Tables 6.1.1.2 SCALE Calculation Cases Codes

SCALE Case Codes	Wt% U235	Burnup	Thermal Power
	%	GWd/ MTU	MW/
	W	B	P
Burnup Time (Years) = 2.54510883			
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B9_P10_10000	5	9.29601	10
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B18_P20_10000	5	18.59202	20
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B27_P30_10000	5	27.88803	30
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B40_P43_10000	5	40	43
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B51_P55_10000	5	51.128055	55
Burnup Time (Years) = 1.81455715			
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B7_P10_10000	5	6.62767	10
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B13_P20_10000	5	13.25534	20
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B20_P30_10000	5	19.88301	30
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B29_P43_10000	5	28.51834	43
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B36_P55_10000	5	36.45219	55
Burnup Time (Years) = 1.20492813			
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B4_P10_10000	5	4.401	10
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B9_P20_10000	5	8.802	20
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B13_P30_10000	5	13.203	30
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B19_P43_10000	5	18.93716	43
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B24_P55_10000	5	24.2055	55
Burnup Time (Years) = 0.55195072			
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B4_P10_10000	5	2.016	10
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B9_P20_10000	5	4.032	20
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B13_P30_10000	5	6.048	30
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B19_P43_10000	5	8.674689	43
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B24_P55_10000	5	11.088	55
Burnup Time (Years) = 2.54510883			
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B9_P10_10000	4.2	9.29601	10
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B18_P20_10000	4.2	18.59202	20
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B27_P30_10000	4.2	27.88803	30
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B40_P43_10000	4.2	40	43
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B51_P55_10000	4.2	51.128055	55
Burnup Time (Years) = 1.81455715			
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B7_P10_10000	4.2	6.62767	10
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B13_P20_10000	4.2	13.25534	20
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B20_P30_10000	4.2	19.88301	30
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B29_P43_10000	4.2	28.51834	43
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B36_P55_10000	4.2	36.45219	55
Burnup Time (Years) = 1.20492813			
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B4_P10_10000	4.2	4.401	10
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B9_P20_10000	4.2	8.802	20
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B13_P30_10000	4.2	13.203	30
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B19_P43_10000	4.2	18.93716	43
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B24_P55_10000	4.2	24.2055	55
Burnup Time (Years) = 0.55195072			
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B4_P10_10000	4.2	2.016	10
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B9_P20_10000	4.2	4.032	20
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B13_P30_10000	4.2	6.048	30
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B19_P43_10000	4.2	8.674689	43
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B24_P55_10000	4.2	11.088	55
Burnup Time (Years) = 2.54510883			
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B9_P10_10000	2.83	9.29601	10
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B18_P20_10000	2.83	18.59202	20
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B27_P30_10000	2.83	27.88803	30
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B40_P43_10000	2.83	40	43
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B51_P55_10000	2.83	51.128055	55

Tables 6.1.2 SCALE Calculation Cases Codes – Continue …

Burnup Time (Years) = 1.81455715			
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B7_P10_10000	2.83	6.62767	10
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B13_P20_10000	2.83	13.25534	20
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B20_P30_10000	2.83	19.88301	30
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B29_P43_10000	2.83	28.51834	43
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B36_P55_10000	2.83	36.45219	55
Burnup Time (Years) = 1.20492813			
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B4_P10_10000	2.83	4.401	10
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B9_P20_10000	2.83	8.802	20
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B13_P30_10000	2.83	13.203	30
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B19_P43_10000	2.83	18.93716	43
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B24_P55_10000	2.83	24.2055	55
Burnup Time (Years) = 0.55195072			
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B4_P10_10000	2.83	2.016	10
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B9_P20_10000	2.83	4.032	20
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B13_P30_10000	2.83	6.048	30
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B19_P43_10000	2.83	8.674689	43
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B24_P55_10000	2.83	11.088	55

Burnup parameters used in SCALE calculations are provided in Tables 6.1.1.3 (Burnup parameters) and 6.1.1.4 (Boron letdown parameters).

Tables 6.1.1.3 Burnup Common Parameters Used in SCALE and TDMAT Calculations

Burn*	**Down***	**NLIB***	**Time****
Days	Days		Years
67.2	0	3	
67.2	0	3	
67.2	**0**	**3**	**0.551951**
67.2	0	3	
71.1	0	3	
71.1	0	3	
29.1	**0**	**3**	**1.204928**
55.5	0	3	
55.5	0	3	
55.5	0	3	
56.167	**0**	**3**	**1.814557**
56.167	0	3	
56.167	0	3	
40.75	0	3	
40.75	0	3	
36.5	0	3	
36.5	**3652500**	**3**	**2.545109**

* Parameters used in "read burndata" SCALE data block;

** Parameter used in "TDMAT" calculations for the data interpolation and listed in Tables 6.1.2;

Tables 6.1.1.4 Boron Letdown Parameters Used in SCALE Burnup Calculations

EFPD	ppmB	BFRAC
Days	-	-
0	1147	1
67.2	921.0164	0.802979
67.2	872.2394	0.760453
67.2	738.2884	0.643669
67.2	608.1684	0.530225
71.1	518.6474	0.452177
71.1	256.1082	0.223285
29.1	237.5449	0.207101
55.5	688.9265	0.600633
55.5	527.5075	0.459902
55.5	353.475	0.308173
56.167	880.3779	0.767548
56.167	694.6803	0.60565
56.167	536.647	0.46787
40.75	382.5951	0.333562
40.75	267.1631	0.232923
36.5	234.6383	0.204567
36.5	128.1642	0.111739

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6.1.2. SCALE CALCULATIONS RESULTS

Because of large amount of data (tenths gigabytes) all SCALE outputs are provided electronically in Attachment ...

For each fuel enrichment a four-dimensional matrix has been extracted from the SCALE output and placed as a TDMAT software input.

Matrix four dimension are:

- Depleted radial material compositions - five groups of fuel rods according Figure 5.1.1.1 and Table 5.1.1.2;
- Thermal power - five values according Tables 6.1.1.2;
- Burnup times – four values in Tables 6.1.1.2 represents times when assembly has been removed from the reactor;
- The spent fuel isotopes used in the MCNP cases and correspond to those of the Principal Isotope Set.

One four-dimensional matrix has been splitted into 25 two-dimensional matrix, each of them consists of nuclide density for each of the Principal Isotope Set for each burnup time and placed into the Report September 2007 Postclosure.xls EXCEL file, at the different "TDMAT Input" sheet for each fuel enrichment.

A sample of one of the table for:

- 5% fuel enrichment,
- 10 MW/MTU thermal power and
- the first group of the fuel rods

presents at the Table 6.1.2.1

No new entries on this page

Table 6.1.2.1 Sample of the Two-Dimensional Matrix for TDMAT Input for 5% Fuel Enrichment, 10 MW/MTU thermal power and the first group of the fuel rods form the Report September 2007 Postclosure.xls EXCEL file

	#	MCNP ID /	SCALE ID	P=10 MW/MTU			
			Years of Burnup:	0.551951	1.20493	1.81456	2.54511
	1	92233.50C	u233	5.94E-03	2.15E-02	4.98E-02	9.04E-02
	2	92234.50C	u234	6.48E+01	6.32E+01	6.17E+01	6.03E+01
	3	92235.50C	u235	7.33E+03	6.91E+03	6.55E+03	6.11E+03
	4	92236.50C	u236	1.14E+02	2.06E+02	2.91E+02	3.88E+02
	5	92238.50C	u238	1.46E+05	1.46E+05	1.46E+05	1.45E+05
	6	94238.50C	pu238	5.49E-27	1.91E-25	1.21E-24	4.33E-24
	7	94239.50C	pu239	1.03E+02	2.00E+02	2.87E+02	3.53E+02
	8	94240.50C	pu240	1.50E+00	5.91E+00	1.20E+01	1.98E+01
	9	94241.50C	pu241	5.38E-13	1.02E-10	1.96E-09	1.52E-08
	10	94242.50C	pu242	4.23E-03	7.76E-02	3.58E-01	1.08E+00
	11	93237.55C	np237	1.91E+00	7.05E+00	1.65E+01	3.01E+01
	12	60143.50C	nd143	1.23E+01	2.63E+01	3.87E+01	5.30E+01
	13	60145.50C	nd145	8.37E+00	1.81E+01	2.68E+01	3.72E+01
	14	62147.50C	sm147	4.78E+00	1.00E+01	1.45E+01	1.96E+01
Group # 1	15	62149.50C	sm149	4.60E-01	4.66E-01	4.85E-01	4.73E-01
	16	62150.50C	sm150	2.03E+00	5.02E+00	7.81E+00	1.12E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	8.50E-01	2.24E+00	3.67E+00	5.55E+00
	19	63153.55C	eu153	4.21E-01	1.02E+00	1.70E+00	2.63E+00
	20	64155.50C	gd155	5.52E-02	8.50E-02	1.06E-01	1.34E-01
	21	63151.55C	eu151	7.81E-01	1.33E+00	1.68E+00	1.90E+00
	22	42095.50C	mo95	9.02E+00	1.95E+01	2.90E+01	4.04E+01
	23	43099.50C	tc99	8.93E+00	1.94E+01	2.89E+01	4.03E+01
	24	44101.50C	ru101	7.87E+00	1.72E+01	2.58E+01	3.63E+01
	25	44103.50C	rh103	4.97E+00	1.09E+01	1.64E+01	2.29E+01
	26	95241.50c	am241	4.32E-08	3.53E-07	1.11E-06	2.62E-06
	27	95242.50c	am242m	4.08E-27	1.42E-25	8.99E-25	3.22E-24
	28	95243.50C	am243	1.41E-05	5.70E-04	4.29E-03	1.80E-02
	29	47109.50C	ag109	1.19E-01	3.71E-01	7.16E-01	1.19E+00

6.1.3. TDMAT SOFTWARE

No new entries on this page.

12/01/2007 (AK)(OP)
The following revised draft technical progress report was submitted by AK.

Using 2-D Depletion Model for Isotopics Generation for the Postclosure Loading Curve Evaluation

Technical Progress Report

Draft

November 2007

No new entries on this page

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FIGURES Page

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1. OBJECTIVE

The main objective of this study is to evaluate a proposed disposal criticality methodology for post closure period, specifically, the required minimum burnup as a function of initial pressurized water reactor (PWR) assembly enrichment that would permit loading of the spent nuclear fuel into the 21 PWR waste package with absorber plates (Loading Curve Evaluation).

SCOPE

The criticality analysis covers a range of enrichments from 1.93 (minimal enrichment for the B&W 15x15 assembly design as the most limiting PWR fuel assembly design according *21-PWR Waste Package with Absorber Plates Loading Curve Evaluation*) through 5.0 weight percent U-235, and a burnup range of fresh(0) through 45 GWd/MTU.

