATTICE SUPPORT PLATE
CYLINDER 1 1 0.63245 25.4 0.0
CYLINDER 0 1 0.64135 25.4 0.0
CYLINDER 2 1 0.70735 25.4 0.0
CUBOID 7 1 4P0.945 25.4 0.0
UNIT 5
'BOTTOM OF SMEARED FUEL
CUBOID 500 1 1.7483 0 2P0.945 2.54 0.0
CUBOID 7 1 1.890 0 2P0.945 2.54 0.0
UNIT 6
'SMEARED FUEL BETWEEN THE TWO LATTICE SUPPORT PLATES
CUBOID 500 1 1.7483 0 2P0.945 67.29 0.0
CUBOID 7 1 1.890 0 2P0.945 67.29 0.0
UNIT 7
'SMEARED FUEL IN UPPER LATTICE SUPPORT PLATE
CUBOID 500 1 1.7483 0 2P0.945 1.27 0.0
CUBOID 7 1 1.890 0 2P0.945 1.27 0.0
UNIT 8
'SMEARED FUEL ABOVE THE UPPER LATTICE SUPPORT PLATE
CUBOID 500 1 1.7483 0 2P0.945 25.4 0.0
CUBOID 7 1 1.890 0 2P0.945 25.4 0.0
GLOBAL
UNIT 9
ARRAY 1 -29.295 -37.80 0.0
CUBOID 7 1 2P39.80 2P37.94 111.7 0.0
CUBOID 8 1 2P41.705 2P39.845 111.7 -17.105
REFLECTOR 6 2 4R3 2R0 10
END GEOMETRY

READ BIAS ID=500 2 11 END BIAS

READ ARRAY
ARA=1 NUX=31 NUY=40 NUZ=4 FILL 30R1 5 39Q31 30R2 6 39Q31
30R3 7 39Q31 30R4 8 39Q31

END FILL
END ARRAY
READ PLOT
TTL='X-Y SLICE OF PNL4267B AT Z=50'

```

XUL=-45. YUL=45.0 ZUL=50
XLR= 45. YLR=-45. ZLR=50
UAX=1 VDN=-1 NAX=130 NCH=' 12 45 78&' END
END PLOT
END DATA
END

SCALE INPUT DECK FOR PNL-4267 EXPERIMENT 178

=CSAS2X

```

/
/ PROBLEM ID -- PNL-4267
/ CITATION ID -- EXP. NO. 178
/
/ 4.31% U-235 ENRICHED UO2 RODS, 1.4147 CM OD AL CLAD, 1.2827
CM ID,
/ 1.2649 CM OD. UO2 91.44 CM LONG, ROD 96.52 CM LONG.
/ SINGLE ARRAY 44X11.57 RODS(509 TOTAL RODS), 1.715 CM SQUARE
PITCH.
/ NO SOLUBLE BORON
/ REFERENCE: PNL-4267 EXP. 178
/ SCALE MODULE: CSAS2X
/

```

1.715 CM PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000
MWD/T

27BURNUPLIB LATTICECELL

'UO2 1 0.949 293 92235 4.31 92238 95.69 END UO2

INSERT MIX 1 HERE

AL 2 1.0 END AL

H2O 3 1.0 END H2O

ARBM RUBBER 1.321 6 0 0 0 6012 58. 1001 6.5 20000 11.4
16000 1.7 8016 22.1 14000 0.3 4 END

PLEXIGLASS 5 DEN=.904 END

H2O 6 END

BORON 7 DEN=.00255 1.0 END

H2O 7 END

PLEXIGLASS 8 1.0 END

'UO2 9 0.949 293 92235 4.31 92238 95.69 END UO2

INSERT MIX 9 HERE

AL 10 1.0 END AL

H2O 11 1.0 END H2O

END COMP

```

/
/ PITCH FOD F M COD C CID G
SQUAREPITCH 1.715 1.2649 9 11 1.4147 10 1.2827 0 END

```

MORE DATA

RES=1 CYLINDER .63245 DAN(1)=.269915

END MORE

PNL-4267 EXP. 178 44 X 11.57ARRAY (509 TOTAL RODS) BORON = 0
G/L

READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30

WRS=34 RES=205 END PARM

READ GEOM

UNIT 1

'BOTTOM OF FUEL - RUBBER CAP IN LOWER LATTICE SUPPORT PLATE

CYLINDER 4 1 0.64135 2.54 0.0

CYLINDER 2 1 0.70735 2.54 0.0

CUBOID 5 1 4P0.8575 2.54 0.0

UNIT 2

