CRWMS/M&O

Calculation Cover Sheet

Complete only applicable items.

1. QA: L

2. Calculation Title Criticality Evaluation of Intact and Degraded PWR WPs Containing MOX SNF			
3. Document Identifier (including Revision Number) A00000000-01717-0210-00002 REV 00			4. Total Pages 76
5. Total Attachments 3 paper, 1 CD-ROM	6. Attachment Numbers - Number of pages in each I-21, II-5, III-8		

	Print Name	Signature	Date
7. Originator	John R. Massari	[signature]	7/10/98
8. Checker	John A. McClure	[signature] John A McClure	7/10/98
9. Lead Design Engineer	Peter Gottlieb	[signature] Peter Gottlieb	7/10/98

10. Remarks

PCG compliance review by WEWallin 7/10/98

Revision History

11. Revision No.	12. Date Approved	13. Description of Revision
00	07/10/98	Initial Issue

Table of Contents

Item **Page**

List of Tables

Item **Page**

List of Figures

Item **Page**

1. PURPOSE

The purpose of this calculation is to perform criticality evaluations for mixed oxide spent nuclear fuel (MOX SNF) in 12 and 21 Pressurized Water Reactor (PWR) waste packages (WPs) for both intact and degraded configurations.

2. METHOD

The MOX assembly design considered in previous studies on Pu disposition in commercial reactors is based on the Westinghouse (W) 17x17 Vantage 5 assembly (Ref. 7.2). Depletion analyses of four Pu enrichment and burnup (expressed as gigawatt days/metric ton heavy metal; GWd/MTHM) combinations were performed in Reference 7.4. These are:

1) 4.0% initial Pu, 35.5 GWd/MTHM burnup,
2) 4.5% initial Pu, 39.3 GWd/MTHM burnup,
3) 4.5% initial Pu, 46.5 GWd/MTHM burnup,
4) 4.0% initial Pu, 50.1 GWd/MTHM burnup, and
5) 4.0% initial Pu, 56.6 GWd/MTHM burnup.

This calculation will generally consider only the first two, as these represent the expected lowest assembly burnup at discharge. However, the calculations for the 12 PWR WP will also consider the third and fourth burnup/enrichment pairs, as these are more representative of the higher burned fuel for which this package is intended. Reference 7.4 provides isotopic compositions for each fuel in grams per assembly, for decay times from a few days, out to 1 million years.

In this calculation, k_{eff} values are calculated for intact and various degraded WP configurations using the Monte Carlo N-Particle Version 4B2 (MCNP4B2; CSCI: 30033 V4B2LV; Ref. 7.6). Fuel region number densities used in this criticality evaluation were calculated simply by homogenizing the isotopic concentrations from Reference 7.4 for a particular fuel and decay time throughout the volume of the active fuel region.

The degraded configurations to be considered are based on those evaluated for the commercial PWR WP (Ref. 7.13, Section 7.1). Figure 2-1 shows a schematic view of the sequence of degradation for the 21 PWR absorber plate waste package following breach of the package. Since the WP interior was inerted with He prior breach, the initial configuration will be the as-built basket (Fig. 2-1A). Within a few hundred years following breach, the carbon steel and aluminum components will degrade to insoluble corrosion products as shown in Figure 2-1B (Ref. 7.17). While structural calculations show that the absorber plates can support the load of the assemblies, localized corrosion in the crevice regions at the corners of each cell will likely cause collapse shortly after failure of the structural components. However, the majority of the borated stainless steel (B-SS) absorber plates will remain largely undegraded and remain between the assemblies, with corrosion products from the degraded carbon steel tubes (Fig. 2-1C). Eventually, after thousands of years, general corrosion will also fully degrade the absorber plates, allowing the soluble boron neutron absorber to be flushed out of the package (Fig. 2-1D). The zircaloy cladding and spacers represent the most corrosion resistant material in the WP, and thus will be the last to degrade. Rod consolidation will likely occur prior to complete cladding degradation (Fig. 2-1E), as the spacer grids are typically fabricated from strips of zircaloy that are thinner than the cladding. The final internal configuration (Fig 2-1F) is complete degradation of the entire WP contents, with only the insoluble materials remaining. Similar configurations would also be expected to form during degradation of the 12 PWR WP, with the exception of configurations B and C, which cannot occur because the 12 PWR WP does not contain B-SS absorber plates.

This calculation will consider configurations A, D, E, and F for both the 21 and 12 PWR WP. Configuration C will be considered for the 21 PWR WP if D shows k_{eff} values which are significantly higher than the intact configuration. Chemical compositions of the remaining basket and fuel corrosion products will be obtained from the geochemistry calculations reported in Reference 7.17. As in Reference 7.13, both settled and uniform corrosion product distributions will be evaluated for configuration D.

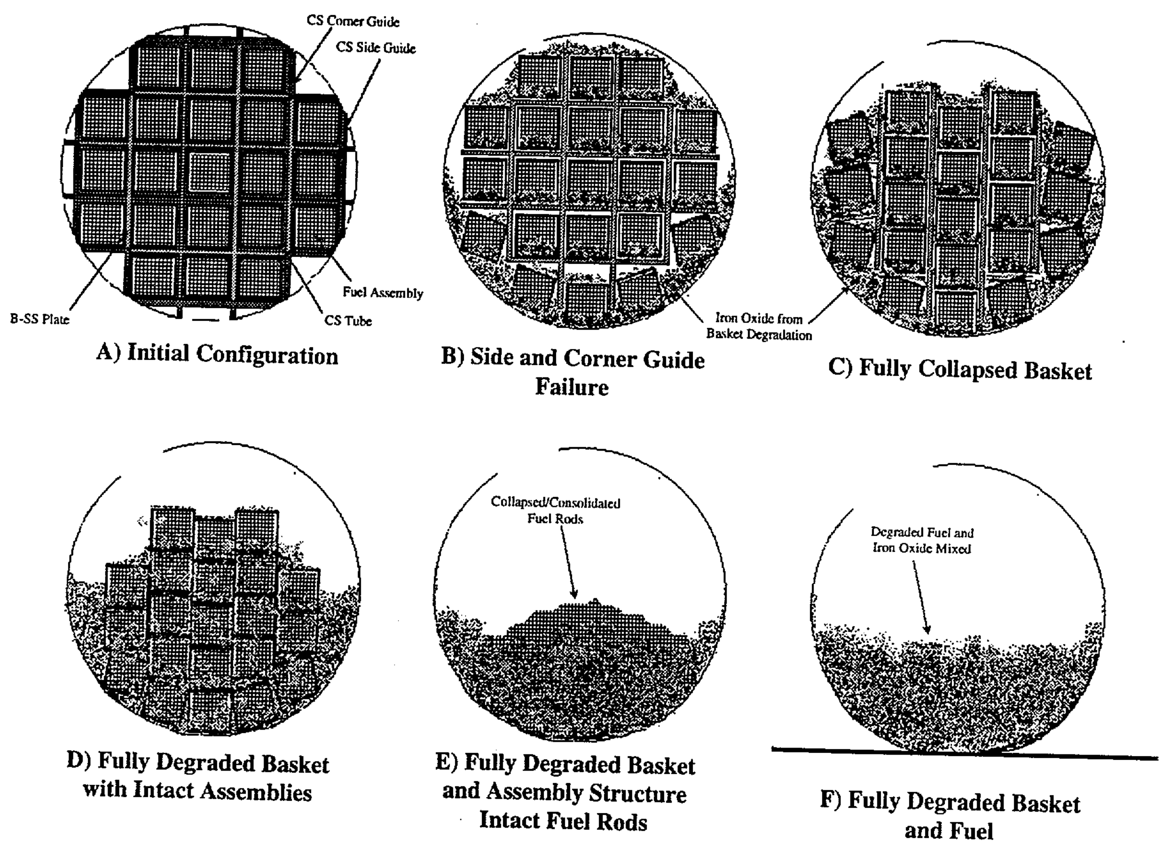

Figure 2-1. Degradation sequence of 21 PWR basket structure following WP breach

3. ASSUMPTIONS

3.1 Principal Isotope (PI) burnup credit is assumed to be an acceptable method to account for reduced reactivity of SNF in criticality evaluations. The basis for this assumption is Controlled

Design Assumption (CDA) Key 009 (Ref. 7.11). This assumption is used throughout Section 5.

3.2 For SNF, the list of "Principal Isotopes" previously established (Ref. 7.16, p. 3-26) for long-term criticality control was used. The 29 principal isotopes are shown in Table 3-1. This assumption is used throughout Sections 5.

Table 3-1. Principal Long-Term Burnup Credit Isotopes

-	Mo-95	Tc-99	Ru-101	Rh-103
Ag-109	Nd-143	Nd-145	Sm-147	Sm-149
Sm-150	Sm-151	Sm-152	Eu-151	Eu-153
Gd-155	U-233	U-234	U-235	U-236
U-238	Np-237	Pu-238	Pu-239	Pu-240
Pu-241	Pu-242	Am-241	Am-242m	Am-243

3.3 It is assumed that the WP is fully flooded for this analysis. The basis for this assumption is that it is conservative, and moderation is a required condition for criticality in commercial SNF with an enrichment of less than 5 wt% (Ref. 7.15, p. 68). Furthermore, scenarios leading to a fully flooded WP have been proposed in previous QAP-3-9 analyses (Ref. 7.13). This assumption is used throughout Section 5.

3.4 It is assumed that the degraded UO_2 fuel will have a volume equivalent to that of soddyite containing the same amount of U. The basis for this assumption is the geochemistry calculations in Reference 7.17, which indicate that the majority of U retained in the WP, following degradation of the fuel, will be in the mineral soddyite. This assumption is used in Section 5.4.3.

3.5 It is assumed that the thermal shunt material will be Aluminum Alloy 6061. The basis for this is that Reference 7.7 does not provide information on the material for this component. This assumption is used throughout Section 5.

4. USE OF COMPUTER SOFTWARE

4.1 Software Approved for QA Work

The calculation of k_{eff} of degraded internal WP configurations was performed with the MCNP4B2 computer code (CSCI: 30033; Ref. 7.6). MCNP4B2 calculates k_{eff} for a variety of geometric configurations with neutron cross sections for elements and isotopes described in the Evaluated Nuclear Data File version B-V (ENDF-B/V). MCNP4B2 is appropriate for the fuel geometries and materials required for these analyses. The calculations using the MCNP4B2 software were executed on a Hewlett-Packard workstation. The software qualification of the MCNP4B2 software, including problems related to calculation of k_{eff} for fissile systems, is summarized in the Software Qualification

Report for the Monte Carlo N-Particle code (Ref. 7.6). The MCNP4B2 evaluations performed for this calculation are fully within the range of the validation for the MCNP4B2 software used. Access to and use of the MCNP4B2 software for this analysis was granted by Software Configuration Management and performed in accordance with the QAP-SI series procedures. Inputs and outputs for the MCNP4B2 software are included as attachments as described in the following design analysis.

4.2 Software Routines

Microsoft Excel 97, loaded on a Pentium II PC. Calculations of corrosion product volumes and number densities were performed electronically in this spreadsheet software package. The location of the electronic copy of the MOXoxide.xls spreadsheet containing all inputs and outputs is given in Section 8, and Attachment I provides a hard copy. All calculations/data manipulations performed in MOXoxide.xls are described in Section 5 and may also be examined electronically.

MS-DOS Qbasic version 1.1 BASIC interpreter, loaded on a Pentium II PC. Calculation of number densities for the principal isotopes from the SAS2H/ORIGEN-S output was performed using a short BASIC software routine entitled AMIGO1.BAS, which also automatically placed them into the appropriate spot in an MCNP4B2 input file template. The AMIGO1.BAS code is an automation of a simple number density calculation and data manipulation task, which is easily checked by hand. AMIGO1.BAS does not generate data. The input consists of an ASCII file containing the isotope gram concentration tables from a SAS2H/ORIGEN-S output file, and one or more MCNP4B2 template files. The template files are simply standard MCNP4B2 input with the mnemonics "FUELTOT" and "FUELNUM" in place of the cell card total number density and that material card for the fuel region. The AMIGO1.BAS output is simply one or more MCNP4B2 input files. See Section 8 for the location of the SAS2H/ORIGEN-S summary files containing the gram concentrations of the principal isotopes (*.sum), the MCNP4B2 template files, and the resulting MCNP4B2 input files. The source code for AMIGO1.BAS is provided in Attachment II.

Pro/Engineer version 17.0 loaded on an HP workstation. Pro/Engineer is drafting software that is used to produce WP drawings (Refs. 7.20 to 7.37) and is not required to be qualified under the QAP-SI series procedures. Based on the component dimensions used to create the drawings, Pro/Engineer provides the option of determining the volume of the component. This Pro/Engineer volume information for the 12 PWR WP basket components is included as Attachment III, and is summarized in Table 5.1-3. Hand calculations verifying the accuracy of the Pro/Engineer volume calculations are documented in Section 5.1.2.

5. CALCULATION

5.1 Inputs

5.1.1 Spent Fuel Assembly Parameters

The fuel assembly upon which this calculation is based is the W 17 x 17 Vantage 5 fuel assembly. The mechanical parameters for this assembly type were obtained from Reference 7.4 (p. 7) and are shown in Table 5.1-1. Note that inches are converted to centimeters exactly (2.54 cm/in.). This information represents actual W fuel assembly dimensions and is considered qualified data.

Table 5.1-1. Mechanical Parameters of W 17x17 Vantage 5 Fuel Assembly

No. fuel pins/assembly	264
No. guide tubes/assembly	25
Cladding material	Zircaloy-4
Fuel pellet OD (in./cm)	0.3088 / 0.784352
Fuel rod OD (in./cm)	0.36 / 0.9144
Active fuel length (in./cm)	144 / 365.76
Pitch (in./cm)	0.496 / 1.25984
Fuel rod clad ID (in./cm)	0.315 / 0.8001
Guide tube OD (in./cm)	0.482 / 1.22428
Guide tube ID (in./cm)	0.45 / 1.143
Assembly width (in./cm)	8.44 / 21.4376
Heavy metal per assembly (kg)	422.7979

5.1.2 Intact Waste Package Geometry Parameters

The intact waste package geometry parameters used in this analysis are listed in Table 5.1-2. The general WP assembly was obtained from References 7.29 and 7.30. This is information is based on qualified drawings or QAP-3-9 analyses and is therefore considered qualified. Table 5.1-3 provides information on the volumes of the 12 PWR WP basket components for purpose of calculating corrosion product volumes. Corrosion product volume information for the 21 PWR WP was calculated in Reference 7.17 and is summarized in Section 5.1.5.

Table 5.1-2. Intact WP Dimensions

Component	21 PWR WP Dimensions (cm)	Ref.	Material (Ref. 7.7)	12 PWR WP Dimensions (cm)	Ref.	Material (Ref. 7.7)
Outer barrier length (skirt edge to skirt edge)	533.50	7.20	A 516 Carbon Steel (CS)	533.50	7.31	A 516 Carbon Steel
Outer barrier skirt length (both ends)	22.50	7.20		22.50	7.31	
Outer barrier lid thickness	11.00	7.20		11.0	7.31	
Outer barrier inner radii	73.17	7.20		56.00	7.31	
Outer barrier outer radii	83.17	7.20		66.00	7.31	
Gap between inner and outer lids	3.00	7.20 & 7.21	N/A	3.00	7.31 & 7.32	N/A
Inner barrier length (overall)	463.50	7.21	Alloy C-22	463.50	7.32	Alloy C-22
Inner barrier lid thickness	2.50	7.21		2.50	7.32	
Inner barrier inner radii	71.17	7.21		54.00	7.32	
Inner barrier outer radii	73.17	7.21		56.00	7.32	
Fuel cell tube thickness	0.50	7.22	A 516 CS	0.50	7.33	A 516 CS
Fuel cell tube outside width	23.60	7.22		23.60	7.33	
Fuel basket A-plate thickness	0.70	7.23	Neutronit A978 Borated Stainless Steel	1.00	7.34	A 516 Carbon Steel
Fuel basket B-plate thickness	0.70	7.24		1.00	7.35	
Fuel basket C-plate thickness	0.70	7.25		0.50	7.36	
Fuel basket D-plate thickness	0.50	7.26	Al Alloy 6061*	N/A	N/A	N/A
Fuel basket E-plate thickness	0.50	7.27		N/A	N/A	N/A
Structural component plate thickness	1.00	7.28	A 516 CS	1.00	7.37	A 516 CS

* - See Assumption 3.5.

Table 5.1-3. Volume of 12 PWR WP Basket Components

Basket Comp.	Volume (mm^3)	Number per WP	Volume/WP (mm^3)
A-Plate	1.08E+07	4	4.33E+07
B-Plate	1.08E+07	4	4.33E+07
C-Plate	2.70E+06	16	4.33E+07
A-Guide	5.22E+06	16	8.35E+07
B-Guide	5.31E+05	16	8.50E+06
Corner Guide	5.30E+06	16	8.49E+07
Stiffener	3.08E+05	32	9.85E+06
Tube	2.09E+07	12	2.51E+08

These volumes were verified by performing a hand calculation of the A-Plate from the dimensions given on Reference 7.34 (966 mm x 1132 mm x 10 mm – 2 x 566 mm x 5 mm x 10 mm – 566 mm x 10 mm x 10 mm = 1.08E7 mm^3).

5.1.3 Material Properties

Densities of non-fuel materials used in this analysis are as follows:

A 516 Grade 55 Carbon Steel	7832	kg/m^3	Reference 7.9, p. I-1
SS316B6A (B-SS)	7770	kg/m^3	Reference 7.9, p. I-10
Aluminum 6061	2700	kg/m^3	Reference 7.19, p. 2
Iron Oxide (Fe_2O_3)	5240	kg/m^3	Reference 7.12, p. B-104
Zircaloy-4	6560	kg/m^3	Reference 7.9, p. I-16
Alloy C-22	8690	kg/m^3	Reference 7.9, p. I-3
Water	1000	kg/m^3	Reference 7.9, p. I-19

It should be noted that the SS316B6A discussed above is similar to the Neutronit A978 material noted in Reference 7.7. The atomic weights of isotopes are listed in Table 5.1-4 (Ref. 7.8, pp. 941-978, unless otherwise noted). Avogadro's Number $[N_A] = 0.602252 \text{ (g-mol)}^{-1} \times 10^{24}$ (Ref. 7.8, p. 933). Chemical compositions of alloys used in this analysis are given in Table 5.1-5. This information is obtained from qualified QAP-3-9 analyses, or is considered established fact, and is therefore considered qualified.

Table 5.1-4. Atomic Weights in g/mole

Isotope	MCNP ID#	Atomic Weight
B-10	5010.50C	10.0129388
B-11	5011.56C	11.0093053
Nat. O	not used	15.9994*
O-16	8016.50C	15.994915
Nat. Fe	26000.55C	55.847*
Mo-95	42095.50C	94.905839
Tc-99	43099.50C	98.90627501**
Ru-101	44101.50C	100.905576
Rh-103	45103.50C	102.905511
Ag-109	47109.50C	108.904756
Nd-143	60143.50C	142.909779
Nd-145	60145.50C	144.912538
Sm-147	62147.50C	146.914867
Sm-149	62149.50C	148.91718
Sm-150	62150.50C	149.917276
Sm-151	62151.50C	150.919919
Sm-152	62152.50C	151.919756
Eu-151	63151.55C	150.919838
Eu-153	63153.55C	152.921242
Gd-155	64155.50C	154.922664
U-233	92233.50C	233.039522
U-234	92234.50C	234.040904
U-235	92235.50C	235.043915
U-236	92236.50C	236.045637
U-238	92238.50C	238.05077
Np-237	93237.55C	237.048056
Pu-238	94238.50C	238.049511
Pu-239	94239.55C	239.052146
Pu-240	94240.50C	240.053882
Pu-241	94241.50C	241.056737
Pu-242	94242.50C	242.058725
Am-241	95241.50C	241.056714
Am-242m	95242.50C	242.059502
Am-243	95243.50C	243.061367

* From Reference 7.10, pp. 16 & 17

** From Reference 7.9, p. 29

Table 5.1-5. Chemical compositons of WP and fuel assembly alloys modeled

Element \ Material	A 516 Gr. 55 Carbon Steel (Ref. 7.9, p. I-1)	Alloy C-22 (Ref. 7.9, p. I-3)	Aluminum Alloy 6061 (Ref. 7.19, p. 2)	Zircaloy-4 (Ref. 7.9, p. I-16)	SS316B6A 1.6% B (Ref. 7.9, p. I-10)
Fe	98.535%	3.000%	0.700%	0.200%	60.445%
^{10}B / ^{11}B	-	-	-	-	0.288%/ 1.312%
Cr	-	22.000%	0.195%	0.100%	19.000%
Ni	-	56.000%	-	-	13.500%
Mg	-	-	1.000%	-	-
Mn	0.900%	0.500%	0.150%	-	2.000%
Mo	-	13.000%	-	-	2.500%
N	-	-	-	-	0.100%
S	0.035%	-	-	-	0.030%
Si	0.275%	0.080%	0.600%	-	0.750%
P	0.035%	-	-	-	0.045%
C	0.220%	0.010%	-	-	0.030%
O	-	-	-	0.120%	-
Cu	-	-	0.275%	-	-
Co	-	2.060%	-	-	-
W	-	3.000%	-	-	-
Ti	-	-	0.150%	-	-
Al	-	-	96.680%	-	-
V	-	0.350%	-	-	-
Zn	-	-	0.250%*	-	-
Zr	-	-	-	98.180%	-
Sn	-	-	-	1.400%	-
TOTAL	100.00%	100.00%	100.00%	100.00%	100.00%

* Due to lack of cross-section data for Zn in the ENDF-B/V library, the wt% Zn has been conservatively lumped into that of Al, which has a smaller thermal absorption cross-section than Zn (Ref. 7.14, pp. 644-647).

5.1.4 Fuel Isotopic Concentrations

Reference 7.4 provides the MOX isotopic compositions in grams per assembly, for decay times from a few days, out to 1 million years. The principal isotope compositions for the 4.0% initial Pu, 35.5 GWd/MTHM burnup fuel were obtained from the Reference 7.4 SAS2H/ORIGEN-S output file w3_35-5gwd_2cy-6stps.ouput and summarized in the file w3_35-5.sum. The principal isotope compositions for the 4.5% initial Pu, 39.3 GWd/MTHM burnup fuel were obtained from the Reference 7.4 SAS2H/ ORIGEN-S output file w3_39-3gwd_2cy-6stps.output and summarized in the file w3_39-3.sum. The principal isotope compositions for the 4.5% initial Pu, 46.5 GWd/MTHM burnup fuel were obtained from the Reference 7.4 SAS2H/ORIGEN-S output file w3_46-6gwd_crit-6stps.output and summarized in the file w3_46-5.sum. See Section 8 for the locations of these files.

5.1.5 Basket and Fuel Degradation Product Compositions

Reference 7.17 performed geochemistry calculations to determine the composition of the corrosion product mixture remaining in the 21 PWR waste package following complete basket degradation. Table 5.1-6 summarizes the concentrations of insoluble corrosion products that remain after the basket has completely degraded. Reference 7.17 indicates that this final composition remains fairly constant over the range of possible B-SS degradation rates and drip rates. The moles/WP column is calculated by multiplying the moles/L H_2O column by 4550 liters of H_2O, which is the amount of water considered to be in the WP in Reference 7.17 (equivalent to the void space available in a loaded WP with an undegraded basket).

Table 5.1-6. Corrosion products remaining following basket degradation

Basket Corrosion Product	Volume per WP (m^3)	moles/liter H_2O	moles/WP
Diaspore (AlOOH)	1.8392E-01	2.291	10424.05
Hematite (Fe_2O_3)	1.7707E+00	12.77	58103.5
Pyrolusite (MnO2)	2.7361E-02	0.35	1592.5
Ni_2SiO_4	3.0867E-02	0.1592	724.36
Nontronite-Ca ($Si_{3.7}Ca_{0.33}Al_{0.33}$ $Fe_2H_2O_{12}$)	1.2874E-02	0.0216	98.28
Nontronite-K ($Si_{3.7}K_{0.17}Al_{0.33}$ $Fe_2H_2O_{12}$)	5.6325E-04	0.0009151	4.163705
Nontronite-Mg ($Si_{3.7}Mg_{0.2}Al_{0.33}$ $Fe_2H_2O_{12}$)	8.9323E-03	0.01513	68.8415
Nontronite-Na ($Si_{3.7}Na_{0.33}Al_{0.33}$ $Fe_2H_2O_{12}$)	9.0407E-04	0.001504	6.8432
TOTAL	2.0362E+00		

Reference 7.17 also examined the effects that fuel degradation will have on the principal isotope inventory. Reference 7.17 examined two cases for both commercial and MOX PWR fuel: 1) fuel degradation concurrent with basket degradation, and 2) fuel degradation beginning after basket degradation is completed. The former case for the commercial PWR resulted in the greatest loss of principal isotopes due to lower pH conditions during degradation of the B-SS and fuel, and will be used in this analysis for conservatism. Table 5.1-7 summarizes the percentage of each principal isotope remaining at different times from the beginning of fuel degradation. Note that the geochemistry

calculations of Reference 7.17, and thus the results in Table 5.1-7, do not account for the decay of the principle isotopes. Decay will be accounted for in this analysis by applying the reduced principle isotope concentration for a given degradation time to a decay time from the ORIGEN-S output (see Section 5.1.4) that is equally offset from the point at which degradation began (i.e., if degradation is assumed to begin at 10,000 years, the principle isotope inventories at 12,000 years will be reduced as indicated for a degradation time of 2,000 years). Cases involving degraded fuel will examine these reduced principal isotope inventories, as well as a conservative case including only 100% of the U and Pu principal isotopes.

Table 5.1-7. Effects of fuel degradation on principal isotope inventory

Fuel Deg. Time (yrs)	2000	4000	8000	15000	25000	35000	90000	240000
U	100%	100%	100%	100%	99%	99%	96%	88%
Np	85%	70%	38%	0%	0%	0%	0%	0%
Pu	100%	100%	100%	100%	100%	100%	100%	100%
Am	0%	0%	0%	0%	0%	0%	0%	0%
Mo	0%	0%	0%	0%	0%	0%	0%	0%
Tc	0%	0%	0%	0%	0%	0%	0%	0%
Ru	100%	100%	100%	100%	100%	100%	100%	100%
Rh	100%	100%	100%	100%	100%	100%	100%	100%
Ag	87%	80%	67%	43%	12%	0%	0%	0%
Nd	99%	98%	97%	95%	95%	95%	95%	95%
Sm	80%	70%	46%	27%	26%	26%	24%	20%
Eu	82%	71%	46%	9%	8%	7%	2%	0%
Gd	56%	35%	14%	5%	5%	5%	5%	3%

5.2 Calculation of Number Densities for Degraded Basket Material

Based on the total volume of corrosion products remaining following full basket degradation (see Section 5.1.5), and the total volume contained within the inner barrier minus that occupied by the fuel assemblies (volume of the fuel rods), the corrosion products will occupy 36.8% of the interior void space of a 21 PWR WP. If the corrosion products settle to the bottom of the WP, the physical geometry of packed solids will result in a density that is less than theoretical. For example, the percent solid content noted in for a tight packing of sand (Ref. 7.38, p. 17) is 58%. The porosity (the complement of the solids content) of tightly packed carbon steel tubesheet corrosion products that led to the denting of steam generator tubes at two Westinghouse plants was found to be between 7% and 25% (Ref. 7.39, p. 10). Since the oxides in the tubesheet were compressed to the point of denting the tube, and no such restriction of the oxides in the WP is expected, the tight packing of sand will be taken to be representative of that of iron oxide scale that has settled. At 58% dense packing, if all of the oxides settle to the bottom, they will completely cover the bottom three rows of assemblies, and cover more than 95% of the fourth row (94% or 16 rows of a Westinghouse 17x17 Vantage 5 assembly is conservatively used for this analysis). Number densities were calculated for the above corrosion product and water mixtures by dividing the moles of each element per WP (as indicated in Table 5.1-6) by the void space they occupied and multiplying by Avogadro's Number (0.602252 x 10^{24} atoms/mole). These calculations are performed in the 21PWRoxide sheet of the attached Excel 97 worksheet, MOXoxide.xls (see Section 8 and Attachment I).

Geochemistry calculations were not performed for the 12 PWR WP in Reference 7.17. The geochemistry results of the 21 PWR WP indicated that all of the Fe from the carbon and stainless steel components was incorporated into Fe_2O_3, and remained in the package. Since the 12 PWR WP basket is fabricated entirely from carbon steel, it is expected that the corrosion product resulting from degradation of the basket components will also be Fe_2O_3. If all of the Fe from the 12 PWR WP basket were converted to Fe_2O_3, it would occupy 37.4% of the interior void space of a loaded WP. If this material were settled to the bottom of the WP at a 58% dense packing, it would cover all but the top two assemblies. These volume calculations, and the resulting oxide number density calculations, are performed in the 12PWRoxide sheet of the attached Excel 97 worksheet, MOXoxide.xls (see Section 8 and Attachment I).

5.3 Calculation of Number Densities for Fuel Region

The grams/assembly output for each time step was used to calculate the number density of each principal isotope (see Assumption 3.1). The burnup/enrichment pair number densities for the principal isotopes were calculated from the SAS2H summary files using a short BASIC code, AMIGO1.BAS, which also automatically placed them into the appropriate spot in an MCNP4B2 input file template (see Attachment II for the source code). The AMIGO1 number density calculations are performed using the following equation (Ref. 7.14, p. 35):

$$N_i = \frac{a_i 4 m_i N_A}{\pi d^2 n l M_i}$$

where: N_A is Avogadro's Number - 0.602252 x 10^{24} atoms/mole,
M_i is the gram atomic weight of isotope i,
m_i is the gram concentration per assembly of isotope i,
d is the outer diameter of the fuel pellet in cm,
l is the active fuel length in cm,
n is the number of fuel rods per assembly, and
a_i is a user defined adjustment factor for isotope i (used for degraded fuel evaluations).

The units of the resulting number density are in atoms/cm^3. The required units for subsequent use are atoms/b-cm where 1 barn equals 10^{-24} cm^2. The calculation in AMIGO1 drops the 10^{24} from Avagadro's Number to account for the conversion. The concentration of oxygen in the active fuel region is not provided in the SAS2H/ORIGEN-S output, but can be calculated to be ≈57 kg based on the initial heavy metal (HM; mostly ^{238}U) loading given in Table 5.1-1 (422,000 g HM ÷ 238 g/mole HM x 2 moles O/mole HM x 16 g/mole O). The number densities for each of the principal isotopes plus oxygen are then summed to get a total number density for the fuel region.

AMIGO1 creates MCNP4B2 inputs by searching the lines of a user-supplied template for the mnemonics "FUELTOT" and "FUELNUM". When found in the template file, FUELTOT is replaced with the total number density for the fuel region, and FUELNUM is replaced with the MCNP ID#s and number densities of the principal isotopes. An input file is created for each decay time available from the SAS2H summary file that is within the user-specified range.

5.4 MCNP4B2 Model Description

5.4.1 Intact Fuel and Basket

The purpose of this section is to describe the MCNP4B2 cases needed to evaluate the k_{eff} of the intact 21 PWR and 12 PWR waste package designs (configuration A from Section 2). The composition and dimensions of the containment barriers and basket components are modeled explicitly using the information in Section 5.1.2. Each Westinghouse 17x17 Vantage 5 fuel assembly is treated as a heterogeneous system with the fuel rods and control rod guide tubes modeled explicitly using the information contained in Section 5.1.1. The fuel rods are conservatively modeled with water in the gap region. Figure 5.4-1 shows a detailed view of the MCNP4B2 fuel assembly model common to all of the WP models containing intact fuel. Figure 5.4-2 shows the details of the MCNP4B2 model for the 21 PWR WP. Figure 5.4-3 shows the details of the MCNP4B2 model for the 12 PWR WP. In addition to the base design discussed in Section 5.1.2, an additional case was evaluated with the central A and B plates changed from A516 carbon steel to Aluminum Alloy 6061. This alternative was evaluated because it is being considered in thermal analyses of the 12 PWR WP. Each of the intact designs was evaluated for the 4% Pu-35.5 GWd/MTHM burnup fuel (fuel #1), and the 4.5% Pu-39.3 GWd/MTHM burnup fuel (fuel #2), for decay times from 10 years to 250,000 years. In addition, the intact 12 PWR WP designs were also evaluated for the 4.5% Pu-46.5 GWd/MTHM burnup fuel (as discussed in Section 2).

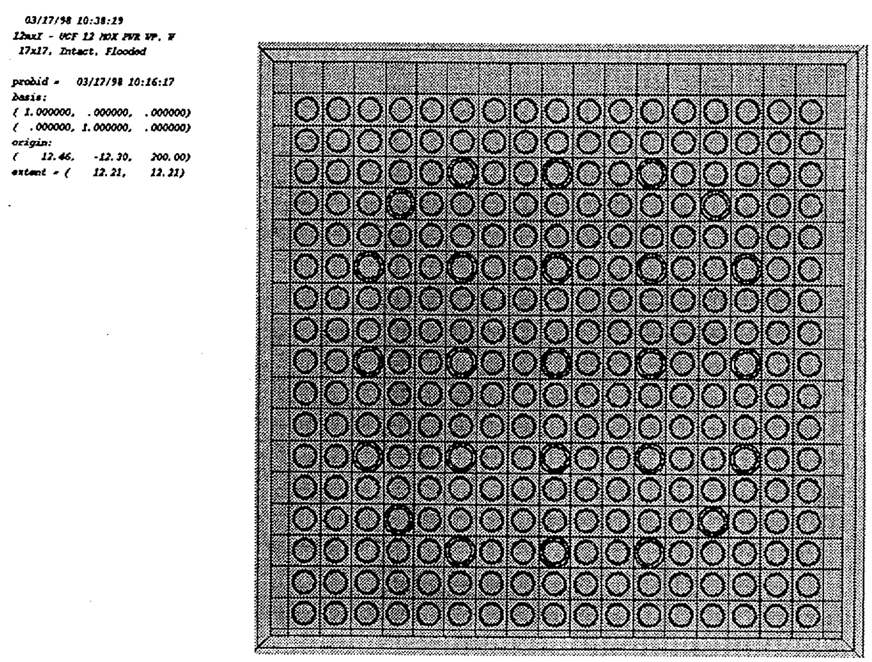

Figure 5.4-1. Westinghouse 17x17 PWR MOX fuel assembly

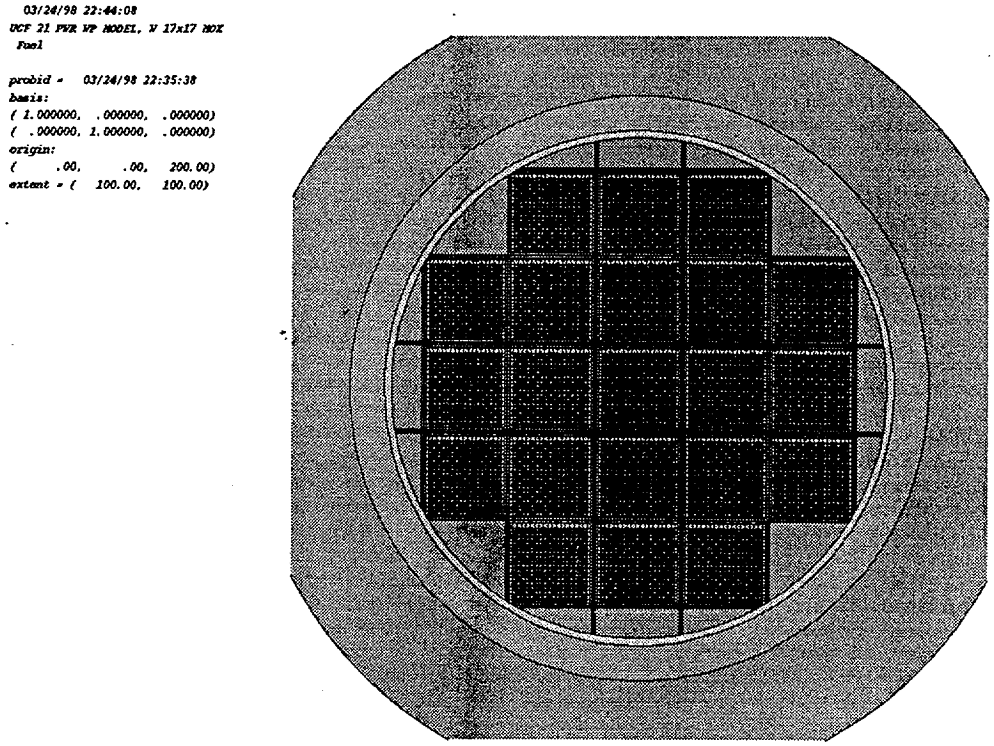

Figure 5.4-2. Intact 21 PWR MOX fuel waste package

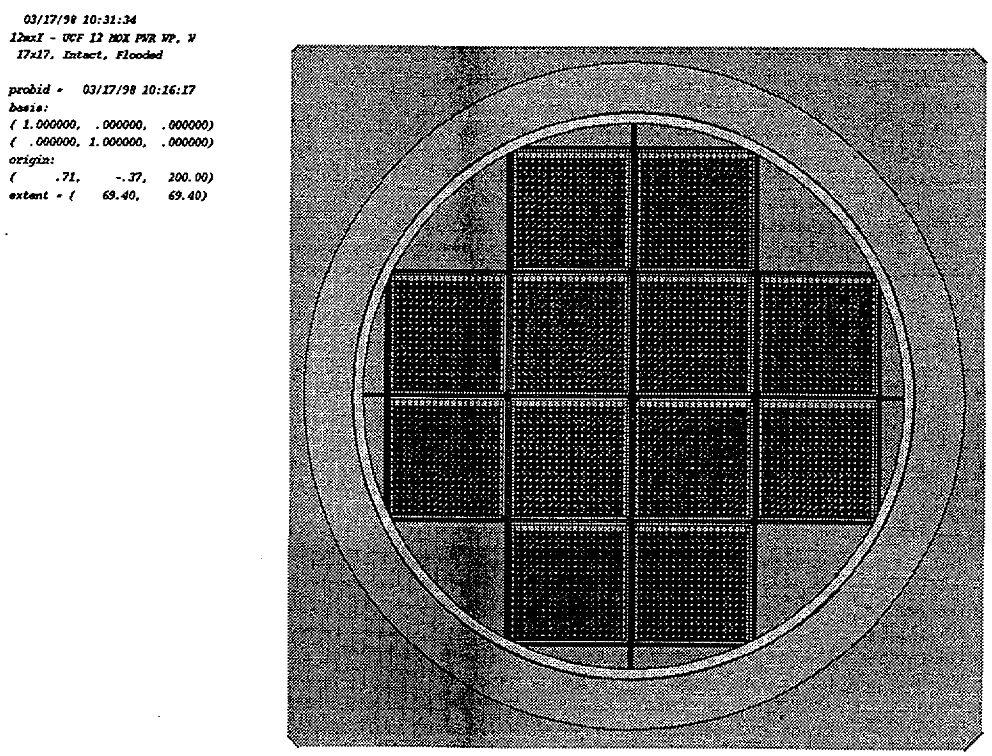

Figure 5.4-3. Intact 12 PWR MOX fuel waste package

5.4.2 Intact Fuel with Fully Degraded Basket

The purpose of this section is to describe the MCNP4B2 cases needed to evaluate the k_{eff} of the 21 PWR and 12 PWR waste package designs with intact fuel and fully degraded basket structures (configuration D from Section 2). Both the uniformly distributed corrosion product and the settled corrosion product configurations were evaluated for each WP, using the information calculated in Section 5.2. The composition and dimensions of the containment barriers are modeled explicitly using the information in Section 5.1.2. Each Westinghouse 17x17 Vantage 5 fuel assembly is treated as a heterogeneous system with the fuel rods and control rod guide tubes modeled explicitly using the information contained in Section 5.1.1. The fuel rods are conservatively modeled with water in the gap region and guide tubes, even when surrounded by water/corrosion product mixtures, as there is no physical mechanism for getting basket corrosion products into these locations while the assembly remains intact. Figure 5.4-4 shows the geometry details of the MCNP4B2 model for the 21 PWR WP with a fully degraded basket and uniformly distributed corrosion products. Figure 5.4-5 shows the geometry details of the MCNP4B2 model for the 21 PWR WP with a fully degraded basket and settled corrosion products. Figure 5.4-6 shows the geometry details of the MCNP4B2 model for the base 12 PWR WP with a fully degraded basket and uniformly distributed corrosion products. Figure 5.4-7 shows the geometry details of the MCNP4B2 model for the base 12 PWR WP with a fully degraded basket and settled corrosion products. Each of these configurations were evaluated for the 4% Pu-35.5 GWd/MTHM burnup fuel (fuel #1), and the 4.5% Pu-39.3 GWd/MTHM burnup fuel (fuel #2), for decay times from 10 years to 250,000 years.

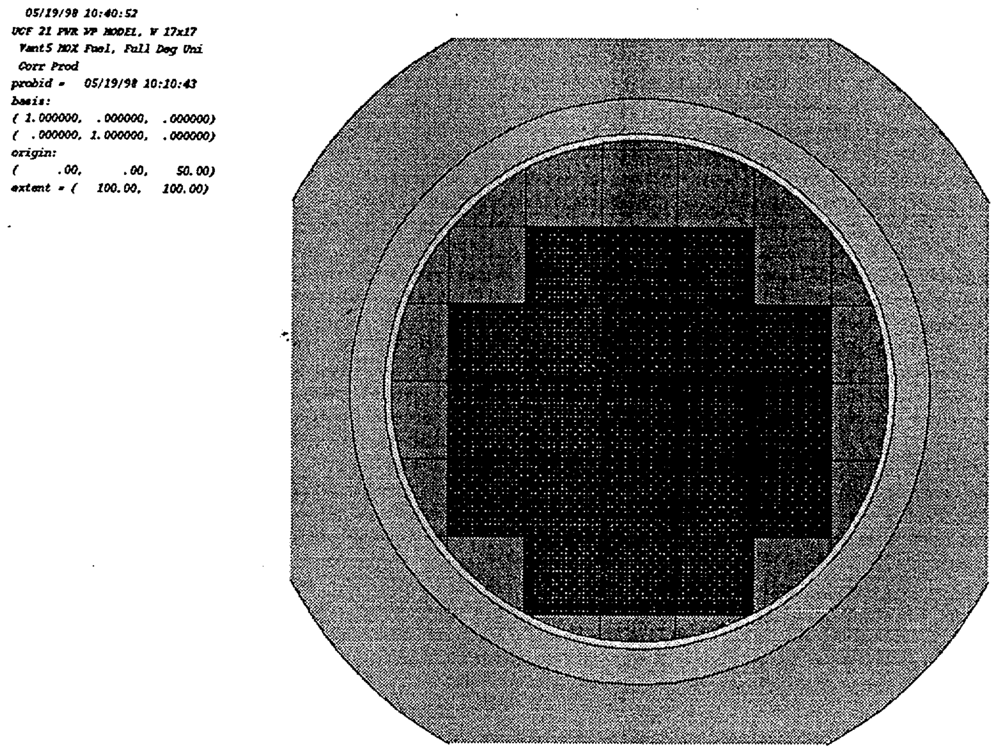

Figure 5.4-4. Degraded 21 PWR MOX fuel waste package with uniform corrosion product distribution

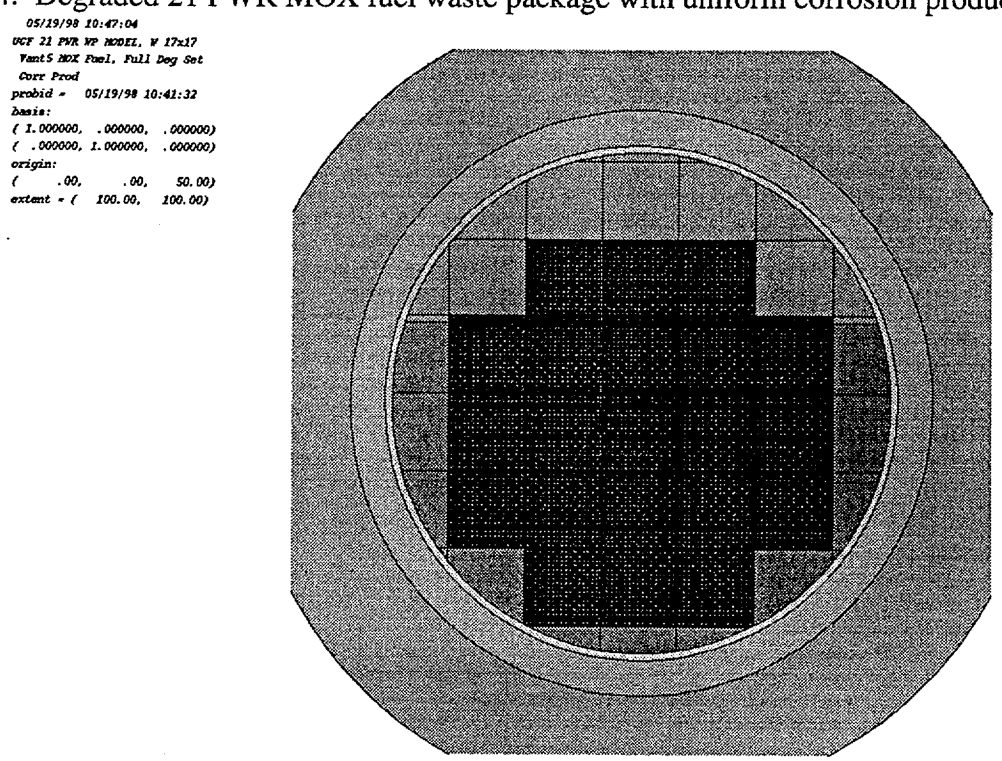

Figure 5.4-5. Degraded 21 PWR MOX waste package with settled corrosion product distribution (58% solid content)

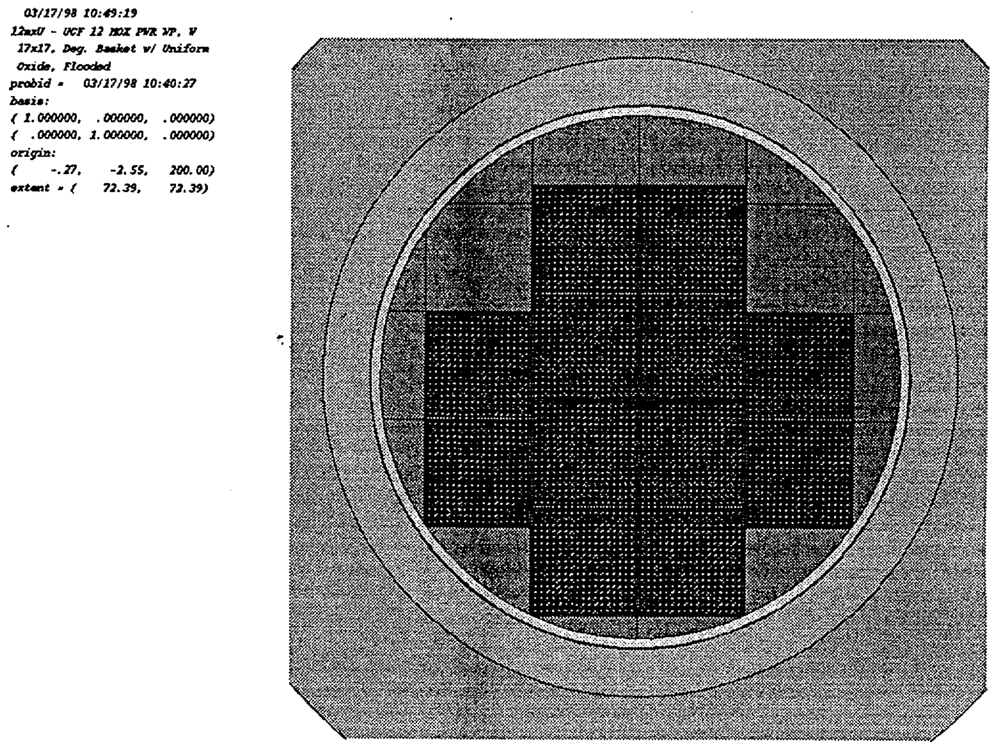

Figure 5.4-6. Degraded 12 PWR MOX fuel waste package with uniform corrosion product distribution

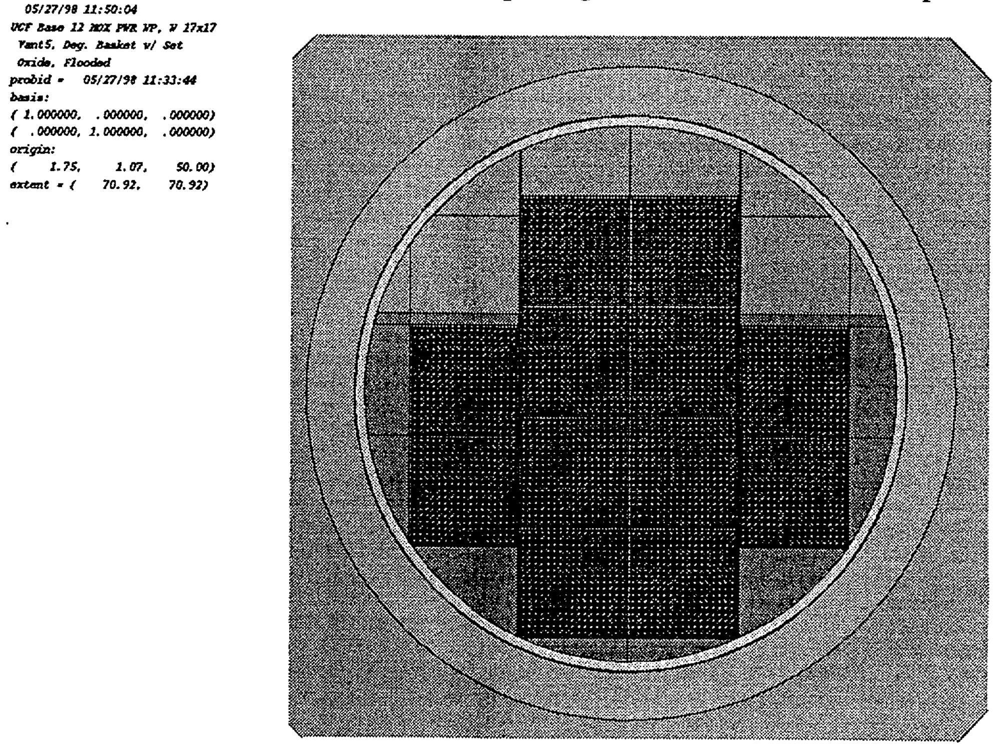

Figure 5.4-7. Degraded 12 PWR MOX waste package with settled corrosion product distribution (58% solid content)

5.4.3 Degraded Fuel and Basket

The purpose of this section is to describe the MCNP4B2 cases needed to evaluate the k_{eff} of the 21 PWR waste package design with fully degraded basket structures and fuel that is partially or fully degraded (configurations E and F from Section 2). The former configuration was modeled by settling fuel rods into a cylinder segment at the bottom of the WP into a square lattice, as is shown in Figure 5.4-8. The height of the cylinder segment was calculated to be that which would give a volume equal to 5544 fuel rods (264 rods/assy x 21 assys) in a square lattice at a given pitch. This calculation was performed in the 21PWRoxide worksheet of the Excel 97 spreadsheet MOXoxide.xls. Lattice pitches ranging from 0.9144 cm (rods touching) to 1.2598 cm (as-built fuel rod pitch) were evaluated because the actual separation between collapsed rods cannot be reliably predicted, but would be expected to be less than that of that of the original pitch. The fuel rods were modeled explicitly using the information contained in Section 5.1.1, and were conservatively modeled with water in the gap region. Only a uniform corrosion product distribution of 36.8 vol% was evaluated. Cases were run with full isotope burnup credit, as well as the reduced principal isotope conditions discussed in Section 5.1.5.