Limitations of this evaluation are as follows:

- The k-eff calculation results are based on burnup credit for actinides and selected fission products as proposed in YMP (2003, Table 3-1) and referred to as the *Principal Isotopes,* although all burnup calculation has been performed for a total of 232 nuclides.
- The results are based on fuel basket plates width of 11 mm and consists of Neutronit A978 analogous to 304B6 with 75%% B-10 and B-11 material and having no tuff inside the waste package.
- Preliminary TAD canister design has been used for all MCNP calculations, so all changes in TAD design will affect the results

No new entries on this page

2. METHOD

The method used to perform the reactivity calculations involves the simulation of the burnup and decay of CSNF for various initial enrichments and burnups, and the calculation of k-eff (effective neutron multiplication factor) for the loaded waste package configuration. Because of the most uncertainties in k-eff estimations for the loading curve evaluation are coming from the depletion calculations, the isotopic compositions for SNF were calculated by accurate time-consuming depletion calculations for the assembly consisting of 208 fuels rods. SCALE-5- T-DEPL-TRITON sequence has been used for the SNF calculations providing additional lattice physics capabilities that are not available in the Monte Carlo-based T5- and T6-DEPL sequences, such as the ability to generate lattice physics parameters and perform branch calculations (for instance, T-DEPL provides the option to group independently depleted mixtures together such that they are tracked independently but use a common set of cross sections). Preliminary depletion analysis allowed dividing all 215 fuel rods into the five groups that have almost the same **pin power factors** (available from NEWT transport calculation approach) for a burnup range of fresh (0 GWd/MTU) through 45 GWd/MTU. One of the NEWT powerful options allows performing burnup calculation for a total of 232 nuclides, although the k-eff calculations are based on taking credit for burnup with a subset of the total isotopes present in commercial SNF known as the *Principal Isotopes* (YMP 2003, Table 3-1).

The k-eff calculations were performed using continuous-energy neutron cross-section libraries as selected in *Selection of MCNP Cross Section Libraries* report (CRWMS M&O 1998b, pp. 61-68). The CSNF from the various burnup/enrichment pairs were simulated, and the results reported from the MCNP calculations were the combined average values of k-eff from three estimates (collision, absorption, and track length) listed in the final generation summary in the MCNP output. Waste package configuration was represented in detail using specifications for the Babcock & Wilcox (B&W) 15x15 assembly design (*Summary Report of Commercial Reactor Criticality Data for Crystal River Unit 3* [Punatar 2001, Section 2]), and TAD canister design and waste package dimensions provided in Attachment… from the following references:

- *21-PWR Waste Package with Absorber Plates Loading Curve Evaluation,* Document Identifier: CAL-DSU-NU-000006 REV 00B;

- *Preliminary Transportation, Aging and Disposa Canister System Performance Specification,* WMO-TADCS-000001 Rev. B, DOE/RW-0585;
- *CRC Depletion Calculations for the Non-Rodded Assemblies in Batches 1,2, and 3 of Crystal River Unit 3*, Document Identifier: BBA000000-0 17 17-0200-00032 REV 00.

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3. ASSUMPTIONS

3.1 ASSEMBLY DESIGN

Assumption: It is assumed that the B&W 15x15 assembly design is the most limiting PWR fuel assembly design.

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4. USE OF COMPUTER SOFTWARE AND MODELS

4.1 MCNP

The MCNP code was used to calculate the neutron multiplication factor for the various spent fuel compositions.

The software specifications are as follows:

- Software Title: MCNP
- Version/Revision Number: Version 5.1.40
- RSICC#: CCC-730
- CODE PKG NAME: MCNP/MCNPX
- PACKAGED: 01/20/2006

The input and output files for the MCNP calculations are contained in Attachment ... to this calculation report, such that an independent repetition of the software use may be performed. The MCNP software used was appropriate for the application of multiplication factor calculations.

4.2 SCALE

SCALE-5 "T-DEPL-TRITON" sequence has been used for a burnup and decay calculations in a range of fresh (0 GWd/MTU) through 45 GWd/MTU fuels.

The software specifications are as follows:

- Software Title: SCALE
- Version/Revision Number: Version 5.1

SCALE 5.1 has been installed on Pentium-4, 3.0 GHz CPU, 1.5 GB of RAM with OS Windows 2003 Data Center, on mirrored Drive "C:" 80 Gigabyte. Required registration via the Internet has been successfully completed at the beginning of Scale 5.1 installation.

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5. CALCULATION

The minimum required burnup of an assembly, for a specific initial enrichment, at which the calculated k_{eff} is equal to the critical limit (CL), has been evaluated for the B&W 15x15 assembly as the most limiting PWR fuel assembly design for postclosure time-period. The postclosure time-period is the period after permanent closure of the repository, when reactivity of the SNF reaching its maximum and the critical limit (CL) is the value of k_{eff} at which the configuration is potentially critical.
The CL equation (according *21-PWR Waste Package with Absorber Plates Loading Curve Evaluation*, page 41, Table 22) is:

$$CL\ (AENCF) = -0.06262*AENCF + 0.9920,$$

Where ***AENCF*** is an ***A***verage ***E***nergy of a ***N***eutron ***C***ausing ***F***ission (MeV)

The time, when reactivity of the SNF reaching its maximum because of decaying all neutron absorbers with short half-time decay periods, has been evaluated at the "..."

A burnup credit loading curve depicts the relationship between the initial enrichment of a fuel assembly and the required minimum burnup needed to suppress the reactivity of that fuel assembly sufficiently to allow it to be safely loaded into the waste package. Any assembly which burnup exceeds the required minimum burnup, given the initial enrichment of the fuel assembly, may be safely loaded into the waste package.

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5.1 PARAMETER DESCRIPTION

5.1.1 3-D SNF REPRESENTATION

The fuel distribution that has not been irradiated (which is referred to as the "fresh fuel distribution") would maximize fuel assembly reactivity. This "fresh fuel distribution" assumption is very conservative in calculations of criticality potential. As fuel is burned in a reactor, the burnup of the fuel becomes 3-D distributed and the reactivity of the fuel decreases. 3-D distribution of the fuel in an assembly can be simplified by expression **[5.1.1.1]**:

$$\textit{SNF Density}\,(r, z) \sim \textit{SNF Density}\,(r) * \textit{SNF Density}\,(z), \qquad [5.1.1.1]$$

where ***SNF Density*** (***r***) is an radial fuel distribution and
SNF Density (***z***) is an axial fuel distribution.

The profile of the axial distribution attains a flattened cosine shape with time, although the exact profile will vary significantly with operating history and other effects unique to the individual reactor. An axial profile database has been composed for various PWR fuel assembly designs, which included variations in enrichment, burnup, and burnable absorbers. To develop a waste package loading curve, which would encompass the isotopic axial variations caused by different assembly irradiation histories, requires the using of a limiting axial profile that takes credit for fuel burnup.

The axial profiles used in this calculation were developed for a set of eight burnup groups in *PWR Axial Burnup Profile Analysis* (BSC 2003a, Table 32) and listed in "*21-PWR Waste Package with Absorber Plates Loading Curve Evaluation*", page 16, Table 1. They have been recalculated at the Report September 2007 Postclosure.xls, sheet "Axial Profiles", to be more convenience for the present calculations, for ten axial positions, so the first and last values has been extrapolated – see
Table 5.1.1.1

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Table 5.1.1.1. Recalculated Axial Profiles for Ten Axial Positions

#****	Axial Pos Original* % **	Axial Pos Calculated *** [cm]	Burnup range GWd/MTU							
			[10...15[	[15...20[	[20...25[	[25...30[	[30...35[	[35...40[	[40...45[	≥45
-		0	0.3239	0.3870	0.3432	0.42613	0.4422	0.4688	0.4884	0.494
1	0.028	10.0848	0.497	0.554	0.525	0.587	0.599	0.619	0.635	0.64
2	0.083	29.8943	0.837	0.882	0.882	0.903	0.907	0.914	0.923	0.926
3	0.139	50.0639	1.009	1.021	0.986	1.016	1.028	1.027	1.024	1.023
4	0.194	69.8734	1.15	1.126	1.122	1.113	1.104	1.094	1.094	1.086
5	0.806	290.2986	1.15	1.126	1.122	1.113	1.104	1.094	1.094	1.086
6	0.861	310.1080	0.859	0.92	0.934	0.95	0.971	0.988	0.991	0.998
7	0.917	330.2777	0.664	0.694	0.766	0.738	0.778	0.822	0.8	0.841
8	0.972	350.0872	0.333	0.416	0.44	0.454	0.471	0.506	0.502	0.541
9		360.172	0.16449	0.2745	0.27403	0.3094	0.31470	0.3451	0.3503	0.388

* *see 21-PWR Waste Package with Absorber Plates Loading Curve Evaluation*", page 16, Table 1

** of core height from bottom to top

*** Recalculated at the Report September 2007 Postclosure.xls, sheet "Axial Profiles", to suit more to the present calculations, for ten axial positions, so the first and last values (presented in green color) are the results of extrapolation.

**** Axial Zone Number

Radial profiles are accounted for during the fuel depletion calculations. Preliminary depletion analysis (see SCALE input:

Scale Input\AD_N_L4_W5_BMY_BGN_TMH_H0_G30_B40.inp

And SCALE output:

Scale Input\AD_N_L4_W5_BMY_BGN_TMH_H0_G30_B40.out – see Attachement ... allowed dividing 215 fuel roads of an assembly into the five groups, so each group has almost the same **pin power factors** (available from NEWT approach) for a burnup range of fresh(0) through 45 GWd/MTU and the result shown at figure 5.1.1.1 and table 5.1.1.2. Assuming that the Space and Energy neutron distributions during CSNF reactor utilization are not changing significantly, CSNF nuclear densities for appropriationdepletions can be applied for k_{eff} estimation.