```

'FUEL BETWEEN THE TWO LATTICE SUPPORT PLATES
CYLINDER 1 1 0.63245 67.29 0.0
CYLINDER 0 1 0.64135 67.29 0.0
CYLINDER 2 1 0.70735 67.29 0.0
CUBOID 3 1 4P0.8575 67.29 0.0
UNIT 3
'FUEL IN UPPER LATTICE SUPPORT PLATE
CYLINDER 1 1 0.63245 1.27 0.0
CYLINDER 0 1 0.64135 1.27 0.0
CYLINDER 2 1 0.70735 1.27 0.0
CUBOID 5 1 4P0.8575 1.27 0.0
UNIT 4
'FUEL ABOVE THE UPPER LATTICE SUPPORT PLATE
CYLINDER 1 1 0.63245 25.4 0.0
CYLINDER 0 1 0.64135 25.4 0.0
CYLINDER 2 1 0.70735 25.4 0.0
CUBOID 3 1 4P0.8575 25.4 0.0
UNIT 5
'BOTTOM OF SMEARED FUEL
CUBOID 500 1 0.9744 0 2P0.8575 2.54 0.0
CUBOID 3 1 1.715 0 2P0.8575 2.54 0.0
UNIT 6
'SMEARED FUEL BETWEEN THE TWO LATTICE SUPPORT PLATES
CUBOID 500 1 0.9744 0 2P0.8575 67.29 0.0
CUBOID 3 1 1.715 0 2P0.8575 67.29 0.0
UNIT 7
'SMEARED FUEL IN UPPER LATTICE SUPPORT PLATE
CUBOID 500 1 0.9744 0 2P0.8575 1.27 0.0
CUBOID 3 1 1.715 0 2P0.8575 1.27 0.0
UNIT 8
'SMEARED FUEL ABOVE THE UPPER LATTICE SUPPORT PLATE
CUBOID 500 1 0.9744 0 2P0.8575 25.4 0.0
CUBOID 3 1 1.715 0 2P0.8575 25.4 0.0
GLOBAL
UNIT 9
ARRAY 1 -10.29 -37.73 0.0
CUBOID 3 1 2P39.80 2P37.94 111.7 0.0
CUBOID 8 1 2P41.705 2P39.845 111.7 -17.105
REFLECTOR 6 2 4R3 2R0 10
END GEOMETRY

READ BIAS ID=500 2 11 END BIAS
READ ARRAY
ARA=1 NUX=12 NUY=44 NUZ=4 FILL 11R1 5 43Q12 11R2 6 43Q12
11R3 7 43Q12 11R4 8 43Q12
END FILL
END ARRAY
READ PLOT
TTL='X-Y SLICE OF PNL4267C AT Z=50'
XUL=-45. YUL=45.0 ZUL=50
XLR= 45. YLR=-45. ZLR=50

```

UAX=1 VDN=-1 NAX=130 NCH=' 12 45 78&' END
END PLOT
END DATA
END

SCALE INPUT DECK FOR PNL-4267 EXPERIMENT 181

```
=CSAS2X
/
/ PROBLEM ID -- PNL-4267
/ CITATION ID -- EXP. NO. 181
/
/ 4.31% U-235 ENRICHED UO2 RODS, 1.4147 CM OD AL CLAD, 1.2827
CM ID,
/ 1.2649 CM OD. UO2 91.44 CM LONG, ROD 96.52 CM LONG.
/ SINGLE ARRAY 44 X 27.09 RODS (1192 TOTAL RODS), 1.715 CM
SQUARE PITCH.
/ BORON = 2.55 G/L
/ REFERENCE: PNL-4267 EXP. 181
/ SCALE MODULE: CSAS2X
/
1.715 CM PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000
MWD/T
27BURNUPLIB LATTICECELL
'UO2 1 0.949 293 92235 4.31 92238 95.69 END UO2
INSERT MIX 1 HERE
AL 2 1.0 END AL
H2O 3 1.0 END H2O
ARBM RUBBER 1.321 6 0 0 0 6012 58. 1001 6.5 20000 11.4
16000 1.7 8016 22.1 14000 0.3 4 END
PLEXIGLASS 5 DEN=.904 END
H2O 6 END
BORON 7 DEN=.00255 1.0 END
H2O 7 END
PLEXIGLASS 8 1.0 END
'UO2 9 0.949 293 92235 4.31 92238 95.69 END UO2
INSERT MIX 9 HERE
AL 10 1.0 END AL
H2O 11 1.0 END H2O
BORON 11 DEN=.00255 1.0 END
END COMP
/
PITCH FOD F M COD C CID G
SQUAREPITCH 1.715 1.2649 9 11 1.4147 10 1.2827 0 END
MORE DATA
RES=1 CYLINDER .63245 DAN(1)=.269915
END MORE
PNL-4267 EXP. 181 44 X 27.09 ARRAY (1192 TOTAL RODS) BORON =
2.55 G/L
READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30
WRS=34 RES=205 END PARM
READ GEOM
UNIT 1
'BOTTOM OF FUEL - RUBBER CAP IN LOWER LATTICE SUPPORT PLATE
CYLINDER 4 1 0.64135 2.54 0.0
CYLINDER 2 1 0.70735 2.54 0.0
CUBOID 5 1 4P0.8575 2.54 0.0
```