The fully degraded fuel and basket configuration was modeled by homogenizing the remaining principal isotopes, zircaloy, and basket corrosion products in the WP interior volume. The volume of degraded fuel material was assumed to be that which would occur if all of the initial UO_2 degraded to soddyite ($[UO_2]_2SiO_4:2H_2O$), as is indicated in the geochemistry calculations (Ref. 7.17). Additional Si, H, and O were also added to the mixture to account for that which would be present if the fuel degraded to soddyite. The volume of zircaloy was equivalent to that contained in the cladding and guide tubes of 21 Vantage 5 assemblies. The degraded basket materials and volumes are given in Table 5.1-6. All together, the degraded fuel, zircaloy, and basket corrosion products occupied 62.5% of the WP interior volume. Water was assumed to fill the remaining void space. Number densities for this mixture were calculated in the 21PWRoxide worksheet of the Excel 97 spreadsheet MOXoxide.xls (See Section 8 and Attachment I). Figure 5.4-9 shows the geometry details of the MCNP4B2 model for the 21 PWR WP with fully degraded fuel and basket corrosion products uniformly distributed. Cases were conservatively run with U and Pu principal isotopes only.

Each of these configurations were evaluated for the 4% Pu-35.5 GWd/MTHM burnup fuel (fuel #1) for decay times from 1,000 years to 250,000 years.

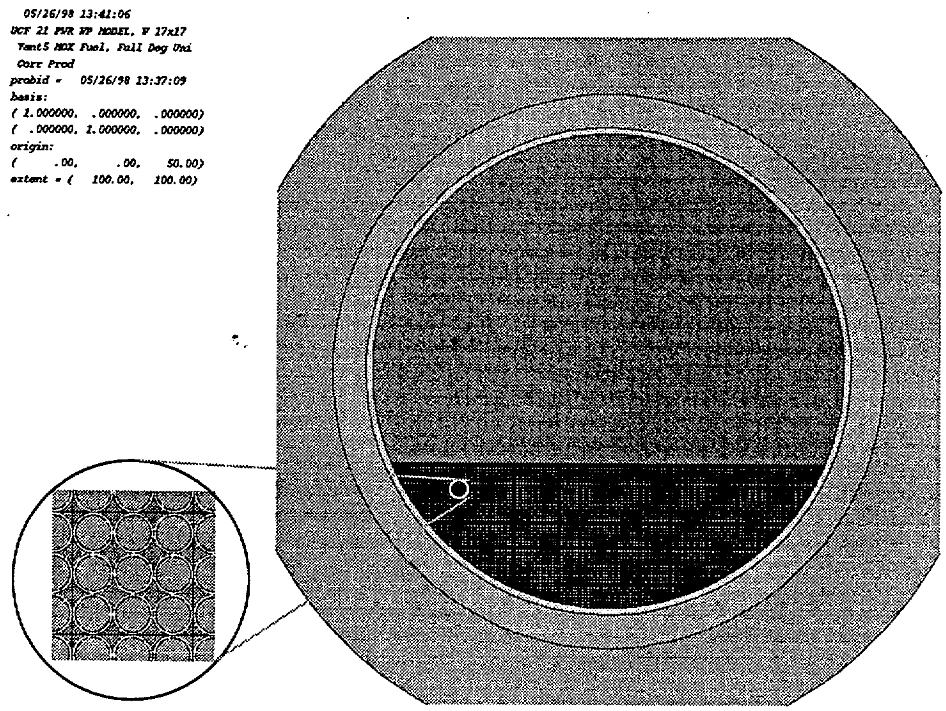

Figure 5.4-8. Degraded 21 PWR MOX WP with fuel rods collapsed to bottom of package surrounded by uniformly distributed basket corrosion products

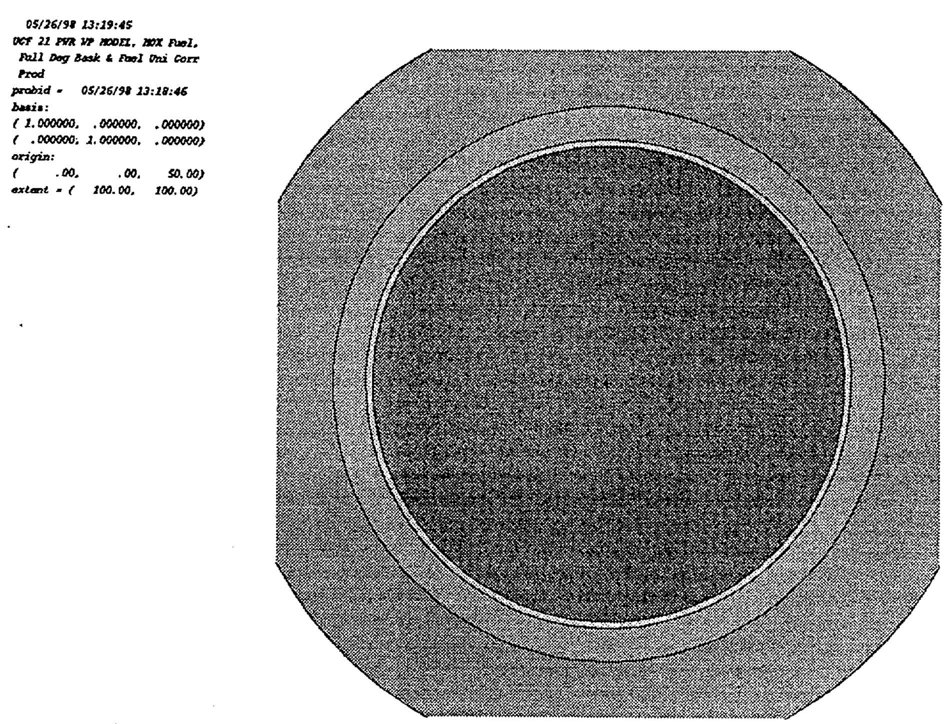

Figure 5.4-9. Fully degraded fuel and basket material uniformly distributed throughout interior volume of 21 PWR WP

6. RESULTS

6.1 Intact Fuel and Basket

Tables 6.1-1, 6.1-2, and 6.1-3 list the k_{eff} and average energy of the neutron causing fission (AENCF) results of the MCNP4B2 calculations for different decay times and burnup/Pu enrichment combinations for the intact 21 PWR WP, 12 PWR WP, and 12 PWR WP with Al thermal shunts, respectively. For the first ≈100 years after being discharged, the k_{eff} of the MOX SNF decreases as the Pu-241 (13.2-year half-life) fissile material decays. From ≈100 years out to ≈20,000 years the k_{eff} increases as Pu-240 (6,580-year half-life) and other medium half-life neutron absorbers decay. After the ≈20,000 year local peak, the k_{eff} decreases again as the Pu-239 (24,400-year half-life) fissile material decays. The time effects on k_{eff} are best illustrated with plotted data. Figures 6.1-1, 6.1-2, and 6.1-3 show the plotted k_{eff} results as a function of time for the intact 21 PWR WP, 12 PWR WP, and 12 PWR WP with Al thermal shunts, respectively.

The 12 PWR WP designs showed higher k_{eff} values than the 21 PWR WP design for the same fuel type because these WP designs do not include criticality control plates. The 12 PWR WP with Al thermal shunts showed an ≈1% increase in k_{eff} over the 12 PWR WP with the all carbon steel basket primarily because the Al has a much smaller neutron absorption cross section than the Fe that it replaced. The average energy of the neutron causing fission was in the range of 0.18 to 0.26 MeV, and generally peaked at ≈100 years. The 4% Pu, 35.5 GWd/MTHM burnup fuel generally showed higher k_{eff} values than the 4.5%, 39.3 GWd/MTHM fuel for all cases evaluated.

Additional cases were also run for a dry 21 PWR WP, and for a flooded 12 PWR WP containing 7 mm of 316B6A borated stainless steel between adjacent assemblies and Al thermal shunts. Both cases were run for the 4% Pu, 35.5 GWd/MTHM fuel at an age of 10 years. The dry 21 PWR WP had a k_{eff} of 0.3161±0.0009 (case "21MIDN"). The 12 PWR WP with borated stainless steel had a k_{eff} of 0.8228±0.0030 (case "12MIB").

The H/X ratios (where X is the sum of the fissile isotopes U-233, U-235, Pu-239, and Pu-241) are calculated in the H/X Ratio worksheet of the Excel 97 spreadsheet MOXoxide.xls. The calculation was performed on a per fuel rod basis.

INTENTIONALLY LEFT BLANK

Table 6.1-1. k_{eff} and AENCF Results for MOX SNF in an Intact 21 PWR WP

Time (years)	4.0% Pu, 35.5 GWd/MTHM					4.5% Pu, 39.3 GWd/MTHM				
	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)
10	21MI1N	0.8410	0.0026	285.63	0.2213	21MI2N	0.8374	0.0025	274.85	0.2214
15	21MI1O	0.8184	0.0028	294.01	0.2280	21MI2O	0.8099	0.0023	283.70	0.2321
20	21MI1P	0.8041	0.0027	301.41	0.2341	21MI2P	0.7911	0.0028	291.20	0.2338
30	21MI1Q	0.7763	0.0026	311.85	0.2415	21MI2Q	0.7650	0.0028	302.20	0.2474
50	21MI1R	0.7542	0.0030	322.96	0.2499	21MI2R	0.7377	0.0025	314.35	0.2561
100	21MI1S	0.7413	0.0024	329.59	0.2536	21MI2S	0.7283	0.0028	321.42	0.2584
150	21MI1T	0.7432	0.0024	330.23	0.2547	21MI2T	0.7291	0.0027	322.07	0.2550
200	21MI1U	0.7453	0.0027	330.28	0.2507	21MI2U	0.7324	0.0023	322.12	0.2576
250	21MI1V	0.7483	0.0025	330.27	0.2497	21MI2V	0.7335	0.0027	322.11	0.2536
500	21MI1W	0.7620	0.0029	330.28	0.2435	21MI2W	0.7489	0.0023	321.61	0.2495
1000	21MI1X	0.7761	0.0031	329.92	0.2409	21MI2X	0.7627	0.0026	321.57	0.2442
2000	21MI1Y	0.7926	0.0025	329.35	0.2354	21MI2Y	0.7782	0.0023	321.18	0.2390
4000	21MI1Z	0.7978	0.0025	329.02	0.2289	21MI2Z	0.7842	0.0022	320.35	0.2319
8000	21MI1A	0.8064	0.0021	327.52	0.2251	21MI2A	0.7935	0.0025	318.90	0.2272
10000	21MI1B	0.8104	0.0024	327.23	0.2207	21MI2B	0.7962	0.0028	318.20	0.2257
12000	21MI1C	0.8092	0.0027	326.51	0.2184	21MI2C	0.8014	0.0026	317.93	0.2234
14000	21MI1D	0.8071	0.0031	326.70	0.2145	21MI2D	0.8003	0.0022	317.67	0.2228
18000	21MI1E	0.8115	0.0031	325.77	0.2130	21MI2E	0.8019	0.0031	317.19	0.2179
25000	21MI1F	0.8062	0.0028	325.02	0.2094	21MI2F	0.7977	0.0028	316.45	0.2145
35000	21MI1G	0.7987	0.0028	324.57	0.2064	21MI2G	0.7862	0.0025	315.99	0.2095
45000	21MI1H	0.7812	0.0032	324.30	0.2058	21MI2H	0.7709	0.0020	315.69	0.2103
100000	21MI1I	0.7352	0.0021	323.25	0.2035	21MI2I	0.7248	0.0026	314.45	0.2062
250000	21MI1J	0.7209	0.0022	321.37	0.2017	21MI2J	0.7150	0.0025	312.62	0.2044

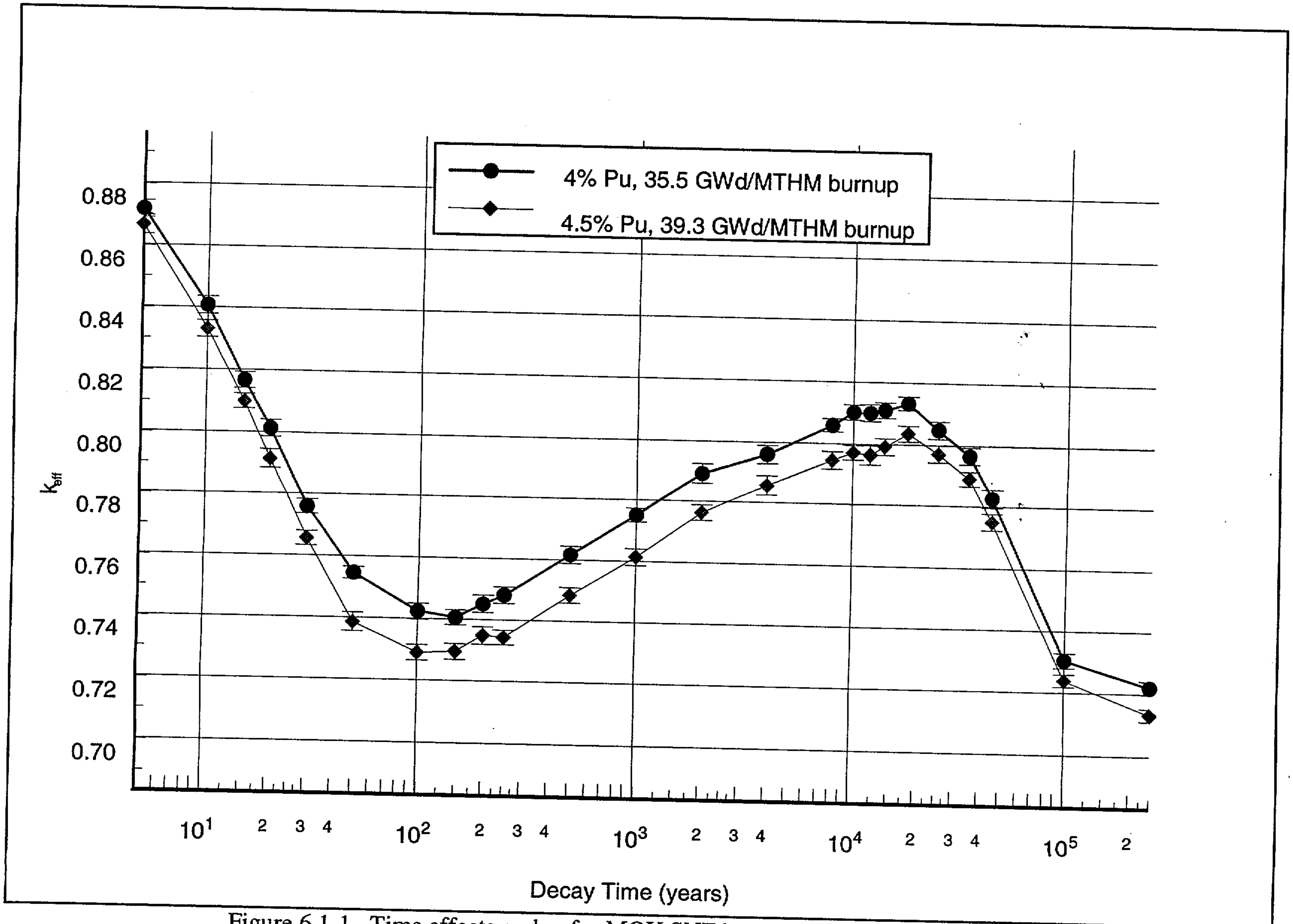

Figure 6.1-1. Time effects on k_{eff} for MOX SNF in a 21 PWR Absorber Plate WP

Table 6.1-2. k_{eff} and AENCF Results for MOX SNF in an Intact 12 PWR WP

Time (years)	4.0% Pu, 35.5 GWd/MTHM					4.5% Pu, 39.3 GWd/MTHM				
	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)
10	12MI1N	0.8972	0.0021	285.63	0.2065	12MI2N	0.8902	0.0026	274.85	0.2081
15	12MI1O	0.8715	0.0025	294.01	0.2133	12MI2O	0.8622	0.0027	283.70	0.2129
20	12MI1P	0.8539	0.0032	301.41	0.2159	12MI2P	0.8403	0.0022	291.20	0.2176
30	12MI1Q	0.8259	0.0025	311.85	0.2232	12MI2Q	0.8152	0.0027	302.20	0.2256
50	12MI1R	0.8011	0.0024	322.96	0.2322	12MI2R	0.7863	0.0023	314.35	0.2357
100	12MI1S	0.7903	0.0025	329.59	0.2322	12MI2S	0.7722	0.0023	321.42	0.2401
150	12MI1T	0.7909	0.0028	330.23	0.2296	12MI2T	0.7768	0.0028	322.07	0.2377
200	12MI1U	0.7971	0.0024	330.28	0.2332	12MI2U	0.7799	0.0028	322.12	0.2368
250	12MI1V	0.7995	0.0022	330.27	0.2320	12MI2V	0.7826	0.0025	322.11	0.2339
500	12MI1W	0.8113	0.0028	330.28	0.2292	12MI2W	0.7967	0.0024	321.61	0.2331
1000	12MI1X	0.8269	0.0027	329.92	0.2235	12MI2X	0.8131	0.0021	321.57	0.2259
2000	12MI1Y	0.8421	0.0025	329.35	0.2160	12MI2Y	0.8250	0.0028	321.18	0.2229
4000	12MI1Z	0.8499	0.0024	329.02	0.2150	12MI2Z	0.8360	0.0028	320.35	0.2146
8000	12MI1A	0.8601	0.0026	327.52	0.2072	12MI2A	0.8462	0.0024	318.90	0.2112
10000	12MI1B	0.8623	0.0021	327.23	0.2037	12MI2B	0.8505	0.0023	318.20	0.2065
12000	12MI1C	0.8643	0.0029	326.51	0.1991	12MI2C	0.8522	0.0023	317.93	0.2046
14000	12MI1D	0.8666	0.0028	326.70	0.2005	12MI2D	0.8535	0.0024	317.67	0.2034
18000	12MI1E	0.8651	0.0028	325.77	0.1978	12MI2E	0.8570	0.0026	317.19	0.1987
25000	12MI1F	0.8638	0.0021	325.02	0.1943	12MI2F	0.8509	0.0024	316.45	0.1952
35000	12MI1G	0.8532	0.0025	324.57	0.1896	12MI2G	0.8421	0.0025	315.99	0.1921
45000	12MI1H	0.8401	0.0028	324.30	0.1851	12MI2H	0.8260	0.0024	315.69	0.1913
100000	12MI1I	0.7855	0.0023	323.25	0.1891	12MI2I	0.7735	0.0024	314.45	0.1901
250000	12MI1J	0.7764	0.0023	321.37	0.1859	12MI2J	0.7656	0.0020	312.62	0.1883

Table 6.1-2. k_{eff} and AENCF Results for MOX SNF in an Intact 12 PWR WP (Cont.)

Time (years)	4.5% Pu, 46.5 GWd/MTHM					4.0% Pu, 50.0 GWd/MTHM				
	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)
10	12MI3N	0.8559	0.0026	299.03	0.2145	12MI4N	0.8007	0.0029	376.80	0.2249
15	12MI3O	0.8291	0.0025	309.93	0.2214	12MI4O	0.7676	0.0022	393.15	0.2326
20	12MI3P	0.8033	0.0028	319.53	0.2283	12MI4P	0.7427	0.0028	406.96	0.2418
30	12MI3Q	0.7753	0.0023	333.59	0.2360	12MI4Q	0.7120	0.0022	427.87	0.2540
50	12MI3R	0.7437	0.0025	349.34	0.2455	12MI4R	0.6783	0.0021	451.89	0.2670
100	12MI3S	0.7291	0.0024	358.15	0.2498	12MI4S	0.6613	0.0022	465.47	0.2712
150	12MI3T	0.7321	0.0024	359.05	0.2470	12MI4T	0.6633	0.0017	467.04	0.2703
200	12MI3U	0.7353	0.0025	359.17	0.2480	12MI4U	0.6668	0.0019	466.52	0.2696
250	12MI3V	0.7372	0.0025	359.22	0.2476	12MI4V	0.6692	0.0026	466.79	0.2691
500	12MI3W	0.7525	0.0022	358.91	0.2435	12MI4W	0.6821	0.0024	466.28	0.2617
1000	12MI3X	0.7708	0.0024	358.29	0.2393	12MI4X	0.6995	0.0027	465.44	0.2558
2000	12MI3Y	0.7844	0.0027	357.83	0.2299	12MI4Y	0.7109	0.0017	463.85	0.2502
4000	12MI3Z	0.7935	0.0027	356.04	0.2246	12MI4Z	0.7238	0.0024	460.80	0.2451
8000	12MI3A	0.8023	0.0026	354.30	0.2212	12MI4A	0.7308	0.0026	456.31	0.2394
10000	12MI3B	0.8053	0.0025	352.94	0.2162	12MI4B	0.7350	0.0025	454.17	0.2332
12000	12MI3C	0.8083	0.0021	352.63	0.2164	12MI4C	0.7359	0.0022	452.91	0.2318
14000	12MI3D	0.8070	0.0025	352.34	0.2117	12MI4D	0.7342	0.0020	451.67	0.2317
18000	12MI3E	0.8105	0.0023	350.76	0.2094	12MI4E	0.7321	0.0022	450.09	0.2275
25000	12MI3F	0.8082	0.0024	349.90	0.2048	12MI4F	0.7323	0.0021	447.28	0.2237
35000	12MI3G	0.7989	0.0022	349.39	0.2033	12MI4G	0.7174	0.0023	445.90	0.2214
45000	12MI3H	0.7795	0.0023	348.54	0.2025	12MI4H	0.6997	0.0021	445.58	0.2221
100000	12MI3I	0.7279	0.0022	346.90	0.2011	12MI4I	0.6456	0.0023	442.82	0.2233
250000	12MI3J	0.7191	0.0020	344.24	0.2008	12MI4J	0.6382	0.0022	438.97	0.2217

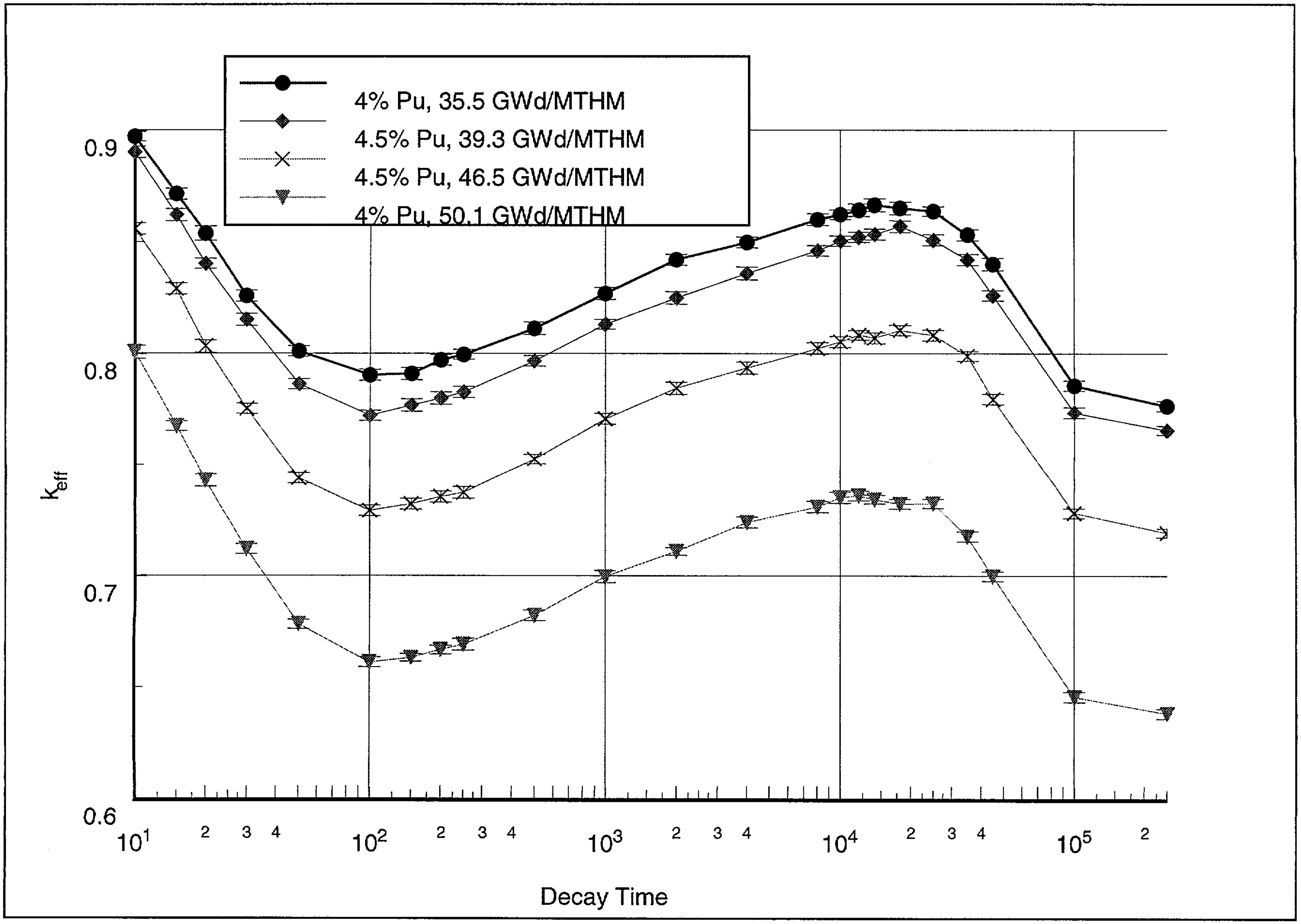

Figure 6.1-2. Time effects on k_{eff} for MOX SNF in a 12 PWR WP

Table 6.1-3. k_{eff} and AENCF Results for MOX SNF in an Intact 12 PWR WP with Al shunts

Time (years)	4.0% Pu, 35.5 GWd/MTHM					4.5% Pu, 39.3 GWd/MTHM				
	MCNP Case	k_{eff}	$\pm 2\sigma$	H/X	AENCF (MeV)	MCNP Case	k_{eff}	$\pm 2\sigma$	H/X	AENCF (MeV)
10	12MIA1N	0.9095	0.0029	285.63	0.2048	12MIA2N	0.9029	0.0029	274.85	0.2057
15	12MIA1O	0.8872	0.0026	294.01	0.2090	12MIA2O	0.8771	0.0024	283.70	0.2111
20	12MIA1P	0.8654	0.0028	301.41	0.2162	12MIA2P	0.8572	0.0027	291.20	0.2179
30	12MIA1Q	0.8369	0.0025	311.85	0.2237	12MIA2Q	0.8264	0.0024	302.20	0.2262
50	12MIA1R	0.8121	0.0024	322.96	0.2279	12MIA2R	0.7970	0.0022	314.35	0.2342
100	12MIA1S	0.8014	0.0024	329.59	0.2316	12MIA2S	0.7863	0.0025	321.42	0.2342
150	12MIA1T	0.8053	0.0025	330.23	0.2318	12MIA2T	0.7901	0.0026	322.07	0.2408
200	12MIA1U	0.8070	0.0026	330.28	0.2310	12MIA2U	0.7912	0.0028	322.12	0.2350
250	12MIA1V	0.8106	0.0030	330.27	0.2296	12MIA2V	0.7942	0.0026	322.11	0.2337
500	12MIA1W	0.8234	0.0025	330.28	0.2247	12MIA2W	0.8083	0.0026	321.61	0.2298
1000	12MIA1X	0.8422	0.0026	329.92	0.2188	12MIA2X	0.8241	0.0026	321.57	0.2231
2000	12MIA1Y	0.8541	0.0029	329.35	0.2147	12MIA2Y	0.8389	0.0030	321.18	0.2184
4000	12MIA1Z	0.8640	0.0026	329.02	0.2093	12MIA2Z	0.8515	0.0022	320.35	0.2149
8000	12MIA1A	0.8729	0.0025	327.52	0.2064	12MIA2A	0.8612	0.0026	318.90	0.2085
10000	12MIA1B	0.8751	0.0025	327.23	0.2006	12MIA2B	0.8626	0.0025	318.20	0.2058
12000	12MIA1C	0.8802	0.0024	326.51	0.2014	12MIA2C	0.8642	0.0028	317.93	0.2036
14000	12MIA1D	0.8806	0.0022	326.70	0.2009	12MIA2D	0.8686	0.0029	317.67	0.2012
18000	12MIA1E	0.8802	0.0023	325.77	0.1967	12MIA2E	0.8683	0.0029	317.19	0.1999
25000	12MIA1F	0.8791	0.0024	325.02	0.1928	12MIA2F	0.8635	0.0026	316.45	0.1949
35000	12MIA1G	0.8651	0.0022	324.57	0.1892	12MIA2G	0.8566	0.0021	315.99	0.1914
45000	12MIA1H	0.8532	0.0023	324.30	0.1867	12MIA2H	0.8399	0.0023	315.69	0.1904
100000	12MIA1I	0.8024	0.0022	323.25	0.1856	12MIA2I	0.7848	0.0025	314.45	0.1872
250000	12MIA1J	0.7894	0.0023	321.37	0.1837	12MIA2J	0.7791	0.0022	312.62	0.1839

Table 6.1-3. k_{eff} and AENCF Results for MOX SNF in an Intact 12 PWR WP with Al shunts (Cont.)

Time (years)	4.5% Pu, 46.5 GWd/MTHM					4.0% Pu, 50.1 GWd/MTHM				
	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)
10	12MIA3N	0.8680	0.0024	299.03	0.2108	12MAI4N	0.8130	0.0020	376.80	0.2216
15	12MIA3O	0.8385	0.0025	309.93	0.2206	12MAI4O	0.7801	0.0021	393.15	0.2319
20	12MIA3P	0.8171	0.0029	319.53	0.2254	12MAI4P	0.7554	0.0023	406.96	0.2438
30	12MIA3Q	0.7839	0.0027	333.59	0.2368	12MAI4Q	0.7215	0.0020	427.87	0.2516
50	12MIA3R	0.7590	0.0025	349.34	0.2426	12MAI4R	0.6870	0.0019	451.89	0.2673
100	12MIA3S	0.7411	0.0023	358.15	0.2491	12MAI4S	0.6746	0.0022	465.47	0.2716
150	12MIA3T	0.7448	0.0025	359.05	0.2457	12MAI4T	0.6737	0.0021	467.04	0.2687
200	12MIA3U	0.7461	0.0022	359.17	0.2474	12MAI4U	0.6783	0.0022	466.52	0.2693
250	12MIA3V	0.7490	0.0024	359.22	0.2426	12MAI4V	0.6797	0.0024	466.79	0.2671
500	12MIA3W	0.7644	0.0023	358.91	0.2400	12MAI4W	0.6939	0.0020	466.28	0.2593
1000	12MIA3X	0.7803	0.0023	358.29	0.2354	12MAI4X	0.7128	0.0025	465.44	0.2490
2000	12MIA3Y	0.7954	0.0029	357.83	0.2290	12MAI4Y	0.7236	0.0021	463.85	0.2464
4000	12MIA3Z	0.8063	0.0028	356.04	0.2234	12MAI4Z	0.7331	0.0027	460.80	0.2427
8000	12MIA3A	0.8169	0.0020	354.30	0.2146	12MAI4A	0.7416	0.0022	456.31	0.2372
10000	12MIA3B	0.8196	0.0023	352.94	0.2154	12MAI4B	0.7473	0.0021	454.17	0.2316
12000	12MIA3C	0.8238	0.0028	352.63	0.2116	12MAI4C	0.7501	0.0022	452.91	0.2313
14000	12MIA3D	0.8236	0.0024	352.34	0.2096	12MAI4D	0.7496	0.0025	451.67	0.2270
18000	12MIA3E	0.8266	0.0026	350.76	0.2072	12MAI4E	0.7489	0.0021	450.09	0.2241
25000	12MIA3F	0.8213	0.0024	349.90	0.2041	12MAI4F	0.7447	0.0023	447.28	0.2226
35000	12MIA3G	0.8104	0.0025	349.39	0.2019	12MAI4G	0.7317	0.0023	445.90	0.2199
45000	12MIA3H	0.7953	0.0024	348.54	0.2008	12MAI4H	0.7128	0.0021	445.58	0.2169
100000	12MIA3I	0.7422	0.0022	346.90	0.1976	12MAI4I	0.6607	0.0020	442.82	0.2189
250000	12MIA3J	0.7316	0.0019	344.24	0.1977	12MAI4J	0.6526	0.0021	438.97	0.2189

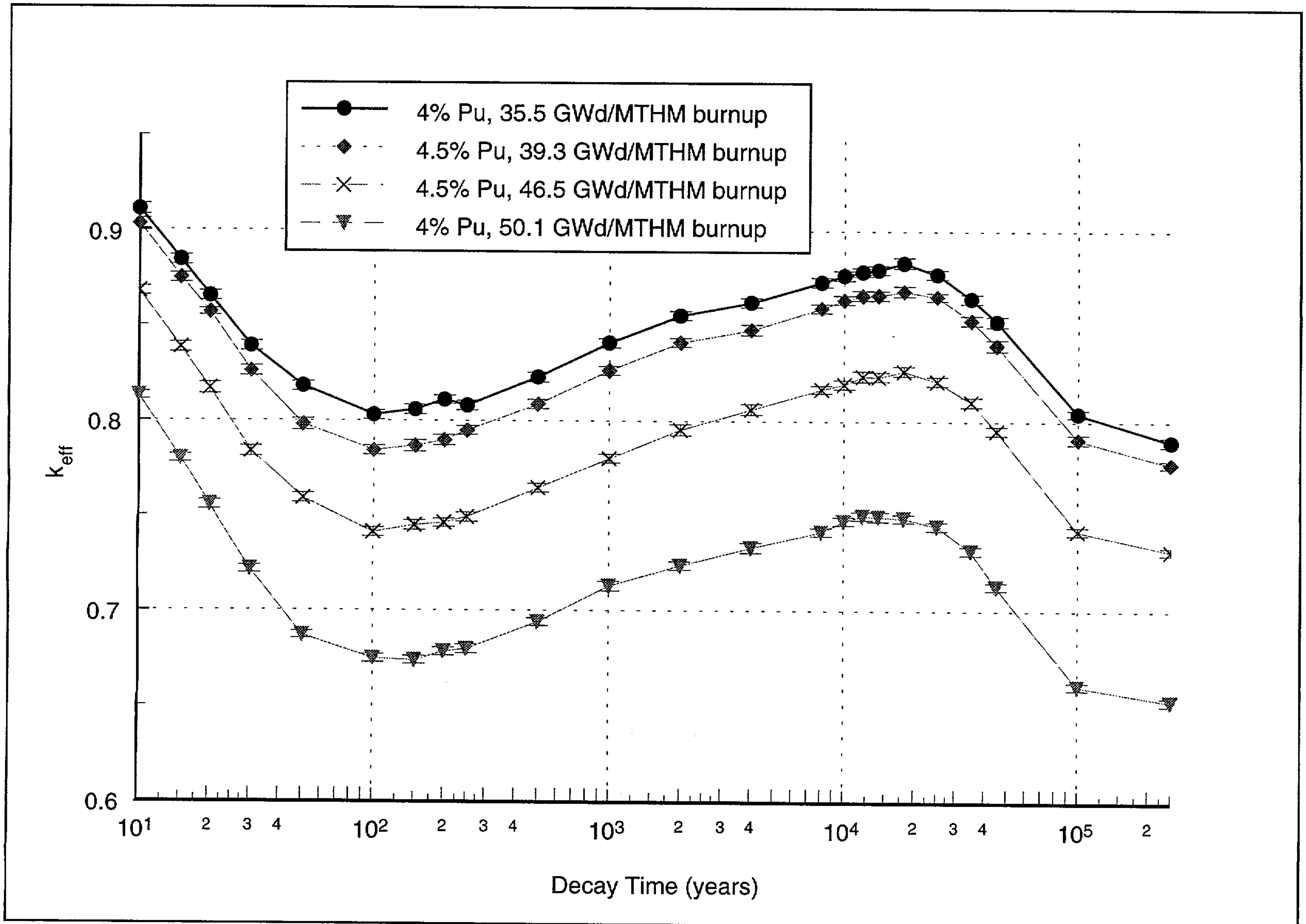

Figure 6.1-3. Time effects on k_{eff} for MOX SNF in a 12 PWR WP with Al shunts

6.2 Intact Fuel with Fully Degraded Basket

Tables 6.2-1 and 6.2-2 list the k_{eff} and average energy of the neutron causing fission (AENCF) results of the MCNP4B2 calculations for different decay times and burnup/Pu enrichment combinations for the 21 PWR WP with intact fuel, a fully degraded basket, and uniform and settled corrosion products, respectively. Tables 6.2-3 and 6.2-4 list the same information for the base 12 PWR WP with intact fuel, a fully degraded basket, and uniform and settled corrosion products, respectively. Figures 6.2-1, 6.2-2, 6.2-3, and 6.2-4 show the plotted k_{eff} results as a function of time for each of the above cases. The time effect behavior is essentially the same as the intact configurations.

As with the intact results presented in Section 6.1, the all of the degraded cases for the 4% Pu, 35.5 GWd/MTHM fuel consistently showed higher k_{eff} values than those for the 4.5% Pu, 39.3 GWd/MTHM fuel. The degraded basket cases for the 21 PWR WP showed increases in k_{eff} over the intact WP for the same fuel and decay time. The 58 vol% settled corrosion product case showed a 6.8% increase in k_{eff} (measured at the post-closure peak for the 4% Pu, 35.5 GWd/MTHM fuel) from the intact configuration, while the uniform corrosion product case showed only 4.1% increase. This increase results from loss of the boron following degradation of the B-SS. However, the increased volume of the corrosion products serves to exclude some moderator from between the rods, thus offsetting some of the effect of the boron loss. The degraded basket cases for the 12 PWR WP actually showed decreases in k_{eff} over the intact WP for the same fuel and decay time. The 58 vol% settled corrosion product case showed a 4.3% decrease in k_{eff} (measured at the post-closure peak for the 4% Pu, 35.5 GWd/MTHM fuel) from the intact configuration, while the uniform corrosion product case showed a 6.8% decrease.

The AENCF was in the range of 0.21 to 0.30 MeV, and genearally peaked at ≈100 years. This slight hardening of the neutron spectrum also results from corrsion products displacing moderator from the fuel region.

The H/X ratios (where X is the sum of the fissile isotopes U-233, U-235, Pu-239, and Pu-241) are calculated in the H/X Ratio worksheet of the Excel 97 spreadsheet MOXoxide.xls. The calculation was performed on a per fuel rod basis.

Table 6.2-1. k_{eff} and AENCF Results for MOX SNF in a 21 PWR WP with a fully degraded basket (no boron remaining) and uniform corrosion product distribution

Time (years)	4.0% Pu, 35.5 GWd/MTHM					4.5% Pu, 39.3 GWd/MTHM				
	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)
10	21MU1N	0.8766	0.0026	187.55	0.2620	21MU2N	0.8736	0.0025	180.47	0.2640
15	21MU1O	0.8543	0.0029	193.05	0.2665	21MU2O	0.8444	0.0025	186.28	0.2719
20	21MU1P	0.8348	0.0025	197.91	0.2740	21MU2P	0.8229	0.0023	191.21	0.2790
30	21MU1Q	0.8142	0.0020	204.77	0.2830	21MU2Q	0.7992	0.0024	198.43	0.2891
50	21MU1R	0.7811	0.0024	212.06	0.2943	21MU2R	0.7687	0.0022	206.41	0.2983
100	21MU1S	0.7707	0.0021	216.41	0.2995	21MU2S	0.7558	0.0025	211.05	0.3035
150	21MU1T	0.7726	0.0023	216.83	0.2963	21MU2T	0.7572	0.0020	211.47	0.3032
200	21MU1U	0.7759	0.0023	216.86	0.2959	21MU2U	0.7614	0.0023	211.51	0.3028
250	21MU1V	0.7821	0.0024	216.86	0.2970	21MU2V	0.7648	0.0024	211.50	0.2992
500	21MU1W	0.7918	0.0025	216.86	0.2896	21MU2W	0.7771	0.0021	211.17	0.2953
1000	21MU1X	0.8076	0.0024	216.63	0.2828	21MU2X	0.7927	0.0029	211.14	0.2871
2000	21MU1Y	0.8190	0.0027	216.26	0.2764	21MU2Y	0.8070	0.0022	210.89	0.2826
4000	21MU1Z	0.8332	0.0025	216.04	0.2684	21MU2Z	0.8171	0.0022	210.35	0.2747
8000	21MU1A	0.8408	0.0026	215.05	0.2622	21MU2A	0.8266	0.0024	209.39	0.2650
10000	21MU1B	0.8399	0.0024	214.86	0.2611	21MU2B	0.8318	0.0024	208.93	0.2622
12000	21MU1C	0.8433	0.0022	214.39	0.2563	21MU2C	0.8353	0.0021	208.75	0.2616
14000	21MU1D	0.8472	0.0026	214.51	0.2546	21MU2D	0.8350	0.0024	208.59	0.2580
18000	21MU1E	0.8486	0.0025	213.91	0.2501	21MU2E	0.8391	0.0025	208.27	0.2543
25000	21MU1F	0.8491	0.0020	213.41	0.2461	21MU2F	0.8386	0.0025	207.79	0.2497
35000	21MU1G	0.8392	0.0023	213.12	0.2421	21MU2G	0.8280	0.0023	207.48	0.2451
45000	21MU1H	0.8264	0.0025	212.94	0.2426	21MU2H	0.8134	0.0023	207.29	0.2431
100000	21MU1I	0.7693	0.0024	212.25	0.2433	21MU2I	0.7579	0.0022	206.47	0.2402
250000	21MU1J	0.7574	0.0019	211.02	0.2390	21MU2J	0.7464	0.0020	205.27	0.2421

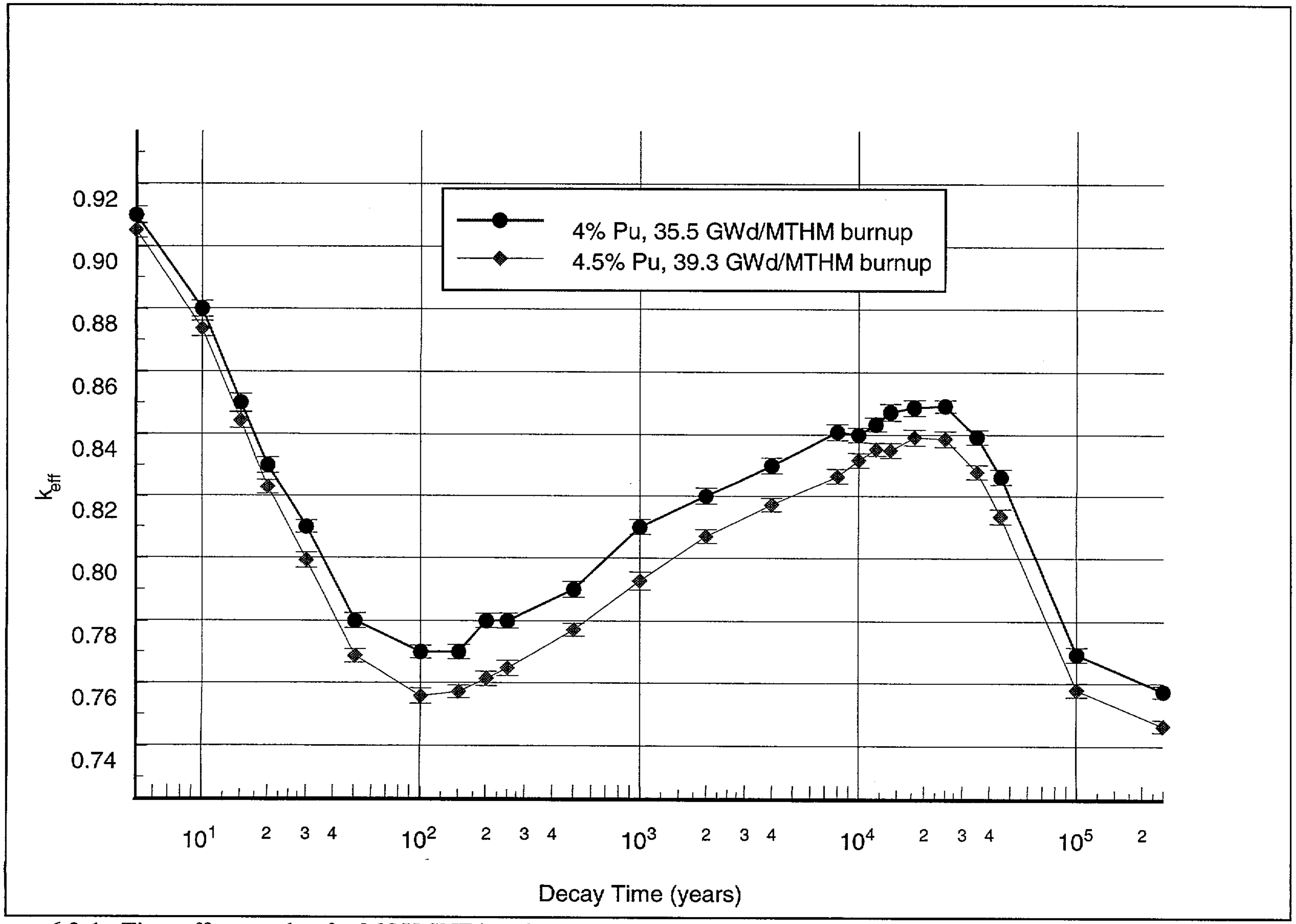

Figure 6.2-1. Time effects on k_{eff} for MOX SNF in a 21 PWR WP with a fully degraded basket (no boron remaining) and uniformly distributed corrosion products.

Table 6.2-2. k_{eff} and AENCF Results for MOX SNF in a 21 PWR WP with a fully degraded basket (no boron remaining) and settled corrosion product distribution

Time (years)	4.0% Pu, 35.5 GWd/MTHM					4.5% Pu, 39.3 GWd/MTHM				
	MCNP Case	k_{eff}	±2σ	H/X*	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)
10	21MS1N	0.8847	0.0019	131.12	0.2465	21MS2N	0.8784	0.0026	126.17	0.2471
15	21MS1O	0.8619	0.0023	134.96	0.2495	21MS2O	0.8499	0.0032	130.23	0.2543
20	21MS1P	0.8418	0.0027	138.36	0.2558	21MS2P	0.8333	0.0029	133.68	0.2590
30	21MS1Q	0.8223	0.0026	143.15	0.2613	21MS2Q	0.8033	0.0030	138.73	0.2706
50	21MS1R	0.7957	0.0024	148.25	0.2700	21MS2R	0.7805	0.0025	144.30	0.2751
100	21MS1S	0.7839	0.0028	151.30	0.2726	21MS2S	0.7676	0.0026	147.55	0.2806
150	21MS1T	0.7869	0.0026	151.59	0.2727	21MS2T	0.7679	0.0027	147.84	0.2789
200	21MS1U	0.7892	0.0025	151.61	0.2730	21MS2U	0.7728	0.0028	147.87	0.2808
250	21MS1V	0.7914	0.0028	151.61	0.2721	21MS2V	0.7727	0.0021	147.86	0.2776
500	21MS1W	0.8050	0.0026	151.61	0.2685	21MS2W	0.7887	0.0028	147.63	0.2711
1000	21MS1X	0.8204	0.0026	151.45	0.2631	21MS2X	0.8038	0.0025	147.61	0.2677
2000	21MS1Y	0.8319	0.0023	151.19	0.2558	21MS2Y	0.8180	0.0028	147.44	0.2604
4000	21MS1Z	0.8423	0.0025	151.04	0.2514	21MS2Z	0.8334	0.0027	147.06	0.2550
8000	21MS1A	0.8545	0.0027	150.34	0.2430	21MS2A	0.8417	0.0027	146.39	0.2453
10000	21MS1B	0.8607	0.0025	150.21	0.2408	21MS2B	0.8472	0.0026	146.07	0.2439
12000	21MS1C	0.8629	0.0029	149.89	0.2356	21MS2C	0.8485	0.0030	145.94	0.2404
14000	21MS1D	0.8624	0.0027	149.97	0.2330	21MS2D	0.8519	0.0023	145.83	0.2393
18000	21MS1E	0.8685	0.0025	149.54	0.2301	21MS2E	0.8555	0.0028	145.61	0.2320
25000	21MS1F	0.8659	0.0029	149.20	0.2237	21MS2F	0.8546	0.0024	145.27	0.2288
35000	21MS1G	0.8606	0.0024	148.99	0.2222	21MS2G	0.8477	0.0024	145.05	0.2250
45000	21MS1H	0.8450	0.0024	148.87	0.2196	21MS2H	0.8340	0.0023	144.92	0.2239
100000	21MS1I	0.7963	0.0022	148.39	0.2129	21MS2I	0.7884	0.0021	144.35	0.2159
250000	21MS1J	0.7888	0.0025	147.52	0.2130	21MS2J	0.7743	0.0023	143.51	0.2116

* H/X calculated for rods in 58% corrosion product/water mixture. H/X for rods above corrosion product level same as for intact 21 PWR WP cases.