25	25	25	24	24	24	24	24	24	24	24	24	25	25	25
25	25	25	24	24	22	24	24	24	22	24	24	25	25	25
25	25	24	22	21	4	22	24	22	4	21	22	24	25	25
24	24	22	4	21	21	23	24	23	21	21	4	22	24	24
24	24	21	21	22	21	23	24	23	21	22	21	21	24	24
24	23	4	21	21	4	22	23	22	4	21	21	4	23	24
24	24	22	23	23	22	23	22	23	22	23	23	22	24	24
24	24	24	24	24	23	22	6	22	23	24	24	24	24	24
24	24	22	23	23	22	23	22	23	22	23	23	22	24	24
24	23	4	21	21	4	22	23	22	4	21	21	4	23	24
24	24	21	21	22	21	23	24	23	21	22	21	21	24	24
24	24	22	4	21	21	23	24	23	21	21	4	22	24	24
25	25	24	22	21	4	22	24	22	4	21	22	24	25	25
25	25	25	24	24	22	24	24	24	22	24	24	25	25	25
25	25	25	24	24	24	24	24	24	24	24	24	25	25	25

Figure 5.1.1.1 Dividing the Set of Fuel Rods of an Assembly into the Five Groups according their * **pin power factors** (group 21 - group 25)

Table 5.1.1.2 Minimal and Maximal Pin Power Factors for 5 groups of Fuel Rods

Group #	Minimal Pin Power Factor*	Maximal Pin Power Factor*	Average in Group Pin Power Factor*
1	1.0642	1.0818	1.0695375
2	1.0261	1.0471	1.03748
3	0.9972	1.026	1.004475
4	0.9888	0.9603	0.972708
5	0.9546	0.9358	0.949475

* Average pin power factors for two time moments: at the start of burnup (time = 0) and after 929.6 days of burnup at the nominal thermal power of 43 MWt/MTU (Burnup 49 GWd/MTU)

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5.2 SCALE AND MCNP MATERIALS AND GEOMETRY DESCRIPTION

5.2.1 FUEL ASSEMBLY SCALE / MCNP MATERIAL AND GEOMETRY DESCRIPTIONS

Simplifying:

- Spacer grids were omitted both from the MCNP and SCALE representations;
- Because of fuel assembly symmetry only upper right quarter with appropriate boundary conditions has been taken into account for SCALE burnup calculations (see Figures 5.2.3, 5.2.4);
- Space grid dimensions for Discrete Ordinate Method implementation are 60 x 60 cells (30 x 30 for a quarter), so each fuel rod consists of at least 12 cells of the grid (see Figures 5.2.3, 5.2.4);

Fresh fuel Compositions, calculated from *"21-PWR Waste Package with Absorber Plates Loading Curve Evaluation"*, page 25, Table 15: "Fresh Fuel Compositions" and shown at the Table 5.2.1, have been used for SCALE burnup calculations.

Table 5.2.1. Fresh Fuel Compositions for the SCALE burnup calculations

Nuclide	U-234	U-235	U-236	U-238	O-16
Nuclide Atomic Weight	234.0405	235.0441	236.0458	238.051	15.9994
Enrichment					
1.93 %	3.61159E-06	0.000441168	2.01923E-06	0.022128	0.045150222
2%	3.75014E-06	0.000457171	2.09153E-06	0.022112	0.045150214
2.54%	4.87522E-06	0.000580598	2.65136E-06	0.021989	0.04515348
2.83%	5.47944E-06	0.000646884	2.96588E-06	0.021922	0.045155235
4.2 %	8.40655E-06	0.000960002	4.38963E-06	0.021608	0.045161795
5 %	1.01566E-05	0.001142849	5.24174E-06	0.021425	0.045165833

Fuel clad composition in Table 5.2.2 has been obtained from *"21-PWR Waste Package with Absorber Plates Loading Curve Evaluation"* and used both for MCNP and SCALE calculations

Table 5.2.2 Fuel Clad Composition

Element	O	Cr	Fe	Zr	Sn
MCNP ID	8016.50c	24000.50c	26000.55c	50000.56c	40000.42c

SCALE ID	8016	24000	26000	50000	40000
Atomic Density at/cm^3	2.9638x10^{20}	7.5976 x10^{19}	1.4147 x10^{20}	4.2518 x10^{22}	4.6597x10^{20}

Original assembly geometry (see Fig. 5.2.1) and its MCNP representation (see Fig. 5.2.2) for certain non-rodded fuel assemblies of the Crystal River Unit 3 PWR are obtained from *CRC Depletion Calculations for the Non-Rodded Assemblies in Batches 1,2, and 3 of Crystal River Unit 3*, Document Identifier: BBA000000-0 17 17-0200-00032 REV 00.

Assembly parameters has been used both for SCALE and MCNP calculations are obtained from *Assemblies in Batches 1,2, and 3 of Crystal River Unit 3*, Document Identifier: BBA000000-0 17 17-0200-00032 REV 00 and listed in Tables 5.2.3, 5.2.4.

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Table 5.2.3. Assembly parameters has been used for SCALE and MCNP calculations

Assembly Parameter	**Unit**	**Value**
Rod pitch	cm	1.44272
Fuel pellet Diameter	cm	0.9398
Fuel rods Count	-	208
Fuel Clad outer D	cm	1.0922
Empty guide tubes #	-	16
Roaded guide tubes #	-	0
Guide tube outer D	cm	1.3462
Guide tube inner D	cm	1.26492
BPR Cladding outer D	cm	1.0922
Instrument tube inner D	cm	1.12014
Instrument tube outer D	cm	1.38193
Volume Fraction of Spacer Grid	-	0.005758
Assembly pitch	cm	27

Table 5.2.4. Assembly Important Areas and Fuel/Moderator Ratio

Fuel area cm^2	Fuel Outer area cm^2	Empty GT's area cm^2	Instrum. Tube area cm^2	Fuel/Moderator Ratio cm^2
144.286	238.064	30.636	1.567	0.53386

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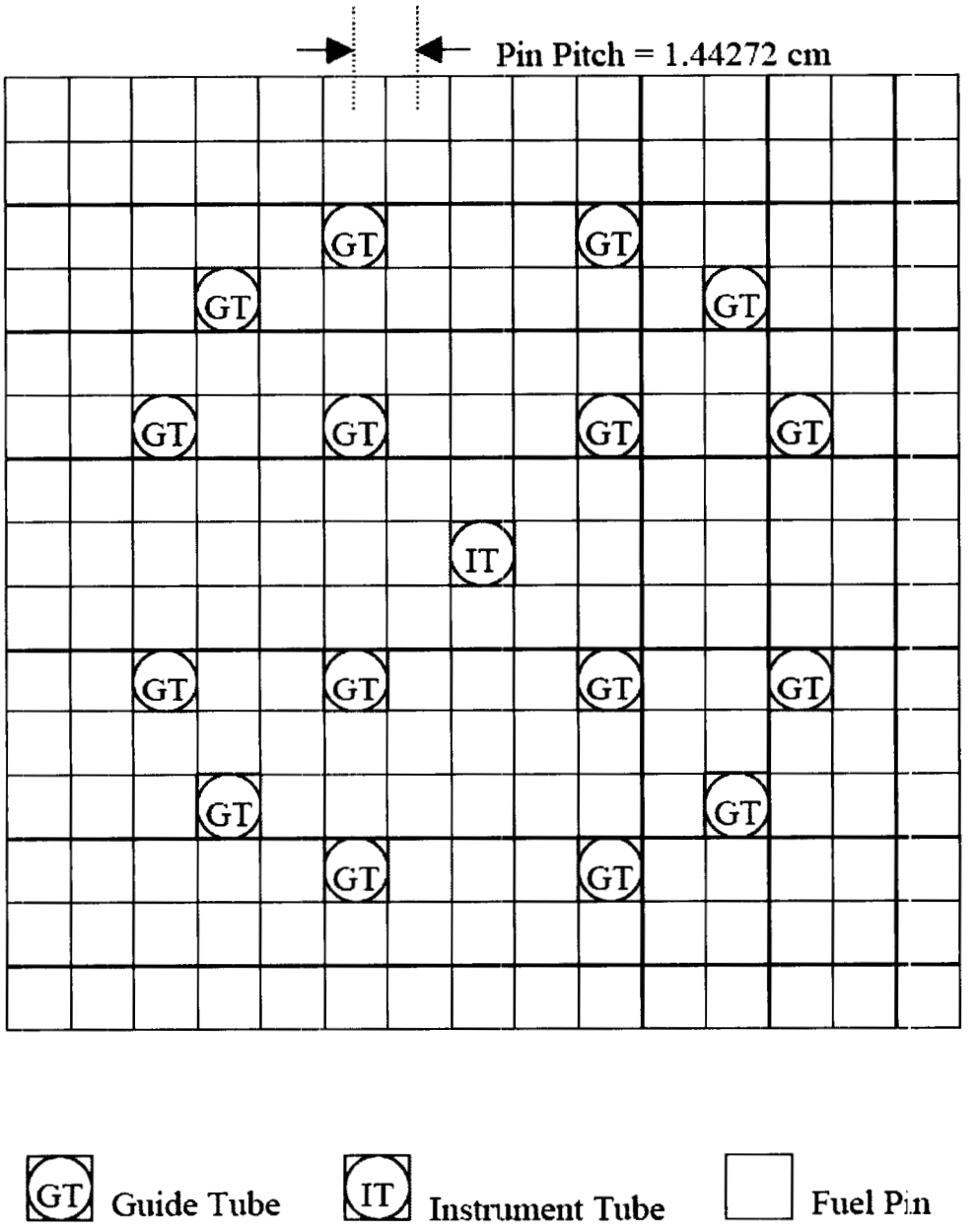

Figures 5.2.1. Original Assembly Geometry Design.

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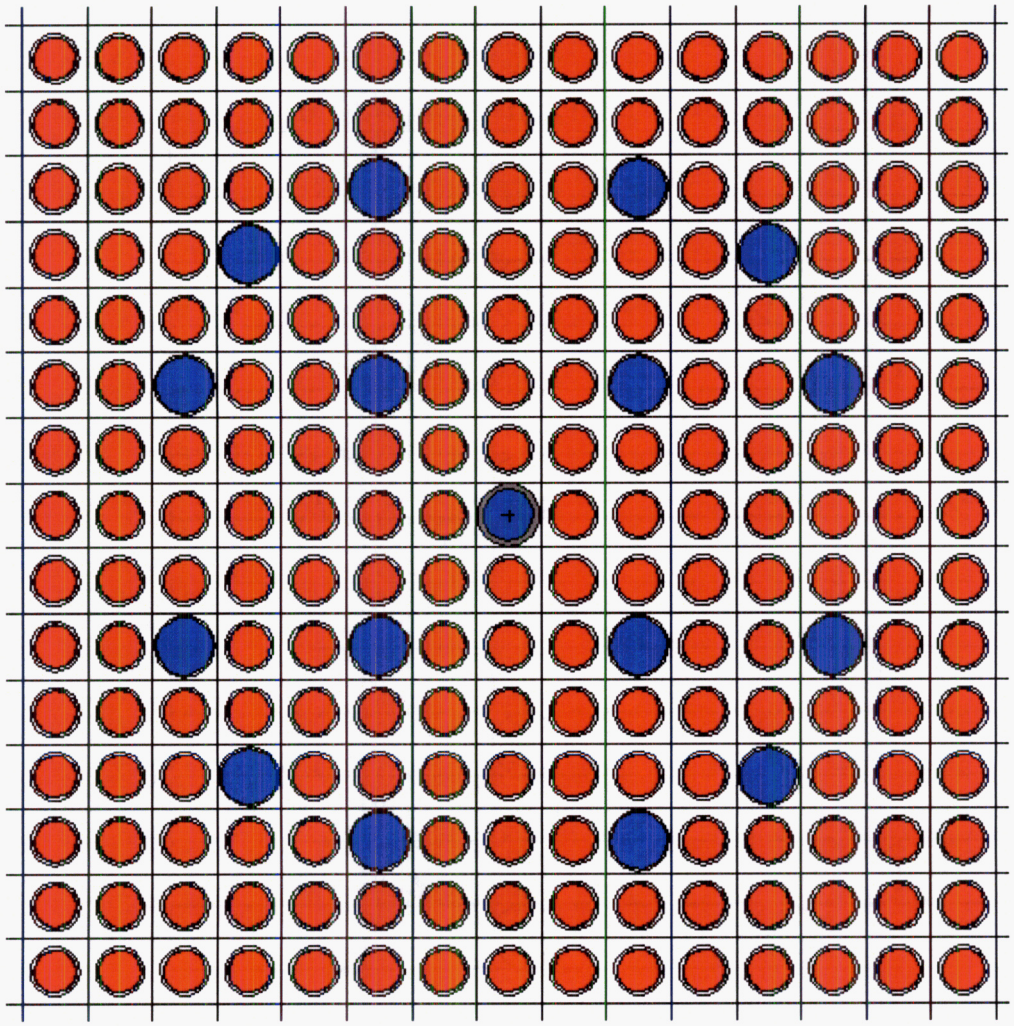