```

UNIT 2
'FUEL BETWEEN THE TWO LATTICE SUPPORT PLATES
CYLINDER 1 1 0.63245 67.29 0.0
CYLINDER 0 1 0.64135 67.29 0.0
CYLINDER 2 1 0.70735 67.29 0.0
CUBOID 7 1 4P0.8575 67.29 0.0
UNIT 3
'FUEL IN UPPER LATTICE SUPPORT PLATE
CYLINDER 1 1 0.63245 1.27 0.0
CYLINDER 0 1 0.64135 1.27 0.0
CYLINDER 2 1 0.70735 1.27 0.0
CUBOID 5 1 4P0.8575 1.27 0.0
UNIT 4
'FUEL ABOVE THE UPPER LATTICE SUPPORT PLATE
CYLINDER 1 1 0.63245 25.4 0.0
CYLINDER 0 1 0.64135 25.4 0.0
CYLINDER 2 1 0.70735 25.4 0.0
CUBOID 7 1 4P0.8575 25.4 0.0
UNIT 5
'BOTTOM OF SMEARED FUEL
CUBOID 500 1 0.1559 0 2P0.8575 2.54 0.0
CUBOID 7 1 1.715 0 2P0.8575 2.54 0.0
UNIT 6
'SMEARED FUEL BETWEEN THE TWO LATTICE SUPPORT PLATES
CUBOID 500 1 0.1559 0 2P0.8575 67.29 0.0
CUBOID 7 1 1.715 0 2P0.8575 67.29 0.0
UNIT 7
'SMEARED FUEL IN UPPER LATTICE SUPPORT PLATE
CUBOID 500 1 0.1559 0 2P0.8575 1.27 0.0
CUBOID 7 1 1.715 0 2P0.8575 1.27 0.0
UNIT 8
'SMEARED FUEL ABOVE THE UPPER LATTICE SUPPORT PLATE
CUBOID 500 1 0.1559 0 2P0.8575 25.4 0.0
CUBOID 7 1 1.715 0 2P0.8575 25.4 0.0
GLOBAL
UNIT 9
ARRAY 1 -24.01 -37.73 0.0
CUBOID 7 1 2P39.80 2P37.94 111.7 0.0
CUBOID 8 1 2P41.705 2P39.845 111.7 -17.105
REFLECTOR 6 2 4R3 2R0 10
END GEOMETRY
READ BIAS ID=500 2 11 END BIAS
READ ARRAY
ARA=1 NUX=28 NUY=44 NUZ=4 FILL 27R1 5 43Q28 27R2 6 43Q28
27R3 7 43Q28 27R4 8 43Q28
END FILL
END ARRAY
READ PLOT
TTL='X-Y SLICE OF PNL4267D AT Z=50'
XUL=-45. YUL=45.0 ZUL=50
XLR= 45. YLR=-45. ZLR=50

```

UAX=1 VDN=-1 NAX=130 NCH=' 12 45 78&' END
END PLOT
END DATA
END

SCALE INPUT DECK FOR PNL-2438 EXPERIMENT 005