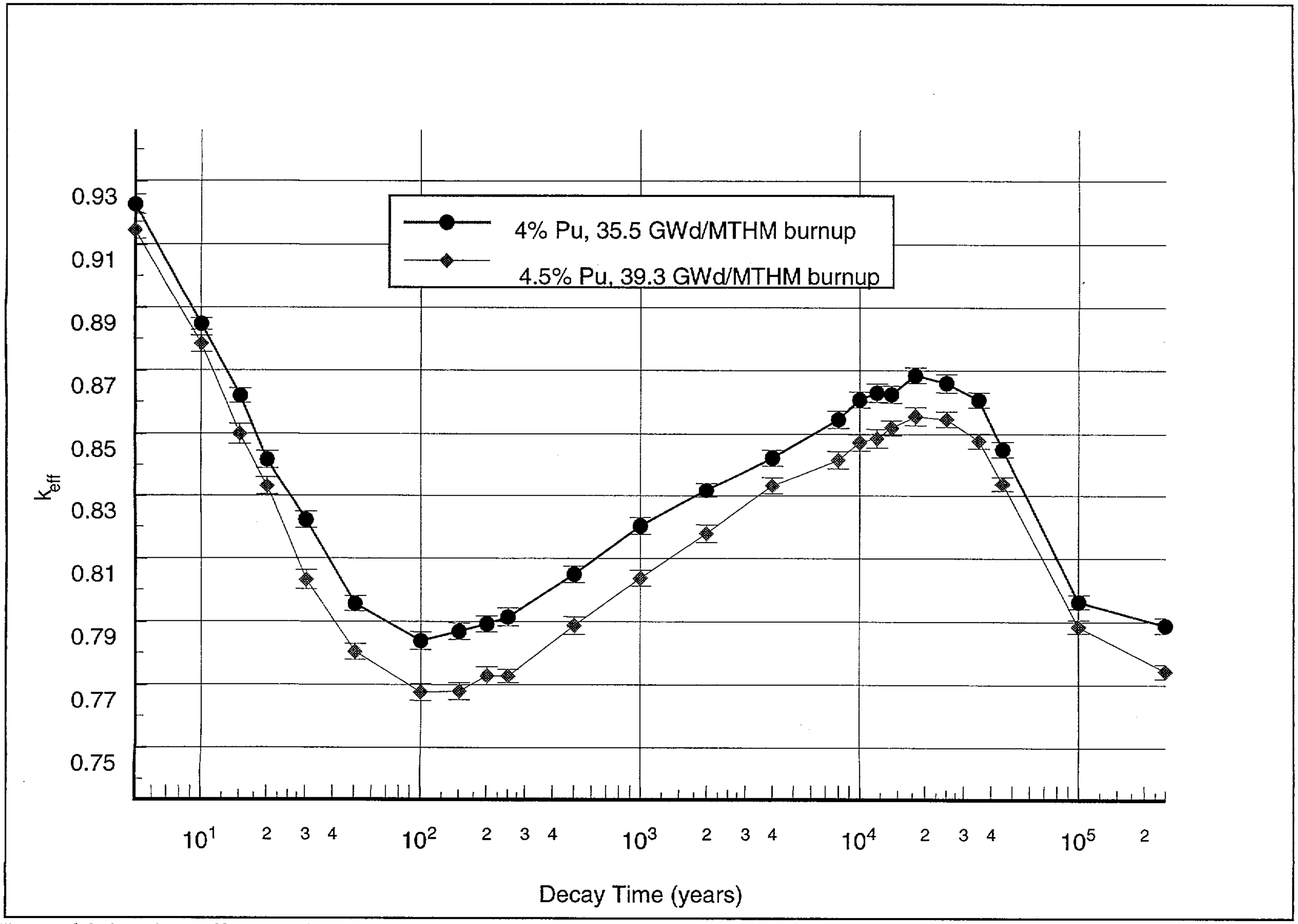

Figure 6.2-2. Time effects on k_{eff} for MOX SNF in a 21 PWR WP with a fully degraded basket (no boron remaining) and settled corrosion products.

Table 6.2-3. k_{eff} and AENCF Results for MOX SNF in a 12 PWR WP with a fully degraded basket (no boron remaining) and uniformly distributed corrosion products

Time (years)	4.0% Pu, 35.5 GWd/MTHM					4.5% Pu, 39.3 GWd/MTHM				
	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)
10	12MU1N	0.8414	0.0022	180.97	0.2606	12MU2N	0.8356	0.0027	174.14	0.2599
15	12MU1O	0.8178	0.0029	186.28	0.2666	12MU2O	0.8103	0.0028	179.75	0.2748
20	12MU1P	0.8002	0.0021	190.97	0.2739	12MU2P	0.7913	0.0026	184.50	0.2779
30	12MU1Q	0.7724	0.0023	197.58	0.2830	12MU2Q	0.7633	0.0027	191.47	0.2874
50	12MU1R	0.7501	0.0027	204.62	0.2919	12MU2R	0.7363	0.0024	199.17	0.2979
100	12MU1S	0.7420	0.0025	208.82	0.2970	12MU2S	0.7241	0.0020	203.65	0.3041
150	12MU1T	0.7399	0.0023	209.23	0.2996	12MU2T	0.7279	0.0022	204.06	0.3046
200	12MU1U	0.7425	0.0029	209.26	0.2928	12MU2U	0.7276	0.0024	204.09	0.3014
250	12MU1V	0.7463	0.0020	209.26	0.2920	12MU2V	0.7327	0.0025	204.09	0.2973
500	12MU1W	0.7547	0.0024	209.26	0.2918	12MU2W	0.7453	0.0025	203.76	0.2973
1000	12MU1X	0.7722	0.0022	209.03	0.2853	12MU2X	0.7608	0.0027	203.74	0.2885
2000	12MU1Y	0.7846	0.0024	208.67	0.2771	12MU2Y	0.7720	0.0021	203.50	0.2800
4000	12MU1Z	0.7936	0.0023	208.46	0.2696	12MU2Z	0.7806	0.0022	202.97	0.2754
8000	12MU1A	0.8007	0.0021	207.51	0.2624	12MU2A	0.7905	0.0023	202.05	0.2671
10000	12MU1B	0.8018	0.0023	207.33	0.2609	12MU2B	0.7940	0.0026	201.60	0.2629
12000	12MU1C	0.8057	0.0022	206.87	0.2597	12MU2C	0.7942	0.0023	201.43	0.2609
14000	12MU1D	0.8058	0.0024	206.99	0.2589	12MU2D	0.7974	0.0022	201.27	0.2597
18000	12MU1E	0.8077	0.0021	206.40	0.2508	12MU2E	0.7968	0.0026	200.97	0.2564
25000	12MU1F	0.8062	0.0024	205.93	0.2455	12MU2F	0.7942	0.0023	200.50	0.2507
35000	12MU1G	0.7977	0.0021	205.65	0.2435	12MU2G	0.7875	0.0021	200.20	0.2465
45000	12MU1H	0.7837	0.0026	205.47	0.2428	12MU2H	0.7729	0.0020	200.01	0.2432
100000	12MU1I	0.7299	0.0019	204.81	0.2409	12MU2I	0.7234	0.0022	199.23	0.2436
250000	12MU1J	0.7193	0.0021	203.62	0.2390	12MU2J	0.7122	0.0020	198.07	0.2423

Table 6.2-3. k_{eff} and AENCF Results for MOX SNF in a 12 PWR WP with a fully degraded basket (no boron remaining) and uniformly distributed corrosion products (Cont.)

Time (years)	4.5% Pu, 46.5 GWd/MTHM					4.0% Pu, 50.1 GWd/MTHM				
	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)
10	12MU3N	0.8018	0.0023	189.46	0.2725	12MU4N	0.7494	0.0023	238.74	0.2858
15	12MU3O	0.7766	0.0026	196.37	0.2811	12MU4O	0.7176	0.0023	249.09	0.2996
20	12MU3P	0.7552	0.0023	202.45	0.2890	12MU4P	0.6942	0.0021	257.84	0.3081
30	12MU3Q	0.7262	0.0027	211.36	0.3001	12MU4Q	0.6645	0.0021	271.09	0.3237
50	12MU3R	0.6951	0.0020	221.34	0.3141	12MU4R	0.6325	0.0017	286.31	0.3381
100	12MU3S	0.6826	0.0021	226.92	0.3196	12MU4S	0.6184	0.0018	294.91	0.3470
150	12MU3T	0.6834	0.0025	227.49	0.3170	12MU4T	0.6212	0.0019	295.91	0.3510
200	12MU3U	0.6841	0.0027	227.56	0.3181	12MU4U	0.6239	0.0018	295.58	0.3448
250	12MU3V	0.6898	0.0027	227.60	0.3163	12MU4V	0.6261	0.0020	295.75	0.3443
500	12MU3W	0.7014	0.0024	227.40	0.3125	12MU4W	0.6347	0.0019	295.43	0.3382
1000	12MU3X	0.7186	0.0025	227.01	0.2999	12MU4X	0.6498	0.0022	294.90	0.3263
2000	12MU3Y	0.7330	0.0021	226.72	0.2932	12MU4Y	0.6629	0.0021	293.89	0.3183
4000	12MU3Z	0.7384	0.0023	225.58	0.2922	12MU4Z	0.6697	0.0022	291.95	0.3136
8000	12MU3A	0.7476	0.0022	224.48	0.2800	12MU4A	0.6770	0.0024	289.11	0.3058
10000	12MU3B	0.7514	0.0028	223.62	0.2773	12MU4B	0.6819	0.0021	287.76	0.3047
12000	12MU3C	0.7512	0.0022	223.42	0.2758	12MU4C	0.6812	0.0019	286.96	0.3004
14000	12MU3D	0.7545	0.0021	223.23	0.2693	12MU4D	0.6817	0.0020	286.17	0.3000
18000	12MU3E	0.7561	0.0023	222.23	0.2687	12MU4E	0.6822	0.0019	285.17	0.2915
25000	12MU3F	0.7501	0.0024	221.69	0.2640	12MU4F	0.6789	0.0020	283.39	0.2891
35000	12MU3G	0.7414	0.0021	221.37	0.2585	12MU4G	0.6662	0.0022	282.51	0.2844
45000	12MU3H	0.7295	0.0023	220.83	0.2572	12MU4H	0.6506	0.0018	282.31	0.2859
100000	12MU3I	0.6776	0.0018	219.79	0.2607	12MU4I	0.6007	0.0017	280.56	0.2891
250000	12MU3J	0.6649	0.0020	218.10	0.2566	12MU4J	0.5903	0.0015	278.12	0.2876

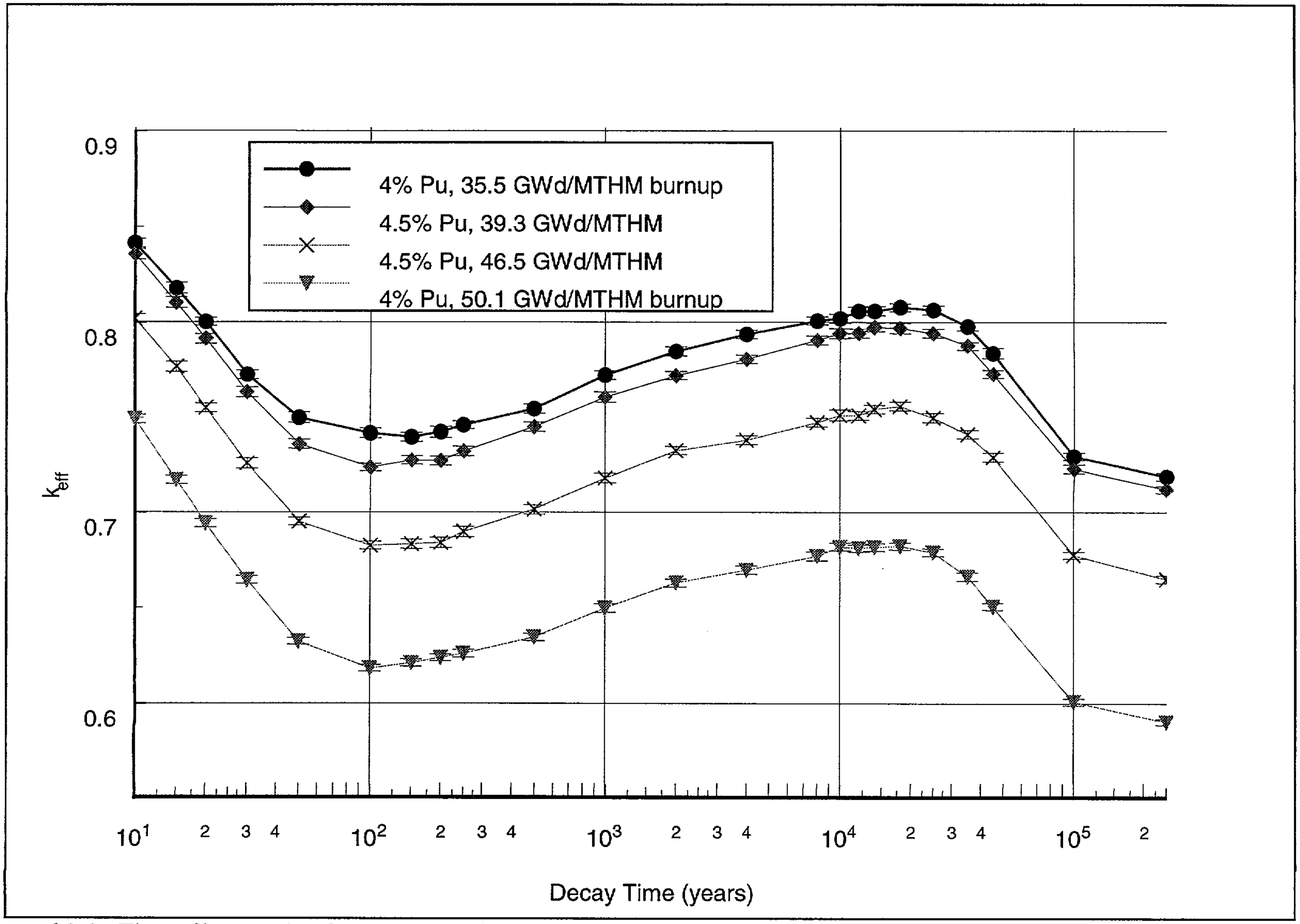

Figure 6.2-3. Time effects on k_{eff} for MOX SNF in a 12 PWR WP with a fully degraded basket (no boron remaining) and uniformly distributed corrosion products.

Table 6.2-4. k_{eff} and AENCF Results for MOX SNF in a 12 PWR WP with a fully degraded basket (no boron remaining) and settled corrosion product distribution

Time (years)	4.0% Pu, 35.5 GWd/MTHM					4.5% Pu, 39.3 GWd/MTHM				
	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)
10	12MS1N	0.8463	0.0029	123.38	0.2420	12MS2N	0.8434	0.0025	118.72	0.2427
15	12MS1O	0.8257	0.0026	127.00	0.2501	12MS2O	0.8169	0.0024	122.55	0.2552
20	12MS1P	0.8084	0.0026	130.20	0.2567	12MS2P	0.7961	0.0029	125.79	0.2591
30	12MS1Q	0.7823	0.0020	134.71	0.2634	12MS2Q	0.7709	0.0027	130.54	0.2702
50	12MS1R	0.7605	0.0023	139.51	0.2717	12MS2R	0.7478	0.0029	135.79	0.2753
100	12MS1S	0.7513	0.0026	142.37	0.2762	12MS2S	0.7363	0.0022	138.84	0.2834
150	12MS1T	0.7519	0.0026	142.65	0.2742	12MS2T	0.7328	0.0023	139.12	0.2844
200	12MS1U	0.7540	0.0029	142.67	0.2742	12MS2U	0.7378	0.0024	139.14	0.2814
250	12MS1V	0.7560	0.0025	142.67	0.2720	12MS2V	0.7443	0.0025	139.14	0.2767
500	12MS1W	0.7700	0.0025	142.67	0.2666	12MS2W	0.7503	0.0021	138.92	0.2745
1000	12MS1X	0.7889	0.0026	142.52	0.2608	12MS2X	0.7712	0.0020	138.90	0.2639
2000	12MS1Y	0.7984	0.0024	142.27	0.2529	12MS2Y	0.7817	0.0025	138.74	0.2621
4000	12MS1Z	0.8055	0.0026	142.13	0.2508	12MS2Z	0.7951	0.0029	138.38	0.2533
8000	12MS1A	0.8183	0.0027	141.47	0.2407	12MS2A	0.8059	0.0024	137.75	0.2442
10000	12MS1B	0.8205	0.0025	141.35	0.2372	12MS2B	0.8088	0.0023	137.45	0.2434
12000	12MS1C	0.8220	0.0026	141.04	0.2351	12MS2C	0.8097	0.0029	137.33	0.2416
14000	12MS1D	0.8250	0.0029	141.12	0.2357	12MS2D	0.8136	0.0022	137.22	0.2360
18000	12MS1E	0.8290	0.0024	140.72	0.2306	12MS2E	0.8119	0.0028	137.02	0.2370
25000	12MS1F	0.8262	0.0028	140.40	0.2251	12MS2F	0.8122	0.0021	136.69	0.2274
35000	12MS1G	0.8175	0.0026	140.20	0.2221	12MS2G	0.8027	0.0026	136.50	0.2218
45000	12MS1H	0.8065	0.0024	140.08	0.2212	12MS2H	0.7910	0.0024	136.37	0.2245
100000	12MS1I	0.7575	0.0023	139.63	0.2158	12MS2I	0.7457	0.0021	135.83	0.2196
250000	12MS1J	0.7495	0.0024	138.82	0.2114	12MS2J	0.7362	0.0021	135.04	0.2157

Table 6.2-4. k_{eff} and AENCF Results for MOX SNF in a 12 PWR WP with a fully degraded basket (no boron remaining) and settled corrosion product distribution (Cont.)

Time (years)	4.5% Pu, 46.5 GWd/MTHM					4.0% Pu, 50.1 GWd/MTHM				
	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	H/X	AENCF (MeV)
10	12MS3N	0.8095	0.0022	129.17	0.2547	12MS4N	0.7596	0.0024	162.76	0.2652
15	12MS3O	0.7869	0.0026	133.88	0.2597	12MS4O	0.7300	0.0030	169.83	0.2735
20	12MS3P	0.7620	0.0022	138.03	0.2676	12MS4P	0.7086	0.0026	175.79	0.2834
30	12MS3Q	0.7342	0.0025	144.10	0.2799	12MS4Q	0.6777	0.0022	184.83	0.2973
50	12MS3R	0.7031	0.0025	150.90	0.2905	12MS4R	0.6441	0.0023	195.20	0.3124
100	12MS3S	0.6919	0.0024	154.71	0.2952	12MS4S	0.6279	0.0024	201.07	0.3193
150	12MS3T	0.6943	0.0027	155.10	0.2977	12MS4T	0.6317	0.0022	201.74	0.3176
200	12MS3U	0.6947	0.0025	155.15	0.2956	12MS4U	0.6328	0.0023	201.52	0.3198
250	12MS3V	0.6978	0.0026	155.17	0.2917	12MS4V	0.6388	0.0024	201.63	0.3163
500	12MS3W	0.7128	0.0023	155.04	0.2887	12MS4W	0.6494	0.0020	201.42	0.3075
1000	12MS3X	0.7318	0.0022	154.77	0.2760	12MS4X	0.6654	0.0022	201.05	0.3013
2000	12MS3Y	0.7406	0.0028	154.57	0.2756	12MS4Y	0.6779	0.0020	200.37	0.2949
4000	12MS3Z	0.7545	0.0027	153.80	0.2661	12MS4Z	0.6891	0.0023	199.05	0.2853
8000	12MS3A	0.7648	0.0030	153.04	0.2590	12MS4A	0.7000	0.0025	197.11	0.2738
10000	12MS3B	0.7681	0.0024	152.46	0.2520	12MS4B	0.7019	0.0021	196.19	0.2727
12000	12MS3C	0.7694	0.0026	152.32	0.2514	12MS4C	0.7041	0.0024	195.64	0.2732
14000	12MS3D	0.7693	0.0026	152.20	0.2493	12MS4D	0.7054	0.0020	195.11	0.2687
18000	12MS3E	0.7735	0.0024	151.51	0.2465	12MS4E	0.7044	0.0025	194.42	0.2618
25000	12MS3F	0.7714	0.0022	151.14	0.2397	12MS4F	0.7018	0.0020	193.21	0.2588
35000	12MS3G	0.7633	0.0020	150.92	0.2330	12MS4G	0.6875	0.0024	192.61	0.2561
45000	12MS3H	0.7529	0.0022	150.56	0.2316	12MS4H	0.6752	0.0021	192.48	0.2560
100000	12MS3I	0.7018	0.0021	149.85	0.2328	12MS4I	0.6267	0.0019	191.28	0.2568
250000	12MS3J	0.6906	0.0024	148.70	0.2319	12MS4J	0.6210	0.0021	189.62	0.2519

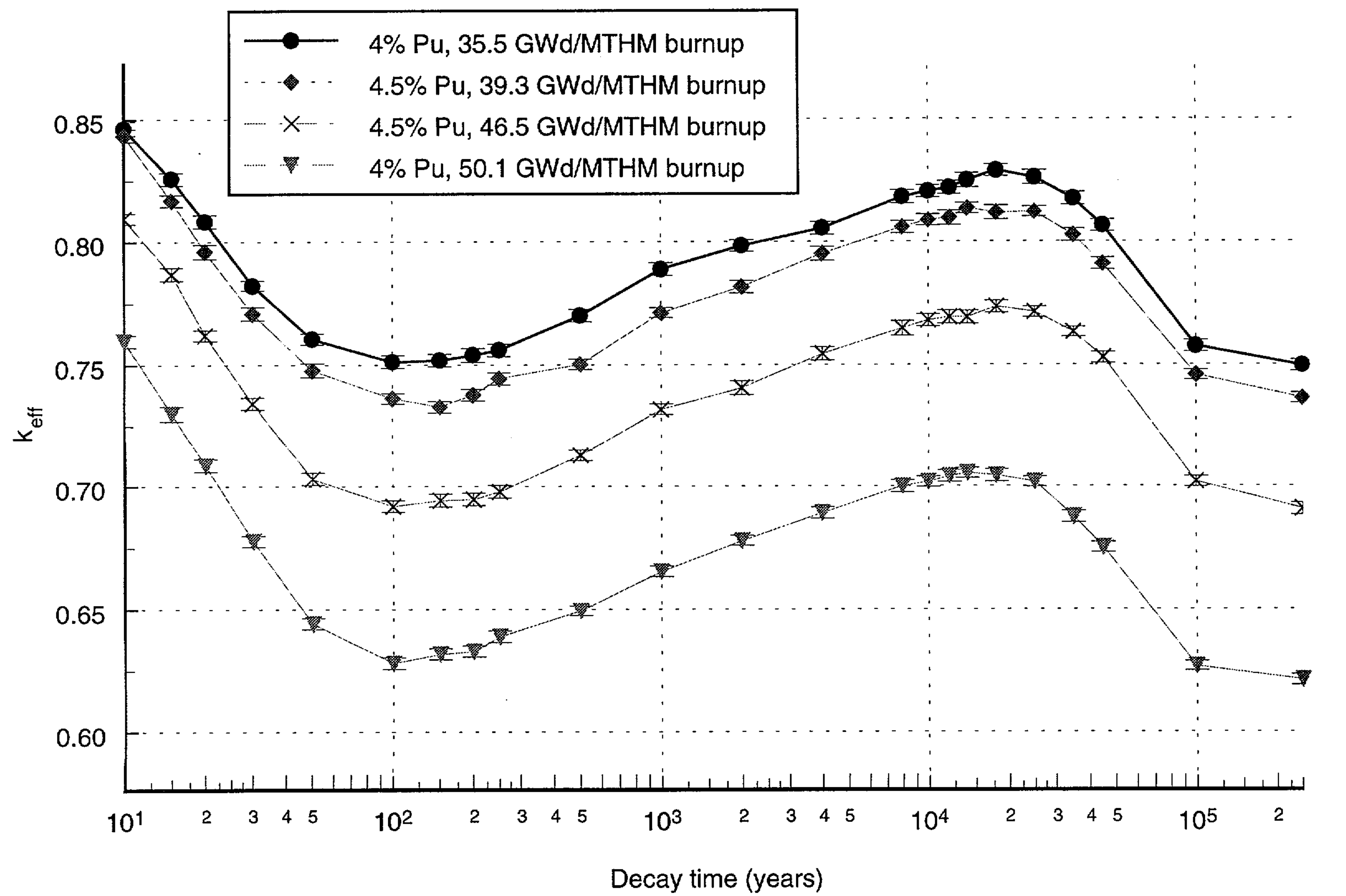

Figure 6.2-4. Time effects on k_{eff} for MOX SNF in a 12 PWR WP with a fully degraded basket (no boron remaining) and settled corrosion products

6.3 Degraded Fuel and Basket

Table 6.3-1 presents the k_{eff} and AENCF results of the MCNP4B2 calculations for different decay times and degrees of fuel degradation (as defined in Section 5.1.5) for the 21 PWR WP with a fully degraded basket, collapse fuel rods, and a uniform corrosion product distribution. Figure 6.3-1 shows a plot of these k_{eff} results as a function of time. All values in this table are for a rod center-to-center spacing of 0.9144 cm (rods touching in square lattice). As expected loss of all but the U and Pu principal isotopes results in a 24% increase in k_{eff} (0.12 Δk) over the full principal isotope case at the time of peak k_{eff}. However, a more realistic degradation (based on the information in Section 5.1.5) assumed to start at 10,000 years shows only a 15% increase in k_{eff} (0.08 Δk). Also of interest is the reduced peak-and-valley effect with time, and the movement of the peak k_{eff} out to ≈45,000 years. Both effects result from increased resonance absorption due to the harder spectrum of this configuration (as is evident by comparing the AENCF values to the other configurations evaluated). The location of the peak shifts outward in time because the increased absorption in Pu-240 in a harder spectrum is not matched by an equal increase in Pu-239 fission. Thus, longer decay times are required to eliminate the absorption effect from Pu-240.

Table 6.3-2 shows the results of the 18,000 and 45,000 year cases run for various fuel rod spacing, up to the original pitch of 1.2598 cm. As expected, the optimum point of moderation occurs at the original assembly pitch. However, the k_{eff} values only exceed those of the 21 PWR WP in Configuration D with settled oxide (see Section 6.2) under the combination of conservative isotopic degradation (U and Pu principal isotopes only) and rod spacing within ≈1 mm of the original pitch. This is not a likely situation, as the original rod geometry (much less the spacing) would not be expected to be maintained at such a degree of fuel degradation. Figure 6.3-2 shows a plot of these k_{eff} values at the two decay times. Table 6.3-3 and Figure 6.3-3 show the results of the time and degradation effects on k_{eff} analysis perfomed for the 1.26 cm rod spacing. Note also the shifting of the peak back to earlier times with the increasing rod pitch (and associated reduction in AENCF), which confirms the above discussion on this subject.

Table 6.3-4 and Figure 6.3-4 show the k_{eff} results for the fully degraded fuel and basket configuration (Configuration F). As expected, this configuration shows lower k_{eff} values than Configuration D with settled oxide (see Section 6.2). The time effect behavior is essentially the same as the intact and degraded configurations, as would be expected based on the AENCF.

The H/X ratios (where X is the sum of the fissile isotopes U-233, U-235, Pu-239, and Pu-241) are calculated in the H/X Ratio worksheet of the Excel 97 spreadsheet MOXoxide.xls. The calculation was performed on a per fuel rod basis.

Table 6.3-1. Time and fuel degradation effects on k_{eff} for 21 PWR WP with a fully degraded basket, minimally spaced (0.9144 cm) collapsed rods, and uniformly distributed corrosion products

Decay Time (years)	H/X	No Fuel Degradation Full PI			Fuel Deg. Starting at 10k years			U & Pu PIs Only		
		MCNP Case	k_{eff}±2σ	AENCF (MeV)	MCNP Case	k_{eff}±2σ	AENCF (MeV)	MCNP Case	k_{eff}±2σ	AENCF (MeV)
1000	47.27	21MP1X	0.5133±0.0021	0.9105	N/A	N/A	N/A	21MP1NX	0.5970±0.0024	0.7710
2000	47.19	21MP1Y	0.5178±0.0023	0.8899	N/A	N/A	N/A	21MP1NY	0.6008±0.0025	0.7623
4000	47.14	21MP1Z	0.5222±0.0021	0.8787	N/A	N/A	N/A	21MP1NZ	0.6058±0.0020	0.7468
8000	46.92	21MP1A	0.5308±0.0022	0.8509	N/A	N/A	N/A	21MP1NA	0.6205±0.0022	0.7230
10000	46.88	21MP1B	0.5308±0.0022	0.8394	N/A	N/A	N/A	21MP1NB	0.6253±0.0020	0.7131
12000	46.78	21MP1C	0.5316±0.0021	0.8362	21MP1DC	0.5470±0.0022	0.8159	21MP1NC	0.6302±0.0023	0.7083
14000	46.80	21MP1D	0.5356±0.0021	0.8268	21MP1DD	0.5590±0.0022	0.7923	21MP1ND	0.6350±0.0026	0.6954
18000	46.67	21MP1E	0.5395±0.0024	0.8130	21MP1DE	0.5796±0.0022	0.7495	21MP1NE	0.6442±0.0027	0.6706
25000	46.57	21MP1F	0.5444±0.0021	0.7915	21MP1DF	0.6162±0.0022	0.6908	21MP1NF	0.6581±0.0024	0.6478
35000	46.50	21MP1G	0.5454±0.0016	0.7755	21MP1DG	0.6233±0.0021	0.6691	21MP1NG	0.6700±0.0024	0.6273
45000	46.46	21MP1H	0.5452±0.0019	0.7625	21MP1DH	0.6264±0.0022	0.6489	21MP1NH	0.6748±0.0024	0.6070
100000	46.31	21MP1I	0.5245±0.0020	0.7466	21MP1DI	0.6077±0.0018	0.6167	21MP1NI	0.6671±0.0023	0.5745
250000	46.04	21MP1J	0.5196±0.0020	0.7326	21MP1DJ	0.5996±0.0021	0.5801	21MP1NJ	0.6624±0.0023	0.5688

Table 6.3-2. Effect of collapsed rod spacing at time of peak k_{eff}

Decay Time	Lattice Pitch (cm)	H/X	Full Principal Isotope Inventory				Uranium and Plutonium PIs Only			
			MCNP Case	k_{eff}	±2σ	AENCF (MeV)	MCNP Case	k_{eff}	±2σ	AENCF (MeV)
18,000 years	0.9144	46.67	21MP1E	0.5395	0.0024	0.8130	21MP1NE	0.6442	0.0027	0.6706
	1.0	83.16	MP1E1	0.6362	0.0023	0.5879	MP1NE1	0.7725	0.0026	0.4768
	1.1	129.92	MP1E11	0.7266	0.0027	0.4313	MP1NE11	0.8775	0.0029	0.3529
	1.2	181.13	MP1E12	0.7840	0.0022	0.3371	MP1NE12	0.9325	0.0025	0.2814
	1.26	213.91	MP1E13	0.8051	0.0026	0.2989	MP1NE13	0.9532	0.0025	0.2512
45,000 years	0.9144	46.46	21MP1H	0.5452	0.0019	0.7625	21MP1NH	0.6748	0.0024	0.6070
	1.0	82.78	MP1H1	0.6446	0.0022	0.5411	MP1NH1	0.8103	0.0023	0.4318
	1.1	129.33	MP1H11	0.7255	0.0021	0.3984	MP1NH11	0.9012	0.0024	0.3196
	1.2	180.31	MP1H12	0.7736	0.0025	0.3215	MP1NH12	0.9486	0.0028	0.2566
	1.26	212.94	MP1H13	0.7892	0.0024	0.2838	MP1NH13	0.9620	0.0026	0.2305

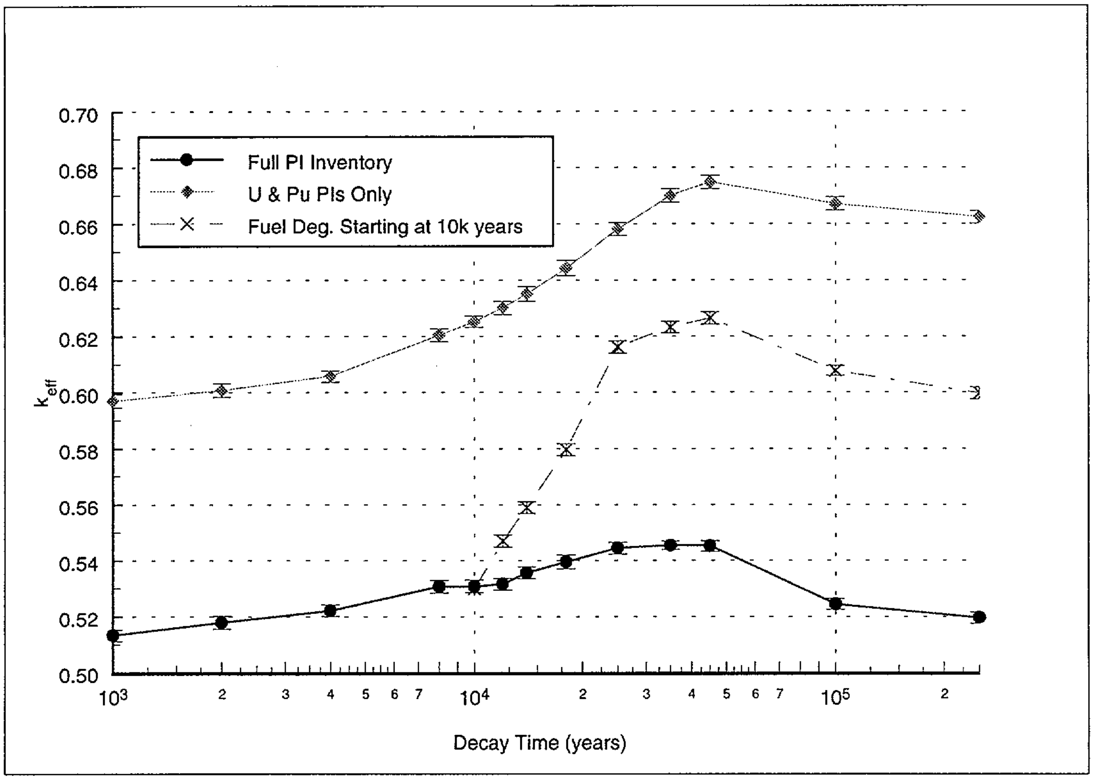

Figure 6.3-1. Time and fuel degradation effects on k_{eff} for 21 PWR WP with a fully degraded basket, minimally spaced (0.9144 cm) collapsed rods, and uniformly distributed corrosion products

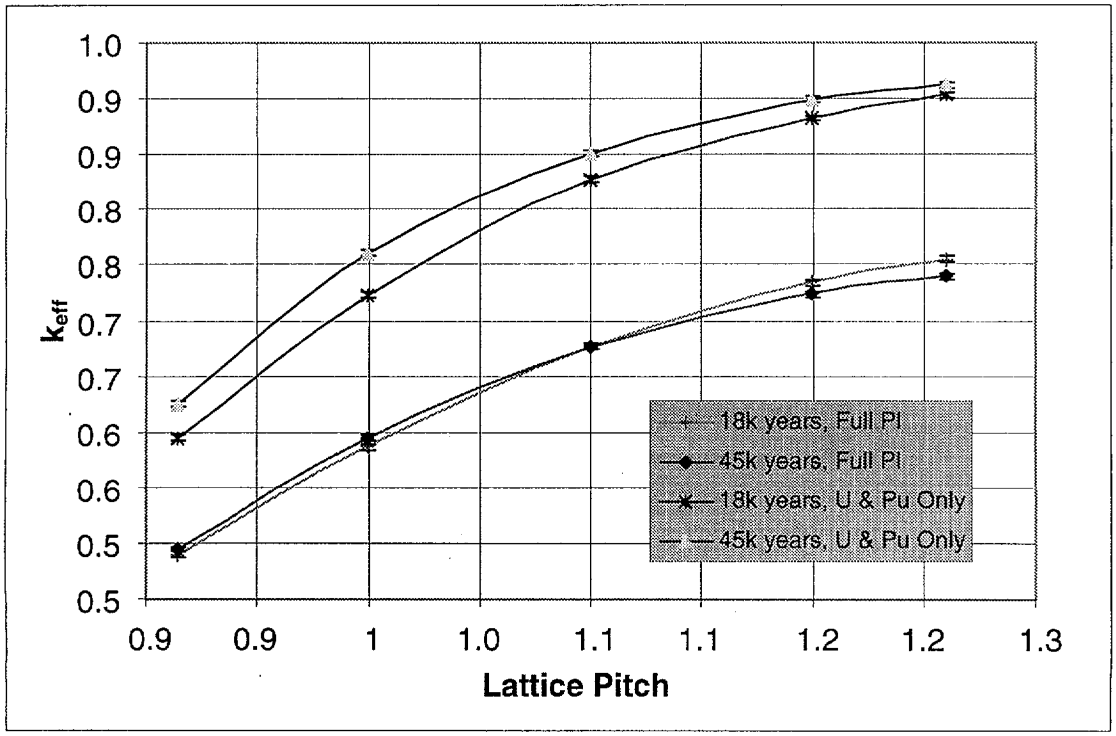

Figure 6.3-2. Effect of collapsed rod spacing on k_{eff} for 18k and 45k year cases.

Table 6.3-3. Time and fuel degradation effects on k_{eff} for 21 PWR WP with a fully degraded basket, maximally spaced (1.26 cm) collapsed rods, and uniformly distributed corrosion products

Decay Time (years)	H/X	No Fuel Degradation Full PI				Fuel Deg. Starting at 10k years				U & Pu PIs Only			
		MCNP Case	k_{eff}	$\pm 2\sigma$	AENCF (MeV)	MCNP Case	k_{eff}	$\pm 2\sigma$	AENCF (MeV)	MCNP Case	k_{eff}	$\pm 2\sigma$	AENCF (MeV)
1000	216.63	MP13F1X	0.7559	0.0022	0.3428	N/A	N/A	N/A	N/A	MP13N1X	0.8921	0.0027	0.2862
2000	216.26	MP13F1Y	0.7739	0.0024	0.3327	N/A	N/A	N/A	N/A	MP13N1Y	0.8979	0.0025	0.2868
4000	216.04	MP13F1Z	0.7829	0.0026	0.3256	N/A	N/A	N/A	N/A	MP13N1Z	0.9071	0.0027	0.2780
8000	215.05	MP13F1A	0.7924	0.0025	0.3182	N/A	N/A	N/A	N/A	MP13N1A	0.9285	0.0029	0.2663
10000	214.86	MP13F1B	0.7969	0.0023	0.3103	N/A	N/A	N/A	N/A	MP13N1B	0.9344	0.0026	0.2639
12000	214.39	MP13F1C	0.7991	0.0022	0.3119	MP13D1C	0.8246	0.0022	0.2984	MP13N1C	0.9430	0.0028	0.2592
14000	214.51	MP13F1D	0.8027	0.0028	0.3059	MP13D1D	0.8370	0.0022	0.2914	MP13N1D	0.9466	0.0025	0.2574
18000	213.91	MP1E13	0.8051	0.0026	0.2989	MP13D1E	0.8725	0.0024	0.2753	MP1NE13	0.9532	0.0025	0.2512
25000	213.41	MP13F1F	0.8076	0.0031	0.2913	MP13D1F	0.9108	0.0025	0.2580	MP13N1F	0.9698	0.0025	0.2414
35000	213.12	MP13F1G	0.8025	0.0020	0.2864	MP13D1G	0.9131	0.0024	0.2478	MP13N1G	0.9687	0.0026	0.2339
45000	212.94	MP1H13	0.7892	0.0024	0.2838	MP13D1H	0.9057	0.0023	0.2442	MP1NH13	0.9620	0.0026	0.2305
100000	212.25	MP13F1I	0.7410	0.0020	0.2835	MP13D1I	0.8530	0.0021	0.2340	MP13N1I	0.9235	0.0024	0.2240
250000	211.02	MP13F1J	0.7271	0.0021	0.2806	MP13D1J	0.8224	0.0022	0.2204	MP13N1J	0.9049	0.0024	0.2239

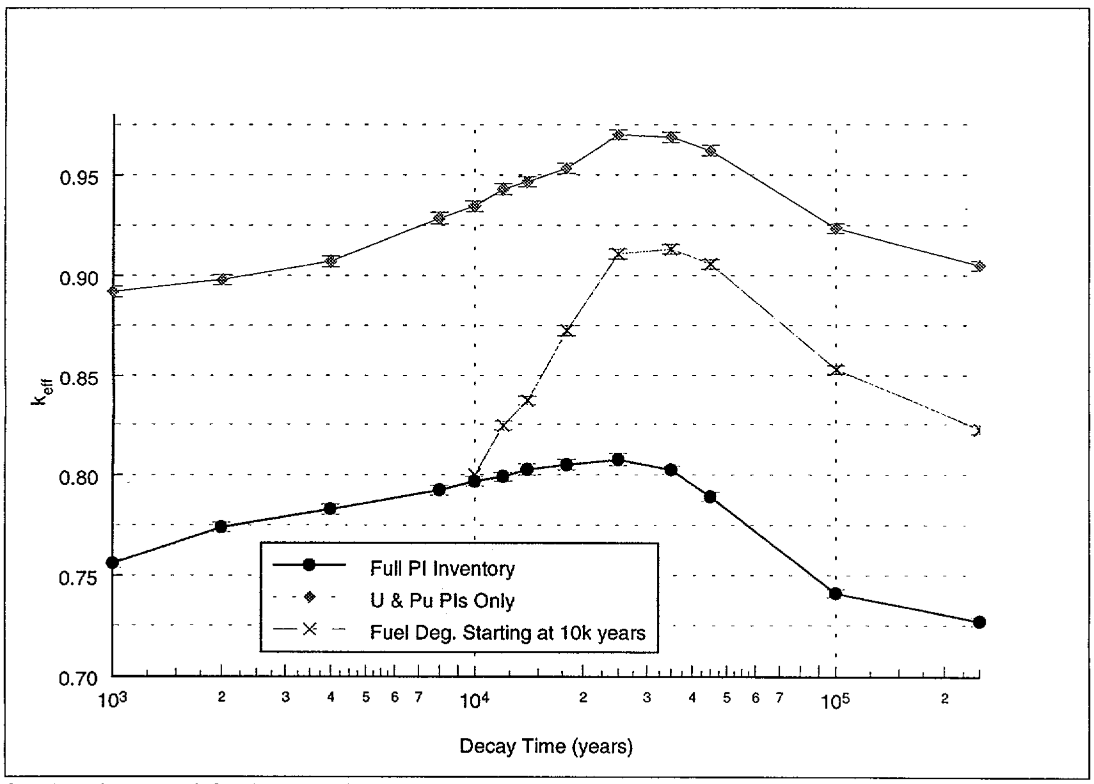

Figure 6.3-3. Time and fuel degradation effects on k_{eff} for 21 PWR WP with a fully degraded basket, maximally spaced (1.26 cm) collapsed rods, and uniformly distributed corrosion products

Table 6.3-4. Time and fuel degradation effects on k_{eff} for a 21 PWR WP with fully degraded basket and fuel uniformly distributed

Time (years)	H/X	4.0% Pu, 35.5 GWd/MTHM U & Pu PIs Only			
		MCNP Case	k_{eff}	$\pm 2\sigma$	AENCF (MeV)
1000	600.48	21FU1NX	0.80795	0.0022	0.1371
2000	599.44	21FU1NY	0.81186	0.0021	0.1354
4000	598.84	21FU1NZ	0.82137	0.00226	0.1332
8000	596.10	21FU1NA	0.83741	0.00188	0.1284
10000	595.57	21FU1NB	0.83874	0.00212	0.1264
12000	594.28	21FU1NC	0.84371	0.00204	0.1254
14000	594.61	21FU1ND	0.84418	0.0022	0.1234
18000	592.92	21FU1NE	0.8437	0.00178	0.1222
25000	591.56	21FU1NF	0.84022	0.00188	0.1207
35000	590.75	21FU1NG	0.82021	0.0016	0.1188
45000	590.24	21FU1NH	0.80348	0.00178	0.1183
100000	588.34	21FU1NI	0.73886	0.00208	0.1196
250000	584.92	21FU1NJ	0.72158	0.00166	0.1185

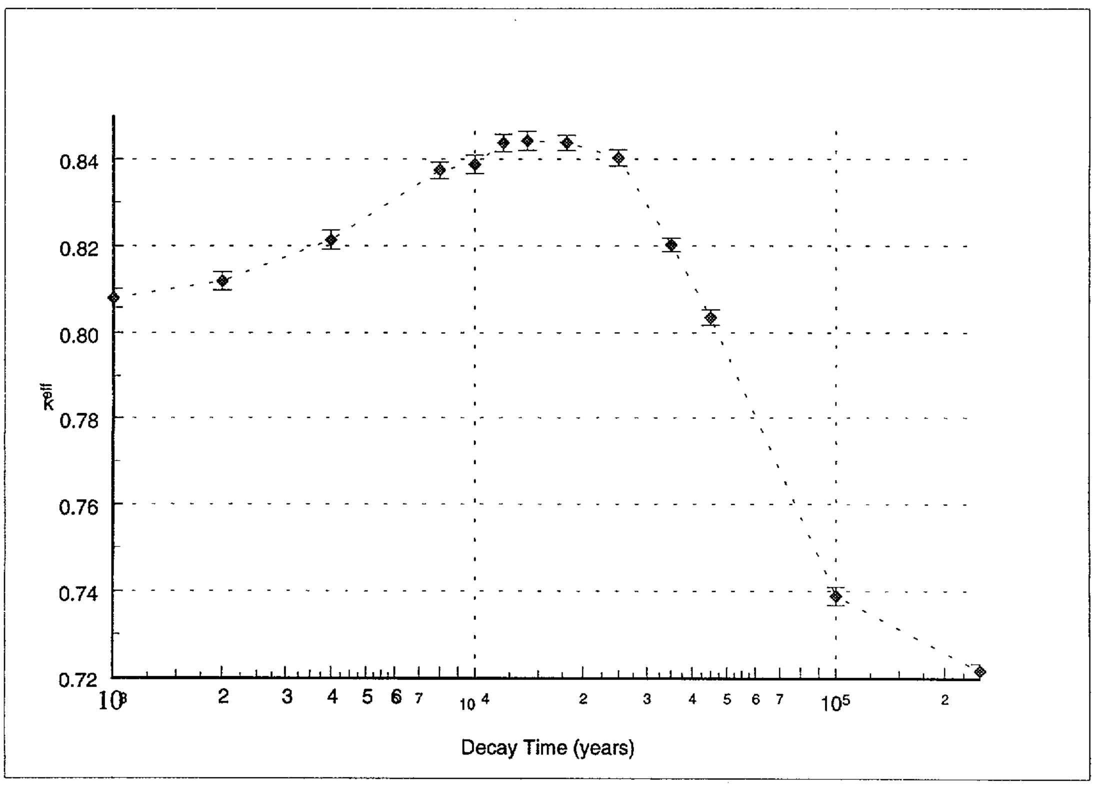

Figure 6.3-4. Time and fuel degradation effects on k_{eff} for a 21 PWR WP with fully degraded basket and fuel uniformly distributed

7. REFERENCES

7.1 *Reserved.*

7.2 Westinghouse Electric Corporation, *Plutonium Disposition Study; Implementation of Weapons Grade MOX Fuel in Existing Pressurized Water Reactors*, DOE/SF/19683-7, TIC#: 237139, August 30, 1996.

7.3 *Reserved.*

7.4 *Westinghouse MOX SNF Isotopic Source*, Document Identifier Number (DI #): A00000000-01717-0210-00007 REV 00, Civilian Radioactive Waste Management System (CRWMS) Management and Operating Contractor (M&O).

7.5 *Reserved.*

7.6 *Software Qualification Report for MCNP V4B2LV*, DI#: 30033-2003 REV 01, CRWMS M&O.

7.7 *Waste Package Materials Selection Analysis,* DI#: BBA000000-01717-0200-00020 REV 01, AC#: MOL.19980324.0242, CRWMS M&O.

7.8 Benedict, Manson, et al., *Nuclear Chemical Engineering,* Second Edition, McGraw-Hill Book Company, New York, 1981.

7.9 *Material Compositions and Number Densities for Neutronics Calculations,* DI#: BBA000000-01717-0200-00002 REV 00, AC#: MOL.19960624.0023, CRWMS M&O.

7.10 *Nuclides and Isotopes*, 14th Edition, General Electric Company, TIC#: 201637, 1989.

7.11 *Controlled Design Assumptions Document*, DI#: B00000000-01717-4600-00032 REV 04, ICN 04, AC#: MOL.19980511.0260, CRWMS M&O.

7.12 *CRC Handbook of Chemistry and Physics*, 66th Edition, CRC Press, TIC#: 216054, 1985.

7.13 *Criticality Evaluation of Degraded Internal Configurations for the PWR AUCF Waste Package Designs*, DI#: BBA000000-01717-0200-00056 REV 00, AC#: MOL.19971231.0251, CRWMS M&O.

7.14 Lamarsh, John. R., *Introduction to Nuclear Engineering - 2nd Edition,* Addison-Wesley Publishing Company, 1983.

7.15 Knief, R. A., *Nuclear Criticality Safety - Theory and Practice*, American Nuclear Society, La Grange Park, IL, 1993.