Fig. 5.2.2. MCNP Representation of Assembly Geometry Design

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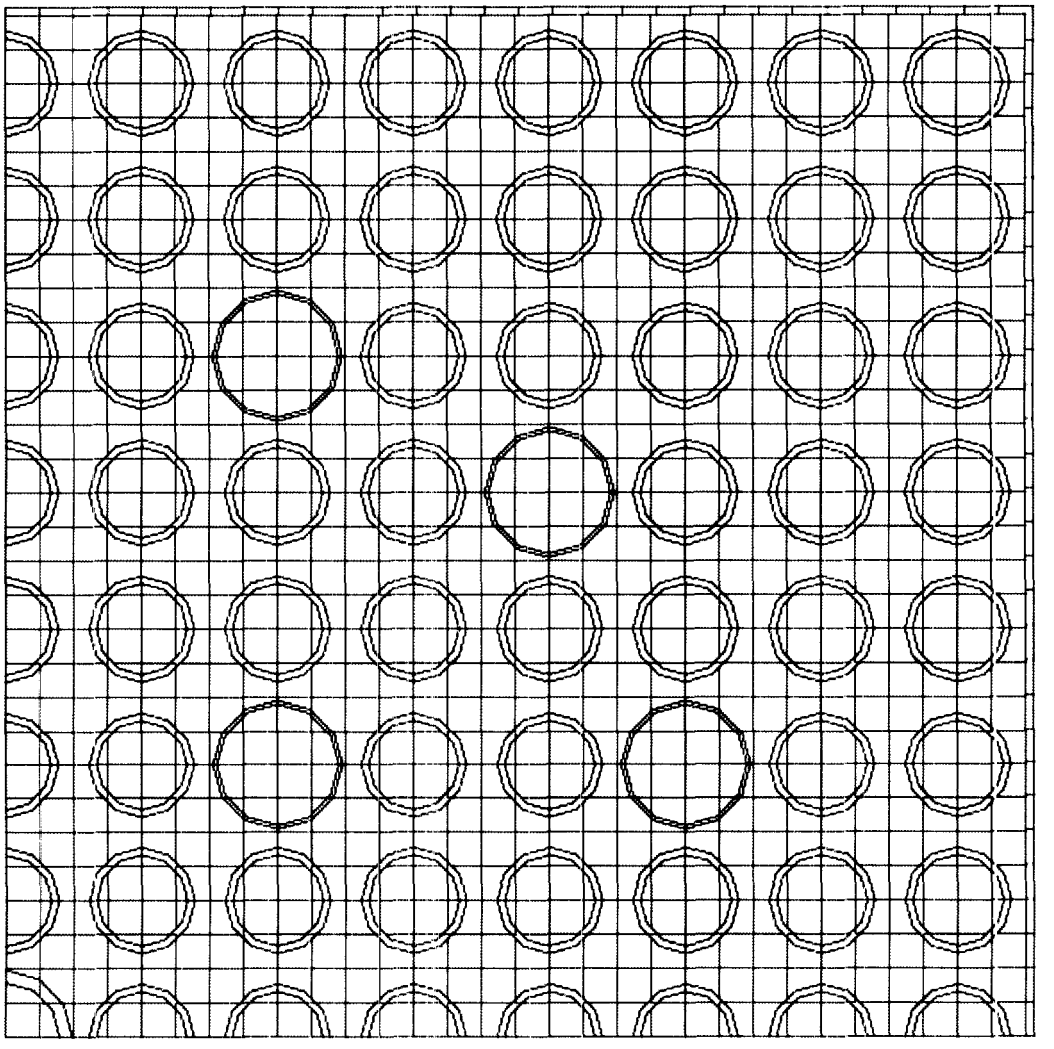

Figures 5.2.3. SCALE (NewT) Assembly Grid. Upper Right Quarter of the Assembly has been Calculated with the Reflection Boundary Condition on the Bottom and Left Boundaries.

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101 group 1; u-235 = 5
102 group 2; u-235 = 5
103 group 3; u-235 = 5
104 group 4; u-235 = 5
105 group 5; u-235 = 5
21 group 1 fuel cladding
22 group 2 fuel cladding
23 group 3 fuel cladding
24 group 4 fuel cladding
25 group 5 fuel cladding
31 group 1 moderator within unit cell with smeared inconel spacer grids and bpa
32 group 2 moderator within unit cell with smeared inconel spacer grids and bpa
33 group 3 moderator within unit cell with smeared inconel spacer grids and bpa
34 group 4 moderator within unit cell with smeared inconel spacer grids and bpa
35 group 5 moderator within unit cell with smeared inconel spacer grids and bpa
4 guide tube, instrument tube, bpr cladding

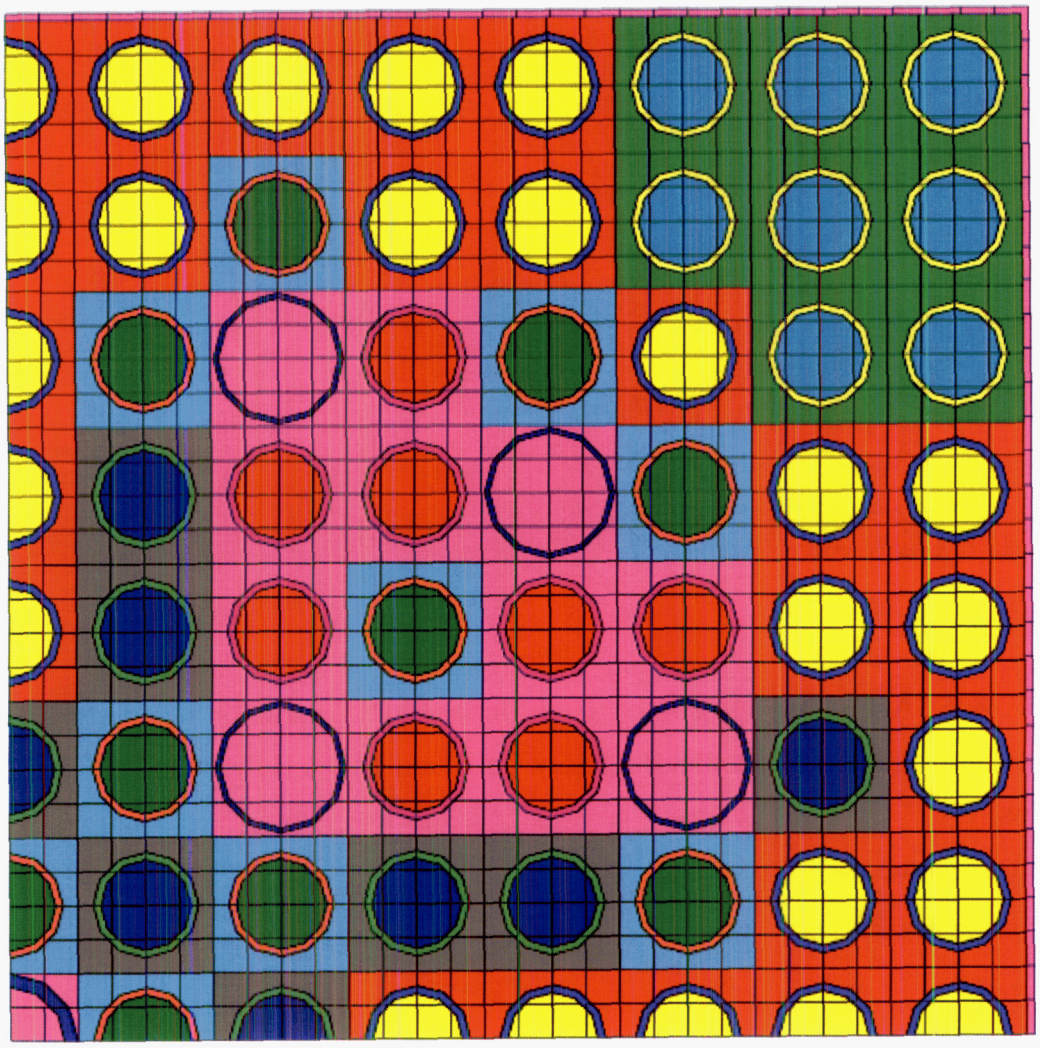

Figure 5.2.4. SCALE (NewT) Assembly Grid – Material Map. Upper Right Quarter of the Assembly has been Calculated with the Reflection Boundary Condition on the Bottom and Left Boundaries.