```
=CSAS25
'
' PROBLEM ID 1051024
' CITATION ID 2094 EXP. NO. 005
'
' 2.35% U-235 ENRICHED UO2 RODS, 1.1176 CM DIAM. AL CLAD,
1.1176 CM ID,
' 1.270 CM OD. UO2 91.44 CM LONG, ROD 97.79 CM LONG. H2O
MODERATED AND
' REFLECTED. NO PLATES BETWEEN CLUSTERS.
' 3 20X16 CLUSTERS, 2.032 CM SQUARE PITCH.
' ---- CM BETWEEN CENTRAL CLUSTER AND ABSORBERS, 8.39 CM
SEPARATION
' BETWEEN CLUSTERS. EXP. NO. 5
' REFERENCE: PNL-2438
' SCALE MODULE: CSAS25
'
0.8 IN PITCH LATTICE CELL, ?? WT% ENRICHED FUEL ??000 MWD/T
27BURNUPLIB LATTICECELL
'UO2 1 0.84 293 92235 2.35 92238 97.65 END UO2
INSERT MIX 1 HERE
AL 2 1.0 END AL
H2O 3 1.0 END H2O
PLEXIGLASS 4 1.0 END PLEXIGLASS
H2O 5 END
END COMP
SQUAREPITCH 2.032 1.1176 1 3 1.27 2 END GEOMETRY
EXP#5, 8.39 CM H2O SEPARATING 3 20X16 ARRAYS ?? WT% ??000
MWD/T
READ PARM FLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=25
WRS=34 RES=205 END PARM
READ GEOM
UNIT 1
CUBOID 4 1 1.016 -1.016 1.016 -1.016 1.27 -1.27
UNIT 2
CYLINDER 1 1 0.5588 91.44 0.0
CYLINDER 2 1 0.635 96.52 -1.27
CUBOID 3 1 1.016 -1.016 1.016 -1.016 96.52 -1.27
UNIT 3
ARRAY 1 3*0.0
UNIT 4
CUBOID 4 1 8.39 0.0 32.512 0.0 2.54 0.0
UNIT 5
ARRAY 2 3*0.0
UNIT 6
CUBOID 5 1 8.39 0.0 32.512 0.0 97.79 0.0
GLOBAL UNIT 7
ARRAY 3 3*0.0
REFLECTOR 5 2 6R3.04 5
```

REFLECTOR 5 7 4R3.06 0 0 5
END GEOMETRY

READ BIAS ID=500 2 11 END PIAS

READ ARRAY

ARA=1 NUX=20 NUY=16 NUZ=1 FILL F1 END

FILL

ARA=2 NUX=20 NUY=16 NUZ=1 FILL F2 END

FILL

ARA=3 NUX=5 NUY=1 NUZ=2 FILL 3 4 3 4 3 5 6 5 6 5 END

FILL

END ARRAY

READ PLOT

TTL='X-Y SLICE OF PNL-2438 EXP 05 AT Z=50'

XUL=0.0 YUL=35.5 ZUL=50

XLR=143. YLR=0.0 ZLR=50

UAX=1 VDN=-1 NAX=260 NCH=' 12 4 67' END

END PLOT

END DATA

END

SCALE INPUT DECK FOR PNL-2438 EXPERIMENT 017

=CSAS25

'
' PROBLEM ID 1171024
' CITATION ID 2094 EXP. NO. 017
'
' 2.35% U-235 ENRICHED UO2 RODS, 1.1176 CM DIAM. AL CLAD,
1.1176 CM ID,
' 1.270 CM OD. UO2 91.44 CM LONG, ROD 97.79 CM LONG. H2O
MODERATED AND
' REACTED. BORAL PLATES BETWEEN CLUSTERS 0.713 CM THICKNESS
' 2 22X16 CLUSTERS, WITH 1 20X16 CENTRAL CLUSTER, 2.032 CM
SQUARE PITCH.
' 0.645CM BETWEEN CENTRAL CLUSTER AND ABSORBERS, 5.05 CM
SEPARATION
' BETWEEN CLUSTERS. EXP. NO. 17
' REFERENCE: PNL-2438
' SCALE MODULE: CSAS25
'

0.8 IN PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000 MWD/T
27BURNUP LIB LATTICE CELL

INSERT MIX 1 HERE

AL 2 1.0 END AL

H2O 3 1.0 END H2O

PLEXIGLASS 4 1.0 END PLEXIGLASS

H2O 5 END

ARMBORAL 2.49 4 1 0 1 5000 28.7 13027 63.0

6012 7.97 26000 .33 6 1 293

END

BORAL

END COMP

SQUAREPITCH 2.032 1.1176 1 3 1.27 2 END GEOMETRY

PNL-2438 EXP.017 BORAL PLATES ?? WT% ??000 MWD/MTU

READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30

WRS=34 RES=205 END PARM

READ GEOM

UNIT 1

CUBOID 4 1 1.016 -1.016 1.016 -1.016 1.27 -1.27

UNIT 2

CYLINDER 1 1 0.5588 91.44 0.0

CYLINDER 2 1 0.635 96.52 -1.27

CUBOID 3 1 1.016 -1.016 1.016 -1.016 96.52 -1.27

UNIT 3

ARRAY 1 3*0.0

CUBOID 5 1 44.704 0.0 34.506 -1.994 2.54 0.0

UNIT 4

ARRAY 3 3*0.0

CUBOID 5 1 40.64 0.0 34.506 -1.994 2.54 0.0

UNIT 5

CUBOID 4 1 5.05 0.0 36.5 0.0 2.54 0.0

UNIT 6