7.16 *Disposal Criticality Analysis Methodology Technical Report*, DI#: B00000000-01717-5705-00020 REV 01, AC#: MOL.19980108.0700, CRWMS M&O.

7.17 *EQ6 Calculations for Chemical Degradation of PWR Spent Fuel Waste Packages*, DI#: BBA000000-01717-0210-00009 REV 00, CRWMS M&O.

7.18 *Reserved.*

7.19 *Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles*, ASTM B308/B308M-96, American Society for Testing and Materials.

7.20 *21-PWR Waste Package Corrosion Allowance Shell*, DI#: BBAA00000-01717-2700-16001 REV 00, AC#: MOL.19971222.0371, CRWMS M&O.

7.21 *21-PWR Waste Package Corrosion Resistant Shell*, DI#: BBAA00000-01717-2700-16004 REV 00, AC#: MOL.19971222.0100, CRWMS M&O.

7.22 *21-PWR Waste Package Fuel Basket Tube*, DI#: BBAA00000-01717-2700-16019 REV 00, AC#: MOL.19971222.0325, CRWMS M&O.

7.23 *21-PWR Waste Package Fuel Basket A-plate*, DI#: BBAA00000-01717-2700-16014 REV 00, AC#: MOL.19971223.0013, CRWMS M&O.

7.24 *21-PWR Waste Package Fuel Basket B-plate*, DI#: BBAA00000-01717-2700-16015 REV 00, AC#: MOL.19971218.1103, CRWMS M&O.

7.25 *21-PWR Waste Package Fuel Basket C-plate*, DI#: BBAA00000-01717-2700-16016 REV 00, AC#: MOL.19971222.0345, CRWMS M&O.

7.26 *21-PWR Waste Package Fuel Basket D-plate*, DI#: BBAA00000-01717-2700-16017 REV 00, AC#: MOL.19971222.0312, CRWMS M&O.

7.27 *21-PWR Waste Package Fuel Basket E-plate*, DI#: BBAA00000-01717-2700-16018 REV 00, AC#: MOL.19971224.0093, CRWMS M&O.

7.28 *21-PWR Waste Package Corner Guide Assembly*, DI#: BBAA00000-01717-2700-16009 REV 00, AC#: MOL.19971222.0141, CRWMS M&O.

7.29 *21-PWR Waste Package Disposal Container Assembly*, DI#: BBAA00000-01717-2700-15998 REV 00, AC#: MOL.19971222.0299, CRWMS M&O.

7.30 *12-PWR Waste Package Disposal Container Assembly*, DI#: BBAA00000-01717-2700-16086 REV 00, AC#: MOL.19980119.0362, CRWMS M&O.

7.31 *12-PWR Waste Package Corrosion Allowance Shell*, DI#: BBAA00000-01717-2700-16089 REV 00, AC#: MOL19980114.0258, CRWMS M&O.

7.32 *12-PWR Waste Package Corrosion Resistant Shell*, DI#: BBAA00000-01717-2700-16092 REV 00, AC#: MOL19980114.0297, CRWMS M&O.

7.33 *12-PWR Waste Package Fuel Basket Tube*, DI#: BBAA00000-01717-2700-17005 REV 00, AC#: MOL.19980122.0550, CRWMS M&O.

7.34 *12-PWR Waste Package Fuel Basket A-plate*, DI#: BBAA00000-01717-2700-17002 REV 00, AC#: MOL.19980122.0508, CRWMS M&O.

7.35 *12-PWR Waste Package Fuel Basket B-plate*, DI#: BBAA00000-01717-2700-17003 REV 00, AC#: MOL.19980122.0522, CRWMS M&O.

7.36 *12-PWR Waste Package Fuel Basket C-plate*, DI#: BBAA00000-01717-2700-17004 REV 00, AC#: MOL.19980122.0536, CRWMS M&O.

7.37 *12-PWR Waste Package Corner Guide Assembly*, DI#: BBAA00000-01717-2700-16097 REV 00, AC#: MOL.19980123.0445, CRWMS M&O.

7.38 Brown, R. L., Richards, J. C., *Principles of Powder Mechanics - Essays on the Packing and Flow of Powders and Bulk Solids,* Pergamon Press, 1970.

7.39 *Radiation Effects on Tube Denting in the Steam Generators of Pressurized Water Reactors,* UCRL-52892, Lawrence Livermore National Laboratory, February 1980.

7.40 Roberts, W. L., Rapp, Jr., G. R., Weber, J., *Encyclopedia of Minerals*, Van Nostrand Reinhold Company, AC#: NNA.19891120.0009, 1974.

8. ATTACHMENTS

Attachments to this document are listed in Table 8-1 below.

Table 8-1. List of Attachments

Attachment Number	Description	Size
I	MOXoxide.xls Excel 97 Spreadsheet printout	21 pp.
II	AMIGO1.bas QBASIC source code	5 pp.
III	Volumes of 12 PWR WP basket components from Pro/Engineer	8 pp.
IV	CD-ROM containing all input and output files (see below)	1 CD

The following supporting documents are in electronic form on the attached CD-ROM. Each file is identified by it's name, size (in bytes), and the date and time of last access. Note that for files transferred from the HP to the PC, the date and time will reflect the time of transfer. The actual date and time of run completion can be found in the file.

DOS Filename		byte size	date	time	WIN95 filename
Directory of \Sect6-1					
12MI1A		27,536	06-29-98	3:56p	12MI1A
12MI1A	O	449,089	06-29-98	3:56p	12MI1A.O
12MI1B		27,537	06-29-98	3:56p	12MI1B
12MI1B	O	449,089	06-29-98	3:56p	12MI1B.O
12MI1C		27,505	06-29-98	3:56p	12MI1C
12MI1C	O	448,476	06-29-98	3:56p	12MI1C.O
12MI1D		27,507	06-29-98	3:56p	12MI1D
12MI1D	O	448,867	06-29-98	3:56p	12MI1D.O
12MI1E		27,443	06-29-98	3:56p	12MI1E
12MI1E	O	446,785	06-29-98	3:56p	12MI1E.O
12MI1F		27,442	06-29-98	3:56p	12MI1F
12MI1F	O	447,515	06-29-98	3:56p	12MI1F.O
12MI1G		27,443	06-29-98	3:56p	12MI1G
12MI1G	O	447,442	06-29-98	3:56p	12MI1G.O
12MI1H		27,442	06-29-98	3:56p	12MI1H
12MI1H	O	447,515	06-29-98	3:56p	12MI1H.O
12MI1I		27,443	06-29-98	3:56p	12MI1I
12MI1I	O	446,831	06-29-98	3:56p	12MI1I.O
12MI1J		27,442	06-29-98	3:56p	12MI1J
12MI1J	O	447,508	06-29-98	3:56p	12MI1J.O
12MI1M		27,539	06-29-98	3:56p	12MI1M
12MI1M	O	449,089	06-29-98	3:56p	12MI1M.O
12MI1N		27,532	06-29-98	3:56p	12MI1N
12MI1N	O	449,146	06-29-98	3:56p	12MI1N.O
12MI1O		27,530	06-29-98	3:56p	12MI1O
12MI1O	O	449,146	06-29-98	3:56p	12MI1O.O
12MI1P		27,532	06-29-98	3:56p	12MI1P
12MI1P	O	448,576	06-29-98	3:56p	12MI1P.O
12MI1Q		27,524	06-29-98	3:56p	12MI1Q
12MI1Q	O	471,009	06-29-98	3:56p	12MI1Q.O
12MI1R		27,533	06-29-98	3:56p	12MI1R
12MI1R	O	449,195	06-29-98	3:56p	12MI1R.O
12MI1S		27,529	06-29-98	3:57p	12MI1S
12MI1S	O	449,146	06-29-98	3:57p	12MI1S.O
12MI1T		27,529	06-29-98	3:57p	12MI1T
12MI1T	O	449,278	06-29-98	3:57p	12MI1T.O
12MI1U		27,536	06-29-98	3:57p	12MI1U
12MI1U	O	448,416	06-29-98	3:57p	12MI1U.O
12MI1V		27,535	06-29-98	3:57p	12MI1V
12MI1V	O	449,089	06-29-98	3:57p	12MI1V.O
12MI1W		27,537	06-29-98	3:57p	12MI1W
12MI1W	O	449,089	06-29-98	3:57p	12MI1W.O
12MI1X		27,538	06-29-98	3:57p	12MI1X
12MI1X	O	449,146	06-29-98	3:57p	12MI1X.O
12MI1Y		27,534	06-29-98	3:57p	12MI1Y
12MI1Y	O	449,146	06-29-98	3:57p	12MI1Y.O

```
12MI1Z             27,528  06-29-98  3:57p 12MI1Z
12MI1Z    O       449,146  06-29-98  3:57p 12MI1Z.O
12MI2A             27,534  06-29-98  3:57p 12MI2A
12MI2A    O       449,146  06-29-98  3:57p 12MI2A.O
12MI2B             27,534  06-29-98  3:57p 12MI2B
12MI2B    O       449,146  06-29-98  3:57p 12MI2B.O
12MI2C             27,504  06-29-98  3:57p 12MI2C
12MI2C    O       447,819  06-29-98  3:57p 12MI2C.O
12MI2D             27,501  06-29-98  3:57p 12MI2D
12MI2D    O       448,794  06-29-98  3:57p 12MI2D.O
12MI2E             27,439  06-29-98  3:57p 12MI2E
12MI2E    O       446,627  06-29-98  3:57p 12MI2E.O
12MI2F             27,440  06-29-98  3:57p 12MI2F
12MI2F    O       447,197  06-29-98  3:57p 12MI2F.O
12MI2G             27,441  06-29-98  3:57p 12MI2G
12MI2G    O       446,785  06-29-98  3:57p 12MI2G.O
12MI2H             27,440  06-29-98  3:57p 12MI2H
12MI2H    O       447,458  06-29-98  3:57p 12MI2H.O
12MI2I             27,440  06-29-98  3:57p 12MI2I
12MI2I    O       447,385  06-29-98  3:57p 12MI2I.O
12MI2J             27,441  06-29-98  3:57p 12MI2J
12MI2J    O       447,458  06-29-98  3:57p 12MI2J.O
12MI2M             27,537  06-29-98  3:57p 12MI2M
12MI2M    O       449,146  06-29-98  3:57p 12MI2M.O
12MI2N             27,533  06-29-98  3:57p 12MI2N
12MI2N    O       449,089  06-29-98  3:57p 12MI2N.O
12MI2O             27,532  06-29-98  3:57p 12MI2O
12MI2O    O       449,146  06-29-98  3:57p 12MI2O.O
12MI2P             27,533  06-29-98  3:57p 12MI2P
12MI2P    O       449,146  06-29-98  3:57p 12MI2P.O
12MI2Q             27,532  06-29-98  3:57p 12MI2Q
12MI2Q    O       449,139  06-29-98  3:57p 12MI2Q.O
12MI2R             27,532  06-29-98  3:57p 12MI2R
12MI2R    O       447,586  06-29-98  3:57p 12MI2R.O
12MI2S             27,535  06-29-98  3:57p 12MI2S
12MI2S    O       448,416  06-29-98  3:57p 12MI2S.O
12MI2T             27,534  06-29-98  3:57p 12MI2T
12MI2T    O       449,073  06-29-98  3:57p 12MI2T.O
12MI2U             27,534  06-29-98  3:57p 12MI2U
12MI2U    O       449,146  06-29-98  3:57p 12MI2U.O
12MI2V             27,535  06-29-98  3:57p 12MI2V
12MI2V    O       449,146  06-29-98  3:57p 12MI2V.O
12MI2W             27,535  06-29-98  3:57p 12MI2W
12MI2W    O       449,146  06-29-98  3:57p 12MI2W.O
12MI2X             27,535  06-29-98  3:57p 12MI2X
12MI2X    O       449,146  06-29-98  3:57p 12MI2X.O
12MI2Y             27,526  06-29-98  3:57p 12MI2Y
12MI2Y    O       448,402  06-29-98  3:57p 12MI2Y.O
12MI2Z             27,536  06-29-98  3:57p 12MI2Z
12MI2Z    O       449,146  06-29-98  3:57p 12MI2Z.O
12MI3A             27,533  06-29-98  3:57p 12MI3A
12MI3A    O       449,383  06-29-98  3:57p 12MI3A.O
12MI3B             27,538  06-29-98  3:57p 12MI3B
12MI3B    O       449,513  06-29-98  3:57p 12MI3B.O
12MI3C             27,506  06-29-98  3:57p 12MI3C
```

12MI3C	O	448,867	06-29-98	3:57p	12MI3C.O
12MI3D		27,505	06-29-98	3:57p	12MI3D
12MI3D	O	448,867	06-29-98	3:57p	12MI3D.O
12MI3E		27,442	06-29-98	3:57p	12MI3E
12MI3E	O	446,831	06-29-98	3:57p	12MI3E.O
12MI3F		27,441	06-29-98	3:57p	12MI3F
12MI3F	O	447,515	06-29-98	3:57p	12MI3F.O
12MI3G		27,441	06-29-98	3:57p	12MI3G
12MI3G	O	446,831	06-29-98	3:57p	12MI3G.O
12MI3H		27,442	06-29-98	3:57p	12MI3H
12MI3H	O	446,582	06-29-98	3:57p	12MI3H.O
12MI3I		27,436	06-29-98	3:57p	12MI3I
12MI3I	O	447,458	06-29-98	3:57p	12MI3I.O
12MI3J		27,436	06-29-98	3:57p	12MI3J
12MI3J	O	446,785	06-29-98	3:57p	12MI3J.O
12MI3M		27,542	06-29-98	3:57p	12MI3M
12MI3M	O	449,464	06-29-98	3:57p	12MI3M.O
12MI3N		27,535	06-29-98	3:57p	12MI3N
12MI3N	O	449,407	06-29-98	3:57p	12MI3N.O
12MI3O		27,526	06-29-98	3:57p	12MI3O
12MI3O	O	449,464	06-29-98	3:57p	12MI3O.O
12MI3P		27,535	06-29-98	3:57p	12MI3P
12MI3P	O	448,531	06-29-98	3:57p	12MI3P.O
12MI3Q		27,535	06-29-98	3:57p	12MI3Q
12MI3Q	O	448,588	06-29-98	3:57p	12MI3Q.O
12MI3R		27,534	06-29-98	3:57p	12MI3R
12MI3R	O	449,391	06-29-98	3:58p	12MI3R.O
12MI3S		27,533	06-29-98	3:58p	12MI3S
12MI3S	O	449,464	06-29-98	3:58p	12MI3S.O
12MI3T		27,536	06-29-98	3:58p	12MI3T
12MI3T	O	449,407	06-29-98	3:58p	12MI3T.O
12MI3U		27,534	06-29-98	3:58p	12MI3U
12MI3U	O	449,407	06-29-98	3:58p	12MI3U.O
12MI3V		27,536	06-29-98	3:58p	12MI3V
12MI3V	O	448,783	06-29-98	3:58p	12MI3V.O
12MI3W		27,527	06-29-98	3:58p	12MI3W
12MI3W	O	448,572	06-29-98	3:58p	12MI3W.O
12MI3X		27,535	06-29-98	3:58p	12MI3X
12MI3X	O	449,464	06-29-98	3:58p	12MI3X.O
12MI3Y		27,528	06-29-98	3:58p	12MI3Y
12MI3Y	O	449,464	06-29-98	3:58p	12MI3Y.O
12MI3Z		27,537	06-29-98	3:58p	12MI3Z
12MI3Z	O	449,407	06-29-98	3:58p	12MI3Z.O
12MIA1A		27,517	06-29-98	3:58p	12MIA1A
12MIA1A	O	451,123	06-29-98	3:58p	12MIA1A.O
12MIA1B		27,518	06-29-98	3:58p	12MIA1B
12MIA1B	O	451,123	06-29-98	3:58p	12MIA1B.O
12MIA1C		27,486	06-29-98	3:58p	12MIA1C
12MIA1C	O	450,469	06-29-98	3:58p	12MIA1C.O
12MIA1D		27,488	06-29-98	3:58p	12MIA1D
12MIA1D	O	450,526	06-29-98	3:58p	12MIA1D.O
12MIA1E		27,424	06-29-98	3:58p	12MIA1E
12MIA1E	O	449,174	06-29-98	3:58p	12MIA1E.O
12MIA1F		27,423	06-29-98	3:58p	12MIA1F
12MIA1F	O	449,174	06-29-98	3:58p	12MIA1F.O

```
12MIA1G          27,424  06-29-98   3:58p 12MIA1G
12MIA1G  O      449,117  06-29-98   3:58p 12MIA1G.O
12MIA1H          27,423  06-29-98   3:58p 12MIA1H
12MIA1H  O      449,174  06-29-98   3:58p 12MIA1H.O
12MIA1I          27,424  06-29-98   3:58p 12MIA1I
12MIA1I  O      448,282  06-29-98   3:58p 12MIA1I.O
12MIA1J          27,423  06-29-98   3:58p 12MIA1J
12MIA1J  O      449,174  06-29-98   3:58p 12MIA1J.O
12MIA1N          27,513  06-29-98   3:58p 12MIA1N
12MIA1N  O      451,066  06-29-98   3:58p 12MIA1N.O
12MIA1O          27,511  06-29-98   3:58p 12MIA1O
12MIA1O  O      451,066  06-29-98   3:58p 12MIA1O.O
12MIA1P          27,513  06-29-98   3:58p 12MIA1P
12MIA1P  O      451,123  06-29-98   3:58p 12MIA1P.O
12MIA1Q          27,505  06-29-98   3:58p 12MIA1Q
12MIA1Q  O      450,247  06-29-98   3:58p 12MIA1Q.O
12MIA1R          27,514  06-29-98   3:58p 12MIA1R
12MIA1R  O      450,247  06-29-98   3:58p 12MIA1R.O
12MIA1S          27,510  06-29-98   3:58p 12MIA1S
12MIA1S  O      451,123  06-29-98   3:58p 12MIA1S.O
12MIA1T          27,510  06-29-98   3:58p 12MIA1T
12MIA1T  O      450,480  06-29-98   3:58p 12MIA1T.O
12MIA1U          27,517  06-29-98   3:58p 12MIA1U
12MIA1U  O      451,123  06-29-98   3:58p 12MIA1U.O
12MIA1V          27,516  06-29-98   3:58p 12MIA1V
12MIA1V  O      509,175  06-29-98   3:58p 12MIA1V.O
12MIA1W          27,518  06-29-98   3:58p 12MIA1W
12MIA1W  O      451,123  06-29-98   3:58p 12MIA1W.O
12MIA1X          27,519  06-29-98   3:58p 12MIA1X
12MIA1X  O      451,123  06-29-98   3:58p 12MIA1X.O
12MIA1Y          27,515  06-29-98   3:58p 12MIA1Y
12MIA1Y  O      450,993  06-29-98   3:58p 12MIA1Y.O
12MIA1Z          27,509  06-29-98   3:58p 12MIA1Z
12MIA1Z  O      451,123  06-29-98   3:58p 12MIA1Z.O
12MIA2A          27,515  06-29-98   3:58p 12MIA2A
12MIA2A  O      451,050  06-29-98   3:58p 12MIA2A.O
12MIA2B          27,515  06-29-98   3:58p 12MIA2B
12MIA2B  O      450,423  06-29-98   3:58p 12MIA2B.O
12MIA2C          27,485  06-29-98   3:58p 12MIA2C
12MIA2C  O      450,396  06-29-98   3:58p 12MIA2C.O
12MIA2D          27,482  06-29-98   3:58p 12MIA2D
12MIA2D  O      450,469  06-29-98   3:58p 12MIA2D.O
12MIA2E          27,420  06-29-98   3:58p 12MIA2E
12MIA2E  O      449,117  06-29-98   3:58p 12MIA2E.O
12MIA2F          27,421  06-29-98   3:58p 12MIA2F
12MIA2F  O      449,101  06-29-98   3:58p 12MIA2F.O
12MIA2G          27,422  06-29-98   3:58p 12MIA2G
12MIA2G  O      449,158  06-29-98   3:58p 12MIA2G.O
12MIA2H          27,421  06-29-98   3:58p 12MIA2H
12MIA2H  O      448,298  06-29-98   3:58p 12MIA2H.O
12MIA2I          27,421  06-29-98   3:58p 12MIA2I
12MIA2I  O      449,101  06-29-98   3:58p 12MIA2I.O
12MIA2J          27,422  06-29-98   3:58p 12MIA2J
12MIA2J  O      449,174  06-29-98   3:58p 12MIA2J.O
12MIA2N          27,514  06-29-98   3:58p 12MIA2N
```

```
12MIA2N  O     450,993  06-29-98  3:58p 12MIA2N.O
12MIA2O         27,513  06-29-98  3:58p 12MIA2O
12MIA2O  O     483,511  06-29-98  3:58p 12MIA2O.O
12MIA2P         27,514  06-29-98  3:58p 12MIA2P
12MIA2P  O     451,017  06-29-98  3:58p 12MIA2P.O
12MIA2Q         27,513  06-29-98  3:58p 12MIA2Q
12MIA2Q  O     451,123  06-29-98  3:58p 12MIA2Q.O
12MIA2R         27,513  06-29-98  3:59p 12MIA2R
12MIA2R  O     451,066  06-29-98  3:59p 12MIA2R.O
12MIA2S         27,516  06-29-98  3:59p 12MIA2S
12MIA2S  O     450,393  06-29-98  3:59p 12MIA2S.O
12MIA2T         27,515  06-29-98  3:59p 12MIA2T
12MIA2T  O     500,664  06-29-98  3:59p 12MIA2T.O
12MIA2U         27,515  06-29-98  3:59p 12MIA2U
12MIA2U  O     451,066  06-29-98  3:59p 12MIA2U.O
12MIA2V         27,516  06-29-98  3:59p 12MIA2V
12MIA2V  O     451,066  06-29-98  3:59p 12MIA2V.O
12MIA2W         27,516  06-29-98  3:59p 12MIA2W
12MIA2W  O     451,066  06-29-98  3:59p 12MIA2W.O
12MIA2X         27,516  06-29-98  3:59p 12MIA2X
12MIA2X  O     450,393  06-29-98  3:59p 12MIA2X.O
12MIA2Y         27,507  06-29-98  3:59p 12MIA2Y
12MIA2Y  O     451,123  06-29-98  3:59p 12MIA2Y.O
12MIA2Z         27,517  06-29-98  3:59p 12MIA2Z
12MIA2Z  O     474,350  06-29-98  3:59p 12MIA2Z.O
12MIA3A         27,514  06-29-98  3:59p 12MIA3A
12MIA3A  O     450,565  06-29-98  3:59p 12MIA3A.O
12MIA3B         27,519  06-29-98  3:59p 12MIA3B
12MIA3B  O     450,549  06-29-98  3:59p 12MIA3B.O
12MIA3C         27,487  06-29-98  3:59p 12MIA3C
12MIA3C  O     450,114  06-29-98  3:59p 12MIA3C.O
12MIA3D         27,486  06-29-98  3:59p 12MIA3D
12MIA3D  O     549,214  06-29-98  3:59p 12MIA3D.O
12MIA3E         27,423  06-29-98  3:59p 12MIA3E
12MIA3E  O     449,492  06-29-98  3:59p 12MIA3E.O
12MIA3F         27,422  06-29-98  3:59p 12MIA3F
12MIA3F  O     449,394  06-29-98  3:59p 12MIA3F.O
12MIA3G         27,422  06-29-98  3:59p 12MIA3G
12MIA3G  O     448,705  06-29-98  3:59p 12MIA3G.O
12MIA3H         27,423  06-29-98  3:59p 12MIA3H
12MIA3H  O     449,419  06-29-98  3:59p 12MIA3H.O
12MIA3I         27,417  06-29-98  3:59p 12MIA3I
12MIA3I  O     449,492  06-29-98  3:59p 12MIA3I.O
12MIA3J         27,417  06-29-98  3:59p 12MIA3J
12MIA3J  O     449,435  06-29-98  3:59p 12MIA3J.O
12MIA3M         27,523  06-29-98  3:59p 12MIA3M
12MIA3M  O     463,934  06-29-98  3:59p 12MIA3M.O
12MIA3N         27,516  06-29-98  3:59p 12MIA3N
12MIA3N  O     451,441  06-29-98  3:59p 12MIA3N.O
12MIA3O         27,507  06-29-98  3:59p 12MIA3O
12MIA3O  O     451,441  06-29-98  3:59p 12MIA3O.O
12MIA3P         27,516  06-29-98  3:59p 12MIA3P
12MIA3P  O     451,490  06-29-98  3:59p 12MIA3P.O
12MIA3Q         27,516  06-29-98  3:59p 12MIA3Q
12MIA3Q  O     451,368  06-29-98  3:59p 12MIA3Q.O
```

```
12MIA3R            27,515  06-29-98   3:59p 12MIA3R
12MIA3R  O        451,384  06-29-98   3:59p 12MIA3R.O
12MIA3S            27,514  06-29-98   3:59p 12MIA3S
12MIA3S  O        450,654  06-29-98   3:59p 12MIA3S.O
12MIA3T            27,517  06-29-98   3:59p 12MIA3T
12MIA3T  O        451,441  06-29-98   3:59p 12MIA3T.O
12MIA3U            27,515  06-29-98   3:59p 12MIA3U
12MIA3U  O        451,441  06-29-98   3:59p 12MIA3U.O
12MIA3V            27,517  06-29-98   3:59p 12MIA3V
12MIA3V  O        488,661  06-29-98   3:59p 12MIA3V.O
12MIA3W            27,508  06-29-98   3:59p 12MIA3W
12MIA3W  O        450,757  06-29-98   3:59p 12MIA3W.O
12MIA3X            27,516  06-29-98   3:59p 12MIA3X
12MIA3X  O        451,384  06-29-98   3:59p 12MIA3X.O
12MIA3Y            27,509  06-29-98   3:59p 12MIA3Y
12MIA3Y  O        451,311  06-29-98   3:59p 12MIA3Y.O
12MIA3Z            27,518  06-29-98   3:59p 12MIA3Z
12MIA3Z  O        451,500  06-29-98   3:59p 12MIA3Z.O
12MIB              27,502  06-29-98   3:59p 12MIB
12MIB    O        457,271  06-29-98   3:59p 12MIB.O
12MAI4A            27,512  06-29-98   3:59p 12mai4a
12MAI4A  O        451,368  06-29-98   3:59p 12mai4a.O
12MAI4B            27,514  06-29-98   3:59p 12mai4b
12MAI4B  O        450,508  06-29-98   3:59p 12mai4b.O
12MAI4C            27,481  06-29-98   3:59p 12mai4c
12MAI4C  O        449,284  06-29-98   3:59p 12mai4c.O
12MAI4D            27,482  06-29-98   3:59p 12mai4d
12MAI4D  O        450,787  06-29-98   3:59p 12mai4d.O
12MAI4E            27,419  06-29-98   3:59p 12mai4e
12MAI4E  O        475,076  06-29-98   3:59p 12mai4e.O
12MAI4F            27,409  06-29-98   3:59p 12mai4f
12MAI4F  O        449,492  06-29-98   4:00p 12mai4f.O
12MAI4G            27,418  06-29-98   4:00p 12mai4g
12MAI4G  O        449,362  06-29-98   4:00p 12mai4g.O
12MAI4H            27,416  06-29-98   4:00p 12mai4h
12MAI4H  O        448,738  06-29-98   4:00p 12mai4h.O
12MAI4I            27,420  06-29-98   4:00p 12mai4i
12MAI4I  O        448,705  06-29-98   4:00p 12mai4i.O
12MAI4J            27,417  06-29-98   4:00p 12mai4j
12MAI4J  O        449,492  06-29-98   4:00p 12mai4j.O
12MAI4N            27,510  06-29-98   4:00p 12mai4n
12MAI4N  O        451,490  06-29-98   4:00p 12mai4n.O
12MAI4O            27,511  06-29-98   4:00p 12mai4o
12MAI4O  O        451,066  06-29-98   4:00p 12mai4o.O
12MAI4P            27,512  06-29-98   4:00p 12mai4p
12MAI4P  O        451,050  06-29-98   4:00p 12mai4p.O
12MAI4Q            27,510  06-29-98   4:00p 12mai4q
12MAI4Q  O        451,441  06-29-98   4:00p 12mai4q.O
12MAI4R            27,511  06-29-98   4:00p 12mai4r
12MAI4R  O        451,441  06-29-98   4:00p 12mai4r.O
12MAI4S            27,512  06-29-98   4:00p 12mai4s
12MAI4S  O        450,393  06-29-98   4:00p 12mai4s.O
12MAI4T            27,512  06-29-98   4:00p 12mai4t
12MAI4T  O        451,368  06-29-98   4:00p 12mai4t.O
12MAI4U            27,513  06-29-98   4:00p 12mai4u
```

```
12MAI4U  O    450,393  06-29-98  4:00p 12mai4u.O
12MAI4V        27,511  06-29-98  4:00p 12mai4v
12MAI4V  O    451,123  06-29-98  4:00p 12mai4v.O
12MAI4W        27,513  06-29-98  4:00p 12mai4w
12MAI4W  O    451,123  06-29-98  4:00p 12mai4w.O
12MAI4X        27,510  06-29-98  4:00p 12mai4x
12MAI4X  O    578,047  06-29-98  4:00p 12mai4x.O
12MAI4Y        27,514  06-29-98  4:00p 12mai4y
12MAI4Y  O    451,123  06-29-98  4:00p 12mai4y.O
12MAI4Z        27,514  06-29-98  4:00p 12mai4z
12MAI4Z  O    450,757  06-29-98  4:00p 12mai4z.O
12MI4A         27,531  06-29-98  4:00p 12mi4a
12MI4A   O    459,395  06-29-98  4:00p 12mi4a.O
12MI4B         27,533  06-29-98  4:00p 12mi4b
12MI4B   O    449,391  06-29-98  4:00p 12mi4b.O
12MI4C         27,500  06-29-98  4:00p 12mi4c
12MI4C   O    448,867  06-29-98  4:00p 12mi4c.O
12MI4D         27,501  06-29-98  4:00p 12mi4d
12MI4D   O    448,137  06-29-98  4:00p 12mi4d.O
12MI4E         27,438  06-29-98  4:00p 12mi4e
12MI4E   O    446,728  06-29-98  4:00p 12mi4e.O
12MI4F         27,428  06-29-98  4:00p 12mi4f
12MI4F   O    446,785  06-29-98  4:00p 12mi4f.O
12MI4G         27,437  06-29-98  4:00p 12mi4g
12MI4G   O    447,515  06-29-98  4:00p 12mi4g.O
12MI4H         27,435  06-29-98  4:00p 12mi4h
12MI4H   O    446,069  06-29-98  4:00p 12mi4h.O
12MI4I         27,439  06-29-98  4:00p 12mi4i
12MI4I   O    447,466  06-29-98  4:00p 12mi4i.O
12MI4J         27,436  06-29-98  4:00p 12mi4j
12MI4J   O    446,639  06-29-98  4:00p 12mi4j.O
12MI4N         27,529  06-29-98  4:00p 12mi4n
12MI4N   O    449,160  06-29-98  4:00p 12mi4n.O
12MI4O         27,530  06-29-98  4:00p 12mi4o
12MI4O   O    449,146  06-29-98  4:00p 12mi4o.O
12MI4P         27,531  06-29-98  4:00p 12mi4p
12MI4P   O    449,146  06-29-98  4:00p 12mi4p.O
12MI4Q         27,529  06-29-98  4:00p 12mi4q
12MI4Q   O    449,146  06-29-98  4:00p 12mi4q.O
12MI4R         27,530  06-29-98  4:00p 12mi4r
12MI4R   O    448,416  06-29-98  4:00p 12mi4r.O
12MI4S         27,531  06-29-98  4:00p 12mi4s
12MI4S   O    448,359  06-29-98  4:00p 12mi4s.O
12MI4T         27,531  06-29-98  4:00p 12mi4t
12MI4T   O    449,407  06-29-98  4:00p 12mi4t.O
12MI4U         27,532  06-29-98  4:00p 12mi4u
12MI4U   O    449,089  06-29-98  4:00p 12mi4u.O
12MI4V         27,530  06-29-98  4:00p 12mi4v
12MI4V   O    491,386  06-29-98  4:00p 12mi4v.O
12MI4W         27,532  06-29-98  4:00p 12mi4w
12MI4W   O    449,407  06-29-98  4:00p 12mi4w.O
12MI4X         27,529  06-29-98  4:00p 12mi4x
12MI4X   O    449,146  06-29-98  4:00p 12mi4x.O
12MI4Y         27,533  06-29-98  4:00p 12mi4y
12MI4Y   O    449,464  06-29-98  4:00p 12mi4y.O
```

12MI4Z		27,533	06-29-98	4:00p	12mi4z
12MI4Z	O	448,588	06-29-98	4:00p	12mi4z.O
21MI1A		29,761	06-29-98	4:00p	21MI1A
21MI1A	O	495,940	06-29-98	4:00p	21MI1A.O
21MI1B		29,762	06-29-98	4:00p	21MI1B
21MI1B	O	495,305	06-29-98	4:00p	21MI1B.O
21MI1C		29,730	06-29-98	4:00p	21MI1C
21MI1C	O	494,627	06-29-98	4:00p	21MI1C.O
21MI1D		29,732	06-29-98	4:00p	21MI1D
21MI1D	O	495,216	06-29-98	4:00p	21MI1D.O
21MI1E		29,668	06-29-98	4:00p	21MI1E
21MI1E	O	540,410	06-29-98	4:00p	21MI1E.O
21MI1F		29,667	06-29-98	4:00p	21MI1F
21MI1F	O	493,234	06-29-98	4:01p	21MI1F.O
21MI1G		29,668	06-29-98	4:01p	21MI1G
21MI1G	O	530,828	06-29-98	4:01p	21MI1G.O
21MI1H		29,667	06-29-98	4:01p	21MI1H
21MI1H	O	493,934	06-29-98	4:01p	21MI1H.O
21MI1I		29,668	06-29-98	4:01p	21MI1I
21MI1I	O	493,934	06-29-98	4:01p	21MI1I.O
21MI1J		29,667	06-29-98	4:01p	21MI1J
21MI1J	O	493,991	06-29-98	4:01p	21MI1J.O
21MI1N		29,757	06-29-98	4:01p	21MI1N
21MI1N	O	495,622	06-29-98	4:01p	21MI1N.O
21MI1O		29,755	06-29-98	4:01p	21MI1O
21MI1O	O	494,865	06-29-98	4:01p	21MI1O.O
21MI1P		29,757	06-29-98	4:01p	21MI1P
21MI1P	O	506,657	06-29-98	4:01p	21MI1P.O
21MI1Q		29,749	06-29-98	4:01p	21MI1Q
21MI1Q	O	495,622	06-29-98	4:01p	21MI1Q.O
21MI1R		29,758	06-29-98	4:01p	21MI1R
21MI1R	O	495,622	06-29-98	4:01p	21MI1R.O
21MI1S		29,754	06-29-98	4:01p	21MI1S
21MI1S	O	495,622	06-29-98	4:01p	21MI1S.O
21MI1T		29,754	06-29-98	4:01p	21MI1T
21MI1T	O	494,917	06-29-98	4:01p	21MI1T.O
21MI1U		29,761	06-29-98	4:01p	21MI1U
21MI1U	O	495,565	06-29-98	4:01p	21MI1U.O
21MI1V		29,760	06-29-98	4:01p	21MI1V
21MI1V	O	495,622	06-29-98	4:01p	21MI1V.O
21MI1W		29,762	06-29-98	4:01p	21MI1W
21MI1W	O	495,552	06-29-98	4:01p	21MI1W.O
21MI1X		29,763	06-29-98	4:01p	21MI1X
21MI1X	O	523,061	06-29-98	4:01p	21MI1X.O
21MI1Y		29,759	06-29-98	4:01p	21MI1Y
21MI1Y	O	494,725	06-29-98	4:01p	21MI1Y.O
21MI1Z		29,753	06-29-98	4:01p	21MI1Z
21MI1Z	O	494,922	06-29-98	4:01p	21MI1Z.O
21MI2A		29,759	06-29-98	4:01p	21MI2A
21MI2A	O	495,495	06-29-98	4:01p	21MI2A.O
21MI2B		29,759	06-29-98	4:01p	21MI2B
21MI2B	O	495,919	06-29-98	4:01p	21MI2B.O
21MI2C		29,729	06-29-98	4:01p	21MI2C
21MI2C	O	494,503	06-29-98	4:01p	21MI2C.O
21MI2D		29,726	06-29-98	4:01p	21MI2D

```
21MI2D    O       495,343  06-29-98  4:01p 21MI2D.O
21MI2E             29,664  06-29-98  4:01p 21MI2E
21MI2E    O       493,991  06-29-98  4:01p 21MI2E.O
21MI2F             29,665  06-29-98  4:01p 21MI2F
21MI2F    O       522,657  06-29-98  4:01p 21MI2F.O
21MI2G             29,666  06-29-98  4:01p 21MI2G
21MI2G    O       493,470  06-29-98  4:01p 21MI2G.O
21MI2H             29,665  06-29-98  4:01p 21MI2H
21MI2H    O       493,934  06-29-98  4:01p 21MI2H.O
21MI2I             29,665  06-29-98  4:01p 21MI2I
21MI2I    O       493,991  06-29-98  4:01p 21MI2I.O
21MI2J             29,666  06-29-98  4:01p 21MI2J
21MI2J    O       493,991  06-29-98  4:01p 21MI2J.O
21MI2N             29,758  06-29-98  4:01p 21MI2N
21MI2N    O       494,782  06-29-98  4:01p 21MI2N.O
21MI2O             29,757  06-29-98  4:01p 21MI2O
21MI2O    O       494,766  06-29-98  4:01p 21MI2O.O
21MI2P             29,758  06-29-98  4:01p 21MI2P
21MI2P    O       495,565  06-29-98  4:01p 21MI2P.O
21MI2Q             29,757  06-29-98  4:01p 21MI2Q
21MI2Q    O       494,982  06-29-98  4:01p 21MI2Q.O
21MI2R             29,757  06-29-98  4:01p 21MI2R
21MI2R    O       494,868  06-29-98  4:01p 21MI2R.O
21MI2S             29,760  06-29-98  4:01p 21MI2S
21MI2S    O       494,212  06-29-98  4:01p 21MI2S.O
21MI2T             29,759  06-29-98  4:01p 21MI2T
21MI2T    O       494,868  06-29-98  4:01p 21MI2T.O
21MI2U             29,759  06-29-98  4:01p 21MI2U
21MI2U    O       561,008  06-29-98  4:01p 21MI2U.O
21MI2V             29,760  06-29-98  4:01p 21MI2V
21MI2V    O       495,565  06-29-98  4:01p 21MI2V.O
21MI2W             29,760  06-29-98  4:01p 21MI2W
21MI2W    O       495,622  06-29-98  4:01p 21MI2W.O
21MI2X             29,760  06-29-98  4:01p 21MI2X
21MI2X    O       537,002  06-29-98  4:01p 21MI2X.O
21MI2Y             29,751  06-29-98  4:01p 21MI2Y
21MI2Y    O       495,622  06-29-98  4:01p 21MI2Y.O
21MI2Z             29,761  06-29-98  4:01p 21MI2Z
21MI2Z    O       495,622  06-29-98  4:01p 21MI2Z.O
21MIDN             29,916  06-29-98  4:01p 21MIDN
21MIDN    O       705,239  06-29-98  4:01p 21MIDN.O
        472 file(s)     115,825,007 bytes
```

Directory of \Sect6-2

```
12MS1A             27,270  06-29-98  4:30p 12MS1A
12MS1A    O       446,495  06-29-98  4:30p 12MS1A.O
12MS1B             27,271  06-29-98  4:30p 12MS1B
12MS1B    O       446,438  06-29-98  4:30p 12MS1B.O
12MS1C             27,239  06-29-98  4:30p 12MS1C
12MS1C    O       445,841  06-29-98  4:30p 12MS1C.O
12MS1D             27,241  06-29-98  4:30p 12MS1D
12MS1D    O       445,971  06-29-98  4:30p 12MS1D.O
12MS1E             27,177  06-29-98  4:30p 12MS1E
12MS1E    O       444,751  06-29-98  4:30p 12MS1E.O
```

```
12MS1F             27,176  06-29-98   4:30p 12MS1F
12MS1F   O        444,619  06-29-98   4:30p 12MS1F.O
12MS1G             27,177  06-29-98   4:30p 12MS1G
12MS1G   O        444,489  06-29-98   4:30p 12MS1G.O
12MS1H             27,176  06-29-98   4:30p 12MS1H
12MS1H   O        444,562  06-29-98   4:30p 12MS1H.O
12MS1I             27,177  06-29-98   4:30p 12MS1I
12MS1I   O        444,546  06-29-98   4:30p 12MS1I.O
12MS1J             27,176  06-29-98   4:30p 12MS1J
12MS1J   O        444,049  06-29-98   4:30p 12MS1J.O
12MS1N             27,266  06-29-98   4:30p 12MS1N
12MS1N   O        446,568  06-29-98   4:30p 12MS1N.O
12MS1O             27,264  06-29-98   4:31p 12MS1O
12MS1O   O        446,568  06-29-98   4:31p 12MS1O.O
12MS1P             27,266  06-29-98   4:31p 12MS1P
12MS1P   O        446,438  06-29-98   4:31p 12MS1P.O
12MS1Q             27,258  06-29-98   4:31p 12MS1Q
12MS1Q   O        446,511  06-29-98   4:31p 12MS1Q.O
12MS1R             27,267  06-29-98   4:31p 12MS1R
12MS1R   O        446,495  06-29-98   4:31p 12MS1R.O
12MS1S             27,263  06-29-98   4:31p 12MS1S
12MS1S   O        446,438  06-29-98   4:31p 12MS1S.O
12MS1T             27,263  06-29-98   4:31p 12MS1T
12MS1T   O        446,511  06-29-98   4:31p 12MS1T.O
12MS1U             27,270  06-29-98   4:31p 12MS1U
12MS1U   O        446,568  06-29-98   4:31p 12MS1U.O
12MS1V             27,269  06-29-98   4:31p 12MS1V
12MS1V   O        446,537  06-29-98   4:31p 12MS1V.O
12MS1W             27,271  06-29-98   4:31p 12MS1W
12MS1W   O        446,495  06-29-98   4:31p 12MS1W.O
12MS1X             27,272  06-29-98   4:31p 12MS1X
12MS1X   O        446,627  06-29-98   4:31p 12MS1X.O
12MS1Y             27,268  06-29-98   4:31p 12MS1Y
12MS1Y   O        446,438  06-29-98   4:31p 12MS1Y.O
12MS1Z             27,262  06-29-98   4:31p 12MS1Z
12MS1Z   O        446,511  06-29-98   4:31p 12MS1Z.O
12MS2A             27,268  06-29-98   4:31p 12MS2A
12MS2A   O        446,568  06-29-98   4:31p 12MS2A.O
12MS2B             27,268  06-29-98   4:31p 12MS2B
12MS2B   O        445,925  06-29-98   4:31p 12MS2B.O
12MS2C             27,238  06-29-98   4:31p 12MS2C
12MS2C   O        445,214  06-29-98   4:31p 12MS2C.O
12MS2D             27,235  06-29-98   4:31p 12MS2D
12MS2D   O        445,898  06-29-98   4:31p 12MS2D.O
12MS2E             27,173  06-29-98   4:31p 12MS2E
12MS2E   O        444,546  06-29-98   4:31p 12MS2E.O
12MS2F             27,174  06-29-98   4:31p 12MS2F
12MS2F   O        444,619  06-29-98   4:31p 12MS2F.O
12MS2G             27,175  06-29-98   4:31p 12MS2G
12MS2G   O        443,976  06-29-98   4:31p 12MS2G.O
12MS2H             27,174  06-29-98   4:31p 12MS2H
12MS2H   O        444,489  06-29-98   4:31p 12MS2H.O
12MS2I             27,174  06-29-98   4:31p 12MS2I
12MS2I   O        444,562  06-29-98   4:31p 12MS2I.O
12MS2J             27,175  06-29-98   4:31p 12MS2J
```

```
12MS2J   O    444,619  06-29-98  4:31p 12MS2J.O
12MS2N         27,267  06-29-98  4:31p 12MS2N
12MS2N   O    446,568  06-29-98  4:31p 12MS2N.O
12MS2O         27,266  06-29-98  4:31p 12MS2O
12MS2O   O    446,495  06-29-98  4:31p 12MS2O.O
12MS2P         27,267  06-29-98  4:31p 12MS2P
12MS2P   O    445,811  06-29-98  4:31p 12MS2P.O
12MS2Q         27,266  06-29-98  4:31p 12MS2Q
12MS2Q   O    446,568  06-29-98  4:31p 12MS2Q.O
12MS2R         27,266  06-29-98  4:31p 12MS2R
12MS2R   O    446,488  06-29-98  4:31p 12MS2R.O
12MS2S         27,269  06-29-98  4:31p 12MS2S
12MS2S   O    446,495  06-29-98  4:31p 12MS2S.O
12MS2T         27,268  06-29-98  4:31p 12MS2T
12MS2T   O    446,568  06-29-98  4:31p 12MS2T.O
12MS2U         27,268  06-29-98  4:31p 12MS2U
12MS2U   O    446,495  06-29-98  4:31p 12MS2U.O
12MS2V         27,269  06-29-98  4:31p 12MS2V
12MS2V   O    446,438  06-29-98  4:31p 12MS2V.O
12MS2W         27,269  06-29-98  4:31p 12MS2W
12MS2W   O    446,495  06-29-98  4:31p 12MS2W.O
12MS2X         27,269  06-29-98  4:31p 12MS2X
12MS2X   O    446,495  06-29-98  4:31p 12MS2X.O
12MS2Y         27,260  06-29-98  4:31p 12MS2Y
12MS2Y   O    446,568  06-29-98  4:31p 12MS2Y.O
12MS2Z         27,270  06-29-98  4:31p 12MS2Z
12MS2Z   O    446,495  06-29-98  4:31p 12MS2Z.O
12MS3A         27,267  06-29-98  4:31p 12MS3A
12MS3A   O    446,495  06-29-98  4:31p 12MS3A.O
12MS3B         27,272  06-29-98  4:31p 12MS3B
12MS3B   O    446,743  06-29-98  4:31p 12MS3B.O
12MS3C         27,240  06-29-98  4:31p 12MS3C
12MS3C   O    446,146  06-29-98  4:31p 12MS3C.O
12MS3D         27,239  06-29-98  4:31p 12MS3D
12MS3D   O    445,576  06-29-98  4:31p 12MS3D.O
12MS3E         27,176  06-29-98  4:31p 12MS3E
12MS3E   O    444,867  06-29-98  4:31p 12MS3E.O
12MS3F         27,175  06-29-98  4:31p 12MS3F
12MS3F   O    444,595  06-29-98  4:31p 12MS3F.O
12MS3G         27,175  06-29-98  4:31p 12MS3G
12MS3G   O    444,859  06-29-98  4:31p 12MS3G.O
12MS3H         27,176  06-29-98  4:31p 12MS3H
12MS3H   O    444,867  06-29-98  4:31p 12MS3H.O
12MS3I         27,170  06-29-98  4:31p 12MS3I
12MS3I   O    444,867  06-29-98  4:31p 12MS3I.O
12MS3J         27,170  06-29-98  4:31p 12MS3J
12MS3J   O    444,916  06-29-98  4:31p 12MS3J.O
12MS3N         27,269  06-29-98  4:31p 12MS3N
12MS3N   O    446,495  06-29-98  4:31p 12MS3N.O
12MS3O         27,260  06-29-98  4:31p 12MS3O
12MS3O   O    446,438  06-29-98  4:31p 12MS3O.O
12MS3P         27,269  06-29-98  4:31p 12MS3P
12MS3P   O    446,438  06-29-98  4:31p 12MS3P.O
12MS3Q         27,269  06-29-98  4:31p 12MS3Q
12MS3Q   O    446,568  06-29-98  4:31p 12MS3Q.O
```

```
12MS3R             27,268  06-29-98   4:31p 12MS3R
12MS3R    O       446,568  06-29-98   4:31p 12MS3R.O
12MS3S             27,267  06-29-98   4:32p 12MS3S
12MS3S    O       446,568  06-29-98   4:32p 12MS3S.O
12MS3T             27,270  06-29-98   4:32p 12MS3T
12MS3T    O       446,568  06-29-98   4:32p 12MS3T.O
12MS3U             27,268  06-29-98   4:32p 12MS3U
12MS3U    O       446,568  06-29-98   4:32p 12MS3U.O
12MS3V             27,270  06-29-98   4:32p 12MS3V
12MS3V    O       446,568  06-29-98   4:32p 12MS3V.O
12MS3W             27,261  06-29-98   4:32p 12MS3W
12MS3W    O       446,568  06-29-98   4:32p 12MS3W.O
12MS3X             27,269  06-29-98   4:32p 12MS3X
12MS3X    O       446,438  06-29-98   4:32p 12MS3X.O
12MS3Y             27,262  06-29-98   4:32p 12MS3Y
12MS3Y    O       446,495  06-29-98   4:32p 12MS3Y.O
12MS3Z             27,271  06-29-98   4:32p 12MS3Z
12MS3Z    O       446,495  06-29-98   4:32p 12MS3Z.O
12MU1A             29,730  06-29-98   4:32p 12MU1A
12MU1A    O       448,441  06-29-98   4:32p 12MU1A.O
12MU1B             29,731  06-29-98   4:32p 12MU1B
12MU1B    O       447,684  06-29-98   4:32p 12MU1B.O
12MU1C             29,699  06-29-98   4:32p 12MU1C
12MU1C    O       447,844  06-29-98   4:32p 12MU1C.O
12MU1D             29,701  06-29-98   4:32p 12MU1D
12MU1D    O       447,787  06-29-98   4:32p 12MU1D.O
12MU1E             29,637  06-29-98   4:32p 12MU1E
12MU1E    O       445,922  06-29-98   4:32p 12MU1E.O
12MU1F             29,636  06-29-98   4:32p 12MU1F
12MU1F    O       446,492  06-29-98   4:32p 12MU1F.O
12MU1G             29,637  06-29-98   4:32p 12MU1G
12MU1G    O       446,403  06-29-98   4:32p 12MU1G.O
12MU1H             29,636  06-29-98   4:32p 12MU1H
12MU1H    O       446,476  06-29-98   4:32p 12MU1H.O
12MU1I             29,637  06-29-98   4:32p 12MU1I
12MU1I    O       445,762  06-29-98   4:32p 12MU1I.O
12MU1J             29,636  06-29-98   4:32p 12MU1J
12MU1J    O       445,930  06-29-98   4:32p 12MU1J.O
12MU1M             29,733  06-29-98   4:32p 12MU1M
12MU1M    O       448,384  06-29-98   4:32p 12MU1M.O
12MU1N             29,726  06-29-98   4:32p 12MU1N
12MU1N    O       447,565  06-29-98   4:32p 12MU1N.O
12MU1O             29,724  06-29-98   4:32p 12MU1O
12MU1O    O       448,311  06-29-98   4:32p 12MU1O.O
12MU1P             29,726  06-29-98   4:32p 12MU1P
12MU1P    O       448,490  06-29-98   4:32p 12MU1P.O
12MU1Q             29,718  06-29-98   4:32p 12MU1Q
12MU1Q    O       448,384  06-29-98   4:32p 12MU1Q.O
12MU1R             29,727  06-29-98   4:32p 12MU1R
12MU1R    O       448,441  06-29-98   4:32p 12MU1R.O
12MU1S             29,723  06-29-98   4:32p 12MU1S
12MU1S    O       447,711  06-29-98   4:32p 12MU1S.O
12MU1T             29,723  06-29-98   4:32p 12MU1T
12MU1T    O       448,441  06-29-98   4:32p 12MU1T.O
12MU1U             29,730  06-29-98   4:32p 12MU1U
```

```
12MU1U    O    448,368  06-29-98  4:32p 12MU1U.O
12MU1V          29,729  06-29-98  4:32p 12MU1V
12MU1V    O    448,573  06-29-98  4:32p 12MU1V.O
12MU1W          29,731  06-29-98  4:32p 12MU1W
12MU1W    O    448,368  06-29-98  4:32p 12MU1W.O
12MU1X          29,732  06-29-98  4:32p 12MU1X
12MU1X    O    448,384  06-29-98  4:32p 12MU1X.O
12MU1Y          29,728  06-29-98  4:32p 12MU1Y
12MU1Y    O    447,757  06-29-98  4:32p 12MU1Y.O
12MU1Z          29,722  06-29-98  4:32p 12MU1Z
12MU1Z    O    448,368  06-29-98  4:32p 12MU1Z.O
12MU2A          29,728  06-29-98  4:32p 12MU2A
12MU2A    O    448,490  06-29-98  4:32p 12MU2A.O
12MU2B          29,728  06-29-98  4:32p 12MU2B
12MU2B    O    448,441  06-29-98  4:32p 12MU2B.O
12MU2C          29,698  06-29-98  4:32p 12MU2C
12MU2C    O    447,160  06-29-98  4:32p 12MU2C.O
12MU2D          29,695  06-29-98  4:32p 12MU2D
12MU2D    O    447,844  06-29-98  4:32p 12MU2D.O
12MU2E          29,633  06-29-98  4:32p 12MU2E
12MU2E    O    446,468  06-29-98  4:32p 12MU2E.O
12MU2F          29,634  06-29-98  4:32p 12MU2F
12MU2F    O    446,419  06-29-98  4:32p 12MU2F.O
12MU2G          29,635  06-29-98  4:32p 12MU2G
12MU2G    O    446,492  06-29-98  4:32p 12MU2G.O
12MU2H          29,634  06-29-98  4:32p 12MU2H
12MU2H    O    446,435  06-29-98  4:32p 12MU2H.O
12MU2I          29,634  06-29-98  4:32p 12MU2I
12MU2I    O    446,492  06-29-98  4:32p 12MU2I.O
12MU2J          29,635  06-29-98  4:32p 12MU2J
12MU2J    O    445,616  06-29-98  4:32p 12MU2J.O
12MU2M          29,731  06-29-98  4:32p 12MU2M
12MU2M    O    448,441  06-29-98  4:32p 12MU2M.O
12MU2N          29,727  06-29-98  4:32p 12MU2N
12MU2N    O    448,425  06-29-98  4:32p 12MU2N.O
12MU2O          29,726  06-29-98  4:32p 12MU2O
12MU2O    O    448,425  06-29-98  4:32p 12MU2O.O
12MU2P          29,727  06-29-98  4:32p 12MU2P
12MU2P    O    448,311  06-29-98  4:32p 12MU2P.O
12MU2Q          29,726  06-29-98  4:32p 12MU2Q
12MU2Q    O    448,368  06-29-98  4:32p 12MU2Q.O
12MU2R          29,726  06-29-98  4:32p 12MU2R
12MU2R    O    447,711  06-29-98  4:32p 12MU2R.O
12MU2S          29,729  06-29-98  4:32p 12MU2S
12MU2S    O    448,384  06-29-98  4:32p 12MU2S.O
12MU2T          29,728  06-29-98  4:33p 12MU2T
12MU2T    O    447,871  06-29-98  4:33p 12MU2T.O
12MU2U          29,728  06-29-98  4:33p 12MU2U
12MU2U    O    448,441  06-29-98  4:33p 12MU2U.O
12MU2V          29,729  06-29-98  4:33p 12MU2V
12MU2V    O    448,441  06-29-98  4:33p 12MU2V.O
12MU2W          29,729  06-29-98  4:33p 12MU2W
12MU2W    O    448,368  06-29-98  4:33p 12MU2W.O
12MU2X          29,729  06-29-98  4:33p 12MU2X
12MU2X    O    448,441  06-29-98  4:33p 12MU2X.O
```

```
12MU2Y             29,720  06-29-98   4:33p 12MU2Y
12MU2Y    O       448,441  06-29-98   4:33p 12MU2Y.O
12MU2Z             29,730  06-29-98   4:33p 12MU2Z
12MU2Z    O       447,711  06-29-98   4:33p 12MU2Z.O
12MU3A             29,727  06-29-98   4:33p 12MU3A
12MU3A    O       448,384  06-29-98   4:33p 12MU3A.O
12MU3B             29,732  06-29-98   4:33p 12MU3B
12MU3B    O       448,384  06-29-98   4:33p 12MU3B.O
12MU3C             29,700  06-29-98   4:33p 12MU3C
12MU3C    O       447,844  06-29-98   4:33p 12MU3C.O
12MU3D             29,699  06-29-98   4:33p 12MU3D
12MU3D    O       447,114  06-29-98   4:33p 12MU3D.O
12MU3E             29,636  06-29-98   4:33p 12MU3E
12MU3E    O       446,492  06-29-98   4:33p 12MU3E.O
12MU3F             29,635  06-29-98   4:33p 12MU3F
12MU3F    O       445,762  06-29-98   4:33p 12MU3F.O
12MU3G             29,635  06-29-98   4:33p 12MU3G
12MU3G    O       446,492  06-29-98   4:33p 12MU3G.O
12MU3H             29,636  06-29-98   4:33p 12MU3H
12MU3H    O       446,240  06-29-98   4:33p 12MU3H.O
12MU3I             29,630  06-29-98   4:33p 12MU3I
12MU3I    O       445,616  06-29-98   4:33p 12MU3I.O
12MU3J             29,630  06-29-98   4:33p 12MU3J
12MU3J    O       446,753  06-29-98   4:33p 12MU3J.O
12MU3N             29,729  06-29-98   4:33p 12MU3N
12MU3N    O       448,368  06-29-98   4:33p 12MU3N.O
12MU3O             29,720  06-29-98   4:33p 12MU3O
12MU3O    O       447,684  06-29-98   4:33p 12MU3O.O
12MU3P             29,729  06-29-98   4:33p 12MU3P
12MU3P    O       448,441  06-29-98   4:33p 12MU3P.O
12MU3Q             29,729  06-29-98   4:33p 12MU3Q
12MU3Q    O       448,368  06-29-98   4:33p 12MU3Q.O
12MU3R             29,728  06-29-98   4:33p 12MU3R
12MU3R    O       447,757  06-29-98   4:33p 12MU3R.O
12MU3S             29,727  06-29-98   4:33p 12MU3S
12MU3S    O       448,441  06-29-98   4:33p 12MU3S.O
12MU3T             29,730  06-29-98   4:33p 12MU3T
12MU3T    O       448,311  06-29-98   4:33p 12MU3T.O
12MU3U             29,728  06-29-98   4:33p 12MU3U
12MU3U    O       448,384  06-29-98   4:33p 12MU3U.O
12MU3V             29,730  06-29-98   4:33p 12MU3V
12MU3V    O       448,441  06-29-98   4:33p 12MU3V.O
12MU3W             29,721  06-29-98   4:33p 12MU3W
12MU3W    O       448,441  06-29-98   4:33p 12MU3W.O
12MU3X             29,729  06-29-98   4:33p 12MU3X
12MU3X    O       448,441  06-29-98   4:33p 12MU3X.O
12MU3Y             29,722  06-29-98   4:33p 12MU3Y
12MU3Y    O       447,711  06-29-98   4:33p 12MU3Y.O
12MU3Z             29,731  06-29-98   4:33p 12MU3Z
12MU3Z    O       448,441  06-29-98   4:33p 12MU3Z.O
12MS4A             27,265  06-29-98   4:33p 12ms4a
12MS4A    O       446,568  06-29-98   4:33p 12ms4a.O
12MS4B             27,267  06-29-98   4:33p 12ms4b
12MS4B    O       446,568  06-29-98   4:33p 12ms4b.O
12MS4C             27,234  06-29-98   4:33p 12ms4c
```