5.2.2 WASTE PACKAGE MCNP MATERIAL AND GEOMETRY DESCRIPTIONS

Waste package TAD canister specification was obtained from *Preliminary Transportation, Aging and Disposa Canister System Performance Specification,* WMO-TADCS-000001 Rev. B, DOE/RW-0585:

- Neutron absorber plates or tubes made from borated stainless steel produced by powder metallurgy and meeting ASTM A887-89 Grade "A" alloys.
- Minimum thickness of neutron absorber plates shall be 0.433 inches.
- Maximum and nominal thickness can be based on structural requirements.
- The neutron absorber plate shall have a boron content of 1.1 wt % to 1.2 wt %, a range that falls within the specification for 304B4 UNS S30464 as described in ASTM A887-89.
- Neutron absorber plates or tubes must extend the full axial length (+0"/-½") of the canister internals at room temperature.
- Neutron absorber plates or tubes must cover all four longitudinal sides of each fuel assembly.
- Required Materials- Except for thermal shunts and criticality control materials, the TAD canister and structural internals (i.e., basket) shall be constructed of a Type 300-series stainless steel (UNS S3XXXX, such as UNS S31603, which may also be designated as type 316L) as listed in ASTM A-276-06, PWR-21 waste package design has been improved according those specifications

TAD canister and absorber plates geometrical parameters and material compositions according above recommendations are listed in Tables **5.2.2.1, 5.2.2.2.**

Table **5.2.2.1** TAD Canister and Absorber Plates Geometrical Parameters

Parameter	Value	
TAD Canister Length	212 inches	538.48 cm
TAD Canister Diameter	66.5 inches	168.91 cm
Absorber Plate Width	0.433 inches	1.1 cm

Table **5.2.2.2** TAD Canister and Absorber Plates Material Compositions

Fuel Basket Plate: Neutronit A978 analogous to 304B6			TAD Canister Material, Stainless Steel 316NG, Density 7.92 g/cc		
Nuclide	MCNP ID	Atomic Density at/cm^3	Nuclide	MCNP ID	Atomic Density at/cm^3
b-10	5010.50C	1.07650×10^{-21}	26-FE	26000.55C	5.7418×10^{22}
b-11	5011.50C	4.46100×10^{-21}	24-CR	24000.50C	1.4676×10^{22}
c	6000.50C	1.16880×10^{-20}	28-NI	28000.50C	8.9361×10^{21}
n	7014.50C	3.34070×10^{-20}	42-MO	42000.50C	9.9425×10^{20}
si	14000.50C	1.24950×10^{-21}	7-N	7014.50C	3.4060×10^{20}
p-31	15031.50C	6.79120×10^{-19}	14-SI	14000.50C	1.2736×10^{21}
s-32	16032.50C	4.37840×10^{-19}	29-CU	29000.50C	3.7531×10^{20}
cr	24000.50C	1.70980×10^{-22}	23-V	23000.50C	9.3625×10^{19}
mn-55	25055.50C	1.70340×10^{-21}	41-NB	41093.50C	1.2834×10^{19}
fe	26000.55C	5.06420×10^{-22}	16-S	16032.50C	7.4374×10^{20}
ni	28000.50C	1.07590×10^{-21}	13-AL	13027.50C	7.0707×10^{19}
mo	42000.50C	1.21920×10^{-21}	15-P	15031.50C	4.6195×10^{19}
			73-TA	73181.50C	6.5895×10^{18}
			22-TI	22000.50C	4.9785×10^{19}
			5-B	5011.50C	8.8233×10^{18}
			6-C	6000.50C	7.9417×10^{19}
			25-MN	25055.50C	1.7363×10^{21}
			27-CO	27059.50C	8.0929×10^{19}
			83-BI	83209.50C	1.0267×10^{19}

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PWR-21 original waste package geometry has been changed according TAD and Absorber Plates specifications, so resulting geometry has been used for calculations presents in Figures 5.2.2.1, 5.2.2.2, 5.2.2.3.

Material compositions for outer barrier of the waste package presented in Figures 5.2.2.2, 5.2.2.3 are listed in Table 5.2.2.3

Table 5.2.2.3 Outer Barrier Region Material is ALLOY 22 rho=8.69 g/cc; 8.5090E-2 at/(barn*cm)*

MCNP ID	Nuclear Densities at/(barn*cm)
6000.50C	6.54E-05
25055.50C	4.76E-04
14000.50C	1.49E-04
24000.50C	2.26E-02
42000.50C	7.91E-03
27059.50C	2.22E-03
74000.55C	9.96E-04
23000.50C	3.60E-04
26000.55C	5.62E-03
15031.50C	3.38E-05
16032.50C	3.26E-05
28000.50C	4.46E-02

*DENSITY REFERENCE: ML003738719; TDR-WIS-MD-000002 REV 00 ICN 01; Waste Package Degradation Process Model Report

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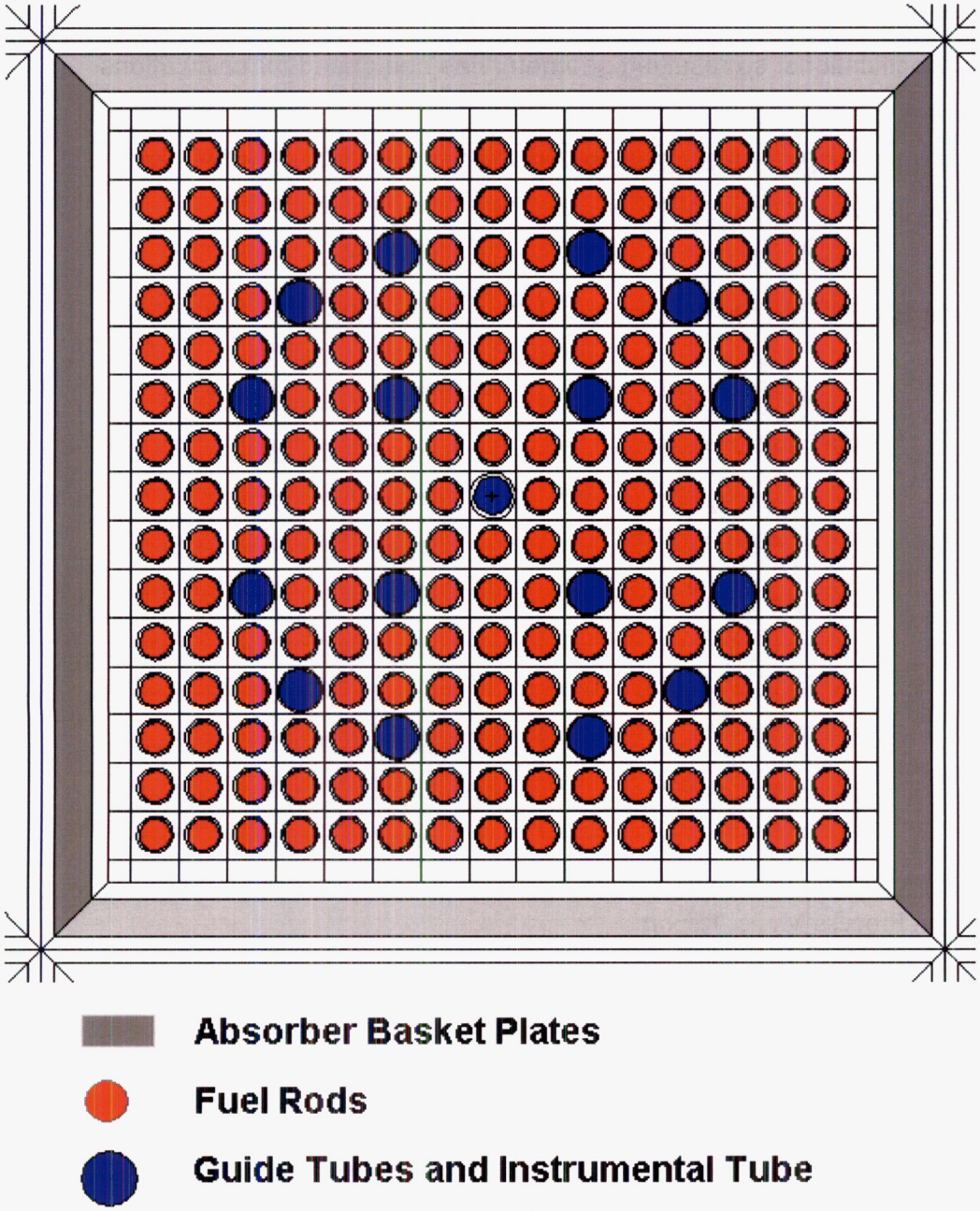

Figure 5.2.2.1 MCNP Geometry Representation of Modified Assembly with Absorber Basket Plates (New Assembly Pitch is 27 cm)

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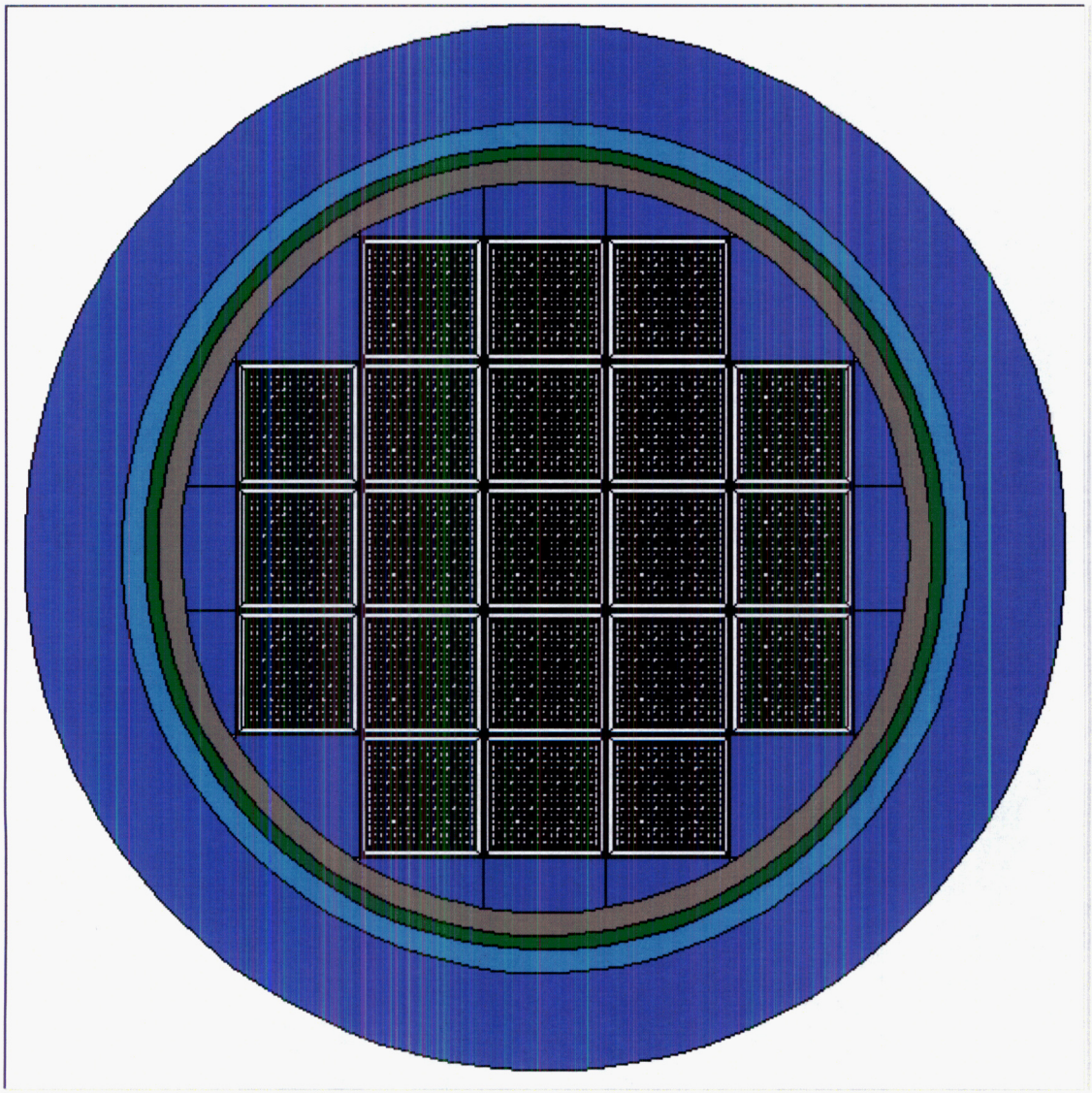