```

ARRAY 2 3*0.0
CUBOID 5 1 44.704 0.0 34.506 -1.994 97.79 0.0
UNIT 7
CUBOID 5 1 3.692 0.0 36.5 0.0 91.5 0.0
CUBOID 6 1 4.405 0.0 36.5 0.0 91.5 0.0
CUBOID 5 1 5.05 0.0 36.5 0.0 97.79 0.0
UNIT 8
CUBOID 5 1 0.645 0.0 36.5 0.0 91.5 0.0
CUBOID 6 1 1.358 0.0 36.5 0.0 91.5 0.0
CUBOID 5 1 5.05 0.0 36.5 0.0 97.79 0.0
UNIT 9
ARRAY 4 3*0.0
CUBOID 5 1 40.64 0.0 34.506 -1.994 97.79 0.0
GLOBAL
UNIT 10
ARRAY 5 3*0.0
REFLECTOR 5 2 6R3.04 5
REFLECTOR 5 7 4R3.06 0 0 5
END GEOMETRY

READ BIAS ID=500 2 11 END BIAS
READ START NST=1 END START
READ ARRAY
ARA=1 NUX=22 NUY=16 NUZ=1 FILL F1 END
FILL
ARA=2 NUX=22 NUY=16 NUZ=1 FILL F2 END
FILL
ARA=3 NUX=20 NUY=16 NUZ=1 FILL F1 END
FILL
ARA=4 NUX=20 NUY=16 NUZ=1 FILL F2 END
FILL
ARA=5 NUX=5 NUY=1 NUZ=2 FILL 3 5 4 5 3 6 7 9 8 6 END
FILL
END ARRAY
READ PLOT
TTL='X-Y SLICE OF PNL-2438 EXP 017 AT Z=50'
XUL=0.7 YUL=35.5 ZUL=50
XLR=145.6 YLR=0.0 ZLR=50
UAX=1 VDN=-1 NAX=260 NCH=' 12 467' END
END PLOT
END DATA
END

```

SCALE INPUT DECK FOR PNL-2438 EXPERIMENT 024

=CSAS25

```

/
/ PROBLEM ID 1241024
/ CITATION ID 2094 EXP. NO. 024
/
/ 2.35% U-235 ENRICHED UO2 RODS, 1.1176 CM DIAM. AL CLAD,
1.1176 CM ID,
/ 1.270 CM OD. UO2 91.44 CM LONG, ROD 97.79 CM LONG. H2O
MODERATED AND
/ REFLECTED. AL PLATES BETWEEN CLUSTERS 0.625 CM THICKNESS
/ 3 20X16 CLUSTERS, 2.032 CM SQUARE PITCH.
/ .645 CM BETWEEN CENTRAL CLUSTER AND ABSORBERS, 8.67 CM
SEPARATION
/ BETWEEN CLUSTERS. EXP. NO. 024
/ REFERENCE: PNL-2438
/ SCALE MODULE: CSAS25
/
0.8 IN PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000 MWD/T
27BURNUPLIB LATTICECELL
'UO2 1 0.84 293 92235 2.35 92238 97.65 END UO2
INSERT MIX 1 HERE
AL 2 1.0 END AL
H2O 3 1.0 END H2O
PLEXIGLASS 4 1.0 END PLEXIGLASS
H2O 5 END
AL 6 END
END COMP
SQUAREPITCH 2.032 1.1176 1 3 1.27 2 END GEOMETRY
EXP#024, 8.67 CM H2O/AL SEPARATING 3 20X16 ARRAYS ?? WT%
??000 MWD/T
READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30
WRS=34 RES=205 END PARM
READ GEOM
UNIT 1
CUBOID 4 1 1.016 -1.016 1.016 -1.016 1.27 -1.27
UNIT 2
CYLINDER 1 1 0.5588 91.44 0.0
CYLINDER 2 1 0.635 96.52 -1.27
CUBOID 3 1 1.016 -1.016 1.016 -1.016 96.52 -1.27
UNIT 3
ARRAY 1 3*0.0
CUBOID 5 1 40.64 0.0 34.056 -1.544 2.54 0.0
UNIT 4
CUBOID 4 1 8.67 0.0 35.6 0.0 2.54 0.0
UNIT 5
CUBOID 4 1 8.67 0.0 35.6 0.0 2.54 0.0
UNIT 6
ARRAY 2 3*0.0
CUBOID 5 1 40.64 0.0 34.056 -1.544 97.79 0.0

```

```

UNIT 7
CUBOID    5 1 7.4      0.0 35.6      0.0 91.5      0.0
CUBOID    6 1 8.025    0.0 35.6      0.0 91.5      0.0
CUBOID    5 1 8.67     0.0 35.6      0.0 97.79     0.0
UNIT 8
CUBOID    5 1 0.645    0.0 35.6      0.0 91.5      0.0
CUBOID    6 1 1.27     0.0 35.6      0.0 91.5      0.0
CUBOID    5 1 8.67     0.0 35.6      0.0 97.79     0.0
GLOBAL UNIT 9
ARRAY 3 3*0.0
REFLECTOR 5 2 6R3.C4 5
REFLECTOR 5 7 4R3.06 2R0 5
END GEOMETRY

```