12MS4C	O	445,971	06-29-98	4:33p	12ms4c.O
12MS4D		27,235	06-29-98	4:33p	12ms4d
12MS4D	O	445,971	06-29-98	4:33p	12ms4d.O
12MS4E		27,172	06-29-98	4:33p	12ms4e
12MS4E	O	444,619	06-29-98	4:33p	12ms4e.O
12MS4F		27,162	06-29-98	4:33p	12ms4f
12MS4F	O	444,619	06-29-98	4:33p	12ms4f.O
12MS4G		27,171	06-29-98	4:33p	12ms4g
12MS4G	O	444,595	06-29-98	4:33p	12ms4g.O
12MS4H		27,169	06-29-98	4:33p	12ms4h
12MS4H	O	443,960	06-29-98	4:33p	12ms4h.O
12MS4I		27,173	06-29-98	4:33p	12ms4i
12MS4I	O	444,562	06-29-98	4:33p	12ms4i.O
12MS4J		27,170	06-29-98	4:33p	12ms4j
12MS4J	O	444,489	06-29-98	4:33p	12ms4j.O
12MS4N		27,263	06-29-98	4:33p	12ms4n
12MS4N	O	446,438	06-29-98	4:33p	12ms4n.O
12MS4O		27,264	06-29-98	4:33p	12ms4o
12MS4O	O	446,495	06-29-98	4:33p	12ms4o.O
12MS4P		27,265	06-29-98	4:33p	12ms4p
12MS4P	O	446,568	06-29-98	4:33p	12ms4p.O
12MS4Q		27,263	06-29-98	4:33p	12ms4q
12MS4Q	O	446,544	06-29-98	4:33p	12ms4q.O
12MS4R		27,264	06-29-98	4:33p	12ms4r
12MS4R	O	445,998	06-29-98	4:33p	12ms4r.O
12MS4S		27,265	06-29-98	4:33p	12ms4s
12MS4S	O	446,495	06-29-98	4:33p	12ms4s.O
12MS4T		27,265	06-29-98	4:33p	12ms4t
12MS4T	O	446,568	06-29-98	4:33p	12ms4t.O
12MS4U		27,266	06-29-98	4:33p	12ms4u
12MS4U	O	446,511	06-29-98	4:33p	12ms4u.O
12MS4V		27,264	06-29-98	4:34p	12ms4v
12MS4V	O	446,495	06-29-98	4:34p	12ms4v.O
12MS4W		27,266	06-29-98	4:34p	12ms4w
12MS4W	O	446,495	06-29-98	4:34p	12ms4w.O
12MS4X		27,263	06-29-98	4:34p	12ms4x
12MS4X	O	446,495	06-29-98	4:34p	12ms4x.O
12MS4Y		27,267	06-29-98	4:34p	12ms4y
12MS4Y	O	446,479	06-29-98	4:34p	12ms4y.O
12MS4Z		27,267	06-29-98	4:34p	12ms4z
12MS4Z	O	446,495	06-29-98	4:34p	12ms4z.O
12MU4A		29,725	06-29-98	4:34p	12mu4a
12MU4A	O	447,027	06-29-98	4:34p	12mu4a.O
12MU4B		29,727	06-29-98	4:34p	12mu4b
12MU4B	O	448,441	06-29-98	4:34p	12mu4b.O
12MU4C		29,694	06-29-98	4:34p	12mu4c
12MU4C	O	447,812	06-29-98	4:34p	12mu4c.O
12MU4D		29,695	06-29-98	4:34p	12mu4d
12MU4D	O	447,844	06-29-98	4:34p	12mu4d.O
12MU4E		29,632	06-29-98	4:34p	12mu4e
12MU4E	O	446,492	06-29-98	4:34p	12mu4e.O
12MU4F		29,622	06-29-98	4:34p	12mu4f
12MU4F	O	445,046	06-29-98	4:34p	12mu4f.O
12MU4G		29,631	06-29-98	4:34p	12mu4g
12MU4G	O	445,762	06-29-98	4:34p	12mu4g.O

```
12MU4H          29,629  06-29-98  4:34p 12mu4h
12MU4H    O    446,492  06-29-98  4:34p 12mu4h.O
12MU4I          29,633  06-29-98  4:34p 12mu4i
12MU4I    O    446,492  06-29-98  4:34p 12mu4i.O
12MU4J          29,630  06-29-98  4:34p 12mu4j
12MU4J    O    445,616  06-29-98  4:34p 12mu4j.O
12MU4N          29,723  06-29-98  4:34p 12mu4n
12MU4N    O    447,757  06-29-98  4:34p 12mu4n.O
12MU4O          29,724  06-29-98  4:34p 12mu4o
12MU4O    O    448,441  06-29-98  4:34p 12mu4o.O
12MU4P          29,725  06-29-98  4:34p 12mu4p
12MU4P    O    448,441  06-29-98  4:34p 12mu4p.O
12MU4Q          29,723  06-29-98  4:34p 12mu4q
12MU4Q    O    446,995  06-29-98  4:34p 12mu4q.O
12MU4R          29,724  06-29-98  4:34p 12mu4r
12MU4R    O    447,565  06-29-98  4:34p 12mu4r.O
12MU4S          29,725  06-29-98  4:34p 12mu4s
12MU4S    O    447,734  06-29-98  4:34p 12mu4s.O
12MU4T          29,725  06-29-98  4:34p 12mu4t
12MU4T    O    447,806  06-29-98  4:34p 12mu4t.O
12MU4U          29,726  06-29-98  4:34p 12mu4u
12MU4U    O    448,441  06-29-98  4:34p 12mu4u.O
12MU4V          29,724  06-29-98  4:34p 12mu4v
12MU4V    O    447,565  06-29-98  4:34p 12mu4v.O
12MU4W          29,726  06-29-98  4:34p 12mu4w
12MU4W    O    448,441  06-29-98  4:34p 12mu4w.O
12MU4X          29,723  06-29-98  4:34p 12mu4x
12MU4X    O    447,733  06-29-98  4:34p 12mu4x.O
12MU4Y          29,727  06-29-98  4:34p 12mu4y
12MU4Y    O    448,441  06-29-98  4:34p 12mu4y.O
12MU4Z          29,727  06-29-98  4:34p 12mu4z
12MU4Z    O    448,384  06-29-98  4:34p 12mu4z.O
21MS1A          15,317  06-29-98  4:34p 21MS1A
21MS1A    O    294,166  06-29-98  4:34p 21MS1A.O
21MS1B          15,318  06-29-98  4:34p 21MS1B
21MS1B    O    294,096  06-29-98  4:34p 21MS1B.O
21MS1C          15,286  06-29-98  4:34p 21MS1C
21MS1C    O    293,569  06-29-98  4:34p 21MS1C.O
21MS1D          15,288  06-29-98  4:34p 21MS1D
21MS1D    O    293,562  06-29-98  4:34p 21MS1D.O
21MS1E          15,224  06-29-98  4:34p 21MS1E
21MS1E    O    292,090  06-29-98  4:34p 21MS1E.O
21MS1F          15,223  06-29-98  4:34p 21MS1F
21MS1F    O    292,139  06-29-98  4:34p 21MS1F.O
21MS1G          15,224  06-29-98  4:34p 21MS1G
21MS1G    O    292,131  06-29-98  4:34p 21MS1G.O
21MS1H          15,223  06-29-98  4:34p 21MS1H
21MS1H    O    292,217  06-29-98  4:34p 21MS1H.O
21MS1I          15,224  06-29-98  4:34p 21MS1I
21MS1I    O    292,140  06-29-98  4:34p 21MS1I.O
21MS1J          15,223  06-29-98  4:34p 21MS1J
21MS1J    O    292,083  06-29-98  4:34p 21MS1J.O
21MS1M          15,320  06-29-98  4:34p 21MS1M
21MS1M    O    294,039  06-29-98  4:34p 21MS1M.O
21MS1N          15,313  06-29-98  4:34p 21MS1N
```

```
21MS1N   O     294,215  06-29-98  4:34p 21MS1N.O
21MS1O          15,311  06-29-98  4:34p 21MS1O
21MS1O   O     294,096  06-29-98  4:34p 21MS1O.O
21MS1P          15,313  06-29-98  4:34p 21MS1P
21MS1P   O     294,166  06-29-98  4:34p 21MS1P.O
21MS1Q          15,305  06-29-98  4:34p 21MS1Q
21MS1Q   O     294,166  06-29-98  4:34p 21MS1Q.O
21MS1R          15,314  06-29-98  4:34p 21MS1R
21MS1R   O     294,109  06-29-98  4:34p 21MS1R.O
21MS1S          15,310  06-29-98  4:34p 21MS1S
21MS1S   O     294,089  06-29-98  4:34p 21MS1S.O
21MS1T          15,310  06-29-98  4:34p 21MS1T
21MS1T   O     294,039  06-29-98  4:34p 21MS1T.O
21MS1U          15,317  06-29-98  4:34p 21MS1U
21MS1U   O     294,039  06-29-98  4:34p 21MS1U.O
21MS1V          15,316  06-29-98  4:34p 21MS1V
21MS1V   O     294,109  06-29-98  4:34p 21MS1V.O
21MS1W          15,318  06-29-98  4:34p 21MS1W
21MS1W   O     294,073  06-29-98  4:34p 21MS1W.O
21MS1X          15,319  06-29-98  4:34p 21MS1X
21MS1X   O     294,088  06-29-98  4:34p 21MS1X.O
21MS1Y          15,315  06-29-98  4:34p 21MS1Y
21MS1Y   O     294,166  06-29-98  4:34p 21MS1Y.O
21MS1Z          15,309  06-29-98  4:34p 21MS1Z
21MS1Z   O     294,337  06-29-98  4:34p 21MS1Z.O
21MS2A          15,315  06-29-98  4:34p 21MS2A
21MS2A   O     294,166  06-29-98  4:34p 21MS2A.O
21MS2B          15,315  06-29-98  4:34p 21MS2B
21MS2B   O     294,166  06-29-98  4:34p 21MS2B.O
21MS2C          15,285  06-29-98  4:34p 21MS2C
21MS2C   O     293,569  06-29-98  4:34p 21MS2C.O
21MS2D          15,282  06-29-98  4:34p 21MS2D
21MS2D   O     293,569  06-29-98  4:35p 21MS2D.O
21MS2E          15,220  06-29-98  4:35p 21MS2E
21MS2E   O     292,147  06-29-98  4:35p 21MS2E.O
21MS2F          15,221  06-29-98  4:35p 21MS2F
21MS2F   O     292,217  06-29-98  4:35p 21MS2F.O
21MS2G          15,222  06-29-98  4:35p 21MS2G
21MS2G   O     292,217  06-29-98  4:35p 21MS2G.O
21MS2H          15,221  06-29-98  4:35p 21MS2H
21MS2H   O     292,217  06-29-98  4:35p 21MS2H.O
21MS2I          15,221  06-29-98  4:35p 21MS2I
21MS2I   O     292,147  06-29-98  4:35p 21MS2I.O
21MS2J          15,222  06-29-98  4:35p 21MS2J
21MS2J   O     292,217  06-29-98  4:35p 21MS2J.O
21MS2M          15,318  06-29-98  4:35p 21MS2M
21MS2M   O     294,109  06-29-98  4:35p 21MS2M.O
21MS2N          15,314  06-29-98  4:35p 21MS2N
21MS2N   O     294,039  06-29-98  4:35p 21MS2N.O
21MS2O          15,313  06-29-98  4:35p 21MS2O
21MS2O   O     294,166  06-29-98  4:35p 21MS2O.O
21MS2P          15,314  06-29-98  4:35p 21MS2P
21MS2P   O     294,166  06-29-98  4:35p 21MS2P.O
21MS2Q          15,313  06-29-98  4:35p 21MS2Q
21MS2Q   O     294,039  06-29-98  4:35p 21MS2Q.O
```

21MS2R		15,313	06-29-98	4:35p	21MS2R
21MS2R	O	294,039	06-29-98	4:35p	21MS2R.O
21MS2S		15,316	06-29-98	4:35p	21MS2S
21MS2S	O	294,145	06-29-98	4:35p	21MS2S.O
21MS2T		15,315	06-29-98	4:35p	21MS2T
21MS2T	O	294,096	06-29-98	4:35p	21MS2T.O
21MS2U		15,315	06-29-98	4:35p	21MS2U
21MS2U	O	294,096	06-29-98	4:35p	21MS2U.O
21MS2V		15,316	06-29-98	4:35p	21MS2V
21MS2V	O	294,166	06-29-98	4:35p	21MS2V.O
21MS2W		15,316	06-29-98	4:35p	21MS2W
21MS2W	O	294,039	06-29-98	4:35p	21MS2W.O
21MS2X		15,316	06-29-98	4:35p	21MS2X
21MS2X	O	294,039	06-29-98	4:35p	21MS2X.O
21MS2Y		15,307	06-29-98	4:35p	21MS2Y
21MS2Y	O	294,088	06-29-98	4:35p	21MS2Y.O
21MS2Z		15,317	06-29-98	4:35p	21MS2Z
21MS2Z	O	294,166	06-29-98	4:35p	21MS2Z.O
21MSDE		14,805	06-29-98	4:35p	21MSDE
21MSDE	O	284,065	06-29-98	4:35p	21MSDE.O
21MU1A		14,504	06-29-98	4:35p	21MU1A
21MU1A	O	293,019	06-29-98	4:35p	21MU1A.O
21MU1B		14,505	06-29-98	4:35p	21MU1B
21MU1B	O	292,319	06-29-98	4:35p	21MU1B.O
21MU1C		14,473	06-29-98	4:35p	21MU1C
21MU1C	O	292,422	06-29-98	4:35p	21MU1C.O
21MU1D		14,475	06-29-98	4:35p	21MU1D
21MU1D	O	292,422	06-29-98	4:35p	21MU1D.O
21MU1E		14,411	06-29-98	4:35p	21MU1E
21MU1E	O	291,054	06-29-98	4:35p	21MU1E.O
21MU1F	O	291,119	06-29-98	4:35p	21MU1F.O
21MU1G		14,411	06-29-98	4:35p	21MU1G
21MU1G	O	291,070	06-29-98	4:35p	21MU1G.O
21MU1H		14,410	06-29-98	4:35p	21MU1H
21MU1H	O	291,070	06-29-98	4:35p	21MU1H.O
21MU1I		14,411	06-29-98	4:35p	21MU1I
21MU1I	O	291,000	06-29-98	4:35p	21MU1I.O
21MU1J		14,410	06-29-98	4:35p	21MU1J
21MU1J	O	291,070	06-29-98	4:35p	21MU1J.O
21MU1M		14,507	06-29-98	4:35p	21MU1M
21MU1M	O	293,019	06-29-98	4:35p	21MU1M.O
21MU1N		14,500	06-29-98	4:35p	21MU1N
21MU1N	O	292,949	06-29-98	4:35p	21MU1N.O
21MU1O		14,498	06-29-98	4:35p	21MU1O
21MU1O	O	293,011	06-29-98	4:35p	21MU1O.O
21MU1P		14,500	06-29-98	4:35p	21MU1P
21MU1P	O	293,019	06-29-98	4:35p	21MU1P.O
21MU1Q		14,492	06-29-98	4:35p	21MU1Q
21MU1Q	O	292,335	06-29-98	4:35p	21MU1Q.O
21MU1R		14,501	06-29-98	4:35p	21MU1R
21MU1R	O	293,019	06-29-98	4:35p	21MU1R.O
21MU1S		14,497	06-29-98	4:35p	21MU1S
21MU1S	O	292,335	06-29-98	4:35p	21MU1S.O
21MU1T		14,497	06-29-98	4:35p	21MU1T
21MU1T	O	292,962	06-29-98	4:35p	21MU1T.O

21MU1U		14,504	06-29-98	4:35p	21MU1U
21MU1U	O	292,381	06-29-98	4:35p	21MU1U.O
21MU1V		14,503	06-29-98	4:35p	21MU1V
21MU1V	O	292,962	06-29-98	4:35p	21MU1V.O
21MU1W		14,505	06-29-98	4:35p	21MU1W
21MU1W	O	292,379	06-29-98	4:35p	21MU1W.O
21MU1X		14,506	06-29-98	4:35p	21MU1X
21MU1X	O	291,635	06-29-98	4:35p	21MU1X.O
21MU1Y		14,502	06-29-98	4:35p	21MU1Y
21MU1Y	O	293,019	06-29-98	4:35p	21MU1Y.O
21MU1Z		14,496	06-29-98	4:35p	21MU1Z
21MU1Z	O	293,019	06-29-98	4:35p	21MU1Z.O
21MU2A		14,502	06-29-98	4:35p	21MU2A
21MU2A	O	293,141	06-29-98	4:35p	21MU2A.O
21MU2B		14,502	06-29-98	4:35p	21MU2B
21MU2B	O	293,019	06-29-98	4:35p	21MU2B.O
21MU2C		14,472	06-29-98	4:35p	21MU2C
21MU2C	O	291,738	06-29-98	4:35p	21MU2C.O
21MU2D		14,469	06-29-98	4:35p	21MU2D
21MU2D	O	292,390	06-29-98	4:35p	21MU2D.O
21MU2E		14,407	06-29-98	4:35p	21MU2E
21MU2E	O	291,070	06-29-98	4:35p	21MU2E.O
21MU2F		14,408	06-29-98	4:35p	21MU2F
21MU2F	O	290,386	06-29-98	4:35p	21MU2F.O
21MU2G		14,409	06-29-98	4:35p	21MU2G
21MU2G	O	290,370	06-29-98	4:35p	21MU2G.O
21MU2H		14,408	06-29-98	4:35p	21MU2H
21MU2H	O	291,013	06-29-98	4:35p	21MU2H.O
21MU2I		14,408	06-29-98	4:35p	21MU2I
21MU2I	O	291,119	06-29-98	4:35p	21MU2I.O
21MU2J		14,409	06-29-98	4:35p	21MU2J
21MU2J	O	291,070	06-29-98	4:35p	21MU2J.O
21MU2M		14,505	06-29-98	4:35p	21MU2M
21MU2M	O	292,319	06-29-98	4:35p	21MU2M.O
21MU2N		14,501	06-29-98	4:35p	21MU2N
21MU2N	O	292,449	06-29-98	4:35p	21MU2N.O
21MU2O		14,500	06-29-98	4:35p	21MU2O
21MU2O	O	293,019	06-29-98	4:35p	21MU2O.O
21MU2P		14,501	06-29-98	4:35p	21MU2P
21MU2P	O	292,823	06-29-98	4:35p	21MU2P.O
21MU2Q		14,500	06-29-98	4:35p	21MU2Q
21MU2Q	O	292,449	06-29-98	4:35p	21MU2Q.O
21MU2R		14,500	06-29-98	4:35p	21MU2R
21MU2R	O	293,019	06-29-98	4:35p	21MU2R.O
21MU2S		14,503	06-29-98	4:36p	21MU2S
21MU2S	O	292,892	06-29-98	4:36p	21MU2S.O
21MU2T		14,502	06-29-98	4:36p	21MU2T
21MU2T	O	293,019	06-29-98	4:36p	21MU2T.O
21MU2U		14,502	06-29-98	4:36p	21MU2U
21MU2U	O	293,019	06-29-98	4:36p	21MU2U.O
21MU2V		14,503	06-29-98	4:36p	21MU2V
21MU2V	O	292,962	06-29-98	4:36p	21MU2V.O
21MU2W		14,503	06-29-98	4:36p	21MU2W
21MU2W	O	293,019	06-29-98	4:36p	21MU2W.O
21MU2X		14,503	06-29-98	4:36p	21MU2X

```
21MU2X    O        292,949  06-29-98   4:36p 21MU2X.O
21MU2Y              14,494  06-29-98   4:36p 21MU2Y
21MU2Y    O        292,962  06-29-98   4:36p 21MU2Y.O
21MU2Z              14,504  06-29-98   4:36p 21MU2Z
21MU2Z    O        293,019  06-29-98   4:36p 21MU2Z.O
       565 file(s)     118,235,432 bytes
```

Directory of \Sect6-3

```
21FU1NA              5,000  06-29-98   4:36p 21FU1NA
21FU1NA   O        176,990  06-29-98   4:36p 21FU1NA.O
21FU1NB              5,001  06-29-98   4:36p 21FU1NB
21FU1NB   O        176,150  06-29-98   4:36p 21FU1NB.O
21FU1NC              5,001  06-29-98   4:36p 21FU1NC
21FU1NC   O        176,990  06-29-98   4:36p 21FU1NC.O
21FU1ND              5,003  06-29-98   4:36p 21FU1ND
21FU1ND   O        177,088  06-29-98   4:36p 21FU1ND.O
21FU1NE              4,971  06-29-98   4:36p 21FU1NE
21FU1NE   O        175,598  06-29-98   4:36p 21FU1NE.O
21FU1NF              4,970  06-29-98   4:36p 21FU1NF
21FU1NF   O        176,438  06-29-98   4:36p 21FU1NF.O
21FU1NG              4,970  06-29-98   4:36p 21FU1NG
21FU1NG   O        175,207  06-29-98   4:36p 21FU1NG.O
21FU1NH              4,970  06-29-98   4:36p 21FU1NH
21FU1NH   O        176,438  06-29-98   4:36p 21FU1NH.O
21FU1NI              4,968  06-29-98   4:36p 21FU1NI
21FU1NI   O        176,756  06-29-98   4:36p 21FU1NI.O
21FU1NJ              4,972  06-29-98   4:36p 21FU1NJ
21FU1NJ   O        175,150  06-29-98   4:36p 21FU1NJ.O
21FU1NX              5,000  06-29-98   4:36p 21FU1NX
21FU1NX   O        176,150  06-29-98   4:36p 21FU1NX.O
21FU1NY              5,001  06-29-98   4:36p 21FU1NY
21FU1NY   O        176,150  06-29-98   4:36p 21FU1NY.O
21FU1NZ              5,002  06-29-98   4:36p 21FU1NZ
21FU1NZ   O        176,086  06-29-98   4:36p 21FU1NZ.O
21MFU1A              5,414  06-29-98   4:36p 21MFU1A
21MFU1A   O        183,353  06-29-98   4:36p 21MFU1A.O
21MFU1B              5,414  06-29-98   4:36p 21MFU1B
21MFU1B   O        183,362  06-29-98   4:36p 21MFU1B.O
21MFU1C              5,384  06-29-98   4:36p 21MFU1C
21MFU1C   O        182,452  06-29-98   4:36p 21MFU1C.O
21MFU1D              5,385  06-29-98   4:36p 21MFU1D
21MFU1D   O        183,551  06-29-98   4:36p 21MFU1D.O
21MFU1E              5,352  06-29-98   4:36p 21MFU1E
21MFU1E   O        182,608  06-29-98   4:36p 21MFU1E.O
21MFU1F              5,350  06-29-98   4:36p 21MFU1F
21MFU1F   O        182,291  06-29-98   4:36p 21MFU1F.O
21MFU1G              5,351  06-29-98   4:36p 21MFU1G
21MFU1G   O        183,048  06-29-98   4:36p 21MFU1G.O
21MFU1H              5,352  06-29-98   4:36p 21MFU1H
21MFU1H   O        182,429  06-29-98   4:36p 21MFU1H.O
21MFU1I              5,349  06-29-98   4:36p 21MFU1I
21MFU1I   O        182,608  06-29-98   4:36p 21MFU1I.O
21MFU1J              5,353  06-29-98   4:36p 21MFU1J
```

```
21MFU1J  O      182,942  06-29-98  4:36p 21MFU1J.O
21MFU1X           5,414  06-29-98  4:36p 21MFU1X
21MFU1X  O      183,646  06-29-98  4:36p 21MFU1X.O
21MFU1Y           5,414  06-29-98  4:36p 21MFU1Y
21MFU1Y  O      182,806  06-29-98  4:36p 21MFU1Y.O
21MFU1Z           5,415  06-29-98  4:36p 21MFU1Z
21MFU1Z  O      183,589  06-29-98  4:36p 21MFU1Z.O
21MP1A            9,975  06-29-98  4:36p 21MP1A
21MP1A   O      230,060  06-29-98  4:36p 21MP1A.O
21MP1B            9,976  06-29-98  4:36p 21MP1B
21MP1B   O      229,358  06-29-98  4:36p 21MP1B.O
21MP1C            9,944  06-29-98  4:37p 21MP1C
21MP1C   O      228,758  06-29-98  4:37p 21MP1C.O
21MP1D            9,946  06-29-98  4:37p 21MP1D
21MP1D   O      229,442  06-29-98  4:37p 21MP1D.O
21MP1DC           9,785  06-29-98  4:37p 21MP1DC
21MP1DC  O      226,692  06-29-98  4:37p 21MP1DC.O
21MP1DD           9,785  06-29-98  4:37p 21MP1DD
21MP1DD  O      226,762  06-29-98  4:37p 21MP1DD.O
21MP1DE           9,752  06-29-98  4:37p 21MP1DE
21MP1DE  O      226,210  06-29-98  4:37p 21MP1DE.O
21MP1DF           9,722  06-29-98  4:37p 21MP1DF
21MP1DF  O      225,033  06-29-98  4:37p 21MP1DF.O
21MP1DG           9,723  06-29-98  4:37p 21MP1DG
21MP1DG  O      225,724  06-29-98  4:37p 21MP1DG.O
21MP1DH           9,690  06-29-98  4:37p 21MP1DH
21MP1DH  O      225,238  06-29-98  4:37p 21MP1DH.O
21MP1DI           9,691  06-29-98  4:37p 21MP1DI
21MP1DI  O      225,238  06-29-98  4:37p 21MP1DI.O
21MP1DJ           9,627  06-29-98  4:37p 21MP1DJ
21MP1DJ  O      224,129  06-29-98  4:37p 21MP1DJ.O
21MP1E            9,882  06-29-98  4:37p 21MP1E
21MP1E   O      228,387  06-29-98  4:37p 21MP1E.O
21MP1F            9,881  06-29-98  4:37p 21MP1F
21MP1F   O      228,444  06-29-98  4:37p 21MP1F.O
21MP1G            9,882  06-29-98  4:37p 21MP1G
21MP1G   O      228,312  06-29-98  4:37p 21MP1G.O
21MP1H            9,881  06-29-98  4:37p 21MP1H
21MP1H   O      227,612  06-29-98  4:37p 21MP1H.O
21MP1I            9,882  06-29-98  4:37p 21MP1I
21MP1I   O      227,790  06-29-98  4:37p 21MP1I.O
21MP1J            9,881  06-29-98  4:37p 21MP1J
21MP1J   O      228,312  06-29-98  4:37p 21MP1J.O
21MP1NA           9,368  06-29-98  4:37p 21MP1NA
21MP1NA  O      219,976  06-29-98  4:37p 21MP1NA.O
21MP1NB           9,370  06-29-98  4:37p 21MP1NB
21MP1NB  O      220,108  06-29-98  4:37p 21MP1NB.O
21MP1NC           9,370  06-29-98  4:37p 21MP1NC
21MP1NC  O      219,976  06-29-98  4:37p 21MP1NC.O
21MP1ND           9,371  06-29-98  4:37p 21MP1ND
21MP1ND  O      219,976  06-29-98  4:37p 21MP1ND.O
21MP1NE           9,339  06-29-98  4:37p 21MP1NE
21MP1NE  O      219,424  06-29-98  4:37p 21MP1NE.O
21MP1NF           9,339  06-29-98  4:37p 21MP1NF
21MP1NF  O      219,481  06-29-98  4:37p 21MP1NF.O
```

```
21MP1NG           9,339  06-29-98  4:37p 21MP1NG
21MP1NG  O      218,584  06-29-98  4:37p 21MP1NG.O
21MP1NH           9,339  06-29-98  4:37p 21MP1NH
21MP1NH  O      219,481  06-29-98  4:37p 21MP1NH.O
21MP1NI           9,339  06-29-98  4:37p 21MP1NI
21MP1NI  O      219,411  06-29-98  4:37p 21MP1NI.O
21MP1NJ           9,338  06-29-98  4:37p 21MP1NJ
21MP1NJ  O      218,797  06-29-98  4:37p 21MP1NJ.O
21MP1NX           9,370  06-29-98  4:37p 21MP1NX
21MP1NX  O      219,333  06-29-98  4:37p 21MP1NX.O
21MP1NY           9,369  06-29-98  4:37p 21MP1NY
21MP1NY  O      219,333  06-29-98  4:37p 21MP1NY.O
21MP1NZ           9,365  06-29-98  4:37p 21MP1NZ
21MP1NZ  O      220,033  06-29-98  4:37p 21MP1NZ.O
21MP1X            9,977  06-29-98  4:37p 21MP1X
21MP1X   O      229,928  06-29-98  4:37p 21MP1X.O
21MP1Y            9,973  06-29-98  4:37p 21MP1Y
21MP1Y   O      229,088  06-29-98  4:37p 21MP1Y.O
21MP1Z            9,971  06-29-98  4:37p 21MP1Z
21MP1Z   O      229,088  06-29-98  4:37p 21MP1Z.O
MP13D1C           9,787  06-29-98  4:37p MP13D1C
MP13D1C  O      225,626  06-29-98  4:37p MP13D1C.O
MP13D1D           9,788  06-29-98  4:37p MP13D1D
MP13D1D  O      225,512  06-29-98  4:37p MP13D1D.O
MP13D1E           9,754  06-29-98  4:37p MP13D1E
MP13D1E  O      225,644  06-29-98  4:37p MP13D1E.O
MP13D1F           9,724  06-29-98  4:37p MP13D1F
MP13D1F  O      225,158  06-29-98  4:37p MP13D1F.O
MP13D1G           9,725  06-29-98  4:37p MP13D1G
MP13D1G  O      225,158  06-29-98  4:37p MP13D1G.O
MP13D1H           9,692  06-29-98  4:37p MP13D1H
MP13D1H  O      224,672  06-29-98  4:37p MP13D1H.O
MP13D1I           9,693  06-29-98  4:37p MP13D1I
MP13D1I  O      224,615  06-29-98  4:37p MP13D1I.O
MP13D1J           9,629  06-29-98  4:37p MP13D1J
MP13D1J  O      222,153  06-29-98  4:37p MP13D1J.O
MP13F1A           9,977  06-29-98  4:37p MP13F1A
MP13F1A  O      229,305  06-29-98  4:37p MP13F1A.O
MP13F1B           9,978  06-29-98  4:37p MP13F1B
MP13F1B  O      229,362  06-29-98  4:37p MP13F1B.O
MP13F1C           9,946  06-29-98  4:37p MP13F1C
MP13F1C  O      229,137  06-29-98  4:37p MP13F1C.O
MP13F1D           9,948  06-29-98  4:37p MP13F1D
MP13F1D  O      228,297  06-29-98  4:37p MP13F1D.O
MP13F1F           9,883  06-29-98  4:37p MP13F1F
MP13F1F  O      227,689  06-29-98  4:37p MP13F1F.O
MP13F1G           9,884  06-29-98  4:37p MP13F1G
MP13F1G  O      228,007  06-29-98  4:37p MP13F1G.O
MP13F1I           9,884  06-29-98  4:37p MP13F1I
MP13F1I  O      227,380  06-29-98  4:37p MP13F1I.O
MP13F1J           9,883  06-29-98  4:37p MP13F1J
MP13F1J  O      228,064  06-29-98  4:37p MP13F1J.O
MP13F1X           9,979  06-29-98  4:37p MP13F1X
MP13F1X  O      228,522  06-29-98  4:37p MP13F1X.O
MP13F1Y           9,975  06-29-98  4:37p MP13F1Y
```

MP13F1Y	O	229,305	06-29-98	4:37p	MP13F1Y.O
MP13F1Z		9,973	06-29-98	4:37p	MP13F1Z
MP13F1Z	O	229,305	06-29-98	4:37p	MP13F1Z.O
MP13N1A		9,370	06-29-98	4:37p	MP13N1A
MP13N1A	O	219,467	06-29-98	4:37p	MP13N1A.O
MP13N1B		9,372	06-29-98	4:37p	MP13N1B
MP13N1B	O	218,611	06-29-98	4:37p	MP13N1B.O
MP13N1C		9,372	06-29-98	4:37p	MP13N1C
MP13N1C	O	219,467	06-29-98	4:37p	MP13N1C.O
MP13N1D		9,373	06-29-98	4:37p	MP13N1D
MP13N1D	O	219,467	06-29-98	4:37p	MP13N1D.O
MP13N1F		9,341	06-29-98	4:37p	MP13N1F
MP13N1F	O	218,345	06-29-98	4:37p	MP13N1F.O
MP13N1G		9,341	06-29-98	4:37p	MP13N1G
MP13N1G	O	218,845	06-29-98	4:37p	MP13N1G.O
MP13N1I		9,341	06-29-98	4:37p	MP13N1I
MP13N1I	O	218,124	06-29-98	4:37p	MP13N1I.O
MP13N1J		9,340	06-29-98	4:37p	MP13N1J
MP13N1J	O	218,915	06-29-98	4:37p	MP13N1J.O
MP13N1X		9,372	06-29-98	4:37p	MP13N1X
MP13N1X	O	218,767	06-29-98	4:37p	MP13N1X.O
MP13N1Y		9,371	06-29-98	4:37p	MP13N1Y
MP13N1Y	O	219,340	06-29-98	4:37p	MP13N1Y.O
MP13N1Z		9,367	06-29-98	4:37p	MP13N1Z
MP13N1Z	O	219,397	06-29-98	4:37p	MP13N1Z.O
MP1E1		9,882	06-29-98	4:37p	MP1E1
MP1E1	O	227,746	06-29-98	4:38p	MP1E1.O
MP1E11		9,882	06-29-98	4:38p	MP1E11
MP1E11	O	227,428	06-29-98	4:38p	MP1E11.O
MP1E12		9,881	06-29-98	4:38p	MP1E12
MP1E12	O	226,588	06-29-98	4:38p	MP1E12.O
MP1E13		9,881	06-29-98	4:38p	MP1E13
MP1E13	O	226,728	06-29-98	4:38p	MP1E13.O
MP1H1		9,881	06-29-98	4:38p	MP1H1
MP1H1	O	226,906	06-29-98	4:38p	MP1H1.O
MP1H11		9,881	06-29-98	4:38p	MP1H11
MP1H11	O	227,428	06-29-98	4:38p	MP1H11.O
MP1H12		9,880	06-29-98	4:38p	MP1H12
MP1H12	O	227,358	06-29-98	4:38p	MP1H12.O
MP1H13		9,880	06-29-98	4:38p	MP1H13
MP1H13	O	226,588	06-29-98	4:38p	MP1H13.O
MP1NE1		9,339	06-29-98	4:38p	MP1NE1
MP1NE1	O	217,897	06-29-98	4:38p	MP1NE1.O
MP1NE11		9,339	06-29-98	4:38p	MP1NE11
MP1NE11	O	218,597	06-29-98	4:38p	MP1NE11.O
MP1NE12		9,338	06-29-98	4:38p	MP1NE12
MP1NE12	O	218,540	06-29-98	4:38p	MP1NE12.O
MP1NE13		9,338	06-29-98	4:38p	MP1NE13
MP1NE13	O	218,597	06-29-98	4:38p	MP1NE13.O
MP1NH1		9,339	06-29-98	4:38p	MP1NH1
MP1NH1	O	218,476	06-29-98	4:38p	MP1NH1.O
MP1NH11		9,339	06-29-98	4:38p	MP1NH11
MP1NH11	O	218,858	06-29-98	4:38p	MP1NH11.O
MP1NH12		9,338	06-29-98	4:38p	MP1NH12
MP1NH12	O	218,915	06-29-98	4:38p	MP1NH12.O

```
MP1NH13               9,338  06-29-98  4:38p MP1NH13
MP1NH13  O          218,215  06-29-98  4:38p MP1NH13.O
       212 file(s)       23,496,951 bytes
```

Directory of \Excel

```
MOXOXIDE XLS        320,512  06-29-98  4:39p MOXoxide.xls
         1 file(s)          320,512 bytes
```

Directory of \Amigo1

```
AMIGO1    BAS        15,874  05-26-98 10:34a AMIGO1.BAS
W3_35-5   SUM        69,135  05-15-98  5:12p w3_35-5.sum
W3_50-0   SUM       135,715  06-15-98  9:21a W3_50-0.sum
12AIW1    TMP        26,527  05-25-98  4:19p 12aiw1.tmp
12IW1     TMP        26,546  05-18-98  3:08p 12iw1.tmp
12SW1     TMP        26,280  05-27-98  1:17p 12SW1.tmp
12UW1     TMP        28,740  05-15-98  5:46p 12UW1.TMP
21FULLU   TMP         4,656  05-27-98  8:10a 21FULLU.tmp
21IW1N    TMP        28,771  05-25-98  4:18p 21iw1n.tmp
21PILE    TMP         8,992  05-24-98  1:17p 21PILE.tmp
21SW1     TMP        14,327  05-15-98  5:43p 21SW1.TMP
21UW1     TMP        13,514  05-15-98  5:44p 21uw1.tmp
W3_39-3   SUM        68,464  05-15-98  5:12p w3_39-3.sum
W3_46-5   SUM       135,715  05-26-98  6:25p w3_46-5.sum
        14 file(s)          603,256 bytes
```

	A	B	C	D	E	F	G	H
1	**Material and Number Density Worksheet for W 17x17 PWR MOX fuel in a 12 PWR WP**							
2								
3	12 PWR WP Basket Component Volumes	Component Volume		Vol. /WP				
4	Basket Comp.	(mm^3)	# per WP	(mm^3)				
5	A-Plate	1.08E+07	4	4.33E+07				
6	B-Plate	1.08E+07	4	4.33E+07				
7	C-Plate	2.70E+06	16	4.33E+07				
8	A-Guide	5.22E+06	16	8.35E+07				
9	B-Guide	5.31E+05	16	8.50E+06				
10	Corner Guide	5.30E+06	16	8.49E+07				
11	Stiffener	3.08E+05	32	9.85E+06				
12	Tube	2.09E+07	12	2.51E+08				
13								
14								
15	All CS Basket		TOTAL CS (cc)	TOTAL Al (cc)				
16	Basket w/ Al A & B Plates		5.67E+05	0.00E+00				
17			4.81E+05	8.65E+04				
18	Density of Fe2O3 (Hematite)		5.24	g/cc	Ref. 7.12			
19								
20	Molecular Weight of Fe2O3		159.678745	g/mole				
21	Density of A516 CS		7.832	g/cc				
22	Weight Fraction Iron in A516		0.98535		BBA00000-01717-0200-00002 REV00			
23	Mass of Fe in Basket		4.38E+06	g				
24	Moles of Fe in Basket		7.84E+04	moles				
25	Mass of Fe2O3 from degraded basket		6.26E+06	g				
26	Volume of Fe2O3 from degraded basket		1.19E+06	cc				
27	Volume increase		2.11					
28								
29								
30			Isotope List					
31								
32		Element	Symbol	Isotope	MCNP ID	Atomic Weight		
33	1	Hydrogen	H	H-1	1001.50C	1.007825		
34			D	H-2	1002.55C	2.014102		
35			T	H-3	1003.50C	3.01605		
36	2	Helium	He	nat.	2000.01C	4.0026		
37			He	He-4	2004.50C	4.002603		
38	3	Lithium	Li	Li-6	3006.50C	6.015125		
39			Li	Li-7	3007.55C	7.016004		
40	4	Beryillium	Be	Be-9	4009.50C	9.012186		
41	5	Boron	B	B-10	5010.50C	10.01294		
42			B	B-11	5011.56C	11.00931		
43	6	Carbon	C	nat.	6000.50C	12.01115		
44			C	C-12	6012.50C	12		
45	7	Nitrogen	N	N-14	7014.50C	14.00307		
46	8	Oxygen	O	O-16	8016.50C	15.99492		
47	9	Fluorine	F	F-19	9019.50C	18.9984		
48	11	Sodium	Na	Na-23	11023.50C	22.98977		
49	12	Magnesium	Mg	nat.	12000.50C	24.312		
50	13	Aluminum	Al	Al-27	13027.50C	26.98154		
51	14	Silicon	Si	nat.	14000.50C	28.086		
52	15	Phosphorus	P	P-31	15031.50C	30.97376		
53	16	Sulfur	S	S-32	16032.50C	31.97207		
54	17	Chlorine	Cl	nat.	17000.50C	35.452		
55	19	Potasium	K	nat.	19000.50C	39.102		
56	20	Calcium	Ca	nat.	20000.50C	40.08		
57	22	Titanium	Ti	nat.	22000.50C	47.9		
58	23	Vanadium	V	nat.	23000.50C	50.942		
59	24	Chromium	Cr	nat.	24000.50C	51.996		
60	25	Manganese	Mn	Mn-55	25055.50C	54.93805		
61	26	Iron	Fe	nat.	26000.55C	55.847		
62	27	Cobalt	Co	Co-59	27059.50C	58.93319		
63	28	Nickel	Ni	nat.	28000.50C	58.71		