TAD Canister

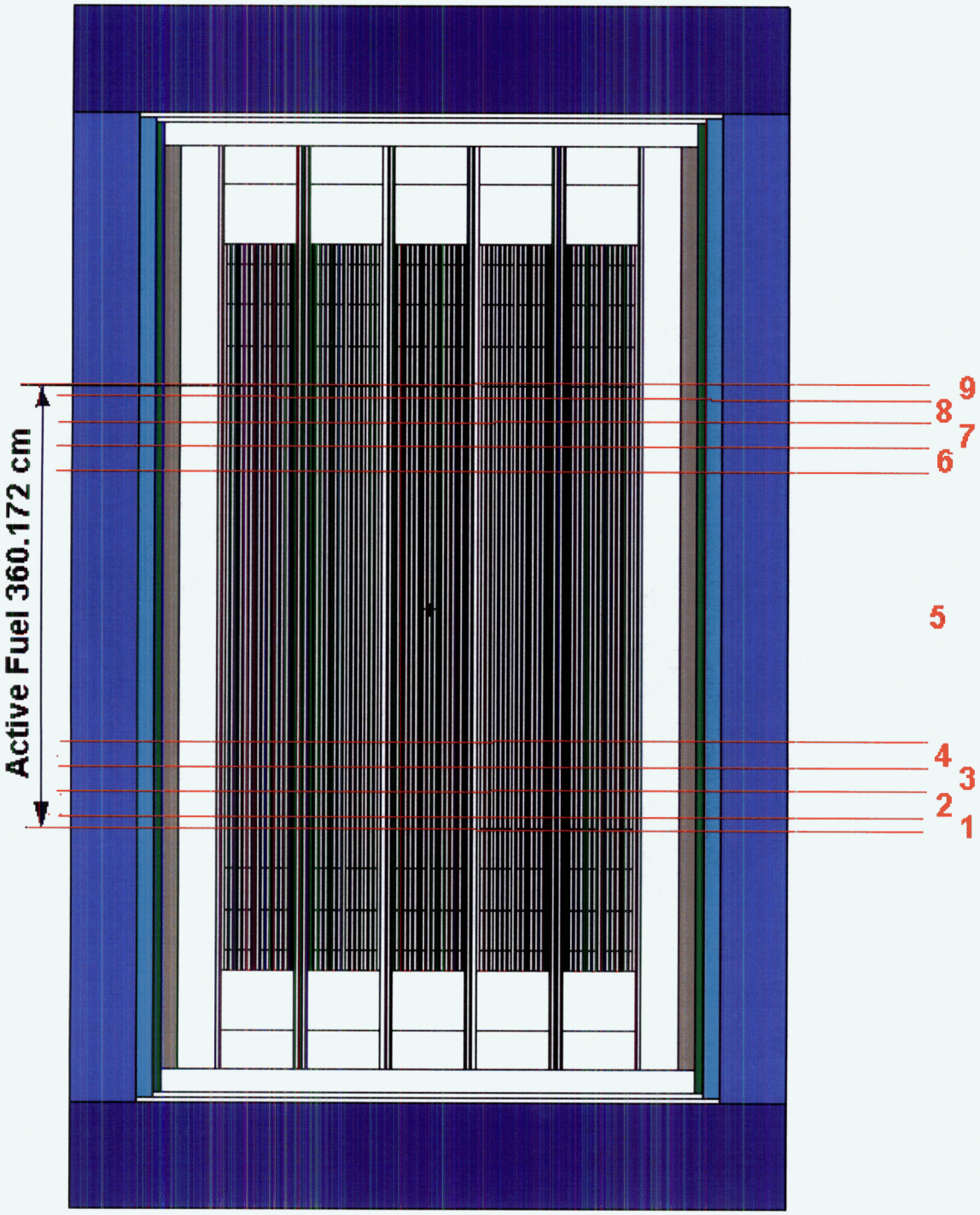
Gap Filled With Water

Outer Barrier

Reflection Region

Modified Assembly with Absorber Basket Plates
see Fig. Figure 5.2.2.1

Figure 5.2.2.2 MCNP Radial Geometry Representation (New Assembly Pitch is 27 cm)



Tad canister

Gap Filled With Water

Outer Barrier

Reflection Region - Top / Bottom

Reflection Region-Radial

Modified Assembly with Absorber Plates

Figure 5.2.2.3 MCNP Axial Geometry Representation (1 throw 9 – Axial Zone Locations for Axial Profiles)

6. RESULTS

The loading curves for the 21 PWR waste package with TAD canister are presented in this section. The k_{eff} results represent the average combined collision, absorption, and track-length estimator from the MCNP calculations. The standard deviation (σ) represents the standard deviation of k_{eff} about the average combined collision, absorption, and track-length estimate due to the Monte Carlo calculation statistics. Any reference to enrichment in the following sections refers to assembly average initial enrichment, and any reference to burnup refers to assembly average burnup.

6.1. CALCULATION CASES

Calculation case codes presents at the Report September 2007 Postclosure.xls EXCEL file, sheets"*Scale Calculations Cases*" and "*MCNP Calculations Cases*". Brief description of calculation cases presents at the section 6.1.1 and 6.1.2 (SCALE and MCNP Calculations Input Parameters)

6.1.1. SCALE CALCULATIONS INPUT PARAMETERS

SCALE-5- T-DEPL-TRITON sequence has been used for the SNF calculations providing additional lattice physics capabilities that are not available in the Monte Carlo-based T5- and T6-DEPL sequences, such as the ability to generate lattice physics parameters and perform branch calculations (for instance, T-DEPL provides the option to group independently depleted mixtures together such that they are tracked independently but use a common set of cross sections). Preliminary depletion analysis allowed dividing all 215 fuel roads into the five groups that have almost the same **pin power factors** (available from NEWT transport calculation approach) for a burnup range of fresh (0 GWd/MTU) through 45 GWd/MTU. One of the NEWT powerful options allows performing burnup calculation for a total of 232 nuclides. Tables 6.1.1.1 and 6.1.1.2 explains calculation case codes.

Tables 6.1.1.1 SCALE Calculation Cases Common parameters

Unit	SCALE Transport	SCALE Library	BPA in Moderator	BPA in GT	Tempe -rature	Height	NEWT Grid Count	Years Down
-	-	**L**	**BM**	**BG**	**TM**	**H**	**G**	-

Parameter			44						-
	-	NEWT	Group ndf5	Yes	No	High	Infinite	-	
Value	**ADRP***	**N**	**4**	**Y**	**N**	**H**	**0**	**30**	**10000**
Case Code	**ADRP***	**N**	**L4**	**BMY**	**BGN**	**TMH**	**H0**	**G30**	**10000**

* Assembly Depletion with Radial Profile estimation;

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Tables 6.1.1.2 SCALE Calculation Cases Codes

SCALE Case Codes	Wt% U235	Burnup	Thermal Power
	%	GWd/ MTU	MW
	W	B	P
Burnup Time (Years) = 2.54510883			
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B9_P10_10000	5	9.29601	10
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B18_P20_10000	5	18.59202	20
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B27_P30_10000	5	27.88803	30
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B40_P43_10000	5	40	43
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B51_P55_10000	5	51.128055	55
Burnup Time (Years) = 1.81455715			
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B7_P10_10000	5	6.62767	10
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B13_P20_10000	5	13.25534	20
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B20_P30_10000	5	19.88301	30
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B29_P43_10000	5	28.51834	43
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B36_P55_10000	5	36.45219	55
Burnup Time (Years) = 1.20492813			
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B4_P10_10000	5	4.401	10
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B9_P20_10000	5	8.802	20
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B13_P30_10000	5	13.203	30
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B19_P43_10000	5	18.93716	43
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B24_P55_10000	5	24.2055	55
Burnup Time (Years) = 0.55195072			
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B4_P10_10000	5	2.016	10
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B9_P20_10000	5	4.032	20
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B13_P30_10000	5	6.048	30
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B19_P43_10000	5	8.674689	43
ADRP_N_L4_W5_BMY_BGN_TMH_H0_G30_B24_P55_10000	5	11.088	55
Burnup Time (Years) = 2.54510883			
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B9_P10_10000	4.5	9.29601	10
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B18_P20_10000	4.5	18.59202	20
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B27_P30_10000	4.5	27.88803	30
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B40_P43_10000	4.5	40	43
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B51_P55_10000	4.5	51.128055	55
Burnup Time (Years) = 1.81455715			
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B7_P10_10000	4.5	6.62767	10
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B13_P20_10000	4.5	13.25534	20
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B20_P30_10000	4.5	19.88301	30
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B29_P43_10000	4.5	28.51834	43
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B36_P55_10000	4.5	36.45219	55
Burnup Time (Years) = 1.20492813			
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B4_P10_10000	4.5	4.401	10
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B9_P20_10000	4.5	8.802	20
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B13_P30_10000	4.5	13.203	30
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B19_P43_10000	4.5	18.93716	43
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B24_P55_10000	4.5	24.2055	55
Burnup Time (Years) = 0.55195072			
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B4_P10_10000	4.5	2.016	10
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B9_P20_10000	4.5	4.032	20
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B13_P30_10000	4.5	6.048	30
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B19_P43_10000	4.5	8.674689	43
ADRP_N_L4_W45_BMY_BGN_TMH_H0_G30_B24_P55_10000	4.5	11.088	55