```

READ BIAS ID=500 2 11 END BIAS

```

```

READ ARRAY
ARA=1 NUX=20 NUY=16 NUZ=1 FILL F1 END
FILL
ARA=2 NUX=20 NUY=16 NUZ=1 FILL F2 END
FILL
ARA=3 NUX=5 NUY=1 NUZ=2 FILL 3 4 3 5 3 6 7 6 8 6 END
FILL
END ARRAY
READ PLOT
TTL='X-Y SLICE OF PNL-2438 EXP 024 AT Z=50'
XUL=0.0 YUL=35.5 ZUL=50
XLR=139. YLR=0.0 ZLR=50
UAX=1 VDN=-1 NAX=260 NCH=' 12 4 67' END
END PLOT
END DATA
END

```

SCALE INPUT DECK FOR PNL-2438 EXPERIMENT 028

```
=CSAS25
/
/ PROBLEM ID 1281024
/ CITATION ID 2094 EXP. NO. 028
/
/ 2.35% U-235 ENRICHED UO2 RODS, 1.1176 CM DIAM. AL CLAD,
1.1176 CM ID,
/ 1.270 CM OD. UO2 91.44 CM LONG, ROD 97.79 CM LONG. H2O
MODERATED AND
/ REFLECTED. SS PLATES BETWEEN CLUSTERS 0.485 CM THICKNESS
/ 3 20X16 CLUSTERS, 2.032 CM SQUARE PITCH.
/ .645 CM BETWEEN CENTRAL CLUSTER AND ABSORBERS, 6.88 CM
SEPARATION
/ BETWEEN CLUSTERS. EXP. NO. 28
/ REFERENCE: PNL-2438
/ SCALE MODULE: CSAS25
/
0.8 IN PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000 MWD/T
27BURNUPLIB LATTICECELL
'UO2 1 0.84 293 92235 2.35 92238 97.65 END UO2
INSERT MIX 1 HERE
AL 2 1.0 END AL
H2O 3 1.0 END H2O
PLEXIGLASS 4 1.0 END PLEXIGLASS
H2O 5 END
SS304 6 END
END COMP
SQUAREPITCH 2.032 1.1176 1 3 1.27 2 END GEOMETRY
EXP#28, 6.88 CM H2O/SS SEPARATING 3 20X16 ARRAYS ?? WT% ??000
MWD/T
READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=30
WRS=34 RES=205 END PARM
READ GEOM
UNIT 1
CUBOID 4 1 1.016 -1.016 1.016 -1.016 1.27 -1.27
UNIT 2
CYLINDER 1 1 0.5588 91.44 0.0
CYLINDER 2 1 0.635 96.52 -1.27
CUBOID 3 1 1.016 -1.016 1.016 -1.016 96.52 -1.27
UNIT 3
ARRAY 1 3*0.0
CUBOID 5 1 40.64 0.0 34.056 -1.544 2.54 0.0
UNIT 4
CUBOID 4 1 6.88 0.0 35.6 0.0 2.54 0.0
UNIT 5
CUBOID 4 1 6.88 0.0 35.6 0.0 2.54 0.0
UNIT 6
ARRAY 2 3*0.0
CUBOID 5 1 40.64 0.0 34.056 -1.544 97.79 0.0
```

```

UNIT 7
CUBOID      5 1 5.750  0.0 35.6    0.0 91.5    0.0
CUBOID      6 1 6.235  0.0 35.6    0.0 91.5    0.0
CUBOID      5 1 6.88   0.0 35.6    0.0 97.79   0.0
UNIT 8
CUBOID      5 1 0.645  0.0 35.6    0.0 91.5    0.0
CUBOID      6 1 1.130  0.0 35.6    0.0 91.5    0.0
CUBOID      5 1 6.88   0.0 35.6    0.0 97.79   0.0
GLOBAL UNIT 9
ARRAY 3 3*0.0
REFLECTOR   5 2 6R3.04  5
REFLECTOR   5 7 4R3.06  0 0 5
END GEOMETRY