	A	B	C	D	E	F	G	H
64			Isotope List (Continued)					
65								
66		Element	Symbol	Isotope	MCNP ID	Atomic Weight		
67	29	Copper	Cu	nat.	29000.50C	63.54		
68	30	Zinc	Zn	nat.		65.37		
69	33	Arsenic	As	As-75	33075.35C	74.9216		
70	38	Strontium	Sr	nat.		87.62		
71	40	Zirconium	Zr	nat.	40000.50C	91.22		
72	41	Niobium	Nb	Nb-93	41093.50C	92.90638		
73	42	Molybdenum	Mo	nat.	42000.50C	95.94		
74			Mo	Mo-95	42095.50C	94.90584		
75	43	Technetium	Tc	Tc-99*	43099.50C	98.90628		
76	44	Ruthenium	Ru	Ru-101	44101.50C	100.9056		
77	45	Rhodium	Rh	Rh-103	45103.50C	102.9055		
78	47	Silver	Ag	Ag-109	47109.50C	108.9048		
79	48	Cadmium	Cd	nat.	48000.50C	112.4		
80	49	Indium	In	nat.		114.82		
81	50	Tin	Sn	nat.	50000.35C	118.69		
82	55	Cesium	Cs	Cs-133	55133.50C	132.9054		
83			Cs	Cs-135		134.9058		
84	56	Barium	Ba	nat.	56138.50C	137.34		
85	57	Lanthanum	La	nat.		138.91		
86	58	Cerium	Ce	nat.		140.12		
87	60	Neodymium	Nd	Nd-143	60143.50C	142.9098		
88			Nd	Nd-145	60145.50C	144.9125		
89	62	Samarium	Sm	Sm-147	62147.50C	146.9149		
90			Sm	Sm-149	62149.50C	148.9172		
91			Sm	Sm-150	62150.50C	149.9173		
92			Sm	Sm-151	62151.50C	150.9199		
93			Sm	Sm-152	62152.50C	151.9198		
94	63	Europium	Eu	Eu-151	63151.55C	150.9198		
95			Eu	Eu-153	63153.55C	152.9212		
96			Eu	Eu-154	63154.50C	153.9231		
97	64	Gadolinium	Gd	nat.	64000.35C	157.25		
98			Gd	Gd-155	64155.50C	154.9227		
99			Gd	Gd-157	64157.50C	156.924		
100	72	Hafnium	Hf	nat.	72000.50C	178.49		
101	73	Tantalum	Ta	Ta-181	73181.50C	180.948		
102	74	Tungsten	W	nat.	74000.55C	183.85		
103	82	Lead	Pb	nat.	82000.50C	207.19		
104	92	Uranium	U	U-233	92233.50C	233.0395		
105			U	U-234	92234.50C	234.0409		
106			U	U-235	92235.50C	235.0439		
107			U	U-236	92236.50C	236.0456		
108			U	U-238	92238.50C	238.0508		
109	93	Neptunium	Np	Np-237	93237.55C	237.0481		
110	94	Plutonium	Pu	Pu-238	94238.50C	238.0495		
111			Pu	Pu-239	94239.55C	239.0521		
112			Pu	Pu-240	94240.50C	240.0539		
113			Pu	Pu-241	94241.50C	241.0567		
114			Pu	Pu-242	94242.50C	242.0587		
115			Pu	Pu-243	94243.35C	243.062		
116	95	Americium	Am	Am-241	95241.50C	241.0567		
117			Am	Am-242m	95242.50C	242.0595		
118			Am	Am-243	95243.50C	243.0614		
119	96	Curium	Cm	Cm-243	96243.35C	243.0614		
120			Cm	Cm-245	96245.35C	245.0654		
121			Cm	Cm-248	96248.35C	248.0722		

	I	J	K	L	M	N	O	P	Q
1									
2	(Materials from Mat. Comp. & Number Density 3-9 BBA000000-01717-0200-00002 REV00)								
3	Water (p. I-19)					Dry Air (p. I-19)			
4	Element	Atoms/b-cm				Element	Atoms/b-cm		
5	H	6.69E-02				N	4.21E-05		
6	O	3.34E-02				O	9.22E-06		
7	H2O	1.00E-01							
8									
9									
10						Hematite			
11	Number Density = (Weight %) * (Density) * (Na) / (Aw)					Fe2O3	wt%	Atoms/b-cm	
12	Avogadro's Number [Na]		0.602252			Fe	69.95%	3.9527E-02	
13	Atomic Weight [Aw]					O	30.05%	5.9290E-02	
14						H	0.00%	0.0000E+00	
15						TOTAL	1	9.8817E-02	
16									
17		0.026	g H2O/g air at 95% RH and 30C						
18	dry air density	0.001225	g/cc air density						
19	H2O density	0.00003185							
20									
21		Pellet OD	0.784352	cm					
22		GT/Assy	25		endfitting mass	12.5	kg	UCRL-ID-108314	
23		Rods/Assy	264		endfitting vol	1602.564103	cc		
24		Rod OD	0.9144	cm					
25		Assy Length	406.654	cm	Assy. Volume	84070.77567	cc		
26		GT OD	1.22428	cm	12 Assy. Vol.	1008849.308	cc		
27		Active Fuel Length	365.76	cm	Total Fuel Vol.	46656.48679	cc/assy		
28		Clad ID	0.8001	cm	Total Zirc. Vol.	18059.86351	cc/assy		
29		GT ID	1.143	cm					
30									
31									
32									
33									
34									
35		WP Filling at 58% Theoretical Density w/ Intact Assys.				Hematite/Water Mixture			
36		Cylinder Radius		54	cm		58% Dense	Uniform	
37		Cylinder Length		458.5	cm	Fe	2.2926E-02	1.4788E-02	
38		Cylinder Volume		4.2003E+06	cc	O	4.8433E-02	4.3111E-02	
39		Segment Volume		2.97466E+06	cc	H	2.8089E-02	4.1857E-02	
40		Distance from Center		-18	cm	TOTAL	9.9447E-02	9.9756E-02	
41									
42		Oxide only Uniform Vol%		37.4134%					
43									
44		Corrosion Product Volume at 58% Packing		2.06E+06		Vol. of Oxide			
45		# Assemblies below centerline		7.411764706		above this point			
46		Void Space below centerline		1.4770E+06	cc	5.82E+05	cc		
47		Void space between center and top of 3rd r(		6.27264E+05	cc	-4.56E+04	cc		
48		Height of oxide level above center line		16.69	cm				
49									
50		16.69 cm partially covers top row of pins in 3rd row of assemblies, so 15.9 is used for conservatism.							
51									
52									
53									
54									
55									
56									
57									
58									
59									
60									
61									
62									
63									

	I	J	K	L	M	N	O	P	Q
64									
65									
66									
67									
68									
69									
70									
71									
72									
73									
74									
75									
76									
77									
78									
79									
80									
81									
82									
83									
84									
85									
86									
87									
88									
89									
90									
91									
92									
93									
94									
95									
96									
97									
98									
99									
100									
101									
102									
103									
104									
105									
106									
107									
108									
109									
110									
111									
112									
113									
114									
115									
116									
117									
118									
119									
120									
121									

	A	B	C	D	E	F	G	H	I	J
1		vol/WP (m^3)	moles/L H2O	moles/WP	H	O	Si	Na	Ca	K
2	Diaspore	1.8392E-01	2.291	10424.05	1.1351E-03	2.2703E-03	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
3	Hematite	1.7707E+00	12.77	58103.5	0.0000E+00	1.8982E-02	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
4	Pyrolusite	2.7361E-02	0.35	1592.5	0.0000E+00	3.4684E-04	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
5	Ni2SiO4	3.0867E-02	0.1592	724.36	0.0000E+00	3.1552E-04	7.8880E-05	0.0000E+00	0.0000E+00	0.0000E+00
6	Nontro-Ca	1.2874E-02	0.0216	98.28	2.1405E-05	1.2843E-04	3.9278E-05	0.0000E+00	3.5318E-06	0.0000E+00
7	Nontro-K	5.6325E-04	0.0009151	4.163705	9.0683E-07	5.4410E-06	1.6640E-06	0.0000E+00	0.0000E+00	7.4813E-08
8	Nontro-Mg	8.9323E-03	0.01513	68.8415	1.4993E-05	8.9959E-05	2.7513E-05	0.0000E+00	0.0000E+00	0.0000E+00
9	Nontre-Na	9.0407E-04	0.001504	6.8432	1.4904E-06	8.9424E-06	2.7349E-06	2.4592E-07	0.0000E+00	0.0000E+00
10	TOTAL	2.0362E+00								
11										
12										
13										
14										
15	Water (from Mat. Comp. & Number Density 3-9 BBA000000-01717-0200-00002 REV00 p.I-19)									
16	Num Dens. for 1 g/cc	Atoms/b-cm								
17	H	6.69E-02								
18	O	3.34E-02								
19	H2O	1.00E-01		NUMBER DENSITIES					Deg. Fuel & Bask.	
20					36.8 Vol%		58% Packed		62.5 Vol%	
21	Avogadro's Number [Na]	0.602252			Uniform Oxide		Settled Oxide		Uniform	
22	21 PWR WP Inner diameter	1.4234	m	MCNP ID	Atoms/b-cm	MCNP ID	Atoms/b-cm	MCNP ID	Atoms/b-cm	
23	21 PWR WP Inner length	4.585	m	1001.50C	4.3429E-02	1001.50C	2.9938E-02	1001.50C	3.2142E-02	
24	Empty 21 PWR WP Int. Volume	7.296	m^3	8016.50C	4.3275E-02	8016.50C	4.8934E-02	8016.50C	4.4732E-02	
25	void in loaded WP - basket vol	5.530	m^3	11023.50C	2.4592E-07	11023.50C	3.8741E-07	11023.50C	1.8641E-07	
26	Liters H2O in WP for EQ3/6	4550		12000.50C	1.2369E-06	12000.50C	1.9486E-06	12000.50C	9.3763E-07	
27	Vol% Corrosion Products	36.82%		13027.50C	1.1415E-03	13027.50C	1.7983E-03	13027.50C	8.6531E-04	
28	WP Volume Occupied by			14000.50C	1.5007E-04	14000.50C	2.3641E-04	14000.50C	1.6535E-03	
29	58% Packed Solids	3.5106		19000.50C	7.4813E-08	19000.50C	1.1786E-07	19000.50C	5.6710E-08	
30				20000.50C	3.5318E-06	20000.50C	5.5638E-06	20000.50C	2.6772E-06	
31	Fuel Volume for 21 Assemlies	0.9798	m^3	25055.50C	1.7342E-04	25055.50C	2.7320E-04	25055.50C	1.3145E-04	
32	Degraded Fuel Volume	2.1430	m^3	26000.55C	1.2693E-02	26000.55C	1.9997E-02	26000.55C	9.6218E-03	
33	Zircaloy Vol. for 21 Assemblies	0.3793	m^3	28000.50C	1.5776E-04	28000.50C	2.4853E-04	28000.50C	1.1959E-04	
34	Vol% Corrosion Products			TOTAL	1.0103E-01	TOTAL	1.0143E-01	40000.56C	2.2513E-03	
35	for Fully Degraded Fuel & Bask	62.48%						TOTAL	9.1521E-02	
36										
37										
38	UO2 Density	10.28	g/cc	Ref. 7.4						
39	Soddyite Density	4.7	g/cc	Ref. 7.40, p. 568						
40	Fuel Volume increase	2.1872								
41	Zircaloy Density	6.56	g/cc	Ref. 7.12						
42	Zr Atomic Wt.	91.22	g/mole							
43	Soddyite is (UO2)2(SiO4):2H2O									
44	Mass U per WP	8878800	g							
45	Moles U per WP	37305.88235								
46	Moles O per WP from Soddyite	1.8653E+05								
47	Moles Si per WP from Soddyite	1.8653E+04								
48	Moles H per WP from Soddyite	7.4612E+04								

	K	L	M	N	O	P	Q	R	S
1	Mg	Mn	Al	Fe	Ni				
2	0.0000E+00	0.0000E+00	1.1351E-03	0.0000E+00	0.0000E+00				
3	0.0000E+00	0.0000E+00	0.0000E+00	1.2655E-02	0.0000E+00				
4	0.0000E+00	1.7342E-04	0.0000E+00	0.0000E+00	0.0000E+00				
5	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	1.5776E-04				
6	0.0000E+00	0.0000E+00	3.5318E-06	2.1405E-05	0.0000E+00				
7	0.0000E+00	0.0000E+00	1.4963E-07	9.0683E-07	0.0000E+00				
8	1.2369E-06	0.0000E+00	2.4739E-06	1.4993E-05	0.0000E+00				
9	0.0000E+00	0.0000E+00	2.4592E-07	1.4904E-06	0.0000E+00				
10									
11		% Full 21 PWR WP Void Space Occupied by Fe2O3							
12	Uniform Vol%	36.82%							
13	58% Settled Vol%	63.48%							
14	% of 4th row fille	99.22%				Volume of			
15	% of 5th row fille	0.00%				Consolidated			
16	rods in 4th row c	16				Rods	Pitch		
17	rods in 5th row c	0				1.8850E+06	0.9144	rods touching	0.4572
18						2.2545E+06	1		0.5
19	Note that a rod row is conservatively not considered covered unless it is fully covered					2.7279E+06	1.1		0.55
20						3.2465E+06	1.2		0.6
21						3.5783E+06	1.25984	as-built	0.62992
22		Void (m^3)	No. Assys.	% Void					
23	Lower Half	2.595	13	46.38%					
24	Upper Half	3.000	8	53.62%					
25	Total	5.595							
26	Void Space in Rc	0.992	3	17.73%					
27	Void Space in Rc	0.964	5	17.23%					
28	Void Space at to	1.044		18.66%					
29									
30					0.9144 cm Pitch	1 cm Pitch	1.1 cm Pitch	1.2 cm Pitch	1.26 cm Pitch
31	Cylinder Segment Volume Calculation				Consolidated	Consolidated	Consolidated	Consolidated	Consolidated
32	Geometry Calculations		top of 4th row up	top of 5th row up	Rods	Rods	Rods	Rods	Rods
33	Cylinder Radius	cm	71.17	71.17	71.17	71.17	71.17	71.17	71.17
34	Cylinder Length	cm	458.5	458.5	458.5	458.5	458.5	458.5	458.5
35	Cylinder Volume	cm^3	7295971.76	7295971.76	7.2960E+06	7.2960E+06	7.2960E+06	7.2960E+06	7.2960E+06
36	Segment Volume	cm^3	5.01705E+06	6.25185E+06	1.88504E+06	2.25449E+06	2.72793E+06	3.24647E+06	3.57832E+06
37	Distance from Ce	cm	21.3	42.6	-27.73	-21.69	-14.19	-6.16	-1.07
38									
39				Source diameter	21.72	24.74	28.49	32.50	35.05
40				Source position	-49.45	-46.43	-42.68	-38.67	-36.12
41									
42									
43									
44									
45									
46									
47									
48									

	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE
1		H	O	Si	Na	Ca	K	Mg	Mn	Al	Fe	Ni
2	Diaspore	1	2							1		
3	Hematite		3								2	
4	Pyrolusite		2						1			
5	Ni2SiO4		4	1								2
6	Nontronite-Ca	2	12	3.67		0.33				0.33	2	
7	Nontronite-K	2	12	3.67			0.165			0.33	2	
8	Nontronite-Mg	2	12	3.67				0.17		0.33	2	
9	Nontronite-Na	2	12	3.67	0.33					0.33	2	
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
32												
33												
34												
35												
36												
37												
38												
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	**H/X Ratios for Various Fuels, Decay Times, and Configurations**												
2													
3	Rod Pitch in cm		1.25984	1.2	1.1	1	0.9144		H/X ratios calculated on a per rod basis				
4	Area of Unit Cell in cm^2 (one rod)		1.5872	1.4400	1.2100	1.0000	0.8361		X = U233+U235+Pu239+Pu241				
5	Area of Pellet in cm^2		0.4832	0.4832	0.4832	0.4832	0.4832						
6	Area of Gap in cm^2		0.0196	0.0196	0.0196	0.0196	0.0196						
7	Area outside Fuel Rod in cm^2		0.9305	0.7833	0.5533	0.3433	0.1794						
8													
9		Total Fissile Number Density				12/21 in Clear Water H/X				12 Uniform H/X			
10	Decay Time	4%/35.5	4.5%/39.3	4.5%/46.5	4.0%/50.0	4%/35.5	4.5%/39.3	4.5%/46.5	4.0%/50.0	4%/35.5	4.5%/39.3	4.5%/46.5	4.0%/50.0
11	10.0 yr	4.604E-04	4.785E-04	4.398E-04	3.490E-04	285.63	274.85	299.03	376.80	180.97	174.14	189.46	238.74
12	15.0 yr	4.473E-04	4.635E-04	4.243E-04	3.345E-04	294.01	283.70	309.93	393.15	186.28	179.75	196.37	249.09
13	20.0 yr	4.363E-04	4.516E-04	4.116E-04	3.231E-04	301.41	291.20	319.53	406.96	190.97	184.50	202.45	257.84
14	30.0 yr	4.217E-04	4.352E-04	3.942E-04	3.073E-04	311.85	302.20	333.59	427.87	197.58	191.47	211.36	271.09
15	50.0 yr	4.072E-04	4.183E-04	3.764E-04	2.910E-04	322.96	314.35	349.34	451.89	204.62	199.17	221.34	286.31
16	100.0 yr	3.990E-04	4.091E-04	3.672E-04	2.825E-04	329.59	321.42	358.15	465.47	208.82	203.65	226.92	294.91
17	150.0 yr	3.982E-04	4.083E-04	3.663E-04	2.816E-04	330.23	322.07	359.05	467.04	209.23	204.06	227.49	295.91
18	200.0 yr	3.982E-04	4.083E-04	3.661E-04	2.819E-04	330.28	322.12	359.17	466.52	209.26	204.09	227.56	295.58
19	250.0 yr	3.982E-04	4.083E-04	3.661E-04	2.817E-04	330.27	322.11	359.22	466.79	209.26	204.09	227.60	295.75
20	500.0 yr	3.982E-04	4.089E-04	3.664E-04	2.820E-04	330.28	321.61	358.91	466.28	209.26	203.76	227.40	295.43
21	1000.0 yr	3.986E-04	4.090E-04	3.670E-04	2.825E-04	329.92	321.57	358.29	465.44	209.03	203.74	227.01	294.90
22	2000.0 yr	3.993E-04	4.094E-04	3.675E-04	2.835E-04	329.35	321.18	357.83	463.85	208.67	203.50	226.72	293.89
23	4000.0 yr	3.997E-04	4.105E-04	3.694E-04	2.854E-04	329.02	320.35	356.04	460.80	208.46	202.97	225.58	291.95
24	8000.0 yr	4.015E-04	4.124E-04	3.712E-04	2.882E-04	327.52	318.90	354.30	456.31	207.51	202.05	224.48	289.11
25	10000.0 yr	4.019E-04	4.133E-04	3.726E-04	2.895E-04	327.23	318.20	352.94	454.17	207.33	201.60	223.62	287.76
26	12000.0 yr	4.028E-04	4.136E-04	3.729E-04	2.904E-04	326.51	317.93	352.63	452.91	206.87	201.43	223.42	286.96
27	14000.0 yr	4.025E-04	4.140E-04	3.732E-04	2.912E-04	326.70	317.67	352.34	451.67	206.99	201.27	223.23	286.17
28	18000.0 yr	4.037E-04	4.146E-04	3.749E-04	2.922E-04	325.77	317.19	350.76	450.09	206.40	200.97	222.23	285.17
29	25000.0 yr	4.046E-04	4.156E-04	3.758E-04	2.940E-04	325.02	316.45	349.90	447.28	205.93	200.50	221.69	283.39
30	35000. yr	4.052E-04	4.162E-04	3.764E-04	2.949E-04	324.57	315.99	349.39	445.90	205.65	200.20	221.37	282.51
31	45000. yr	4.055E-04	4.166E-04	3.773E-04	2.951E-04	324.30	315.69	348.54	445.58	205.47	200.01	220.83	282.31
32	100000. yr	4.068E-04	4.182E-04	3.791E-04	2.970E-04	323.25	314.45	346.90	442.82	204.81	199.23	219.79	280.56
33	250000. yr	4.092E-04	4.207E-04	3.820E-04	2.996E-04	321.37	312.62	344.24	438.97	203.62	198.07	218.10	278.12
34													
35													
36													
37													

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9	21 Uniform H/X			12 Settled H/X					21 Settled H/X		4%/35.5 in Pile w/ Various Rod Pitches					Deg. Fuel & Basket	
10	4%/35.5	4.5%/39.3	4.5%/46.5	4%/35.5	4.5%/39.3	4.5%/46.5	4.0%/50.0	4%/35.5	4.5%/39.3	4.5%/46.5	1.26 cm	1.2 cm	1.1 cm	1.0 cm	0.9144 cm	Fissile ND	H/X
11	187.55	180.47	196.35	123.38	118.72	129.17	162.76	131.12	126.17	137.27	187.55	158.81	113.91	72.91	40.92	6.18E-05	519.86
12	193.05	186.28	203.51	127.00	122.55	133.88	169.83	134.96	130.23	142.27	193.05	163.47	117.25	75.05	42.12	6.01E-05	535.11
13	197.91	191.21	209.81	130.20	125.79	138.03	175.79	138.36	133.68	146.68	197.91	167.58	120.20	76.94	43.18	5.86E-05	548.58
14	204.77	198.43	219.04	134.71	130.54	144.10	184.83	143.15	138.73	153.13	204.77	173.39	124.37	79.61	44.68	5.66E-05	567.59
15	212.06	206.41	229.39	139.51	135.79	150.90	195.20	148.25	144.30	160.37	212.06	179.57	128.80	82.44	46.27	5.47E-05	587.81
16	216.41	211.05	235.17	142.37	138.84	154.71	201.07	151.30	147.55	164.41	216.41	183.25	131.44	84.13	47.22	5.36E-05	599.87
17	216.83	211.47	235.76	142.65	139.12	155.10	201.74	151.59	147.84	164.82	216.83	183.61	131.70	84.30	47.31	5.35E-05	601.04
18	216.86	211.51	235.84	142.67	139.14	155.15	201.52	151.61	147.87	164.88	216.86	183.64	131.72	84.31	47.32	5.35E-05	601.12
19	216.86	211.50	235.87	142.67	139.14	155.17	201.63	151.61	147.86	164.90	216.86	183.63	131.71	84.31	47.32	5.35E-05	601.12
20	216.86	211.17	235.67	142.67	138.92	155.04	201.42	151.61	147.63	164.76	216.86	183.64	131.72	84.31	47.32	5.35E-05	601.12
21	216.63	211.14	235.26	142.52	138.90	154.77	201.05	151.45	147.61	164.47	216.63	183.44	131.58	84.22	47.27	5.35E-05	600.48
22	216.26	210.89	234.96	142.27	138.74	154.57	200.37	151.19	147.44	164.26	216.26	183.12	131.35	84.07	47.19	5.36E-05	599.44
23	216.04	210.35	233.78	142.13	138.38	153.80	199.05	151.04	147.06	163.44	216.04	182.94	131.22	83.99	47.14	5.37E-05	598.84
24	215.05	209.39	232.64	141.47	137.75	153.04	197.11	150.34	146.39	162.64	215.05	182.10	130.62	83.61	46.92	5.39E-05	596.10
25	214.86	208.93	231.75	141.35	137.45	152.46	196.19	150.21	146.07	162.02	214.86	181.94	130.50	83.53	46.88	5.4E-05	595.57
26	214.39	208.75	231.54	141.04	137.33	152.32	195.64	149.89	145.94	161.87	214.39	181.54	130.22	83.35	46.78	5.41E-05	594.28
27	214.51	208.59	231.35	141.12	137.22	152.20	195.11	149.97	145.83	161.74	214.51	181.65	130.29	83.40	46.80	5.41E-05	594.61
28	213.91	208.27	230.31	140.72	137.02	151.51	194.42	149.54	145.61	161.01	213.91	181.13	129.92	83.16	46.67	5.42E-05	592.92
29	213.41	207.79	229.75	140.40	136.69	151.14	193.21	149.20	145.27	160.62	213.41	180.72	129.62	82.97	46.57	5.43E-05	591.56
30	213.12	207.48	229.41	140.20	136.50	150.92	192.61	148.99	145.05	160.38	213.12	180.47	129.44	82.86	46.50	5.44E-05	590.75
31	212.94	207.29	228.86	140.08	136.37	150.56	192.48	148.87	144.92	160.00	212.94	180.31	129.33	82.78	46.46	5.45E-05	590.24
32	212.25	206.47	227.78	139.63	135.83	149.85	191.28	148.39	144.35	159.24	212.25	179.73	128.92	82.52	46.31	5.46E-05	588.34
33	211.02	205.27	226.03	138.82	135.04	148.70	189.62	147.52	143.51	158.02	211.02	178.69	128.16	82.04	46.04	5.5E-05	584.92
34																	
35																	
36																	
37																	

	A	B	C	D	E	F	G	H	I	J	K	L	M
38													
39													
40													
41													
42													
43													
44													
45													
46													
47	4.0%, 35.5 GWd/MTU grams/assembly												
48		10.0 yr	15.0 yr	20.0 yr	30.0 yr	50.0 yr	100.0 yr	150.0 yr	200.0 yr	250.0 yr	500.0 yr	1000.0 yr	2000.0 yr
49	u233	3.01E-04	4.07E-04	5.27E-04	8.15E-04	1.63E-03	5.22E-03	1.10E-02	1.89E-02	2.86E-02	1.01E-01	3.26E-01	9.09E-01
50	u235	3.99E+02	4.00E+02	4.01E+02	4.03E+02	4.07E+02	4.17E+02	4.26E+02	4.36E+02	4.46E+02	4.95E+02	5.91E+02	7.80E+02
51	pu239	6.97E+03	6.97E+03	6.96E+03	6.96E+03	6.96E+03	6.95E+03	6.94E+03	6.93E+03	6.92E+03	6.87E+03	6.78E+03	6.60E+03
52	pu241	1.16E+03	9.14E+02	7.18E+02	4.43E+02	1.68E+02	1.50E+01	1.35E+00	1.23E-01	1.37E-02	2.89E-03	2.77E-03	2.56E-03
53													
54	4.5%, 39.3 GWd/MTU grams/assembly												
55		10.0 yr	15.0 yr	20.0 yr	30.0 yr	50.0 yr	100.0 yr	150.0 yr	200.0 yr	250.0 yr	500.0 yr	1000.0 yr	2000.0 yr
56	u233	3.03E-04	4.13E-04	5.38E-04	8.41E-04	1.70E-03	5.55E-03	1.18E-02	2.03E-02	3.09E-02	1.10E-01	3.54E-01	9.89E-01
57	u235	3.85E+02	3.86E+02	3.87E+02	3.89E+02	3.93E+02	4.03E+02	4.13E+02	4.23E+02	4.33E+02	4.84E+02	5.83E+02	7.78E+02
58	pu239	7.17E+03	7.17E+03	7.17E+03	7.17E+03	7.16E+03	7.15E+03	7.14E+03	7.13E+03	7.12E+03	7.08E+03	6.98E+03	6.79E+03
59	pu241	1.31E+03	1.03E+03	8.06E+02	4.97E+02	1.89E+02	1.69E+01	1.51E+00	1.38E-01	1.57E-02	3.62E-03	3.47E-03	3.20E-03
60													
61	4.5%, 46.5 GWd/MTU grams/assembly												
62		10.0 yr	15.0 yr	20.0 yr	30.0 yr	50.0 yr	100.0 yr	150.0 yr	200.0 yr	250.0 yr	500.0 yr	1000.0 yr	2000.0 yr
63	u233	3.48E-04	4.76E-04	6.19E-04	9.63E-04	1.93E-03	6.13E-03	1.29E-02	2.21E-02	3.34E-02	1.18E-01	3.79E-01	1.06E+00
64	u235	3.30E+02	3.31E+02	3.31E+02	3.33E+02	3.37E+02	3.46E+02	3.55E+02	3.64E+02	3.73E+02	4.18E+02	5.08E+02	6.83E+02
65	pu239	6.44E+03	6.44E+03	6.44E+03	6.44E+03	6.43E+03	6.43E+03	6.42E+03	6.41E+03	6.40E+03	6.36E+03	6.28E+03	6.11E+03
66	pu241	1.38E+03	1.09E+03	8.52E+02	5.26E+02	2.00E+02	1.79E+01	1.60E+00	1.50E-01	2.01E-02	7.27E-03	6.97E-03	6.43E-03
67													
68													
69	4.0%, 50.0 GWd/MTU grams/assembly												
70		10.0 yr	15.0 yr	20.0 yr	30.0 yr	50.0 yr	100.0 yr	150.0 yr	200.0 yr	250.0 yr	500.0 yr	1000.0 yr	2000.0 yr
71	u233	3.55E-04	4.88E-04	6.34E-04	9.79E-04	1.92E-03	5.89E-03	1.22E-02	2.06E-02	3.11E-02	1.08E-01	3.47E-01	9.65E-01
72	u235	2.69E+02	2.70E+02	2.70E+02	2.72E+02	2.74E+02	2.81E+02	2.88E+02	2.95E+02	3.02E+02	3.37E+02	4.05E+02	5.40E+02
73	pu239	4.94E+03	4.94E+03	4.94E+03	4.94E+03	4.93E+03	4.93E+03	4.92E+03	4.92E+03	4.91E+03	4.88E+03	4.82E+03	4.70E+03
74	pu241	1.26E+03	9.88E+02	7.76E+02	4.79E+02	1.82E+02	1.63E+01	1.46E+00	1.41E-01	2.24E-02	1.06E-02	1.02E-02	9.36E-03
75													

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
38																	
39																	
40																	
41																	
42																	
43																	
44																	
45																	
46																	
47																	
48	4000.0 yr	8000.0 yr	10000.0 yr	12000.0 yr	14000.0 yr	18000.0 yr	25000.0 yr	35000. yr	45000. yr	100000. yr	250000. yr						
49	2.18E+00	4.73E+00	5.98E+00	7.22E+00	8.46E+00	1.09E+01	1.50E+01	2.07E+01	2.61E+01	5.17E+01	9.47E+01						
50	1.14E+03	1.81E+03	2.12E+03	2.41E+03	2.68E+03	3.19E+03	3.95E+03	4.80E+03	5.44E+03	6.96E+03	7.35E+03						
51	6.24E+03	5.59E+03	5.28E+03	5.00E+03	4.72E+03	4.22E+03	3.46E+03	2.60E+03	1.95E+03	4.02E+02	5.38E+00						
52	2.17E-03	1.57E-03	1.33E-03	1.13E-03	9.61E-04	6.93E-04	3.92E-04	1.73E-04	7.66E-05	8.63E-07	4.19E-12						
53																	
54																	
55	4000.0 yr	8000.0 yr	10000.0 yr	12000.0 yr	14000.0 yr	18000.0 yr	25000.0 yr	35000. yr	45000. yr	100000. yr	250000. yr						
56	2.38E+00	5.14E+00	6.51E+00	7.86E+00	9.20E+00	1.18E+01	1.64E+01	2.25E+01	2.84E+01	5.63E+01	1.03E+02						
57	1.15E+03	1.84E+03	2.16E+03	2.46E+03	2.74E+03	3.26E+03	4.04E+03	4.92E+03	5.58E+03	7.15E+03	7.55E+03						
58	6.43E+03	5.76E+03	5.45E+03	5.15E+03	4.87E+03	4.35E+03	3.57E+03	2.68E+03	2.01E+03	4.15E+02	5.55E+00						
59	2.72E-03	1.96E-03	1.67E-03	1.42E-03	1.20E-03	8.68E-04	4.90E-04	2.17E-04	9.59E-05	1.08E-06	5.25E-12						
60																	
61																	
62	4000.0 yr	8000.0 yr	10000.0 yr	12000.0 yr	14000.0 yr	18000.0 yr	25000.0 yr	35000. yr	45000. yr	100000. yr	250000. yr						
63	2.54E+00	5.50E+00	6.97E+00	8.41E+00	9.85E+00	1.27E+01	1.75E+01	2.41E+01	3.04E+01	6.03E+01	1.10E+02						
64	1.02E+03	1.64E+03	1.93E+03	2.20E+03	2.45E+03	2.93E+03	3.64E+03	4.43E+03	5.04E+03	6.47E+03	6.84E+03						
65	5.80E+03	5.20E+03	4.93E+03	4.66E+03	4.41E+03	3.95E+03	3.24E+03	2.44E+03	1.83E+03	3.78E+02	5.06E+00						
66	5.46E-03	3.94E-03	3.35E-03	2.84E-03	2.42E-03	1.74E-03	9.85E-04	4.36E-04	1.93E-04	2.17E-06	1.05E-11						
67																	
68																	
69																	
70	4000.0 yr	8000.0 yr	10000.0 yr	12000.0 yr	14000.0 yr	18000.0 yr	25000.0 yr	35000. yr	45000. yr	100000. yr	250000. yr						
71	2.31E+00	5.01E+00	6.34E+00	7.66E+00	8.96E+00	1.15E+01	1.59E+01	2.20E+01	2.77E+01	5.49E+01	1.00E+02						
72	7.99E+02	1.28E+03	1.50E+03	1.71E+03	1.91E+03	2.28E+03	2.84E+03	3.46E+03	3.93E+03	5.06E+03	5.35E+03						
73	4.47E+03	4.03E+03	3.83E+03	3.63E+03	3.44E+03	3.08E+03	2.54E+03	1.92E+03	1.44E+03	2.97E+02	3.98E+00						
74	7.95E-03	5.74E-03	4.87E-03	4.14E-03	3.52E-03	2.54E-03	1.43E-03	6.34E-04	2.80E-04	3.16E-06	1.53E-11						
75																	

	A	B	C	D	E	F	G	H	I	J	K	L	M
76													
77	4.0%, 35.5 GWd/MTU number density												
78		10.0 yr	15.0 yr	20.0 yr	30.0 yr	50.0 yr	100.0 yr	150.0 yr	200.0 yr	250.0 yr	500.0 yr	1000.0 yr	2000.0 yr
79	u233	1.667E-11	2.254E-11	2.919E-11	4.514E-11	9.029E-11	2.891E-10	6.093E-10	1.047E-09	1.584E-09	5.595E-09	1.806E-08	5.035E-08
80	u235	2.191E-05	2.197E-05	2.202E-05	2.213E-05	2.235E-05	2.290E-05	2.340E-05	2.395E-05	2.449E-05	2.719E-05	3.246E-05	4.284E-05
81	pu239	3.764E-04	3.764E-04	3.758E-04	3.758E-04	3.758E-04	3.753E-04	3.748E-04	3.742E-04	3.737E-04	3.710E-04	3.661E-04	3.564E-04
82	pu241	6.212E-05	4.894E-05	3.845E-05	2.372E-05	8.996E-06	8.033E-07	7.229E-08	6.587E-09	7.336E-10	1.548E-10	1.483E-10	1.371E-10
83	Total Fissile	4.604E-04	4.473E-04	4.363E-04	4.217E-04	4.072E-04	3.990E-04	3.982E-04	3.982E-04	3.982E-04	3.982E-04	3.986E-04	3.993E-04
84													
85	4.5%, 39.3 GWd/MTU number density												
86		10.0 yr	15.0 yr	20.0 yr	30.0 yr	50.0 yr	100.0 yr	150.0 yr	200.0 yr	250.0 yr	500.0 yr	1000.0 yr	2000.0 yr
87	u233	1.678E-11	2.288E-11	2.980E-11	4.658E-11	9.417E-11	3.074E-10	6.536E-10	1.124E-09	1.712E-09	6.093E-09	1.961E-08	5.478E-08
88	u235	2.114E-05	2.120E-05	2.125E-05	2.136E-05	2.158E-05	2.213E-05	2.268E-05	2.323E-05	2.378E-05	2.658E-05	3.202E-05	4.273E-05
89	pu239	3.872E-04	3.872E-04	3.872E-04	3.872E-04	3.866E-04	3.861E-04	3.856E-04	3.850E-04	3.845E-04	3.823E-04	3.769E-04	3.667E-04
90	pu241	7.015E-05	5.516E-05	4.316E-05	2.661E-05	1.012E-05	9.050E-07	8.086E-08	7.390E-09	8.407E-10	1.939E-10	1.858E-10	1.714E-10
91	Total Fissile	4.785E-04	4.635E-04	4.516E-04	4.352E-04	4.183E-04	4.091E-04	4.083E-04	4.083E-04	4.083E-04	4.089E-04	4.090E-04	4.094E-04
92													
93	4.5%, 46.5 GWd/MTU number density												
94		10.0 yr	15.0 yr	20.0 yr	30.0 yr	50.0 yr	100.0 yr	150.0 yr	200.0 yr	250.0 yr	500.0 yr	1000.0 yr	2000.0 yr
95	u233	1.928E-11	2.637E-11	3.429E-11	5.334E-11	1.069E-10	3.396E-10	7.146E-10	1.224E-09	1.850E-09	6.536E-09	2.099E-08	5.872E-08
96	u235	1.812E-05	1.818E-05	1.818E-05	1.829E-05	1.851E-05	1.900E-05	1.950E-05	1.999E-05	2.049E-05	2.296E-05	2.790E-05	3.751E-05
97	pu239	3.478E-04	3.478E-04	3.478E-04	3.478E-04	3.472E-04	3.472E-04	3.467E-04	3.461E-04	3.456E-04	3.434E-04	3.391E-04	3.299E-04
98	pu241	7.390E-05	5.837E-05	4.562E-05	2.817E-05	1.071E-05	9.585E-07	8.568E-08	8.033E-09	1.076E-09	3.893E-10	3.732E-10	3.443E-10
99	Total Fissile	4.398E-04	4.243E-04	4.116E-04	3.942E-04	3.764E-04	3.672E-04	3.663E-04	3.661E-04	3.661E-04	3.664E-04	3.670E-04	3.675E-04
100													
101													
102	4.0%, 35.5 GWd/MTU number density												
103		10.0 yr	15.0 yr	20.0 yr	30.0 yr	50.0 yr	100.0 yr	150.0 yr	200.0 yr	250.0 yr	500.0 yr	1000.0 yr	2000.0 yr
104	u233	2.239E-12	3.028E-12	3.920E-12	6.063E-12	1.213E-11	3.883E-11	8.183E-11	1.406E-10	2.127E-10	7.513E-10	2.425E-09	6.762E-09
105	u235	2.943E-06	2.950E-06	2.957E-06	2.972E-06	3.002E-06	3.075E-06	3.142E-06	3.216E-06	3.289E-06	3.651E-06	4.359E-06	5.753E-06
106	pu239	5.054E-05	5.054E-05	5.047E-05	5.047E-05	5.047E-05	5.040E-05	5.033E-05	5.025E-05	5.018E-05	4.982E-05	4.917E-05	4.786E-05
107	pu241	8.342E-06	6.573E-06	5.163E-06	3.186E-06	1.208E-06	1.079E-07	9.708E-09	8.845E-10	9.852E-11	2.078E-11	1.992E-11	1.841E-11
108	Total Fissile	6.183E-05	6.007E-05	5.859E-05	5.663E-05	5.468E-05	5.358E-05	5.348E-05	5.347E-05	5.347E-05	5.347E-05	5.353E-05	5.362E-05
109													
110													
111	4.0%, 50.0 GWd/MTU number density												
112		10.0 yr	15.0 yr	20.0 yr	30.0 yr	50.0 yr	100.0 yr	150.0 yr	200.0 yr	250.0 yr	500.0 yr	1000.0 yr	2000.0 yr
113	u233	1.966E-11	2.703E-11	3.512E-11	5.423E-11	1.064E-10	3.263E-10	6.758E-10	1.141E-09	1.723E-09	5.982E-09	1.922E-08	5.345E-08
114	u235	1.47735E-05	1.4828E-05	1.4828E-05	1.4938E-05	1.5048E-05	1.54325E-05	1.5817E-05	1.62014E-05	1.6586E-05	1.8508E-05	2.2243E-05	2.96568E-05
115	pu239	0.000266755	0.00026676	0.00026676	0.00026676	0.00026622	0.000266215	0.00026568	0.000265675	0.00026514	0.000263516	0.00026028	0.000253796
116	pu241	6.7473E-05	5.2907E-05	4.1555E-05	2.565E-05	9.7461E-06	8.72866E-07	7.8183E-08	7.55055E-09	1.1995E-09	5.6763E-10	5.4621E-10	5.01228E-10
117	Total Fissile	0.000349002	0.00033449	0.00032314	0.00030734	0.00029101	0.000282521	0.00028157	0.000281886	0.00028172	0.00028203	0.00028254	0.000283506

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
76																	
77																	
78	4000.0 yr	8000.0 yr	10000.0 yr	12000.0 yr	14000.0 yr	18000.0 yr	25000.0 yr	35000. yr	45000. yr	100000. yr	250000. yr						
79	1.208E-07	2.620E-07	3.312E-07	3.999E-07	4.686E-07	6.038E-07	8.309E-07	1.147E-06	1.446E-06	2.864E-06	5.246E-06						
80	6.261E-05	9.941E-05	1.164E-04	1.324E-04	1.472E-04	1.752E-04	2.169E-04	2.636E-04	2.988E-04	3.822E-04	4.037E-04						
81	3.370E-04	3.019E-04	2.851E-04	2.700E-04	2.549E-04	2.279E-04	1.868E-04	1.404E-04	1.053E-04	2.171E-05	2.905E-07						
82	1.162E-10	8.407E-11	7.122E-11	6.051E-11	5.146E-11	3.711E-11	2.099E-11	9.264E-12	4.102E-12	4.621E-14	2.244E-19						
83	3.997E-04	4.015E-04	4.019E-04	4.028E-04	4.025E-04	4.037E-04	4.046E-04	4.052E-04	4.055E-04	4.068E-04	4.092E-04						
84																	
85																	
86	4000.0 yr	8000.0 yr	10000.0 yr	12000.0 yr	14000.0 yr	18000.0 yr	25000.0 yr	35000. yr	45000. yr	100000. yr	250000. yr						
87	1.318E-07	2.847E-07	3.606E-07	4.354E-07	5.096E-07	6.536E-07	9.084E-07	1.246E-06	1.573E-06	3.119E-06	5.705E-06						
88	6.316E-05	1.011E-04	1.186E-04	1.351E-04	1.505E-04	1.790E-04	2.219E-04	2.702E-04	3.065E-04	3.927E-04	4.146E-04						
89	3.472E-04	3.110E-04	2.943E-04	2.781E-04	2.630E-04	2.349E-04	1.928E-04	1.447E-04	1.085E-04	2.241E-05	2.997E-07						
90	1.457E-10	1.050E-10	8.943E-11	7.604E-11	6.426E-11	4.648E-11	2.624E-11	1.162E-11	5.135E-12	5.783E-14	2.811E-19						
91	4.105E-04	4.124E-04	4.133E-04	4.136E-04	4.140E-04	4.146E-04	4.156E-04	4.162E-04	4.166E-04	4.182E-04	4.207E-04						
92																	
93																	
94	4000.0 yr	8000.0 yr	10000.0 yr	12000.0 yr	14000.0 yr	18000.0 yr	25000.0 yr	35000. yr	45000. yr	100000. yr	250000. yr						
95	1.407E-07	3.047E-07	3.861E-07	4.658E-07	5.456E-07	7.035E-07	9.694E-07	1.335E-06	1.684E-06	3.340E-06	6.093E-06						
96	5.602E-05	9.007E-05	1.060E-04	1.208E-04	1.346E-04	1.609E-04	1.999E-04	2.433E-04	2.768E-04	3.553E-04	3.757E-04						
97	3.132E-04	2.808E-04	2.662E-04	2.516E-04	2.381E-04	2.133E-04	1.750E-04	1.318E-04	9.882E-05	2.041E-05	2.732E-07						
98	2.924E-10	2.110E-10	1.794E-10	1.521E-10	1.296E-10	9.318E-11	5.275E-11	2.335E-11	1.034E-11	1.162E-13	5.623E-19						
99	3.694E-04	3.712E-04	3.726E-04	3.729E-04	3.732E-04	3.749E-04	3.758E-04	3.764E-04	3.773E-04	3.791E-04	3.820E-04						
100																	
101																	
102																	
103	4000.0 yr	8000.0 yr	10000.0 yr	12000.0 yr	14000.0 yr	18000.0 yr	25000.0 yr	35000. yr	45000. yr	100000. yr	250000. yr						
104	1.622E-08	3.519E-08	4.448E-08	5.371E-08	6.293E-08	8.108E-08	1.116E-07	1.540E-07	1.942E-07	3.846E-07	7.044E-07						
105	8.408E-06	1.335E-05	1.564E-05	1.777E-05	1.977E-05	2.353E-05	2.913E-05	3.540E-05	4.012E-05	5.133E-05	5.421E-05						
106	4.525E-05	4.054E-05	3.829E-05	3.626E-05	3.423E-05	3.060E-05	2.509E-05	1.885E-05	1.414E-05	2.915E-06	3.901E-08						
107	1.561E-11	1.129E-11	9.564E-12	8.126E-12	6.911E-12	4.984E-12	2.819E-12	1.244E-12	5.509E-13	6.206E-15	3.013E-20						
108	5.367E-05	5.392E-05	5.397E-05	5.409E-05	5.406E-05	5.421E-05	5.433E-05	5.441E-05	5.446E-05	5.463E-05	5.495E-05						
109																	
110																	
111																	
112	4000.0 yr	8000.0 yr	10000.0 yr	12000.0 yr	14000.0 yr	18000.0 yr	25000.0 yr	35000. yr	45000. yr	100000. yr	250000. yr						
113	1.280E-07	2.775E-07	3.512E-07	4.243E-07	4.963E-07	6.370E-07	8.807E-07	1.219E-06	1.534E-06	3.041E-06	5.539E-06						
114	4.3881E-05	7.0298E-05	8.23799E-05	9.3913E-05	0.0001049	0.00012522	0.000155973	0.00019002	0.000215835	0.00027789	0.000293822						
115	0.00024138	0.00021762	0.000206816	0.00019602	0.00018576	0.00016632	0.000137158	0.00010368	7.77587E-05	1.6038E-05	2.14916E-07						
116	4.2572E-10	3.0738E-10	2.60789E-10	2.217E-10	1.885E-10	1.3602E-10	7.65765E-11	3.3951E-11	1.4994E-11	1.6922E-13	8.19316E-19						
117	0.00028539	0.00028819	0.000289548	0.00029035	0.00029115	0.00029217	0.000294011	0.00029492	0.000295128	0.00029697	0.000299576						