Burnup Time (Years) = 2.54510883			
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B9_P10_10000	4.2	9.29601	10
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B18_P20_10000	4.2	18.59202	20
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B27_P30_10000	4.2	27.88803	30
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B40_P43_10000	4.2	40	43
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B51_P55_10000	4.2	51.128055	55
Burnup Time (Years) = 1.81455715			
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B7_P10_10000	4.2	6.62767	10
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B13_P20_10000	4.2	13.25534	20
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B20_P30_10000	4.2	19.88301	30
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B29_P43_10000	4.2	28.51834	43
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B36_P55_10000	4.2	36.45219	55
Burnup Time (Years) = 1.20492813			
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B4_P10_10000	4.2	4.401	10
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B9_P20_10000	4.2	8.802	20
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B13_P30_10000	4.2	13.203	30
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B19_P43_10000	4.2	18.93716	43
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B24_P55_10000	4.2	24.2055	55
Burnup Time (Years) = 0.55195072			
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B4_P10_10000	4.2	2.016	10
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B9_P20_10000	4.2	4.032	20
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B13_P30_10000	4.2	6.048	30
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B19_P43_10000	4.2	8.674689	43
ADRP_N_L4_W42_BMY_BGN_TMH_H0_G30_B24_P55_10000	4.2	11.088	55
Burnup Time (Years) = 2.54510883			
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B9_P10_10000	2.83	9.29601	10
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B18_P20_10000	2.83	18.59202	20
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B27_P30_10000	2.83	27.88803	30
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B40_P43_10000	2.83	40	43
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B51_P55_10000	2.83	51.128055	55

No new entries on this page

Tables 6.1.2 SCALE Calculation Cases Codes – Continue …

Burnup Time (Years) = 1.81455715			
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B7_P10_10000	2.83	6.62767	10
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B13_P20_10000	2.83	13.25534	20
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B20_P30_10000	2.83	19.88301	30
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B29_P43_10000	2.83	28.51834	43
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B36_P55_10000	2.83	36.45219	55
Burnup Time (Years) = 1.20492813			
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B4_P10_10000	2.83	4.401	10
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B9_P20_10000	2.83	8.802	20
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B13_P30_10000	2.83	13.203	30
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B19_P43_10000	2.83	18.93716	43
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B24_P55_10000	2.83	24.2055	55
Burnup Time (Years) = 0.55195072			
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B4_P10_10000	2.83	2.016	10
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B9_P20_10000	2.83	4.032	20
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B13_P30_10000	2.83	6.048	30
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B19_P43_10000	2.83	8.674689	43
ADRP_N_L4_W283_BMY_BGN_TMH_H0_G30_B24_P55_10000	2.83	11.088	55

Burnup parameters used in SCALE calculations are provided in Tables 6.1.1.3 (Burnup parameters) and 6.1.1.4 (Boron letdown parameters).

SCALE (NewT) input files are at the:

Scale Input\2p83 Proc Enrichment,

Scale Input\4p2 Proc Enrichment,

Scale Input\4p5 Proc Enrichment,

Scale Input\5 Proc Enrichment,

folders at the

_T0_GwDMTU_8_67,

_T1_GwDMTU_18_94,

_T2_GwDMTU_28_52,

_T3_GwDMTU_40_00,

Set of folders for each enrichment correspondence difference times of depletion (T0 = 0.55195 years, , T1=1.20493 years, T2=1.81456 and T3 = 2.54511years).

No new entries on this page

Tables 6.1.1.3 Burnup Common Parameters Used in SCALE and TDMAT Calculations

Burn*	**Down***	**NLIB***	**Time****
Days	Days		Years
67.2	0	3	
67.2	0	3	
67.2	**0**	**3**	**0.551951**
67.2	0	3	
71.1	0	3	
71.1	0	3	
29.1	**0**	**3**	**1.204928**
55.5	0	3	
55.5	0	3	
55.5	0	3	
56.167	**0**	**3**	**1.814557**
56.167	0	3	
56.167	0	3	
40.75	0	3	
40.75	0	3	
36.5	0	3	
36.5	**3652500**	**3**	**2.545109**

* Parameters used in "read burndata" SCALE data block;

** Parameter used in "TDMAT" calculations for the data interpolation and listed in Tables 6.1.2;

No new entries on this page

Tables 6.1.1.4 Boron Letdown Parameters Used in SCALE Burnup Calculations

EFPD	ppmB	BFRAC
Days	-	-
0	1147	1
67.2	921.0164	0.802979
67.2	872.2394	0.760453
67.2	738.2884	0.643669
67.2	608.1684	0.530225
71.1	518.6474	0.452177
71.1	256.1082	0.223285
29.1	237.5449	0.207101
55.5	688.9265	0.600633
55.5	527.5075	0.459902
55.5	353.475	0.308173
56.167	880.3779	0.767548
56.167	694.6803	0.60565
56.167	536.647	0.46787
40.75	382.5951	0.333562
40.75	267.1631	0.232923
36.5	234.6383	0.204567
36.5	128.1642	0.111739

No new entries on this page

6.1.2. SCALE CALCULATIONS RESULTS

Because of large amount of data (tenths gigabytes) all SCALE outputs are provided electronically in Attachment ...

For each fuel enrichment a four-dimensional matrix has been extracted from the SCALE output and placed as a TDMAT software input.

Matrix four dimension are:

- Depleted radial material compositions - five groups of fuel rods according Figure 5.1.1.1 and Table 5.1.1.2;
- Thermal power - five values according Tables 6.1.1.2;
- Burnup times – four values in Tables 6.1.1.2 represents times when assembly has been removed from the reactor;
- The spent fuel isotopes used in the MCNP cases and correspond to those of the Principal Isotope Set.

One four-dimensional matrix has been splitted into 25 two-dimensional matrix, each of them consists of nuclide density for each of the Principal Isotope Set for each burnup time and placed into the Report September 2007 Postclosure.xls EXCEL file, at the different "TDMAT Input" sheet for each fuel enrichment.

A sample of one of the table for:

- 5% fuel enrichment,
- 10 MW/MTU thermal power and
- the first group of the fuel rods

presents at the Table 6.1.2.1

No new entries on this page

Table 6.1.2.1 Sample of the Two-Dimensional Matrix for TDMAT Input for 5% Fuel Enrichment, 10 MW/MTU thermal power and the first group of the fuel rods form the Report September 2007 Postclosure.xls EXCEL file

	#	MCNP ID	/ SCALE ID	P=10 MW/MTU			
			Years of Burnup:	0.551951	1.20493	1.81456	2.54511
	1	92233.50C	u233	5.94E-03	2.15E-02	4.98E-02	9.04E-02
	2	92234.50C	u234	6.48E+01	6.32E+01	6.17E+01	6.03E+01
	3	92235.50C	u235	7.33E+03	6.91E+03	6.55E+03	6.11E+03
	4	92236.50C	u236	1.14E+02	2.06E+02	2.91E+02	3.88E+02
	5	92238.50C	u238	1.46E+05	1.46E+05	1.46E+05	1.45E+05
	6	94238.50C	pu238	5.49E-27	1.91E-25	1.21E-24	4.33E-24
	7	94239.50C	pu239	1.03E+02	2.00E+02	2.87E+02	3.53E+02
	8	94240.50C	pu240	1.50E+00	5.91E+00	1.20E-01	1.98E+01
	9	94241.50C	pu241	5.38E-13	1.02E-10	1.96E-09	1.52E-08
	10	94242.50C	pu242	4.23E-03	7.76E-02	3.58E-01	1.08E+00
	11	93237.55C	np237	1.91E+00	7.05E+00	1.65E+01	3.01E+01
Group of Fuel Rods # 1 (Table 5.1.1.2)	12	60143.50C	nd143	1.23E+01	2.63E+01	3.87E+01	5.30E+01
	13	60145.50C	nd145	8.37E+00	1.81E+01	2.68E+01	3.72E+01
	14	62147.50C	sm147	4.78E+00	1.00E+01	1.45E+01	1.96E+01
	15	62149.50C	sm149	4.60E-01	4.66E-01	4.85E-01	4.73E-01
	16	62150.50C	sm150	2.03E+00	5.02E+00	7.81E+00	1.12E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	8.50E-01	2.24E+00	3.67E+00	5.55E+00
	19	63153.55C	eu153	4.21E-01	1.02E+00	1.70E+00	2.63E+00
	20	64155.50C	gd155	5.52E-02	8.50E-02	1.06E-01	1.34E-01
	21	63151.55C	eu151	7.81E-01	1.33E+00	1.68E+00	1.90E+00
	22	42095.50C	mo95	9.02E+00	1.95E+01	2.90E+01	4.04E+01
	23	43099.50C	tc99	8.93E+00	1.94E+01	2.89E+01	4.03E+01
	24	44101.50C	ru101	7.87E+00	1.72E+01	2.58E+01	3.63E+01
	25	44103.50C	rh103	4.97E+00	1.09E+01	1.64E+01	2.29E+01
	26	95241.50c	am241	4.32E-08	3.53E-07	1.11E-06	2.62E-06
	27	95242.50c	am242m	4.08E-27	1.42E-25	8.99E-25	3.22E-24
	28	95243.50C	am243	1.41E-05	5.70E-04	4.29E-03	1.80E-02
	29	47109.50C	ag109	1.19E-01	3.71E-01	7.16E-01	1.19E+00

6.1.3. TDMAT SOFTWARE

No new entries on this page.

02/01/2008 (AK)(OP)

Reactivity effect of PWR assembly misload was calculated for DOE example loading curve.

TDMAT Input for 4.5% Fuel Enrichment Sheet "TDMAT Input 4.5%" of the SN December 2007 Postclosure.xlsx EXCEL file.