READ BIAS ID=500 2 11 END BIAS

READ ARRAY
ARA=1 NUX=20 NUY=16 NUZ=1 FILL F1 END
FILL
ARA=2 NUX=20 NUY=16 NUZ=1 FILL F2 END
FILL
ARA=3 NUX=5 NUY=1 NUZ=2 FILL 3 4 3 5 3 6 7 6 8 6 END
FILL
END ARRAY
READ PLOT
TTL='X-Y SLICE OF PNL-2438 EXP 028 AT Z=50'
XUL=0.0 YUL=35.5 ZUL=50
XLR=138.0 YLR=0.0 ZLR=50
UAX=1 VDN=-1 NAX=260 NCH=' 12 4 6' END
END PLOT
END DATA
END

```

SCALE INPUT DECK FOR PNL-6838 EXPERIMENT TTC-5

```
=CSAS25
/
/ PROBLEM ID TTC-5
/
/ 4.31% U-235 ENRICHED UO2 RODS, 1.415 CM DIAM. AL CLAD, 1.283
CM ID,
/ 1.415 CM OD. UO2 91.44 CM LONG, ROD 96.52 CM LONG. H2O
MODERATED AND
/ REFLECTED.
/ 4 14X14 CLUSTERS, 2 14X14 CLUSTERS W/36 LOCATIONS WITHOUT
FUEL,
/ 1 14X14 CENTER CLUSTER W/34 LOCATIONS WITHOUT FUEL AND W/2
GUIDE TUBES
/ REFERENCE: PNL-6838
/ SCALE MODULE: CSAS25
/
1.891 CM PITCH LATTICE CELL, ?? WT% ENRICHED FUEL, ??000
MWD/T
27BURNUPLIB LATTICECELL
'UO2 1 0.9489 293 92235 4.306 92238 95.694 END
INSERT MIX 1 HERE
AL 2 END AL
H2O 3 END H2O
ARBMPOLYPROP 0.90 2 0 1 1 6012 3 1001 6 4 END
ARBMRUBBER 1.321 6 0 0 0 6012 58.0 1001 6.5 20000 11.4
16000 1.7 8016 22.1 14000 0.3 5 END
ARBMALB2 2.64 2 1 0 1 5000 3.41 13027 96.59
6 1.0 293 5010 98.71 5011 1.29 END
H2O 7 END
PLEXIGLASS 8 DEN=1.185 END
H2O 9 END
END COMP
SQUAREPITCH 1.891 1.265 1 3 1.415 2 1.283 0 END
TTC-5 PNL-6838 1264 FUEL RODS ?? WT% ??000 MWD/T
READ PARM PLT=YES RUN=YES GEN=205 NPG=600 NSK=5 TME=45
WRS=34 RES=205 END PARM
READ GEOM
UNIT 1
CYLINDER 5 1 .6415 1.23 0.0
CYLINDER 2 1 .7075 1.23 0.0
CUBOID 4 1 4P.9455 1.23 0.0
UNIT 2
CYLINDER 1 1 .6325 68.58 0.0
CYLINDER 0 1 .6415 68.58 0.0
CYLINDER 5 1 .6415 68.58 -1.31
CYLINDER 2 1 .7075 68.58 -1.31
CUBOID 3 1 4P.9455 68.58 -1.31
UNIT 3
CYLINDER 1 1 .6325 1.23 0.0
```

CYLINDER	0	1	.6415	1.23	0.0
CYLINDER	2	1	.7075	1.23	0.0
CUBOID	4	1	4P.9455	1.23	0.0
UNIT 4					
CYLINDER	1	1	.6325	21.63	0.0
CYLINDER	0	1	.6415	21.63	0.0
CYLINDER	5	1	.6415	24.17	0.0
CYLINDER	2	1	.7075	24.17	0.0
CUBOID	3	1	4P.9455	24.17	0.0

UNIT 5					
CYLINDER	3	1	.6415	1.23	0.0
CYLINDER	2	1	.7075	1.23	0.0
CUBOID	4	1	4P.9455	1.23	0.0

UNIT 6					
CYLINDER	3	1	.6415	68.58	-1.31
CYLINDER	2	1	.7075	68.58	-1.31
CUBOID	3	1	4P.9455	68.58	-1.31

UNIT 7					
CYLINDER	3	1	.6415	24.17	0.0
CYLINDER	2	1	.7075	24.17	0.0
CUBOID	3	1	4P.9455	24.17	0.0

UNIT 8					
CYLINDER	3	1	.7075	1.23	0.0
CUBOID	4	1	4P.9455	1.23	0.0

UNIT 9					
CUBOID	3	1	4P.9455	68.58	-1.31

UNIT 10					
CUBOID	3	1	4P.9455	24.17	0.0

UNIT 11					