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2	Fuel Deg. Time (yrs)	2000	4000	8000	15000	25000	35000	90000	240000				
3	U	100%	100%	100%	100%	99%	99%	96%	88%				
4	Np	85%	70%	38%	0%	0%	0%	0%	0%				
5	Pu	100%	100%	100%	100%	100%	100%	100%	100%				
6	Am	0%	0%	0%	0%	0%	0%	0%	0%				
7	Mo	0%	0%	0%	0%	0%	0%	0%	0%				
8	Tc	0%	0%	0%	0%	0%	0%	0%	0%				
9	Ru	100%	100%	100%	100%	100%	100%	100%	100%				
10	Rh	100%	100%	100%	100%	100%	100%	100%	100%				
11	Ag	87%	80%	67%	43%	12%	0%	0%	0%				
12	Nd	99%	98%	97%	95%	95%	95%	95%	95%				
13	Sm	80%	70%	46%	27%	26%	26%	24%	20%				
14	Eu	82%	71%	46%	9%	8%	7%	2%	0%				
15	Gd	56%	35%	14%	5%	5%	5%	5%	3%				
16													
17	From PWRSF0.15 I, II, III, & IV files in Reference 7.17												
18													
19	Deg.	2	3	4	5	6	7	8	9	10	11	12	
20	Time (yrs)	% U remair	% Np rema	% Pu rema	% Am rem	% Ru rema	% Rh rema	% Ag rema	% Nd rema	% Sm rem	% Eu rema	% Gd remaining	
21													
22	0	99.989	99.989	99.989	99.989	99.989	99.989	99.989	99.989	99.989	99.989	99.989	
23	3.562	100.0157	99.9983	100.0207	99.76374	100.0212	100.0197	99.89476	100.0155	100.0145	100.0161	100.0102	
24	7.255	100.0007	99.97934	100.0088	99.66464	100.0089	100.0068	99.84805	99.99671	99.99649	100.0002	99.99284	
25	11.19	99.99548	99.96886	100.0036	99.56969	100.0062	100.001	99.80497	99.98711	99.989	99.99449	99.98457	
26	14.92	99.99409	99.95938	100.0036	99.48131	100.0062	100.001	99.76594	99.98297	99.98427	99.989	99.98088	
27	20.02	100.0138	99.97763	100.0274	99.37601	100.0302	100.0223	99.71937	99.99773	100.0016	100.0096	100.0004	
28	25.13	99.99675	99.95328	100.0117	99.22653	100.0154	100.0048	99.63614	99.97598	99.98072	99.99361	99.97948	
29	30.23	100.0199	99.9656	100.0356	99.09491	100.0394	100.0261	99.56866	99.99075	99.99649	100.0088	99.9938	
30	35.1	99.99814	99.93871	100.0164	98.89559	100.0231	100.0084	99.45601	99.96789	99.9752	99.98746	99.97004	
31	38.66	99.99328	99.92615	100.0111	98.72636	100.0171	100.0016	99.37599	99.95408	99.96574	99.97846	99.96001	
32	41.78	100.0228	99.94517	100.0443	98.57876	100.049	100.0331	99.32956	99.98471	99.989	100.0121	99.98384	
33	45.31	99.99363	99.90891	100.0216	98.1162	100.0173	100.0162	99.21469	99.95471	99.96534	99.9811	99.95315	
34	49.77	99.99386	99.90062	100.0245	97.60851	100.0259	100.0203	99.092	99.95789	99.96219	99.98219	99.94946	
35	53.2	100.0368	99.92106	100.0594	97.23715	100.0698	100.0533	99.02438	99.989	99.99334	100.0118	99.97417	
36	58.32	100.0163	99.88487	100.0466	96.38066	100.0486	100.0279	98.83659	99.95662	99.96929	99.99032	99.94665	
37	63.41	99.99513	99.84275	100.0396	94.96008	100.0488	100.0225	98.63486	99.94059	99.94051	99.96331	99.90512	
38	68.15	100.0101	99.82516	100.0577	92.93215	100.0546	100.0367	98.45794	99.94948	99.9409	99.96968	99.88586	
39	72.06	100.0076	99.7892	100.035	90.63157	100.0411	100.0169	98.27823	99.93447	99.90735	99.94201	99.83878	
40	76.11	100.0171	99.76397	100.0629	87.10973	100.0767	100.0405	98.10368	99.94901	99.90839	99.93257	99.79874	
41	81.07	100.0331	99.73115	100.0874	81.4744	100.0797	100.0449	97.88647	99.94945	99.89501	99.91128	99.72138	
42	85.75	100.0225	99.68394	100.0763	75.01267	100.0855	100.0391	97.65379	99.94555	99.85705	99.86824	99.61278	
43	89.06	100.0401	99.66404	100.0926	69.97716	100.1018	100.0687	97.49736	99.94293	99.83714	99.84673	99.54173	
44	93.96	100.0399	99.61345	100.0879	61.94066	100.0833	100.0531	97.23833	99.93101	99.7992	99.78701	99.40922	
45	97.06	100.0151	99.56618	100.0612	56.60431	100.0872	100.0359	97.06462	99.92364	99.74202	99.74002	99.3007	
46	101.4	100.0191	99.49498	100.0588	50.12283	100.0833	100.0331	96.83403	99.89928	99.64176	99.61136	98.98148	
47	105	100.0404	99.46465	100.1031	48.36285	100.1031	100.0764	96.67035	99.92887	99.57672	99.51453	98.70414	
48	108.9	100.0426	99.405	100.1095	46.41954	100.111	100.0766	96.45579	99.91676	99.478	99.37709	98.34666	
49	113	100.0524	99.3431	100.1007	44.40289	100.1099	100.0836	96.23761	99.9103	99.36105	99.22669	97.97481	
50	116.2	100.0372	99.29471	100.0955	42.82624	100.12	100.0697	96.05511	99.88837	99.25842	99.08815	97.66677	
51	121	100.0274	99.20971	100.0693	40.44293	100.0954	100.0507	95.78395	99.86116	99.09005	98.90043	97.19374	
52	126.4	100.052	99.14757	100.1141	37.83962	100.1294	100.0722	95.51585	99.88135	98.96178	98.71227	96.69246	
53	131.7	100.0371	99.06569	100.1042	35.21065	100.1164	100.0679	95.21512	99.86014	98.79207	98.49844	96.15813	
54	137.1	100.0398	98.98748	100.0979	32.58534	100.1285	100.0674	94.92502	99.84276	98.6339	98.28828	95.62747	
55	140.6	100.0362	98.91907	100.1169	30.85836	100.1384	100.0835	94.73858	99.83308	98.4749	98.0982	95.12443	
56	145.1	100.0404	98.84421	100.1212	28.65105	100.1396	100.0802	94.49006	99.80732	98.08046	97.53758	93.77246	
57	150.1	100.0425	98.74962	100.1308	26.18707	100.1415	100.0807	94.21491	99.77999	97.61145	96.93986	92.25281	
58	155.6	100.0454	98.59074	100.1311	23.4811	100.1373	100.0796	93.88597	99.7497	97.11334	96.20991	90.56493	
59	161	100.0534	98.49843	100.1388	20.78246	100.1618	100.0859	93.6271	99.72675	96.60679	95.54219	88.87702	
60	166.4	100.0445	98.36098	100.1325	18.15715	100.1524	100.0853	93.30215	99.69745	96.10261	94.83802	87.22554	
61	171.7	100.0508	98.28643	100.1299	15.53551	100.1682	100.0884	93.05058	99.67197	95.62575	94.19241	85.58511	
62	177	100.0571	98.15265	100.1564	12.91387	100.1625	100.0915	92.7293	99.63062	95.12524	93.49191	83.92993	
63	182.4	100.0597	98.07444	100.1501	10.28856	100.1746	100.0909	92.47405	99.60148	94.62105	92.84263	82.27108	
64	187.7	100.0521	97.94066	100.1475	7.666923	100.1689	100.0941	92.15277	99.576	94.12842	92.14213	80.62327	
65	193	100.0548	97.86244	100.1412	5.041616	100.181	100.0935	91.89753	99.54686	93.64001	91.43796	78.96442	
66	198.4	100.0614	97.72903	100.168	2.420342	100.1971	100.117	91.57661	99.52175	93.13987	90.79271	77.3096	
67	203.3	100.0585	97.61884	100.163	0	100.1998	100.101	91.31721	99.49059	92.69083	90.12884	75.78932	
68	206.4	100.0608	97.61884	100.163	0	100.1998	100.101	91.94458	99.50408	92.87219	90.51307	76.56396	
69	210.8	100.0608	97.55961	100.163	0	100.1998	100.101	92.36283	99.51043	93.12452	90.95218	77.5673	
70	214.6	100.0631	97.55961	100.163	0	100.1998	100.101	92.43254	99.53615	93.3453	91.28152	78.35669	
71	219.3	100.0655	97.55961	100.163	0	100.1998	100.101	92.50224	99.54123	93.60552	91.66575	79.24938	
72	222.8	100.0655	97.55961	100.163	0	100.1998	100.101	92.50224	99.55266	93.81053	91.88531	79.87646	
73	227.1	100.0678	97.55961	100.163	0	100.1998	100.101	92.50224	99.56106	94.0263	92.15976	80.57172	
74	230.3	100.0678	97.55961	100.163	0	100.1998	100.101	92.50224	99.57029	94.09896	92.26954	80.79409	
75	233.8	100.0585	97.55961	100.163	0	100.1998	100.101	92.50224	99.56942	94.12371	92.26954	80.8464	
76	238.5	100.0608	97.55961	100.163	0	100.1998	100.101	92.50224	99.5686	94.14087	92.32443	80.91365	

	A	B	C	D	E	F	G	H	I	J	K	L	M
77	241.9	100.0608	97.55961	100.163	0	100.1998	100.101	92.50224	99.56829	94.14971	92.32443	80.95113	
78	246.8	100.0631	97.55961	100.163	0	100.1998	100.101	92.43254	99.56784	94.15884	92.32443	80.99616	
79	250.2	100.0631	97.55961	100.163	0	100.1998	100.101	92.43254	99.56786	94.16748	92.32443	81.01876	
80	254.9	100.0655	97.50037	100.163	0	100.1998	100.101	92.43254	99.56786	94.16842	92.37932	81.04885	
81	258.3	100.0655	97.50037	100.163	0	100.1998	100.101	92.43254	99.56791	94.18476	92.37932	81.06395	
82	263.7	100.0678	97.50037	100.163	0	100.1998	100.101	92.43254	99.56821	94.17756	92.37932	81.07913	
83	269.3	100.0585	97.50037	100.163	0	100.1998	100.101	92.36283	99.56852	94.1938	92.37932	81.0868	
84	272.5	100.0585	97.50037	100.163	0	100.1998	100.101	92.36283	99.5688	94.18609	92.37932	81.08691	
85	276.5	100.0608	97.50037	100.163	0	100.1998	100.101	92.36283	99.56905	94.18623	92.37932	81.09437	
86	280.1	100.0608	97.50037	100.163	0	100.1998	100.101	92.36283	99.56942	94.19419	92.37932	81.08704	
87	285.6	100.0631	97.50037	100.163	0	100.1998	100.101	92.36283	99.57008	94.18635	92.37932	81.08707	
88	290.5	100.0655	97.50037	100.163	0	100.1998	100.101	92.36283	99.57055	94.18634	92.37932	81.07968	
89	293.8	100.0655	97.44114	100.163	0	100.1998	100.101	92.29312	99.57102	94.19421	92.37932	81.07967	
90	299.2	100.0562	97.44114	100.163	0	100.1998	100.101	92.29312	99.57162	94.18629	92.37932	81.07965	
91	302.3	100.0585	97.44114	100.163	0	100.1998	100.101	92.29312	99.57208	94.17837	92.37932	81.07225	
92	307.5	100.0585	97.44114	100.163	0	100.1998	100.101	92.29312	99.57268	94.17831	92.37932	81.07222	
93	312.9	100.0608	97.44114	100.163	0	100.1998	100.101	92.29312	99.57343	94.17826	92.37932	81.06481	
94	318.4	100.0631	97.3819	100.163	0	100.1998	100.101	92.22341	99.57403	94.1782	92.37932	81.05739	
95	323.9	100.0655	97.3819	100.163	0	100.1998	100.101	92.22341	99.57478	94.17025	92.37932	81.05735	
96	329.4	100.0655	97.3819	100.163	0	100.1998	100.101	92.22341	99.57553	94.17018	92.37932	81.04993	
97	332.7	100.0678	97.3819	100.163	0	100.1998	100.101	92.22341	99.57598	94.17802	92.37932	81.03515	
98	337.3	100.0585	97.3819	100.163	0	100.1998	100.101	92.1537	99.57658	94.17798	92.37932	81.03512	
99	343.1	100.0585	97.3819	100.163	0	100.1998	100.101	92.1537	99.57733	94.1779	92.32443	81.0277	
100	348.5	100.0608	97.32267	100.163	0	100.1998	100.101	92.1537	99.57792	94.15419	92.32443	81.02028	
101	353.5	100.0631	97.32267	100.163	0	100.1998	100.101	92.1537	99.57867	94.16989	92.32443	81.02025	
102	356.7	100.0631	97.32267	100.163	0	100.1998	100.101	92.1537	99.57896	94.16197	92.32443	81.02022	
103	362.2	100.0655	97.32267	100.163	0	100.1998	100.101	92.084	99.56384	94.1619	92.32443	81.0128	
104	367.7	100.0562	97.32267	100.163	0	100.1998	100.101	92.084	99.56459	94.16184	92.32443	81.00539	
105	371	100.0562	97.32267	100.163	0	100.1998	100.101	92.084	99.56504	94.15392	92.32443	80.99798	
106	375.6	100.0585	97.26343	100.163	0	100.1998	100.101	92.084	99.57154	94.14291	92.32443	80.94928	
107	380.3	100.0608	97.2042	100.163	0	100.1998	100.101	92.01429	99.57706	94.11347	92.26954	80.87679	
108	384.1	100.0608	97.14496	100.163	0	100.1998	100.101	92.01429	99.56521	94.08297	92.26954	80.81103	
109	389.1	100.0631	97.14496	100.163	0	100.1998	100.101	92.01429	99.5709	94.05258	92.21465	80.72322	
110	394.8	100.0655	97.08573	100.163	0	100.1998	100.101	92.01429	99.56149	94.00639	92.15976	80.61324	
111	400.3	100.0678	97.02649	100.163	0	100.1998	100.101	91.94458	99.5677	93.96796	92.15976	80.51057	
112	405.8	100.0562	96.96726	100.163	0	100.1998	100.101	91.94458	99.55818	93.92159	92.10487	80.39311	
113	411.2	100.0585	96.90802	100.163	0	100.1998	100.101	91.94458	99.5645	93.86734	92.04998	80.2904	
114	416.7	100.0608	96.90802	100.163	0	100.1998	100.101	91.94458	99.55496	93.82094	91.99509	80.18031	
115	422.2	100.0631	96.84879	100.163	0	100.1998	100.101	91.87487	99.5454	93.77454	91.9402	80.07021	
116	427.7	100.0655	96.78955	100.163	0	100.1998	100.101	91.87487	99.55188	93.72815	91.88531	79.95273	
117	433.1	100.0655	96.73032	100.163	0	100.1998	100.101	91.87487	99.54232	93.68174	91.88531	79.84262	
118	438.6	100.0678	96.73032	100.163	0	100.1998	100.101	91.87487	99.54862	93.64319	91.83042	79.72512	
119	444.1	100.0585	96.67108	100.163	0	100.1998	100.101	91.80517	99.53924	93.6047	91.77553	79.61503	
120	449.6	100.0608	96.61185	100.163	0	100.1998	100.101	91.80517	99.54572	93.55828	91.72064	79.49755	
121	455	100.0608	96.55262	100.163	0	100.1998	100.101	91.80517	99.53615	93.51188	91.66575	79.38744	
122	460.5	100.0631	96.55262	100.163	0	100.1998	100.101	91.80517	99.54262	93.46547	91.61086	79.26996	
123	466	100.0655	96.49338	100.163	0	100.1998	100.101	91.73546	99.53323	93.41906	91.61086	79.15247	
124	471.5	100.0562	96.43415	100.163	0	100.1998	100.101	91.73546	99.53954	93.36476	91.55597	79.04974	
125	476.9	100.0585	96.37491	100.163	0	100.1998	100.101	91.73546	99.53013	93.32624	91.50108	78.93225	
126	482.4	100.0585	96.37491	100.163	0	100.1998	100.101	91.73546	99.52073	93.27195	91.44619	78.81477	
127	487.9	100.0608	96.31568	100.163	0	100.1998	100.101	91.66575	99.52705	93.23342	91.3913	78.70466	
128	493.4	100.0631	96.25644	100.163	0	100.1998	100.101	91.66575	99.51764	93.17912	91.33641	78.58718	
129	498.8	100.0655	96.25644	100.163	0	100.1998	100.101	91.66575	99.52412	93.1406	91.28152	78.47707	
130	504.3	100.0678	96.19721	100.163	0	100.1998	100.101	91.59604	99.51456	93.0863	91.28152	78.35958	
131	509.5	100.0562	96.13797	100.163	0	100.1998	100.101	91.59604	99.52102	93.04778	91.22663	78.2421	
132	515	100.0585	96.07874	100.163	0	100.1998	100.101	91.59604	99.51162	93.00137	91.17174	78.13199	
133	520.5	100.0608	96.07874	100.163	0	100.1998	100.101	91.59604	99.5181	92.95496	91.11685	78.02188	
134	525.9	100.0631	96.0195	100.163	0	100.1998	100.101	91.52633	99.50853	92.90855	91.06196	77.90439	
135	528.7	100.0631	95.72333	99.93022	0	99.94247	99.86057	91.38692	99.27304	88.3751	90.89729	77.76457	
136	892	99.81993	92.9393	99.93022	0	99.94247	99.86057	90.20189	99.15345	86.11794	88.53704	71.86328	
137	1256	99.807	90.09603	99.93022	0	99.94247	99.86057	88.94715	99.06749	84.19268	86.56101	66.67062	
138	1621	99.81641	87.312	99.93022	0	99.94247	99.86057	87.69241	98.96723	82.28312	84.53009	61.46696	
139	1976	99.8015	84.52796	99.93022	0	99.94247	99.86057	86.50737	98.8779	80.28146	82.44429	56.18635	
140	2340	99.81121	81.56623	99.93022	0	99.94247	99.86057	85.25263	98.76282	78.1295	80.19381	51.07461	
141	2704	99.79895	78.66373	99.93022	0	99.94247	99.86057	84.0676	98.66378	75.96989	77.94333	46.50659	
142	3069	99.80893	75.70199	99.93022	0	99.94247	99.86057	82.81286	98.54886	73.80248	75.69286	42.40314	
143	3422	99.81671	72.85872	99.93022	0	99.94247	99.86057	81.62783	98.46076	71.68766	73.49727	38.80217	
144	3786	99.80495	69.89699	99.93022	0	99.94247	99.86057	80.37309	98.34283	69.52088	71.24679	35.4769	
145	4151	99.79336	66.99448	99.93022	0	99.94247	99.86057	79.18805	98.24092	67.369	68.99632	32.47948	
146	4515	99.8039	64.03275	99.93022	0	99.94247	99.86057	77.93331	98.13886	65.19426	66.74584	29.76654	
147	4879	99.79264	61.13024	99.93022	0	99.94247	99.86057	76.67857	98.03553	63.03528	64.49536	27.31647	
148	5243	99.80346	58.16851	99.93022	0	99.94247	99.86057	75.49354	97.91632	60.84319	62.19	25.07075	
149	5607	99.79254	55.21862	99.93022	0	99.94247	99.86057	74.2388	97.81299	58.65977	59.93952	23.03721	
150	5971	99.80362	52.26873	99.93022	0	99.94247	99.86057	73.05377	97.70823	56.46768	57.63415	21.18685	
151	6335	99.79304	49.32476	99.93022	0	99.94247	99.86057	71.79903	97.60331	54.28268	55.38368	19.51252	
152	6700	99.78263	46.37487	99.93022	0	99.94247	99.86057	70.54429	97.49855	52.09532	53.08929	17.9777	

	A	B	C	D	E	F	G	H	I	J	K	L	M
153	7064	99.79415	43.42498	99.93022	0	99.94247	99.86057	69.33834	97.39379	49.90402	50.81137	16.58984	
154	7428	99.78407	40.47509	99.93022	0	99.94247	99.86057	68.11149	97.27538	47.74583	48.52796	15.3243	
155	7792	99.79586	37.5252	99.93022	0	99.94247	99.86057	66.88463	97.16792	45.73668	46.24455	14.1889	
156	8156	99.78611	34.57531	99.93022	0	99.94247	99.86057	65.6508	97.05744	43.88128	43.95565	13.18032	
157	8520	99.77886	31.6195	99.93022	0	99.94247	99.86057	64.42394	96.95633	42.15521	41.66675	12.26875	
158	8884	99.79107	28.66369	99.93022	0	99.94247	99.86057	63.19709	96.853	40.54977	39.37236	11.4393	
159	9248	99.78183	25.70787	99.93022	0	99.94247	99.86057	61.97023	96.73078	39.04922	37.07248	10.69188	
160	9613	99.77277	22.75206	99.93022	0	99.94247	99.86057	60.7364	96.63554	37.63697	34.7781	10.01152	
161	9977	99.78542	19.79032	99.93022	0	99.94247	99.86057	59.50954	96.52443	36.31225	32.47273	9.390778	
162	10340	99.77668	16.83451	99.93022	0	99.94247	99.86057	58.28269	96.41015	35.06087	30.17285	8.822266	
163	10710	99.76812	13.87277	99.93022	0	99.94247	99.86057	57.05583	96.30856	33.88833	27.86749	8.298609	
164	11070	99.78118	10.91104	99.93022	0	99.94247	99.86057	55.822	96.18951	32.77258	25.56212	7.812209	
165	11430	99.77296	7.949301	99.93022	0	99.94247	99.86057	54.59514	96.08634	31.71359	23.25675	7.365278	
166	11800	99.78628	4.989342	99.93022	0	99.94247	99.86057	53.36829	95.98793	30.72163	20.9459	6.957596	
167	12160	99.77838	2.024643	99.93022	0	99.94247	99.86057	52.14143	95.87206	29.81956	18.62407	6.591081	
168	12520	99.78966	0	99.93022	0	99.94247	99.86057	50.94246	95.76888	28.99003	16.35163	6.266396	
169	12880	99.76079	0	99.93022	0	99.94247	99.86057	49.7156	95.65301	28.20072	13.99138	5.960376	
170	13250	99.75342	0	99.93022	0	99.94247	99.86057	48.48177	95.54349	27.4603	11.62563	5.680473	
171	13610	99.76745	0	99.93022	0	99.94247	99.86057	47.25491	95.4292	26.76719	9.254398	5.423661	
172	13750	99.75969	0	99.93022	0	99.94247	99.86057	46.80878	95.41492	26.65995	8.897616	5.386774	
173	14110	99.76813	0	99.93022	0	99.94247	99.86057	45.64466	95.41492	26.63393	8.787836	5.376371	
174	14470	99.75771	0	99.93022	0	99.94247	99.86057	44.48054	95.40063	26.60002	8.672568	5.365969	
175	14840	99.74501	0	99.93022	0	99.94247	99.86057	43.30945	95.40381	26.57479	8.562789	5.355567	
176	15200	99.73472	0	99.93022	0	99.94247	99.86057	42.14533	95.38952	26.54167	8.453009	5.344427	
177	15560	99.71453	0	99.93022	0	99.94247	99.86057	41.02304	95.39905	26.53221	8.420075	5.341328	
178	15920	99.72218	0	99.93022	0	99.94247	99.86057	39.87286	95.38952	26.51959	8.381653	5.337271	
179	16280	99.68549	0	99.93022	0	99.94247	99.86057	38.72965	95.39936	26.50934	8.34323	5.332748	
180	16650	99.67062	0	99.93022	0	99.94247	99.86057	37.57947	95.39714	26.4942	8.304807	5.327931	
181	17010	99.65532	0	99.93022	0	99.94247	99.86057	36.42929	95.3819	26.48568	8.266384	5.323098	
182	17380	99.57925	0	99.93022	0	99.94247	99.86057	35.27911	95.38254	26.46692	8.227962	5.318923	
183	17740	99.54315	0	99.93022	0	99.94247	99.86057	34.13591	95.38333	26.45359	8.189539	5.313935	
184	18100	99.50951	0	99.93022	0	99.94247	99.86057	32.9927	95.38476	26.44705	8.151116	5.309605	
185	18470	99.4997	0	99.93022	0	99.94247	99.86057	31.83555	95.38635	26.43128	8.118182	5.305178	
186	18830	99.47	0	99.93022	0	99.94247	99.86057	30.69234	95.38635	26.42339	8.085248	5.30149	
187	19200	99.44274	0	99.93022	0	99.94247	99.86057	29.54216	95.38635	26.41551	8.052315	5.297063	
188	19560	99.45507	0	99.93022	0	99.94247	99.86057	28.39198	95.38635	26.39974	8.019381	5.293374	
189	19930	99.42799	0	99.93022	0	99.94247	99.86057	27.24878	95.38635	26.39185	7.980958	5.288948	
190	20290	99.38017	0	99.93022	0	99.94247	99.86057	26.0986	95.38794	26.37608	7.948024	5.285259	
191	20650	99.39268	0	99.93022	0	99.94247	99.86057	24.95539	95.38794	26.3682	7.915091	5.280833	
192	21020	99.36593	0	99.93022	0	99.94247	99.86057	23.80521	95.37206	26.36031	7.882157	5.276406	
193	21380	99.33704	0	99.93022	0	99.94247	99.86057	22.662	95.37206	26.34454	7.849223	5.272717	
194	21750	99.33131	0	99.93022	0	99.94247	99.86057	21.51183	95.37206	26.33665	7.816289	5.268291	
195	22110	99.3049	0	99.93022	0	99.94247	99.86057	20.36862	95.37365	26.32088	7.783355	5.264602	
196	22480	99.29701	0	99.93022	0	99.94247	99.86057	19.21844	95.37365	26.313	7.744933	5.260175	
197	22840	99.27079	0	99.93022	0	99.94247	99.86057	18.06826	95.37365	26.30511	7.711999	5.256487	
198	23200	99.24244	0	99.93022	0	99.94247	99.86057	16.92505	95.37365	26.28934	7.679065	5.25206	
199	23570	99.23712	0	99.93022	0	99.94247	99.86057	15.77487	95.37365	26.28146	7.646131	5.248371	
200	23930	99.20894	0	99.93022	0	99.94247	99.86057	14.63167	95.37524	26.27357	7.613197	5.243945	
201	24300	99.18312	0	99.93022	0	99.94247	99.86057	13.48149	95.37524	26.2578	7.580264	5.240256	
202	24660	99.17821	0	99.93022	0	99.94247	99.86057	12.33828	95.37524	26.24992	7.54733	5.23583	
203	25020	99.15032	0	99.93022	0	99.94247	99.86057	11.1881	95.35936	26.24203	7.514396	5.232141	
204	25390	99.12488	0	99.93022	0	99.94247	99.86057	10.04489	95.36095	26.22626	7.481462	5.227714	
205	25750	99.11788	0	99.93022	0	99.94247	99.86057	8.894715	95.36095	26.21838	7.443039	5.224026	
206	26120	99.09263	0	99.93022	0	99.94247	99.86057	7.744536	95.36095	26.20261	7.410106	5.219599	
207	26480	99.0881	0	99.93022	0	99.94247	99.86057	6.600631	95.36095	26.19472	7.377172	5.21591	
208	26840	99.06074	0	99.93022	0	99.94247	99.86057	5.453241	95.36095	26.18683	7.344238	5.211484	
209	27210	99.03582	0	99.93022	0	99.94247	99.86057	4.30585	95.36254	26.17106	7.311304	5.207795	
210	27570	99.02922	0	99.93022	0	99.94247	99.86057	3.159157	95.36254	26.16318	7.27837	5.203368	
211	27930	99.00449	0	99.93022	0	99.94247	99.86057	2.011767	95.36254	26.15529	7.245437	5.19968	
212	28310	98.98009	0	99.93022	0	99.94247	99.86057	0.865074	95.36254	26.13952	7.207014	5.195253	
213	28670	98.97364	0	99.93022	0	99.94247	99.86057	0	95.36254	26.13164	7.17408	5.191564	
214	29020	98.94677	0	99.93022	0	99.94247	99.86057	0	95.36413	26.11587	7.141146	5.187138	
215	29400	98.92031	0	99.93022	0	99.94247	99.86057	0	95.36413	26.10798	7.108212	5.183449	
216	29760	98.91663	0	99.93022	0	99.94247	99.86057	0	95.34825	26.1001	7.075279	5.17976	
217	30120	98.89024	0	99.93022	0	99.94247	99.86057	0	95.34825	26.08433	7.042345	5.175334	
218	30470	98.86627	0	99.93022	0	99.94247	99.86057	0	95.34984	26.07644	7.009411	5.171645	
219	30860	98.86281	0	99.93022	0	99.94247	99.86057	0	95.34984	26.06856	6.976477	5.167219	
220	31210	98.83683	0	99.93022	0	99.94247	99.86057	0	95.34984	26.05279	6.943543	5.16353	
221	31570	98.79298	0	99.93022	0	99.94247	99.86057	0	95.34984	26.0449	6.905121	5.159103	
222	31950	98.80756	0	99.93022	0	99.94247	99.86057	0	95.34984	26.03702	6.872187	5.155415	
223	32310	98.76413	0	99.93022	0	99.94247	99.86057	0	95.35143	26.02125	6.839253	5.151726	
224	32660	98.74104	0	99.93022	0	99.94247	99.86057	0	95.35143	26.01336	6.806319	5.147299	
225	33050	98.73561	0	99.93022	0	99.94247	99.86057	0	95.35143	26.00547	6.773385	5.143611	
226	33400	98.71276	0	99.93022	0	99.94247	99.86057	0	95.35143	25.9897	6.740452	5.139184	
227	33760	98.70747	0	99.93022	0	99.94247	99.86057	0	95.35143	25.98182	6.707518	5.135495	
228	34140	98.68477	0	99.93022	0	99.94247	99.86057	0	95.33714	25.97393	6.669095	5.131806	

	A	B	C	D	E	F	G	H	I	J	K	L	M
229	34500	98.65981	0	99.93022	0	99.94247	99.86057	0	95.33714	25.95816	6.636161	5.12738	
230	34850	98.65718	0	99.93022	0	99.94247	99.86057	0	95.33714	25.95028	6.603227	5.123691	
231	35210	98.63456	0	99.93022	0	99.94247	99.86057	0	95.33714	25.93451	6.570294	5.119265	
232	35590	98.60989	0	99.93022	0	99.94247	99.86057	0	95.33714	25.92662	6.53736	5.115576	
233	35950	98.58781	0	99.93022	0	99.94247	99.86057	0	95.33873	25.91874	6.504426	5.111887	
234	36300	98.56338	0	99.93022	0	99.94247	99.86057	0	95.33873	25.90297	6.471492	5.107461	
235	36690	98.56107	0	99.93022	0	99.94247	99.86057	0	95.33873	25.89508	6.438558	5.103772	
236	37040	98.53908	0	99.93022	0	99.94247	99.86057	0	95.33873	25.8872	6.400136	5.100083	
237	37400	98.51498	0	99.93022	0	99.94247	99.86057	0	95.33873	25.87143	6.367202	5.095657	
238	37780	98.51323	0	99.93022	0	99.94247	99.86057	0	95.34032	25.86354	6.334268	5.091968	
239	38140	98.48917	0	99.93022	0	99.94247	99.86057	0	95.32444	25.85566	6.301334	5.088279	
240	38490	98.44818	0	99.93022	0	99.94247	99.86057	0	95.32444	25.83988	6.2684	5.083853	
241	38880	98.44425	0	99.93022	0	99.94247	99.86057	0	95.32444	25.832	6.235467	5.080164	
242	39230	98.423	0	99.93022	0	99.94247	99.86057	0	95.32603	25.82411	6.202533	5.076475	
243	39590	98.4019	0	99.93022	0	99.94247	99.86057	0	95.32603	25.80834	6.16411	5.072049	
244	39950	98.37825	0	99.93022	0	99.94247	99.86057	0	95.32603	25.80046	6.131176	5.06836	
245	40330	98.3574	0	99.93022	0	99.94247	99.86057	0	95.32603	25.79257	6.098242	5.064671	
246	40680	98.35398	0	99.93022	0	99.94247	99.86057	0	95.32603	25.7768	6.065309	5.060245	
247	41040	98.3333	0	99.93022	0	99.94247	99.86057	0	95.32762	25.76892	6.032375	5.056556	
248	41420	98.3104	0	99.93022	0	99.94247	99.86057	0	95.32762	25.76103	5.999441	5.052867	
249	41780	98.30946	0	99.93022	0	99.94247	99.86057	0	95.32762	25.74526	5.966507	5.049178	
250	42140	98.26944	0	99.93022	0	99.94247	99.86057	0	95.32762	25.73738	5.933573	5.044752	
251	42520	98.24673	0	99.93022	0	99.94247	99.86057	0	95.32762	25.72949	5.90064	5.041063	
252	42870	98.24627	0	99.93022	0	99.94247	99.86057	0	95.31333	25.71372	5.862217	5.037374	
253	43230	98.22634	0	99.93022	0	99.94247	99.86057	0	95.31333	25.70584	5.829283	5.033685	
254	43610	98.18465	0	99.93022	0	99.94247	99.86057	0	95.31333	25.69795	5.796349	5.029259	
255	43970	98.18421	0	99.93022	0	99.94247	99.86057	0	95.31333	25.68218	5.763415	5.02557	
256	44330	98.16199	0	99.93022	0	99.94247	99.86057	0	95.31333	25.6743	5.730482	5.021881	
257	44710	98.14251	0	99.93022	0	99.94247	99.86057	0	95.31492	25.65852	5.697548	5.017455	
258	45070	98.14007	0	99.93022	0	99.94247	99.86057	0	95.31492	25.65064	5.664614	5.013766	
259	45420	98.10117	0	99.93022	0	99.94247	99.86057	0	95.31492	25.64275	5.63168	5.010077	
260	45780	98.06274	0	99.93022	0	99.94247	99.86057	0	95.31492	25.62698	5.593257	5.006389	
261	46160	98.0606	0	99.93022	0	99.94247	99.86057	0	95.31492	25.6191	5.560324	5.001962	
262	46520	98.04138	0	99.93022	0	99.94247	99.86057	0	95.31651	25.61121	5.52739	4.998273	
263	46870	98.02025	0	99.93022	0	99.94247	99.86057	0	95.31651	25.59544	5.494456	4.994585	
264	47260	98.02061	0	99.93022	0	99.94247	99.86057	0	95.31651	25.58756	5.460973	4.990896	
265	47610	97.98009	0	99.93022	0	99.94247	99.86057	0	95.30063	25.57967	5.427491	4.987207	
266	47970	97.96151	0	99.93022	0	99.94247	99.86057	0	95.30063	25.5639	5.393459	4.98278	
267	48350	97.96248	0	99.93022	0	99.94247	99.86057	0	95.30222	25.55602	5.359976	4.979092	
268	48710	97.9222	0	99.93022	0	99.94247	99.86057	0	95.30222	25.54813	5.326494	4.975403	
269	49060	97.90429	0	99.93022	0	99.94247	99.86057	0	95.30222	25.54025	5.292462	4.971714	
270	49450	97.90253	0	99.93022	0	99.94247	99.86057	0	95.30222	25.52448	5.258979	4.968025	
271	49800	97.86577	0	99.93022	0	99.94247	99.86057	0	95.30222	25.51659	5.225497	4.963599	
272	50160	97.86651	0	99.93022	0	99.94247	99.86057	0	95.30381	25.50871	5.192014	4.95991	
273	50510	97.84675	0	99.93022	0	99.94247	99.86057	0	95.30381	25.49294	5.157982	4.956221	
274	50900	97.80959	0	99.93022	0	99.94247	99.86057	0	95.30381	25.48505	5.1245	4.952533	
275	51250	97.80851	0	99.93022	0	99.94247	99.86057	0	95.30381	25.47716	5.091017	4.948844	
276	51610	97.79109	0	99.93022	0	99.94247	99.86057	0	95.28794	25.46139	5.057534	4.945155	
277	51990	97.75508	0	99.93022	0	99.94247	99.86057	0	95.28952	25.45351	5.023503	4.940729	
278	52350	97.75392	0	99.93022	0	99.94247	99.86057	0	95.28952	25.44562	4.99002	4.93704	
279	52700	97.7181	0	99.93022	0	99.94247	99.86057	0	95.28952	25.42985	4.956537	4.933351	
280	53090	97.7176	0	99.93022	0	99.94247	99.86057	0	95.28952	25.42197	4.923055	4.929662	
281	53440	97.70027	0	99.93022	0	99.94247	99.86057	0	95.28952	25.41408	4.889023	4.925974	
282	53800	97.6627	0	99.93022	0	99.94247	99.86057	0	95.29111	25.39831	4.85554	4.922285	
283	54180	97.66433	0	99.93022	0	99.94247	99.86057	0	95.29111	25.39043	4.822058	4.918596	
284	54540	97.62923	0	99.93022	0	99.94247	99.86057	0	95.29111	25.38254	4.788026	4.91417	
285	54890	97.61039	0	99.93022	0	99.94247	99.86057	0	95.29111	25.36677	4.754543	4.910481	
286	55280	97.61237	0	99.93022	0	99.94247	99.86057	0	95.29111	25.35889	4.721061	4.906792	
287	55630	97.57545	0	99.93022	0	99.94247	99.86057	0	95.2927	25.351	4.687578	4.903103	
288	55990	97.55871	0	99.93022	0	99.94247	99.86057	0	95.2927	25.33523	4.653546	4.899414	
289	56350	97.54061	0	99.93022	0	99.94247	99.86057	0	95.27683	25.32735	4.620064	4.895726	
290	56730	97.50585	0	99.93022	0	99.94247	99.86057	0	95.27683	25.31946	4.586581	4.892037	
291	57080	97.50877	0	99.93022	0	99.94247	99.86057	0	95.27683	25.31157	4.553098	4.888348	
292	57440	97.4904	0	99.93022	0	99.94247	99.86057	0	95.27841	25.2958	4.519067	4.883922	
293	57820	97.45605	0	99.93022	0	99.94247	99.86057	0	95.27841	25.28792	4.485584	4.880233	
294	58180	97.45923	0	99.93022	0	99.94247	99.86057	0	95.27841	25.28003	4.452101	4.876544	
295	58540	97.42325	0	99.93022	0	99.94247	99.86057	0	95.27841	25.26426	4.418618	4.872855	
296	58920	97.40784	0	99.93022	0	99.94247	99.86057	0	95.27841	25.25638	4.384587	4.869167	
297	59270	97.40895	0	99.93022	0	99.94247	99.86057	0	95.28	25.24849	4.351104	4.865478	
298	59630	97.37498	0	99.93022	0	99.94247	99.86057	0	95.28	25.23272	4.317621	4.861789	
299	60010	97.33904	0	99.93022	0	99.94247	99.86057	0	95.28	25.22484	4.28359	4.8581	
300	60370	97.34268	0	99.93022	0	99.94247	99.86057	0	95.28	25.21695	4.250107	4.854412	
301	60730	97.32814	0	99.93022	0	99.94247	99.86057	0	95.26413	25.20118	4.216625	4.850723	
302	61080	97.29252	0	99.93022	0	99.94247	99.86057	0	95.26571	25.1933	4.183142	4.847034	
303	61460	97.29631	0	99.93022	0	99.94247	99.86057	0	95.26571	25.18541	4.14911	4.843345	
304	61820	97.24296	0	99.93022	0	99.94247	99.86057	0	95.26571	25.16964	4.115628	4.839656	

	A	B	C	D	E	F	G	H	I	J	K	L	M
305	62180	97.22829	0	99.93022	0	99.94247	99.86057	0	95.26571	25.16176	4.082145	4.83523	
306	62560	97.22993	0	99.93022	0	99.94247	99.86057	0	95.26571	25.15387	4.048662	4.831541	
307	62920	97.19752	0	99.93022	0	99.94247	99.86057	0	95.2673	25.14599	4.014631	4.827852	
308	63270	97.16547	0	99.93022	0	99.94247	99.86057	0	95.2673	25.13021	3.981148	4.824164	
309	63660	97.16721	0	99.93022	0	99.94247	99.86057	0	95.2673	25.12233	3.947665	4.820475	
310	64010	97.13578	0	99.93022	0	99.94247	99.86057	0	95.2673	25.11444	3.914182	4.816786	
311	64370	97.11987	0	99.93022	0	99.94247	99.86057	0	95.2673	25.09867	3.880151	4.813097	
312	64750	97.1058	0	99.93022	0	99.94247	99.86057	0	95.25302	25.09079	3.846668	4.809409	
313	65110	97.09276	0	99.93022	0	99.94247	99.86057	0	95.25302	25.0829	3.813185	4.80572	
314	65460	97.05881	0	99.93022	0	99.94247	99.86057	0	95.25302	25.07502	3.779154	4.802031	
315	65850	97.06374	0	99.93022	0	99.94247	99.86057	0	95.25302	25.05925	3.745671	4.798342	
316	66200	97.02963	0	99.93022	0	99.94247	99.86057	0	95.25302	25.05136	3.712188	4.794654	
317	66560	97.01699	0	99.93022	0	99.94247	99.86057	0	95.2546	25.04348	3.678706	4.790965	
318	66910	97.00387	0	99.93022	0	99.94247	99.86057	0	95.2546	25.02771	3.644674	4.787276	
319	67300	96.95264	0	99.93022	0	99.94247	99.86057	0	95.2546	25.01982	3.611191	4.783587	
320	67650	96.95812	0	99.93022	0	99.94247	99.86057	0	95.2546	25.01194	3.577709	4.779899	
321	68010	96.94354	0	99.93022	0	99.94247	99.86057	0	95.2546	25.00405	3.543677	4.77621	
322	68390	96.91278	0	99.93022	0	99.94247	99.86057	0	95.2546	24.98828	3.510194	4.772521	
323	68750	96.89797	0	99.93022	0	99.94247	99.86057	0	95.25619	24.9804	3.476712	4.768832	
324	69100	96.88572	0	99.93022	0	99.94247	99.86057	0	95.25619	24.97251	3.443229	4.765881	
325	69490	96.87377	0	99.93022	0	99.94247	99.86057	0	95.24032	24.95674	3.409746	4.762192	
326	69840	96.84107	0	99.93022	0	99.94247	99.86057	0	95.24032	24.94885	3.375715	4.758504	
327	70200	96.82966	0	99.93022	0	99.94247	99.86057	0	95.24032	24.94097	3.342232	4.754815	
328	70580	96.81539	0	99.93022	0	99.94247	99.86057	0	95.2419	24.9252	3.308749	4.751126	
329	70940	96.78588	0	99.93022	0	99.94247	99.86057	0	95.2419	24.91731	3.274718	4.747437	
330	71290	96.77215	0	99.93022	0	99.94247	99.86057	0	95.2419	24.90943	3.241235	4.743749	
331	71650	96.76016	0	99.93022	0	99.94247	99.86057	0	95.2419	24.90154	3.207752	4.74006	
332	72030	96.73153	0	99.93022	0	99.94247	99.86057	0	95.2419	24.88577	3.17427	4.736371	
333	72390	96.73549	0	99.93022	0	99.94247	99.86057	0	95.24349	24.87789	3.140238	4.732682	
334	72740	96.70656	0	99.93022	0	99.94247	99.86057	0	95.24349	24.87	3.106755	4.728994	
335	73130	96.67562	0	99.93022	0	99.94247	99.86057	0	95.24349	24.85423	3.073273	4.725305	
336	73480	96.66408	0	99.93022	0	99.94247	99.86057	0	95.22762	24.84635	3.039241	4.721616	
337	73840	96.63603	0	99.93022	0	99.94247	99.86057	0	95.22762	24.83846	3.005758	4.717927	
338	74220	96.62271	0	99.93022	0	99.94247	99.86057	0	95.22921	24.83058	2.972276	4.714976	
339	74580	96.61195	0	99.93022	0	99.94247	99.86057	0	95.22921	24.81481	2.938793	4.711288	
340	74940	96.58154	0	99.93022	0	99.94247	99.86057	0	95.22921	24.80692	2.904761	4.707599	
341	75320	96.55375	0	99.93022	0	99.94247	99.86057	0	95.22921	24.79904	2.871279	4.70391	
342	75670	96.56132	0	99.93022	0	99.94247	99.86057	0	95.22921	24.79115	2.837796	4.700221	
343	76030	96.53085	0	99.93022	0	99.94247	99.86057	0	95.23079	24.77538	2.804313	4.696533	
344	76390	96.50298	0	99.93022	0	99.94247	99.86057	0	95.23079	24.76749	2.770282	4.692844	
345	76770	96.50894	0	99.93022	0	99.94247	99.86057	0	95.23079	24.75961	2.736799	4.689155	
346	77130	96.4816	0	99.93022	0	99.94247	99.86057	0	95.23079	24.74384	2.703316	4.685466	
347	77480	96.45361	0	99.93022	0	99.94247	99.86057	0	95.23079	24.73595	2.669834	4.682515	
348	77860	96.44194	0	99.93022	0	99.94247	99.86057	0	95.23238	24.72807	2.635802	4.678826	
349	78220	96.41545	0	99.93022	0	99.94247	99.86057	0	95.21651	24.72018	2.602319	4.675138	
350	78580	96.40333	0	99.93022	0	99.94247	99.86057	0	95.21651	24.70441	2.568837	4.671449	
351	78960	96.48051	0	99.93022	0	99.94247	99.86057	0	95.21651	24.69653	2.534805	4.66776	
352	80000	96.42621	0	99.93022	0	99.94247	99.86057	0	95.21444	24.66764	2.438765	4.657316	Extrapolation
353	81000	96.374	0	99.93022	0	99.94247	99.86057	0	95.21245	24.63987	2.34642	4.647274	beyond this
354	82000	96.32179	0	99.93022	0	99.94247	99.86057	0	95.21046	24.61209	2.254074	4.637232	point
355	83000	96.26958	0	99.93022	0	99.94247	99.86057	0	95.20847	24.58432	2.161728	4.62719	
356	84000	96.21737	0	99.93022	0	99.94247	99.86057	0	95.20648	24.55654	2.069383	4.617147	
357	85000	96.16516	0	99.93022	0	99.94247	99.86057	0	95.20449	24.52877	1.977037	4.607105	
358	86000	96.11295	0	99.93022	0	99.94247	99.86057	0	95.2025	24.50099	1.884691	4.597063	
359	87000	96.06074	0	99.93022	0	99.94247	99.86057	0	95.20051	24.47322	1.792345	4.587021	
360	88000	96.00853	0	99.93022	0	99.94247	99.86057	0	95.19852	24.44544	1.7	4.576978	
361	89000	95.95632	0	99.93022	0	99.94247	99.86057	0	95.19653	24.41767	1.607654	4.566936	
362	90000	95.9041	0	99.93022	0	99.94247	99.86057	0	95.19454	24.38989	1.515308	4.556894	
363	91000	95.85189	0	99.93022	0	99.94247	99.86057	0	95.19255	24.36212	1.422962	4.546852	
364	92000	95.79968	0	99.93022	0	99.94247	99.86057	0	95.19056	24.33434	1.330617	4.536809	
365	93000	95.74747	0	99.93022	0	99.94247	99.86057	0	95.18857	24.30657	1.238271	4.526767	
366	94000	95.69526	0	99.93022	0	99.94247	99.86057	0	95.18658	24.27879	1.145925	4.516725	
367	95000	95.64305	0	99.93022	0	99.94247	99.86057	0	95.18459	24.25102	1.05358	4.506683	
368	96000	95.59084	0	99.93022	0	99.94247	99.86057	0	95.1826	24.22324	0.961234	4.49664	
369	97000	95.53863	0	99.93022	0	99.94247	99.86057	0	95.18061	24.19547	0.868888	4.486598	
370	98000	95.48642	0	99.93022	0	99.94247	99.86057	0	95.17862	24.16769	0.776542	4.476556	
371	99000	95.43421	0	99.93022	0	99.94247	99.86057	0	95.17663	24.13992	0.684197	4.466514	
372	100000	95.382	0	99.93022	0	99.94247	99.86057	0	95.17464	24.11214	0.591851	4.456471	
373	101000	95.32979	0	99.93022	0	99.94247	99.86057	0	95.17265	24.08437	0.499505	4.446429	
374	102000	95.27758	0	99.93022	0	99.94247	99.86057	0	95.17066	24.0566	0.407159	4.436387	
375	103000	95.22537	0	99.93022	0	99.94247	99.86057	0	95.16867	24.02882	0.314814	4.426345	
376	104000	95.17315	0	99.93022	0	99.94247	99.86057	0	95.16668	24.00105	0.222468	4.416302	
377	105000	95.12094	0	99.93022	0	99.94247	99.86057	0	95.16469	23.97327	0.130122	4.40626	
378	106000	95.06873	0	99.93022	0	99.94247	99.86057	0	95.1627	23.9455	0.037777	4.396218	
379	107000	95.01652	0	99.93022	0	99.94247	99.86057	0	95.16071	23.91772	0	4.386176	
380	108000	94.96431	0	99.93022	0	99.94247	99.86057	0	95.15872	23.88995	0	4.376133	