COM='FUEL ROD'					
ARRAY 1	3*0.0				
UNIT 12					
COM='GUIDE TUBE'					
ARRAY 2	3*0.0				
UNIT 13					
COM='UNFILLED SPOT'					
ARRAY 3	3*0.0				

UNIT 14					
COM='14X14 ARRAY '					
ARRAY 4	2*-13.237 0.				
CUBOID	3	1	4P13.2435	96.52	0.0
CUBOID	6	1	4P13.6275	96.52	0.0
CUBOID	7	1	4P16.1025	96.52	0.0

UNIT 15					
COM='14X14 ARRAY WITH 36 MISSING'					
ARRAY 5	2*-13.237 0.				
CUBOID	3	1	4P13.2435	96.52	0.0

CUBOID 6 1 4P13.6275 96.52 0.0
 CUBOID 7 1 4P16.1025 96.52 0.0
 UNIT 16
 COM='14X14 ARRAY WITH 34 MISSING AND 2 GUIDE TUBES'
 ARRAY 6 2*-13.237 0.
 CUBOID 3 1 4P13.2435 96.52 0.0
 CUBOID 6 1 4P13.6275 96.52 0.0
 CUBOID 7 1 4P16.1025 96.52 0.0

UNIT 17
 COM='WATER BLOCK SEPARATOR'
 CUBOID 7 1 16.1025 0.0 32.205 0.0 96.52 0.0

UNIT 18
 COM='2 FULL ASSEMBLIES '
 ARRAY 8 3*0.0

UNIT 19
 COM='3 MIDDLE ASSEMBLIES'
 ARRAY 9 3*0.0

GLOBAL UNIT 20
 ARRAY 10 3*0.0
 CUBOID 8 1 96.615 0.0 96.615 0.0 96.52 -5.08
 REFLECTOR 9 2 6R3 5
 REFLECTOR 9 7 4R3 2R0 5

END GEOM

READ BIAS ID=500 2 11 END BIAS

READ ARRAY
 COM='FUEL ROD' ARA=1 NUX=1 NUY=1 NUZ=4 FILL 1 2 3 4
 END FILL
 COM='GUIDE TUBE' ARA=2 NUX=1 NUY=1 NUZ=4 FILL 5 6 5 7
 END FILL
 COM='UNFILLED' ARA=3 NUX=1 NUY=1 NUZ=4 FILL 8 9 8 10
 END FILL
 COM='FULL ARRAY' ARA=4 NUX=14 NUY=14 NUZ=1 FILL F11
 END FILL
 ARA=5 NUX=14 NUY=14 NUZ=1 FILL 16R11 13 11 5Q2 5Q28 28R11
 END FILL
 ARA=6 NUX=14 NUY=14 NUZ=1 FILL 15R11 13 11 5Q2 11 2Q28
 15R11 13 11 13 11 12 11 13 11
 12 11 13
 17R11 13 11 5Q2 11 1Q28 28R11
 END FILL
 ARA=8 NUX=4 NUY=1 NUZ=1 FILL 17 14 14 17 END FILL
 ARA=9 NUX=3 NUY=1 NUZ=1 FILL 15 16 15 END FILL
 ARA=10 NUX=1 NUY=3 NUZ=1 FILL 18 19 18 END FILL
 END ARRAY

READ PLOT

TTL='X-Y SLICE OF TTC-5 AT Z=1.'

XUL=0.0 YUL=97.0 ZUL=1.

XLR=97.0 YLR=0.0 ZLR=1.

UAX=1 VDN=-1 NAX=260 NCH=' 12 456789' END

TTL='X-Y SLICE OF TTC-5 AT Z=2.'

XUL=0.0 YUL=97.0 ZUL=2.

XLR=97.0 YLR=0.0 ZLR=2.

UAX=1 VDN=-1 NAX=260 NCH=' 12 456789' END

TTL='X-Y SLICE OF TTC-5 AT Z=50.'

XUL=0.0 YUL=97.0 ZUL=50.

XLR=97.0 YLR=0.0 ZLR=50.

UAX=1 VDN=-1 NAX=260 NCH=' 12 456789' END

TTL='X-Y SLICE OF TTC-5 AT Z=72.'

XUL=0.0 YUL=97.0 ZUL=72.

XLR=97.0 YLR=0.0 ZLR=72.

UAX=1 VDN=-1 NAX=260 NCH=' 12 456789' END

TTL='X-Y SLICE OF TTC-5 AT Z=90.'

XUL=0.0 YUL=97.0 ZUL=90.

XLR=97.0 YLR=0.0 ZLR=90.

UAX=1 VDN=-1 NAX=260 NCH=' 12 456789' END

TTL='X-Y SLICE OF TTC-5 AT Z=96.'

XUL=0.0 YUL=97.0 ZUL=96.

XLR=97.0 YLR=0.0 ZLR=96.

UAX=1 VDN=-1 NAX=260 NCH=' 12 456789' END

END PLOT

END DATA

END