	A	B	C	D	E	F	G	H	I	J	K	L	M
381	109000	94.9121	0	99.93022	0	99.94247	99.86057	0	95.15673	23.86217	0	4.366091	
382	110000	94.85989	0	99.93022	0	99.94247	99.86057	0	95.15474	23.8344	0	4.356049	
383	111000	94.80768	0	99.93022	0	99.94247	99.86057	0	95.15275	23.80662	0	4.346007	
384	112000	94.75547	0	99.93022	0	99.94247	99.86057	0	95.15076	23.77885	0	4.335964	
385	113000	94.70326	0	99.93022	0	99.94247	99.86057	0	95.14877	23.75107	0	4.325922	
386	114000	94.65105	0	99.93022	0	99.94247	99.86057	0	95.14678	23.7233	0	4.31588	
387	115000	94.59884	0	99.93022	0	99.94247	99.86057	0	95.14479	23.69552	0	4.305838	
388	116000	94.54663	0	99.93022	0	99.94247	99.86057	0	95.1428	23.66775	0	4.295795	
389	117000	94.49442	0	99.93022	0	99.94247	99.86057	0	95.14081	23.63997	0	4.285753	
390	118000	94.4422	0	99.93022	0	99.94247	99.86057	0	95.13882	23.6122	0	4.275711	
391	119000	94.38999	0	99.93022	0	99.94247	99.86057	0	95.13683	23.58442	0	4.265669	
392	120000	94.33778	0	99.93022	0	99.94247	99.86057	0	95.13484	23.55665	0	4.255627	
393	121000	94.28557	0	99.93022	0	99.94247	99.86057	0	95.13285	23.52887	0	4.245584	
394	122000	94.23336	0	99.93022	0	99.94247	99.86057	0	95.13086	23.5011	0	4.235542	
395	123000	94.18115	0	99.93022	0	99.94247	99.86057	0	95.12887	23.47332	0	4.2255	
396	124000	94.12894	0	99.93022	0	99.94247	99.86057	0	95.12688	23.44555	0	4.215458	
397	125000	94.07673	0	99.93022	0	99.94247	99.86057	0	95.12489	23.41777	0	4.205415	
398	126000	94.02452	0	99.93022	0	99.94247	99.86057	0	95.1229	23.39	0	4.195373	
399	127000	93.97231	0	99.93022	0	99.94247	99.86057	0	95.12091	23.36222	0	4.185331	
400	128000	93.9201	0	99.93022	0	99.94247	99.86057	0	95.11892	23.33445	0	4.175289	
401	129000	93.86789	0	99.93022	0	99.94247	99.86057	0	95.11693	23.30667	0	4.165246	
402	130000	93.81568	0	99.93022	0	99.94247	99.86057	0	95.11494	23.2789	0	4.155204	
403	131000	93.76347	0	99.93022	0	99.94247	99.86057	0	95.11295	23.25113	0	4.145162	
404	132000	93.71125	0	99.93022	0	99.94247	99.86057	0	95.11096	23.22335	0	4.13512	
405	133000	93.65904	0	99.93022	0	99.94247	99.86057	0	95.10897	23.19558	0	4.125077	
406	134000	93.60683	0	99.93022	0	99.94247	99.86057	0	95.10698	23.1678	0	4.115035	
407	135000	93.55462	0	99.93022	0	99.94247	99.86057	0	95.10499	23.14003	0	4.104993	
408	136000	93.50241	0	99.93022	0	99.94247	99.86057	0	95.103	23.11225	0	4.094951	
409	137000	93.4502	0	99.93022	0	99.94247	99.86057	0	95.10101	23.08448	0	4.084908	
410	138000	93.39799	0	99.93022	0	99.94247	99.86057	0	95.09902	23.0567	0	4.074866	
411	139000	93.34578	0	99.93022	0	99.94247	99.86057	0	95.09703	23.02893	0	4.064824	
412	140000	93.29357	0	99.93022	0	99.94247	99.86057	0	95.09504	23.00115	0	4.054782	
413	141000	93.24136	0	99.93022	0	99.94247	99.86057	0	95.09305	22.97338	0	4.044739	
414	142000	93.18915	0	99.93022	0	99.94247	99.86057	0	95.09106	22.9456	0	4.034697	
415	143000	93.13694	0	99.93022	0	99.94247	99.86057	0	95.08907	22.91783	0	4.024655	
416	144000	93.08473	0	99.93022	0	99.94247	99.86057	0	95.08708	22.89005	0	4.014613	
417	145000	93.03252	0	99.93022	0	99.94247	99.86057	0	95.08509	22.86228	0	4.00457	
418	146000	92.9803	0	99.93022	0	99.94247	99.86057	0	95.0831	22.8345	0	3.994528	
419	147000	92.92809	0	99.93022	0	99.94247	99.86057	0	95.08111	22.80673	0	3.984486	
420	148000	92.87588	0	99.93022	0	99.94247	99.86057	0	95.07912	22.77895	0	3.974444	
421	149000	92.82367	0	99.93022	0	99.94247	99.86057	0	95.07713	22.75118	0	3.964401	
422	150000	92.77146	0	99.93022	0	99.94247	99.86057	0	95.07514	22.7234	0	3.954359	
423	151000	92.71925	0	99.93022	0	99.94247	99.86057	0	95.07315	22.69563	0	3.944317	
424	152000	92.66704	0	99.93022	0	99.94247	99.86057	0	95.07116	22.66785	0	3.934275	
425	153000	92.61483	0	99.93022	0	99.94247	99.86057	0	95.06917	22.64008	0	3.924232	
426	154000	92.56262	0	99.93022	0	99.94247	99.86057	0	95.06718	22.6123	0	3.91419	
427	155000	92.51041	0	99.93022	0	99.94247	99.86057	0	95.06519	22.58453	0	3.904148	
428	156000	92.4582	0	99.93022	0	99.94247	99.86057	0	95.0632	22.55675	0	3.894106	
429	157000	92.40599	0	99.93022	0	99.94247	99.86057	0	95.06121	22.52898	0	3.884064	
430	158000	92.35378	0	99.93022	0	99.94247	99.86057	0	95.05922	22.50121	0	3.874021	
431	159000	92.30157	0	99.93022	0	99.94247	99.86057	0	95.05723	22.47343	0	3.863979	
432	160000	92.24935	0	99.93022	0	99.94247	99.86057	0	95.05524	22.44566	0	3.853937	
433	161000	92.19714	0	99.93022	0	99.94247	99.86057	0	95.05325	22.41788	0	3.843895	
434	162000	92.14493	0	99.93022	0	99.94247	99.86057	0	95.05126	22.39011	0	3.833852	
435	163000	92.09272	0	99.93022	0	99.94247	99.86057	0	95.04927	22.36233	0	3.82381	
436	164000	92.04051	0	99.93022	0	99.94247	99.86057	0	95.04728	22.33456	0	3.813768	
437	165000	91.9883	0	99.93022	0	99.94247	99.86057	0	95.04529	22.30678	0	3.803726	
438	166000	91.93609	0	99.93022	0	99.94247	99.86057	0	95.0433	22.27901	0	3.793683	
439	167000	91.88388	0	99.93022	0	99.94247	99.86057	0	95.04131	22.25123	0	3.783641	
440	168000	91.83167	0	99.93022	0	99.94247	99.86057	0	95.03932	22.22346	0	3.773599	
441	169000	91.77946	0	99.93022	0	99.94247	99.86057	0	95.03733	22.19568	0	3.763557	
442	170000	91.72725	0	99.93022	0	99.94247	99.86057	0	95.03534	22.16791	0	3.753514	
443	171000	91.67504	0	99.93022	0	99.94247	99.86057	0	95.03335	22.14013	0	3.743472	
444	172000	91.62283	0	99.93022	0	99.94247	99.86057	0	95.03136	22.11236	0	3.73343	
445	173000	91.57062	0	99.93022	0	99.94247	99.86057	0	95.02937	22.08458	0	3.723388	
446	174000	91.5184	0	99.93022	0	99.94247	99.86057	0	95.02738	22.05681	0	3.713345	
447	175000	91.46619	0	99.93022	0	99.94247	99.86057	0	95.02539	22.02903	0	3.703303	
448	176000	91.41398	0	99.93022	0	99.94247	99.86057	0	95.0234	22.00126	0	3.693261	
449	177000	91.36177	0	99.93022	0	99.94247	99.86057	0	95.02141	21.97348	0	3.683219	
450	178000	91.30956	0	99.93022	0	99.94247	99.86057	0	95.01942	21.94571	0	3.673176	
451	179000	91.25735	0	99.93022	0	99.94247	99.86057	0	95.01743	21.91793	0	3.663134	
452	180000	91.20514	0	99.93022	0	99.94247	99.86057	0	95.01544	21.89016	0	3.653092	
453	181000	91.15293	0	99.93022	0	99.94247	99.86057	0	95.01345	21.86238	0	3.64305	
454	182000	91.10072	0	99.93022	0	99.94247	99.86057	0	95.01146	21.83461	0	3.633007	
455	183000	91.04851	0	99.93022	0	99.94247	99.86057	0	95.00947	21.80683	0	3.622965	
456	184000	90.9963	0	99.93022	0	99.94247	99.86057	0	95.00748	21.77906	0	3.612923	

	A	B	C	D	E	F	G	H	I	J	K	L	M
457	185000	90.94409	0	99.93022	0	99.94247	99.86057	0	95.00549	21.75128	0	3.602881	
458	186000	90.89188	0	99.93022	0	99.94247	99.86057	0	95.0035	21.72351	0	3.592838	
459	187000	90.83967	0	99.93022	0	99.94247	99.86057	0	95.00151	21.69574	0	3.582796	
460	188000	90.78745	0	99.93022	0	99.94247	99.86057	0	94.99952	21.66796	0	3.572754	
461	189000	90.73524	0	99.93022	0	99.94247	99.86057	0	94.99753	21.64019	0	3.562712	
462	190000	90.68303	0	99.93022	0	99.94247	99.86057	0	94.99554	21.61241	0	3.552669	
463	191000	90.63082	0	99.93022	0	99.94247	99.86057	0	94.99355	21.58464	0	3.542627	
464	192000	90.57861	0	99.93022	0	99.94247	99.86057	0	94.99156	21.55686	0	3.532585	
465	193000	90.5264	0	99.93022	0	99.94247	99.86057	0	94.98957	21.52909	0	3.522543	
466	194000	90.47419	0	99.93022	0	99.94247	99.86057	0	94.98758	21.50131	0	3.512501	
467	195000	90.42198	0	99.93022	0	99.94247	99.86057	0	94.98559	21.47354	0	3.502458	
468	196000	90.36977	0	99.93022	0	99.94247	99.86057	0	94.9836	21.44576	0	3.492416	
469	197000	90.31756	0	99.93022	0	99.94247	99.86057	0	94.98161	21.41799	0	3.482374	
470	198000	90.26535	0	99.93022	0	99.94247	99.86057	0	94.97961	21.39021	0	3.472332	
471	199000	90.21314	0	99.93022	0	99.94247	99.86057	0	94.97762	21.36244	0	3.462289	
472	200000	90.16093	0	99.93022	0	99.94247	99.86057	0	94.97563	21.33466	0	3.452247	
473	201000	90.10872	0	99.93022	0	99.94247	99.86057	0	94.97364	21.30689	0	3.442205	
474	202000	90.0565	0	99.93022	0	99.94247	99.86057	0	94.97165	21.27911	0	3.432163	
475	203000	90.00429	0	99.93022	0	99.94247	99.86057	0	94.96966	21.25134	0	3.42212	
476	204000	89.95208	0	99.93022	0	99.94247	99.86057	0	94.96767	21.22356	0	3.412078	
477	205000	89.89987	0	99.93022	0	99.94247	99.86057	0	94.96568	21.19579	0	3.402036	
478	206000	89.84766	0	99.93022	0	99.94247	99.86057	0	94.96369	21.16801	0	3.391994	
479	207000	89.79545	0	99.93022	0	99.94247	99.86057	0	94.9617	21.14024	0	3.381951	
480	208000	89.74324	0	99.93022	0	99.94247	99.86057	0	94.95971	21.11246	0	3.371909	
481	209000	89.69103	0	99.93022	0	99.94247	99.86057	0	94.95772	21.08469	0	3.361867	
482	210000	89.63882	0	99.93022	0	99.94247	99.86057	0	94.95573	21.05691	0	3.351825	
483	211000	89.58661	0	99.93022	0	99.94247	99.86057	0	94.95374	21.02914	0	3.341782	
484	212000	89.5344	0	99.93022	0	99.94247	99.86057	0	94.95175	21.00136	0	3.33174	
485	213000	89.48219	0	99.93022	0	99.94247	99.86057	0	94.94976	20.97359	0	3.321698	
486	214000	89.42998	0	99.93022	0	99.94247	99.86057	0	94.94777	20.94581	0	3.311656	
487	215000	89.37777	0	99.93022	0	99.94247	99.86057	0	94.94578	20.91804	0	3.301613	
488	216000	89.32555	0	99.93022	0	99.94247	99.86057	0	94.94379	20.89027	0	3.291571	
489	217000	89.27334	0	99.93022	0	99.94247	99.86057	0	94.9418	20.86249	0	3.281529	
490	218000	89.22113	0	99.93022	0	99.94247	99.86057	0	94.93981	20.83472	0	3.271487	
491	219000	89.16892	0	99.93022	0	99.94247	99.86057	0	94.93782	20.80694	0	3.261444	
492	220000	89.11671	0	99.93022	0	99.94247	99.86057	0	94.93583	20.77917	0	3.251402	
493	221000	89.0645	0	99.93022	0	99.94247	99.86057	0	94.93384	20.75139	0	3.24136	
494	222000	89.01229	0	99.93022	0	99.94247	99.86057	0	94.93185	20.72362	0	3.231318	
495	223000	88.96008	0	99.93022	0	99.94247	99.86057	0	94.92986	20.69584	0	3.221275	
496	224000	88.90787	0	99.93022	0	99.94247	99.86057	0	94.92787	20.66807	0	3.211233	
497	225000	88.85566	0	99.93022	0	99.94247	99.86057	0	94.92588	20.64029	0	3.201191	
498	226000	88.80345	0	99.93022	0	99.94247	99.86057	0	94.92389	20.61252	0	3.191149	
499	227000	88.75124	0	99.93022	0	99.94247	99.86057	0	94.9219	20.58474	0	3.181106	
500	228000	88.69903	0	99.93022	0	99.94247	99.86057	0	94.91991	20.55697	0	3.171064	
501	229000	88.64682	0	99.93022	0	99.94247	99.86057	0	94.91792	20.52919	0	3.161022	
502	230000	88.5946	0	99.93022	0	99.94247	99.86057	0	94.91593	20.50142	0	3.15098	
503	231000	88.54239	0	99.93022	0	99.94247	99.86057	0	94.91394	20.47364	0	3.140938	
504	232000	88.49018	0	99.93022	0	99.94247	99.86057	0	94.91195	20.44587	0	3.130895	
505	233000	88.43797	0	99.93022	0	99.94247	99.86057	0	94.90996	20.41809	0	3.120853	
506	234000	88.38576	0	99.93022	0	99.94247	99.86057	0	94.90797	20.39032	0	3.110811	
507	235000	88.33355	0	99.93022	0	99.94247	99.86057	0	94.90598	20.36254	0	3.100769	
508	236000	88.28134	0	99.93022	0	99.94247	99.86057	0	94.90399	20.33477	0	3.090726	
509	237000	88.22913	0	99.93022	0	99.94247	99.86057	0	94.902	20.30699	0	3.080684	
510	238000	88.17692	0	99.93022	0	99.94247	99.86057	0	94.90001	20.27922	0	3.070642	
511	239000	88.12471	0	99.93022	0	99.94247	99.86057	0	94.89802	20.25144	0	3.0606	

	A	B	C	D	E	F	G	H	I	J	K	L	M
512	240000	88.0725	0	99.93022	0	99.94247	99.86057	0	94.89603	20.22367	0	3.050557	
513	241000	88.02029	0	99.93022	0	99.94247	99.86057	0	94.89404	20.19589	0	3.040515	
514	242000	87.96808	0	99.93022	0	99.94247	99.86057	0	94.89205	20.16812	0	3.030473	
515	243000	87.91587	0	99.93022	0	99.94247	99.86057	0	94.89006	20.14034	0	3.020431	
516	244000	87.86365	0	99.93022	0	99.94247	99.86057	0	94.88807	20.11257	0	3.010388	
517	245000	87.81144	0	99.93022	0	99.94247	99.86057	0	94.88608	20.0848	0	3.000346	
518	246000	87.75923	0	99.93022	0	99.94247	99.86057	0	94.88409	20.05702	0	2.990304	
519	247000	87.70702	0	99.93022	0	99.94247	99.86057	0	94.8821	20.02925	0	2.980262	
520	248000	87.65481	0	99.93022	0	99.94247	99.86057	0	94.88011	20.00147	0	2.970219	
521	249000	87.6026	0	99.93022	0	99.94247	99.86057	0	94.87812	19.9737	0	2.960177	
522	250000	87.55039	0	99.93022	0	99.94247	99.86057	0	94.87613	19.94592	0	2.950135	
523	251000	87.49818	0	99.93022	0	99.94247	99.86057	0	94.87414	19.91815	0	2.940093	
524	252000	87.44597	0	99.93022	0	99.94247	99.86057	0	94.87215	19.89037	0	2.93005	
525	253000	87.39376	0	99.93022	0	99.94247	99.86057	0	94.87016	19.8626	0	2.920008	
526	254000	87.34155	0	99.93022	0	99.94247	99.86057	0	94.86817	19.83482	0	2.909966	
527	255000	87.28934	0	99.93022	0	99.94247	99.86057	0	94.86618	19.80705	0	2.899924	
528	256000	87.23713	0	99.93022	0	99.94247	99.86057	0	94.86419	19.77927	0	2.889881	
529	257000	87.18492	0	99.93022	0	99.94247	99.86057	0	94.8622	19.7515	0	2.879839	
530	258000	87.1327	0	99.93022	0	99.94247	99.86057	0	94.86021	19.72372	0	2.869797	
531	259000	87.08049	0	99.93022	0	99.94247	99.86057	0	94.85822	19.69595	0	2.859755	
532	260000	87.02828	0	99.93022	0	99.94247	99.86057	0	94.85623	19.66817	0	2.849712	
533	261000	86.97607	0	99.93022	0	99.94247	99.86057	0	94.85424	19.6404	0	2.83967	
534	262000	86.92386	0	99.93022	0	99.94247	99.86057	0	94.85225	19.61262	0	2.829628	
535	263000	86.87165	0	99.93022	0	99.94247	99.86057	0	94.85026	19.58485	0	2.819586	
536	264000	86.81944	0	99.93022	0	99.94247	99.86057	0	94.84827	19.55707	0	2.809543	
537	265000	86.76723	0	99.93022	0	99.94247	99.86057	0	94.84628	19.5293	0	2.799501	
538	266000	86.71502	0	99.93022	0	99.94247	99.86057	0	94.84429	19.50152	0	2.789459	
539	267000	86.66281	0	99.93022	0	99.94247	99.86057	0	94.8423	19.47375	0	2.779417	
540	268000	86.6106	0	99.93022	0	99.94247	99.86057	0	94.84031	19.44597	0	2.769375	
541	269000	86.55839	0	99.93022	0	99.94247	99.86057	0	94.83832	19.4182	0	2.759332	
542	270000	86.50618	0	99.93022	0	99.94247	99.86057	0	94.83633	19.39042	0	2.74929	
543	271000	86.45397	0	99.93022	0	99.94247	99.86057	0	94.83434	19.36265	0	2.739248	
544	272000	86.40175	0	99.93022	0	99.94247	99.86057	0	94.83235	19.33487	0	2.729206	
545	273000	86.34954	0	99.93022	0	99.94247	99.86057	0	94.83036	19.3071	0	2.719163	
546	274000	86.29733	0	99.93022	0	99.94247	99.86057	0	94.82837	19.27933	0	2.709121	
547	275000	86.24512	0	99.93022	0	99.94247	99.86057	0	94.82638	19.25155	0	2.699079	
548	276000	86.19291	0	99.93022	0	99.94247	99.86057	0	94.82439	19.22378	0	2.689037	
549	277000	86.1407	0	99.93022	0	99.94247	99.86057	0	94.8224	19.196	0	2.678994	
550	278000	86.08849	0	99.93022	0	99.94247	99.86057	0	94.82041	19.16823	0	2.668952	
551	279000	86.03628	0	99.93022	0	99.94247	99.86057	0	94.81842	19.14045	0	2.65891	
552	280000	85.98407	0	99.93022	0	99.94247	99.86057	0	94.81643	19.11268	0	2.648868	
553	281000	85.93186	0	99.93022	0	99.94247	99.86057	0	94.81444	19.0849	0	2.638825	
554	282000	85.87965	0	99.93022	0	99.94247	99.86057	0	94.81245	19.05713	0	2.628783	
555	283000	85.82744	0	99.93022	0	99.94247	99.86057	0	94.81046	19.02935	0	2.618741	
556	284000	85.77523	0	99.93022	0	99.94247	99.86057	0	94.80847	19.00158	0	2.608699	
557	285000	85.72302	0	99.93022	0	99.94247	99.86057	0	94.80648	18.9738	0	2.598656	
558	286000	85.6708	0	99.93022	0	99.94247	99.86057	0	94.80449	18.94603	0	2.588614	
559	287000	85.61859	0	99.93022	0	99.94247	99.86057	0	94.8025	18.91825	0	2.578572	
560	288000	85.56638	0	99.93022	0	99.94247	99.86057	0	94.80051	18.89048	0	2.56853	
561	289000	85.51417	0	99.93022	0	99.94247	99.86057	0	94.79852	18.8627	0	2.558487	
562	290000	85.46196	0	99.93022	0	99.94247	99.86057	0	94.79653	18.83493	0	2.548445	
563	291000	85.40975	0	99.93022	0	99.94247	99.86057	0	94.79454	18.80715	0	2.538403	
564	292000	85.35754	0	99.93022	0	99.94247	99.86057	0	94.79255	18.77938	0	2.528361	
565	293000	85.30533	0	99.93022	0	99.94247	99.86057	0	94.79056	18.7516	0	2.518318	
566	294000	85.25312	0	99.93022	0	99.94247	99.86057	0	94.78857	18.72383	0	2.508276	
567	295000	85.20091	0	99.93022	0	99.94247	99.86057	0	94.78658	18.69605	0	2.498234	
568	296000	85.1487	0	99.93022	0	99.94247	99.86057	0	94.78459	18.66828	0	2.488192	
569	297000	85.09649	0	99.93022	0	99.94247	99.86057	0	94.7826	18.6405	0	2.478149	
570	298000	85.04428	0	99.93022	0	99.94247	99.86057	0	94.78061	18.61273	0	2.468107	
571	299000	84.99207	0	99.93022	0	99.94247	99.86057	0	94.77862	18.58495	0	2.458065	
572	300000	84.93985	0	99.93022	0	99.94247	99.86057	0	94.77663	18.55718	0	2.448023	
573													
574													
575													
576													
577													
578													
579													
580													
581													
582													
583													
584													
585													
586													

```
50      CLS
        CLEAR
        '
        'This program gets nuclide concentrations in grams
        'from summarized origin-s output for 30 principal isotopes
        'and creates desired MCNP input files using a user created
        'MCNP template file.  The template file must have a FUELTOT
        'in the cell card where the total number density for the fuel
        'region is to be located, and a FUELNUM in the material card
        'where the number densities for the 30 isotopes are to be placed.
        '
        '
        'dimension variables
        DIM iso$(30)            '29 principl isotopes + oxygen
        DIM grams(30, 100)      'gram concentraions of 30 isotopes at 100 different decay times
        DIM numden(30, 100)     'number densities of 30 isotopes at 100 different decay times
        DIM total(100)          'total number density of 30 isotopes at 100 different deay times
        DIM MW(30)              'atomic weights of the 30 isotopes
        DIM time(100)           '100 decay times
        DIM MCNPID$(30)         'MCNP IDs for 30 principal isotopes
        DIM isored(30)          'isotope reduction factors for degraded fuel
        '
        '30 principal isotopes, their atomic weights, and MCNP IDs
        '
        iso$(1) = "     o 16 ": MW(1) = 15.994915#: MCNPID$(1) = "8016.50C"
        iso$(2) = "    mo 95 ": MW(2) = 94.905839#: MCNPID$(2) = "42095.50C"
        iso$(3) = "    ru101 ": MW(3) = 100.905576#: MCNPID$(3) = "44101.50C"
        iso$(4) = "    tc 99 ": MW(4) = 98.9062749#: MCNPID$(4) = "43099.50C"
        iso$(5) = "    rh103 ": MW(5) = 102.905511#: MCNPID$(5) = "45103.50C"
        iso$(6) = "    ag109 ": MW(6) = 108.904756#: MCNPID$(6) = "47109.50C"
        iso$(7) = "    nd143 ": MW(7) = 142.909779#: MCNPID$(7) = "60143.50C"
        iso$(8) = "    nd145 ": MW(8) = 144.912538#: MCNPID$(8) = "60145.50C"
        iso$(9) = "    sm147 ": MW(9) = 146.914867#: MCNPID$(9) = "62147.50C"
        iso$(10) = "    sm149 ": MW(10) = 148.91718#: MCNPID$(10) = "62149.50C"
        iso$(11) = "    sm150 ": MW(11) = 149.917276#: MCNPID$(11) = "62150.50C"
        iso$(12) = "    sm151 ": MW(12) = 150.919919#: MCNPID$(12) = "62151.50C"
        iso$(13) = "    sm152 ": MW(13) = 151.919756#: MCNPID$(13) = "62152.50C"
        iso$(14) = "    eu151 ": MW(14) = 150.919838#: MCNPID$(14) = "63151.55C"
        iso$(15) = "    eu153 ": MW(15) = 152.921242#: MCNPID$(15) = "63153.55C"
        iso$(16) = "    gd155 ": MW(16) = 154.922662#: MCNPID$(16) = "64155.50C"
        iso$(17) = "     u233 ": MW(17) = 233.039522#: MCNPID$(17) = "92233.50C"
        iso$(18) = "     u234 ": MW(18) = 234.040904#: MCNPID$(18) = "92234.50C"
        iso$(19) = "     u235 ": MW(19) = 235.043915#: MCNPID$(19) = "92235.50C"
        iso$(20) = "     u236 ": MW(20) = 236.045637#: MCNPID$(20) = "92236.50C"
        iso$(21) = "     u238 ": MW(21) = 238.05077#: MCNPID$(21) = "92238.50C"
        iso$(22) = "    np237 ": MW(22) = 237.048056#: MCNPID$(22) = "93237.55C"
        iso$(23) = "    pu238 ": MW(23) = 238.049511#: MCNPID$(23) = "94238.50C"
        iso$(24) = "    pu239 ": MW(24) = 239.052146#: MCNPID$(24) = "94239.55C"
        iso$(25) = "    pu240 ": MW(25) = 240.053882#: MCNPID$(25) = "94240.50C"
        iso$(26) = "    pu241 ": MW(26) = 241.056737#: MCNPID$(26) = "94241.50C"
        iso$(27) = "    pu242 ": MW(27) = 242.058725#: MCNPID$(27) = "94242.50C"
        iso$(28) = "    am241 ": MW(28) = 241.056714#: MCNPID$(28) = "95241.50C"
        iso$(29) = "    am242m": MW(29) = 242.059502#: MCNPID$(29) = "95242.50C"
        iso$(30) = "    am243 ": MW(30) = 243.061367#: MCNPID$(30) = "95243.50C"
        '
        ' other variables used
        '
        n = 30                  'total number of principal isotopes
        tcount = 1              'counter for number of times read
        PelletOD = .3225 * 2.54 'outer diameter of fuel pellet in cm
        ActLength = 144 * 2.54  'active length of fuel
        NumFuelRod = 264        'number of fuel rods per assembly
        OxMass = 62             'mass of oxygen per assembly in kg
        Na = .602252            'Avagadro's number
        totinc = 0              'total number density of added fuel region material
        '
        ' Enter name of input and output files
        '
        INPUT "Enter ORIGEN-S output summary file name"; file$
        OPEN file$ FOR INPUT ACCESS READ AS #1
        '
        'locate start of isotope list
        '
        'Find start of a ORIGEN-S grams table in summary output and get first set of times
        '
        DO UNTIL LEFT$(start$, 31) = "              charge  discharge"
                LINE INPUT #1, start$
```

```
LOOP
columns = (LEN(start$) / 10)       'determine number of columns in table
FOR i = 3 TO (columns - 1)        'get times starting at fourth column
        time(tcount) = VAL(MID$(start$, i * 10 + 2, 7))
        IF MID$(start$, i * 10 + 10, 1) = "d" THEN
                time(tcount) = time(tcount) / 365.25      'convert days to years
        END IF
        tcount = tcount + 1
NEXT i
'
'Get isotope grams from first table
'
DO UNTIL LEFT$(Line$, 21) = "              initial"
        LINE INPUT #1, Line$
        FOR i = 1 TO n          ' Check to see if line has isotope that is on the list
                IF iso$(i) = LEFT$(Line$, 11) THEN
                        FOR j = 3 TO (columns - 1)        'get grams starting at fourth column
                                grams(i, j - 2) = VAL(MID$(Line$, j * 10 + 2, 10))
                        NEXT j
                END IF
        NEXT i
LOOP
'
' Load in times and gram concentrations from remaining tables in output
DO UNTIL EOF(1)
        columns = (LEN(Line$) / 10)       'determine number of columns in table
        itcount = tcount
        Newtable$ = LEFT$(Line$, 31)
        FOR i = 2 TO (columns - 1)        'get times starting at third column
                time(tcount) = VAL(MID$(Line$, i * 10 + 2, 7))
                IF MID$(Line$, i * 10 + 10, 1) = "d" THEN
                        time(tcount) = time(count) / 365.25      'convert days to years
                END IF
                tcount = tcount + 1
        NEXT i
        DO UNTIL (LEFT$(Line$, 21) = "              initial" AND LEFT$(Line$, 31) <> Newtable$) OR EOF(1)
                LINE INPUT #1, Line$
                FOR i = 1 TO n          ' Check to see if line has isotope that is on the list
                        IF iso$(i) = LEFT$(Line$, 11) THEN
                                FOR j = 2 TO (columns - 1)        'get grams starting at third column
                                        grams(i, itcount + j - 2) = VAL(MID$(Line$, j * 10 + 2, 10))
                                NEXT j
                        END IF
                NEXT i
        LOOP
LOOP
CLOSE #1
'
'Calculate number densities (in atoms/b-cm) for each isotope at each time
'
'get assembly specific parameters
'
PRINT "Enter fuel pellet OD in cm ["; PelletOD; "]";
INPUT z$
IF z$ <> "" THEN
        z = VAL(z$)
        IF z <> 0 THEN PelletOD = z
END IF
PRINT "Enter active length of fuel in cm ["; ActLength; "]";
INPUT z$
IF z$ <> "" THEN
        z = VAL(z$)
        IF z <> 0 THEN ActLength = z
END IF
PRINT "Enter number of fuel rods per assembly ["; NumFuelRod; "]";
INPUT z$
IF z$ <> "" THEN
        z = VAL(z$)
        IF z <> 0 THEN NumFuelRod = z
END IF
'
'calculate total fuel volume
'
FuelVol = 3.1415 * (PelletOD / 2) ^ 2 * ActLength * NumFuelRod
'
PRINT "Enter mass oxygen per assembly in kg ["; OxMass; "]";
INPUT z$
IF z$ <> "" THEN
        z = VAL(z$)
```

```
            IF z <> 0 THEN OxMass = z
        END IF
        'enter isotope adjustment factors (if any)
        FOR i = 1 TO n
            isored(i) = 1   'initialize them all to 1
        NEXT i
        INPUT "Enter any isotope adjustment factors? (y/n)"; z$
        IF z$ = "y" OR z$ = "Y" THEN
            FOR i = 1 TO n
                PRINT "Enter adjustment factor for"; iso$(i); "[1]";
                INPUT z$
                IF z$ <> "" THEN z = VAL(z$) ELSE z = 1
                IF z >= 0 THEN isored(i) = z
            NEXT i
        END IF
        'enter total number density for additional material in fuel region
        'not included in ORIGEN output but included in MCNP model
        INPUT "Enter total numden of additonal material in fuel region [0]"; totinc
        'start number density calculations
        FOR i = 1 TO tcount - 1
            numden(1, i) = isored(1) * OxMass * 1000 / FuelVol * Na / MW(1)  'O-16 has constant number density at
all times
            total(i) = numden(1, i) + totinc
            FOR j = 2 TO n
                numden(j, i) = isored(j) * (grams(j, i) / FuelVol) * Na / MW(j)
                total(i) = total(i) + numden(j, i)      'add number density to total
            NEXT j
        NEXT i
        PRINT "Number Densities are available for the following times (#'s 1 to "; (tcount - 1); "):"
        PRINT
        FOR i = 1 TO tcount - 1
            PRINT "    "; i; " - "; time(i); "years",
        NEXT i
100     PRINT "Enter time range for MCNP inputs using the format start#,end#"
        INPUT "(enter same # twice for a single time)"; startnum, endnum
        IF (startnum > (tcount - 1)) OR (endnum > (tcount - 1)) OR (startnum < 1) OR (endnum < 1) THEN
            PRINT "Starting or ending number outside of range! Select again."
            GOTO 100
        END IF
        '
        ' Build MCNP input files
        '
150     INPUT "Enter MCNP input template file name"; tempfile$
        INPUT "Enter first 5 characters of MCNP input files to be created"; outfile$
        FOR i = startnum TO endnum
            OPEN tempfile$ FOR INPUT ACCESS READ AS #1
            '
            'Set file name decay time designator
            '
            SELECT CASE i
                CASE 23
                    x$ = "a"
                CASE 24
                    x$ = "b"
                CASE 25
                    x$ = "c"
                CASE 26
                    x$ = "d"
                CASE 30
                    x$ = "e"
                CASE 37
                    x$ = "f"
                CASE 38
                    x$ = "g"
                CASE 39
                    x$ = "h"
                CASE 45
                    x$ = "i"
                CASE 47
                    x$ = "j"
                CASE 6
                    x$ = "m"
                CASE 7
                    x$ = "n"
                CASE 8
                    x$ = "o"
                CASE 9
                    x$ = "p"
                CASE 10
```

```
                        x$ = "q"
                CASE 11
                        x$ = "r"
                CASE 12
                        x$ = "s"
                CASE 13
                        x$ = "t"
                CASE 14
                        x$ = "u"
                CASE 15
                        x$ = "v"
                CASE 18
                        x$ = "w"
                CASE 19
                        x$ = "x"
                CASE 20
                        x$ = "y"
                CASE 21
                        x$ = "z"
                CASE ELSE
                        x$ = LTRIM$(STR$(i))
        END SELECT
        z$ = outfile$ + x$
        OPEN z$ FOR OUTPUT ACCESS WRITE AS #2
        DO UNTIL EOF(1)
                LINE INPUT #1, Line$
                IF VAL(LEFT$(Line$, 1)) <> 0 THEN
                        outline$ = Line$
                        linelen = LEN(Line$)
                        FOR j = 1 TO (linelen - 7)
                                chunk$ = MID$(Line$, j, 7)
                                IF chunk$ = "FUELTOT" THEN
                                        PRINT Line$
                                        leftline$ = LEFT$(Line$, j - 1)
                                        rightline$ = RIGHT$(Line$, (linelen - 7 - j))
                                        outline$ = leftline$ + STR$(total(i)) + rightline$
                                END IF
                        NEXT j
                        PRINT #2, outline$
                ELSEIF LEFT$(Line$, 1) = "M" THEN
                        flag = 0
                        outline$ = Line$
                        linelen = LEN(Line$)
                        FOR j = 1 TO (linelen)
                                chunk$ = MID$(Line$, j, 7)
                                IF chunk$ = "FUELNUM" THEN
                                        PRINT Line$
                                        leftline$ = LEFT$(Line$, j - 1)
                                        rightline$ = MID$(Line$, j + 7)
                                        outline$ = leftline$ + MCNPID$(1) + "  " + STR$(numden(1, i)) +
rightline$

                                        flag = 1
                                        PRINT #2, "C     "; file$; "  "; time(i); " years decay"
                                END IF
                        NEXT j
                        PRINT #2, outline$
                        IF flag = 1 THEN
                                FOR j = 2 TO n
                                        IF numden(j, i) <> 0 THEN
                                                PRINT #2, "     "; MCNPID$(j); "  "; numden(j, i)
                                        END IF
                                NEXT j
                        END IF
                ELSE
                        PRINT #2, Line$
                END IF
        LOOP
        CLOSE #1
        CLOSE #2
NEXT i
PRINT "MCNP input files created. Process another template file(y/n)?"
DO
        z$ = INKEY$
LOOP UNTIL z$ <> ""
IF z$ = "y" OR z$ = "Y" THEN
        CLS
        GOTO 150
END IF
PRINT "Process another ORIGEN-S file(y/n)?"
```

```
DO
        z$ = INKEY$
LOOP UNTIL z$ <> ""
IF z$ = "y" OR z$ = "Y" THEN
        CLS
        GOTO 50
END IF

END
```

MASS PROPERTIES OF THE PART A-PLATE

```
                         VOLUME =  1.0817392e+07 MM^3
                   SURFACE AREA =  2.2393904e+06 MM^2
                        DENSITY =  7.8500000e-06 KILOGRAM / MM^3
                           MASS =  8.4916527e+01 KILOGRAM

          CENTER OF GRAVITY with respect to _A-PLATE coordinate frame:
X   Y   Z            4.8280000e+02 -5.0000000e+00  5.6303851e+02  MM

      INERTIA with respect to _A-PLATE coordinate frame:  (KILOGRAM * MM^2)

INERTIA TENSOR:
Ixx Ixy Ixz          3.5989514e+07  2.0498850e+05 -2.3083284e+07
Iyx Iyy Iyz          2.0498850e+05  6.2420879e+07  2.3905637e+05
Izx Izy Izz         -2.3083284e+07  2.3905637e+05  2.6437025e+07

     INERTIA at CENTER OF GRAVITY with respect to _A-PLATE coordinate frame:
                                                          (KILOGRAM * MM^2)
INERTIA TENSOR:
Ixx Ixy Ixz          9.0678025e+06  0.0000000e+00  0.0000000e+00
Iyx Iyy Iyz          0.0000000e+00  1.5707600e+07  0.0000000e+00
Izx Izy Izz          0.0000000e+00  0.0000000e+00  6.6412132e+06

                PRINCIPAL MOMENTS OF INERTIA:  (KILOGRAM * MM^2)
I1  I2  I3           6.6412132e+06  9.0678025e+06  1.5707600e+07

          ROTATION MATRIX from _A-PLATE orientation to PRINCIPAL AXES:
                        0.00000        1.00000        0.00000
                        0.00000        0.00000        1.00000
                        1.00000        0.00000        0.00000

     ROTATION ANGLES from _A-PLATE orientation to PRINCIPAL AXES (degrees):
angles about x  y  z  -90.000          0.000          -90.000

                RADII OF GYRATION with respect to PRINCIPAL AXES:
R1  R2  R3           2.7965823e+02  3.2677958e+02  4.3008947e+02  MM
```

MASS PROPERTIES OF THE PART B-PLATE

```
                    VOLUME =  1.0817392e+07 MM^3
              SURFACE AREA =  2.2393904e+06 MM^2
                   DENSITY =  7.8500000e-06 KILOGRAM / MM^3
                      MASS =  8.4916527e+01 KILOGRAM

          CENTER OF GRAVITY with respect to _B-PLATE coordinate frame:
X   Y   Z          4.8280000e+02 -5.0000000e+00  5.6600000e+02  MM

      INERTIA with respect to _B-PLATE coordinate frame:  (KILOGRAM * MM^2)

INERTIA TENSOR:
Ixx Ixy Ixz        3.6274189e+07  2.0498850e+05 -2.3204698e+07
Iyx Iyy Iyz        2.0498850e+05  6.2705553e+07  2.4031377e+05
Izx Izy Izz       -2.3204698e+07  2.4031377e+05  2.6437025e+07

     INERTIA at CENTER OF GRAVITY with respect to _B-PLATE coordinate frame:
                                                        (KILOGRAM * MM^2)
INERTIA TENSOR:
Ixx Ixy Ixz        9.0685473e+06  0.0000000e+00  0.0000000e+00
Iyx Iyy Iyz        0.0000000e+00  1.5708345e+07  0.0000000e+00
Izx Izy Izz        0.0000000e+00  0.0000000e+00  6.6412132e+06

                PRINCIPAL MOMENTS OF INERTIA:  (KILOGRAM * MM^2)
I1  I2  I3         6.6412132e+06  9.0685473e+06  1.5708345e+07

          ROTATION MATRIX from _B-PLATE orientation to PRINCIPAL AXES:
                       0.00000        1.00000        0.00000
                       0.00000        0.00000        1.00000
                       1.00000        0.00000        0.00000

     ROTATION ANGLES from _B-PLATE orientation to PRINCIPAL AXES (degrees):
angles about x  y  z  -90.000          0.000         -90.000

                RADII OF GYRATION with respect to PRINCIPAL AXES:
R1  R2  R3         2.7965823e+02  3.2679300e+02  4.3009967e+02  MM
```

MASS PROPERTIES OF THE PART C-PLATE

```
                    VOLUME =  2.7043480e+06 MM^3
              SURFACE AREA =  1.1035472e+06 MM^2
                   DENSITY =  7.8500000e-06 KILOGRAM / MM^3
                      MASS =  2.1229132e+01 KILOGRAM

      CENTER OF GRAVITY with respect to _C-PLATE coordinate frame:
X   Y   Z          2.4140000e+02 -2.5000000e+00  5.6303851e+02  MM

    INERTIA with respect to _C-PLATE coordinate frame:  (KILOGRAM * MM^2)

INERTIA TENSOR:
Ixx Ixy Ixz        8.9968479e+06  1.2811781e+04 -2.8854104e+06
Iyx Iyy Iyz        1.2811781e+04  1.0650459e+07  2.9882047e+04
Izx Izy Izz       -2.8854104e+06  2.9882047e+04  1.6539644e+06

   INERTIA at CENTER OF GRAVITY with respect to _C-PLATE coordinate frame:
                                                    (KILOGRAM * MM^2)
INERTIA TENSOR:
Ixx Ixy Ixz        2.2668180e+06  0.0000000e+00  0.0000000e+00
Iyx Iyy Iyz        0.0000000e+00  2.6834557e+06  0.0000000e+00
Izx Izy Izz        0.0000000e+00  0.0000000e+00  4.1672619e+05

              PRINCIPAL MOMENTS OF INERTIA:  (KILOGRAM * MM^2)
I1  I2  I3         4.1672619e+05  2.2668180e+06  2.6834557e+06

      ROTATION MATRIX from _C-PLATE orientation to PRINCIPAL AXES:
                      0.00000        1.00000        0.00000
                      0.00000        0.00000        1.00000
                      1.00000        0.00000        0.00000

   ROTATION ANGLES from _C-PLATE orientation to PRINCIPAL AXES (degrees):
angles about x  y  z  -90.000          0.000         -90.000

              RADII OF GYRATION with respect to PRINCIPAL AXES:
R1  R2  R3         1.4010682e+02  3.2677002e+02  3.5553397e+02  MM
```

MASS PROPERTIES OF THE PART TUBE12PWR

```
              VOLUME =  2.0879343e+07 MM^3
        SURFACE AREA =  8.3612301e+06 MM^2
             DENSITY =  7.8500000e-06 KILOGRAM / MM^3
                MASS =  1.6390285e+02 KILOGRAM

     CENTER OF GRAVITY with respect to _TUBE12PWR coordinate frame:
X . Y   Z            1.1320000e+02 -1.1320001e+02  2.2875857e+03  MM

     INERTIA with respect to _TUBE12PWR coordinate frame:  (KILOGRAM * MM^2)

INERTIA TENSOR:
Ixx Ixy Ixz          1.1471680e+09  2.1002905e+06 -4.2443411e+07
Iyx Iyy Iyz          2.1002905e+06  1.1471680e+09  4.2443417e+07
Izx Izy Izz         -4.2443411e+07  4.2443417e+07  7.1053672e+06

    INERTIA at CENTER OF GRAVITY with respect to _TUBE12PWR coordinate frame:
                                                          (KILOGRAM * MM^2)
INERTIA TENSOR:
Ixx Ixy Ixz          2.8735615e+08  0.0000000e+00  0.0000000e+00
Iyx Iyy Iyz          0.0000000e+00  2.8735615e+08  0.0000000e+00
Izx Izy Izz          0.0000000e+00  0.0000000e+00  2.9047862e+06

                PRINCIPAL MOMENTS OF INERTIA:  (KILOGRAM * MM^2)
I1  I2  I3           2.9047862e+06  2.8735615e+08  2.8735615e+08

         ROTATION MATRIX from _TUBE12PWR orientation to PRINCIPAL AXES:
                        0.00000         1.00000         0.00000
                        0.00000         0.00000         1.00000
                        1.00000         0.00000         0.00000

    ROTATION ANGLES from _TUBE12PWR orientation to PRINCIPAL AXES (degrees):
angles about x  y  z  -90.000         0.000          -90.000

                RADII OF GYRATION with respect to PRINCIPAL AXES:
R1  R2  R3           1.3312629e+02  1.3240884e+03  1.3240885e+03  MM
```

MASS PROPERTIES OF THE PART CORNER_GUIDE_

```
                    VOLUME =  5.3032723e+06 MM^3
              SURFACE AREA =  1.0955075e+06 MM^2
                   DENSITY =  7.8500000e-06 KILOGRAM / MM^3
                      MASS =  4.1630688e+01 KILOGRAM

       CENTER OF GRAVITY with respect to _CORNER_GUIDE_ coordinate frame:
X   Y   Z             6.3424054e+01  6.3424054e+01  5.6700000e+02  MM

   INERTIA with respect to _CORNER_GUIDE_ coordinate frame:  (KILOGRAM * MM^2)

INERTIA TENSOR:
Ixx Ixy Ixz           1.8250031e+07 -2.5184809e+04 -1.4970994e+06
Iyx Iyy Iyz          -2.5184809e+04  1.8250031e+07 -1.4970994e+06
Izx Izy Izz          -1.4970994e+06 -1.4970994e+06  8.0990669e+05

  INERTIA at CENTER OF GRAVITY with respect to _CORNER_GUIDE_ coordinate frame:
                                                               (KILOGRAM * MM^2)
INERTIA TENSOR:
Ixx Ixy Ixz           4.6987587e+06  1.4227924e+05  0.0000000e+00
Iyx Iyy Iyz           1.4227924e+05  4.6987587e+06  0.0000000e+00
Izx Izy Izz           0.0000000e+00  0.0000000e+00  4.7497860e+05

                PRINCIPAL MOMENTS OF INERTIA:  (KILOGRAM * MM^2)
I1  I2  I3            4.7497860e+05  4.5564794e+06  4.8410379e+06

       ROTATION MATRIX from _CORNER_GUIDE_ orientation to PRINCIPAL AXES:
                         0.00000        0.70711        0.70711
                         0.00000       -0.70711        0.70711
                         1.00000        0.00000        0.00000

  ROTATION ANGLES from _CORNER_GUIDE_ orientation to PRINCIPAL AXES (degrees):
angles about x  y  z  -90.000          45.000         -90.000

                RADII OF GYRATION with respect to PRINCIPAL AXES:
R1  R2  R3            1.0681450e+02  3.3083231e+02  3.4100634e+02  MM
```

MASS PROPERTIES OF THE PART A-GUIDE

```
                VOLUME =  5.2212031e+06 MM^3
          SURFACE AREA =  1.1064034e+06 MM^2
               DENSITY =  7.8500000e-06 KILOGRAM / MM^3
                  MASS =  4.0986444e+01 KILOGRAM

        CENTER OF GRAVITY with respect to _A-GUIDE coordinate frame:
X   Y   Z          2.4140000e+02  4.9236240e+00  5.6550000e+02  MM

     INERTIA with respect to _A-GUIDE coordinate frame:  (KILOGRAM * MM^2)

INERTIA TENSOR:
Ixx Ixy Ixz        1.7477422e+07 -4.8714964e+04 -5.5951292e+06
Iyx Iyy Iyz       -4.8714964e+04  2.0593963e+07 -1.1411894e+05
Izx Izy Izz       -5.5951292e+06 -1.1411894e+05  3.1192114e+06

    INERTIA at CENTER OF GRAVITY with respect to _A-GUIDE coordinate frame:
                                                       (KILOGRAM * MM^2)
INERTIA TENSOR:
Ixx Ixy Ixz        4.3693631e+06  0.0000000e+00  0.0000000e+00
Iyx Iyy Iyz        0.0000000e+00  5.0984558e+06  0.0000000e+00
Izx Izy Izz        0.0000000e+00  0.0000000e+00  7.2977534e+05

             PRINCIPAL MOMENTS OF INERTIA:  (KILOGRAM * MM^2)
I1  I2  I3         7.2977534e+05  4.3693631e+06  5.0984558e+06

        ROTATION MATRIX from _A-GUIDE orientation to PRINCIPAL AXES:
                      0.00000        1.00000        0.00000
                      0.00000        0.00000        1.00000
                      1.00000        0.00000        0.00000

    ROTATION ANGLES from _A-GUIDE orientation to PRINCIPAL AXES (degrees):
angles about x  y  z  -90.000        0.000        -90.000

             RADII OF GYRATION with respect to PRINCIPAL AXES:
R1  R2  R3         1.3343645e+02  3.2650433e+02  3.5269492e+02  MM
```

MASS PROPERTIES OF THE PART B-GUIDE

```
                    VOLUME =  5.3100450e+05 MM^3
              SURFACE AREA =  1.2975990e+05 MM^2
                   DENSITY =  7.8500000e-06 KILOGRAM / MM^3
                      MASS =  4.1683853e+00 KILOGRAM

          CENTER OF GRAVITY with respect to _B-GUIDE coordinate frame:
X   Y   Z          -5.0000000e+00 -2.3475000e+01  5.6550000e+02  MM

      INERTIA with respect to _B-GUIDE coordinate frame:  (KILOGRAM * MM^2)

INERTIA TENSOR:
Ixx Ixy Ixz         1.7804081e+06 -4.8926423e+02  1.1786110e+04
Iyx Iyy Iyz        -4.8926423e+02  1.7774843e+06  5.5335784e+04
Izx Izy Izz         1.1786110e+04  5.5335784e+04  3.2017402e+03

     INERTIA at CENTER OF GRAVITY with respect to _B-GUIDE coordinate frame:
                                                         (KILOGRAM * MM^2)
INERTIA TENSOR:
Ixx Ixy Ixz         4.4510203e+05  0.0000000e+00  0.0000000e+00
Iyx Iyy Iyz         0.0000000e+00  4.4437106e+05  0.0000000e+00
Izx Izy Izz         0.0000000e+00  0.0000000e+00  8.0043506e+02

                PRINCIPAL MOMENTS OF INERTIA:  (KILOGRAM * MM^2)
I1  I2  I3          8.0043506e+02  4.4437106e+05  4.4510203e+05

          ROTATION MATRIX from _B-GUIDE orientation to PRINCIPAL AXES:
                       0.00000         0.00000        -1.00000
                       0.00000         1.00000         0.00000
                       1.00000         0.00000         0.00000

     ROTATION ANGLES from _B-GUIDE orientation to PRINCIPAL AXES (degrees):
angles about x  y  z     0.000         -90.000           0.000

                RADII OF GYRATION with respect to PRINCIPAL AXES:
R1  R2  R3          1.3857316e+01  3.2650434e+02  3.2677277e+02  MM
```

MASS PROPERTIES OF THE PART CORNER_STIFFENER_

VOLUME = 3.0792713e+05 MM^3
SURFACE AREA = 6.9359225e+04 MM^2
DENSITY = 7.8500000e-06 KILOGRAM / MM^3
MASS = 2.4172280e+00 KILOGRAM

CENTER OF GRAVITY with respect to _CORNER_STIFFENER coordinate frame:

X Y Z	8.2942562e+01	-1.4331844e+02	5.0000000e+00	MM

INERTIA with respect to _CORNER_STIFFENER coordinate frame: (KILOGRAM * MM^2)

INERTIA TENSOR:

Ixx Ixy Ixz	5.7177293e+04	3.1958934e+04	-1.0024554e+03
Iyx Iyy Iyz	3.1958934e+04	2.4156253e+04	1.7321667e+03
Izx Izy Izz	-1.0024554e+03	1.7321667e+03	8.1172397e+04

INERTIA at CENTER OF GRAVITY with respect to _CORNER_STIFFENER coordinate frame: (KILOGRAM * MM^2)

INERTIA TENSOR:

Ixx Ixy Ixz	7.4665781e+03	3.2248660e+03	0.0000000e+00
Iyx Iyy Iyz	3.2248660e+03	7.4665780e+03	0.0000000e+00
Izx Izy Izz	0.0000000e+00	0.0000000e+00	1.4892869e+04

PRINCIPAL MOMENTS OF INERTIA: (KILOGRAM * MM^2)

I1 I2 I3	4.2417120e+03	1.0691444e+04	1.4892869e+04

ROTATION MATRIX from _CORNER_STIFFENER orientation to PRINCIPAL AXES:

-0.70711	-0.70711	0.00000
0.70711	-0.70711	0.00000
0.00000	0.00000	1.00000

ROTATION ANGLES from _CORNER_STIFFENER orientation to PRINCIPAL AXES (degrees):

angles about x y z	0.000	0.000	135.000

RADII OF GYRATION with respect to PRINCIPAL AXES:

R1 R2 R3	4.1890137e+01	6.6505778e+01	7.8492901e+01	MM

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
SPECIAL INSTRUCTION SHEET

QA: L

This is a placeholder page for records that cannot be scanned or microfilmed

1. Record Date 07/10/98	10. Accession Number ATT-TO:MOL.19980701.0482
2. Author Name(s) JOHN R MASSARI	3. Author Organization N/A
4. Title CRITICALITY EVALUATION OF INTACT AND DEGRADED PWR WPS CONTAINING MOX SNF	
5. Document Number(s) A00000000-01717-0210-00002	6. Version REV 00
7. Document Type DATA	8. Medium DISK/optic
9. Access Control Code PUB	
11. Traceability Designator A00000000-01717-0210-00002-00	
12. Comments THESE TWO SPECIAL PROCESS CD ROM'SCAN BE LOCATED THROUGH THE RECORDS PROCESSING CENTER	