P= **10** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	6.12E-03	2.29E-02	5.36E-02	9.70E-02
	2	92234.50C	u234	5.78E+01	5.63E+01	5.49E+01	5.37E+01
	3	92235.50C	u235	6.56E+03	6.15E+03	5.80E+03	5.38E+03
	4	92236.50C	u236	1.09E+02	1.99E+02	2.83E+02	3.77E+02
	5	92238.50C	u238	1.47E+05	1.46E+05	1.46E+05	1.46E+05
	6	94238.50C	pu238	6.90E-27	2.32E-25	1.44E-24	5.01E-24
	7	94239.50C	pu239	1.07E+02	2.06E+02	2.94E+02	3.58E+02
	8	94240.50C	pu240	1.69E+00	6.61E+00	1.33E+01	2.18E+01
	9	94241.50C	pu241	7.85E-13	1.46E-10	2.80E-09	2.13E-08
	10	94242.50C	pu242	5.50E-03	9.91E-02	4.53E-01	1.35E+00
	11	93237.55C	np237	1.98E+00	7.51E+00	1.78E+01	3.23E+01
Group of Fuel Rods #1 (Table 5.1.1.2)	12	60143.50C	nd143	1.22E+01	2.61E+01	3.83E+01	5.24E+01
	13	60145.50C	nd145	8.33E+00	1.80E+01	2.66E+01	3.69E+01
	14	62147.50C	sm147	4.76E+00	9.97E+00	1.44E+01	1.94E+01
	15	62149.50C	sm149	4.15E-01	4.21E-01	4.40E-01	4.29E-01
	16	62150.50C	sm150	2.07E+00	5.06E+00	7.86E+00	1.13E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	8.71E-01	2.31E+00	3.78E+00	5.69E+00
	19	63153.55C	eu153	4.23E-01	1.03E+00	1.74E+00	2.70E+00
	20	64155.50C	gd155	5.42E-02	8.36E-02	1.06E-01	1.35E-01
	21	63151.55C	eu151	7.60E-01	1.27E+00	1.58E+00	1.76E+00
	22	42095.50C	mo95	8.98E+00	1.94E+01	2.88E+01	4.01E+01
	23	43099.50C	tc99	8.90E+00	1.93E+01	2.88E+01	4.01E+01
	24	44101.50C	ru101	7.85E+00	1.72E+01	2.58E+01	3.62E+01
	25	44103.50C	rh103	4.97E+00	1.09E+01	1.65E+01	2.30E+01
	26	95241.50c	am241	5.10E-08	4.09E-07	1.28E-06	3.07E-06
	27	95242.50c	am242m	5.13E-27	1.73E-25	1.07E-24	3.72E-24
	28	95243.50C	am243	1.90E-05	7.56E-04	5.66E-03	2.34E-02
	29	47109.50C	ag109	1.27E-01	4.01E-01	7.81E-01	1.30E+00

No new entries on this page

P= **20** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	2.04E-02	8.87E-02	2.00E-01	3.33E-01
	2	92234.50C	u234	5.64E+01	5.38E+01	5.21E+01	5.16E+01
	3	92235.50C	u235	6.22E+03	5.46E+03	4.83E+03	4.10E+03
	4	92236.50C	u236	1.86E+02	3.60E+02	5.14E+02	6.76E+02
	5	92238.50C	u238	1.46E+05	1.46E+05	1.46E+05	1.45E+05
	6	94238.50C	pu238	8.47E-26	2.10E-24	1.00E-23	2.67E-23
	7	94239.50C	pu239	1.99E+02	3.51E+02	4.70E+02	5.31E+02
	8	94240.50C	pu240	5.84E+00	2.02E+01	3.72E+01	5.70E+01
	9	94241.50C	pu241	9.44E-11	1.57E-08	2.66E-07	1.83E-06
	10	94242.50C	pu242	7.57E-02	1.14E+00	4.46E+00	1.17E+01
	11	93237.55C	np237	6.71E+00	2.96E+01	6.70E+01	1.12E+02
Group of Fuel Rods #1 (Table 5.1.1.2)	12	60143.50C	nd143	2.40E+01	4.99E+01	7.15E+01	9.49E+01
	13	60145.50C	nd145	1.64E+01	3.50E+01	5.11E+01	6.99E+01
	14	62147.50C	sm147	9.17E+00	1.84E+01	2.54E+01	3.30E+01
	15	62149.50C	sm149	4.79E-01	5.00E-01	5.32E-01	5.15E-01
	16	62150.50C	sm150	4.57E+00	1.08E+01	1.69E+01	2.42E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	2.05E+00	5.32E+00	8.35E+00	1.20E+01
	19	63153.55C	eu153	9.32E-01	2.51E+00	4.52E+00	7.31E+00
	20	64155.50C	gd155	8.01E-02	1.31E-01	1.97E-01	3.03E-01
	21	63151.55C	eu151	1.22E+00	1.75E+00	2.06E+00	2.18E+00
	22	42095.50C	mo95	1.78E+01	3.81E+01	5.59E+01	7.69E+01
	23	43099.50C	tc99	1.77E+01	3.80E+01	5.61E+01	7.75E+01
	24	44101.50C	ru101	1.57E+01	3.43E+01	5.14E+01	7.19E+01
	25	44103.50C	rh103	1.01E+01	2.20E+01	3.30E+01	4.54E+01
	26	95241.50c	am241	3.44E-07	2.66E-06	1.34E-05	6.45E-05
	27	95242.50c	am242m	6.31E-26	1.56E-24	7.46E-24	1.99E-23
	28	95243.50C	am243	5.44E-04	1.87E-02	1.21E-01	4.46E-01
	29	47109.50C	ag109	3.56E-01	1.20E+00	2.36E+00	3.95E+00

No new entries on this page

P= **30** MW/MTU

	#	MCNP ID	/ SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	4.48E-02	1.89E-01	3.93E-01	5.98E-01
	2	92234.50C	u234	5.51E+01	5.21E+01	5.15E+01	5.41E+01
	3	92235.50C	u235	5.90E+03	4.82E+03	3.98E+03	3.04E+03
	4	92236.50C	u236	2.62E+02	5.11E+02	7.15E+02	9.17E+02
	5	92238.50C	u238	1.46E+05	1.46E+05	1.45E+05	1.44E+05
	6	94238.50C	pu238	3.29E-25	6.18E-24	2.39E-23	5.10E-23
	7	94239.50C	pu239	2.77E+02	4.54E+02	5.78E+02	6.13E+02
	8	94240.50C	pu240	1.15E+01	3.63E+01	6.30E+01	9.21E+01
	9	94241.50C	pu241	1.49E-09	2.22E-07	3.37E-06	2.11E-05
	10	94242.50C	pu242	3.28E-01	4.26E+00	1.47E+01	3.53E+01
	11	93237.55C	np237	1.49E+01	6.34E+01	1.32E+02	2.01E+02
Group of Fuel Rods #1 (Table 5.1.1.2)	12	60143.50C	nd143	3.52E+01	7.15E+01	1.00E+02	1.28E+02
	13	60145.50C	nd145	2.44E+01	5.11E+01	7.38E+01	9.93E+01
	14	62147.50C	sm147	1.33E+01	2.55E+01	3.38E+01	4.20E+01
	15	62149.50C	sm149	5.49E-01	5.87E-01	6.28E-01	6.00E-01
	16	62150.50C	sm150	7.19E+00	1.71E+01	2.68E+01	3.83E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	3.37E+00	8.38E+00	1.26E+01	1.75E+01
	19	63153.55C	eu153	1.54E+00	4.45E+00	8.17E+00	1.32E+01
	20	64155.50C	gd155	1.01E-01	1.96E-01	3.41E-01	5.72E-01
	21	63151.55C	eu151	1.53E+00	2.01E+00	2.36E+00	2.48E+00
	22	42095.50C	mo95	2.64E+01	5.61E+01	8.15E+01	1.11E+02
	23	43099.50C	tc99	2.63E+01	5.60E+01	8.20E+01	1.12E+02
	24	44101.50C	ru101	2.35E+01	5.13E+01	7.67E+01	1.07E+02
	25	44103.50C	rh103	1.53E+01	3.31E+01	4.89E+01	6.59E+01
	26	95241.50c	am241	1.00E-06	1.18E-05	1.13E-04	6.54E-04
	27	95242.50c	am242m	2.45E-25	4.60E-24	1.78E-23	3.80E-23
	28	95243.50C	am243	3.66E-03	1.11E-01	6.34E-01	2.11E+00
	29	47109.50C	ag109	6.71E-01	2.30E+00	4.50E+00	7.47E+00

No new entries on this page

P= **43** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	9.08E-02	3.48E-01	6.52E-01	8.97E-01
	2	92234.50C	u234	5.37E+01	5.11E+01	5.43E+01	6.40E+01
	3	92235.50C	u235	5.49E+03	4.06E+03	3.05E+03	1.98E+03
	4	92236.50C	u236	3.58E+02	6.87E+02	9.32E+02	1.14E+03
	5	92238.50C	u238	1.46E+05	1.45E+05	1.44E+05	1.43E+05
	6	94238.50C	pu238	9.91E-25	1.36E-23	4.16E-23	6.88E-23
	7	94239.50C	pu239	3.63E+02	5.46E+02	6.56E+02	6.54E+02
	8	94240.50C	pu240	2.02E+01	5.85E+01	9.57E+01	1.32E+02
	9	94241.50C	pu241	1.66E-08	2.16E-06	2.88E-05	1.59E-04
	10	94242.50C	pu242	1.14E+00	1.25E+01	3.83E+01	8.43E+01
	11	93237.55C	np237	3.03E+01	1.17E+02	2.19E+02	3.01E+02
Group of Fuel Rods # 1 (Table 5.1.1.2)	12	60143.50C	nd143	4.92E+01	9.66E+01	1.31E+02	1.59E+02
	13	60145.50C	nd145	3.44E+01	7.09E+01	1.01E+02	1.33E+02
	14	62147.50C	sm147	1.81E+01	3.30E+01	4.14E+01	4.84E+01
	15	62149.50C	sm149	6.48E-01	7.05E-01	7.54E-01	7.10E-01
	16	62150.50C	sm150	1.08E+01	2.60E+01	4.08E+01	5.80E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	5.18E+00	1.22E+01	1.77E+01	2.39E+01
	19	63153.55C	eu153	2.48E+00	7.52E+00	1.38E+01	2.17E+01
	20	64155.50C	gd155	1.30E-01	3.15E-01	6.04E-01	1.03E+00
	21	63151.55C	eu151	1.79E+00	2.26E+00	2.70E+00	2.81E+00
	22	42095.50C	mo95	3.75E+01	7.85E+01	1.13E+02	1.51E+02
	23	43099.50C	tc99	3.74E+01	7.86E+01	1.14E+02	1.53E+02
	24	44101.50C	ru101	3.37E+01	7.32E+01	1.09E+02	1.51E+02
	25	44103.50C	rh103	2.21E+01	4.72E+01	6.83E+01	8.91E+01
	26	95241.50c	am241	2.73E-06	7.48E-05	8.88E-04	4.83E-03
	27	95242.50c	am242m	7.37E-25	1.01E-23	3.09E-23	5.12E-23
	28	95243.50C	am243	1.90E-02	4.91E-01	2.45E+00	7.24E+00
	29	47109.50C	ag109	1.19E+00	4.09E+00	7.89E+00	1.29E+01

No new entries on this page

P= **55** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	1.45E-01	5.01E-01	8.68E-01	1.10E+00
	2	92234.50C	u234	5.26E+01	5.17E+01	6.05E+01	7.81E+01
	3	92235.50C	u235	5.13E+03	3.45E+03	2.34E+03	1.29E+03
	4	92236.50C	u236	4.43E+02	8.30E+02	1.09E+03	1.27E+03
	5	92238.50C	u238	1.46E+05	1.45E+05	1.43E+05	1.41E+05
	6	94238.50C	pu238	1.95E-24	2.06E-23	5.26E-23	7.00E-23
	7	94239.50C	pu239	4.28E+02	6.01E+02	6.94E+02	6.65E+02
	8	94240.50C	pu240	2.89E+01	7.88E+01	1.23E+02	1.61E+02
	9	94241.50C	pu241	8.30E-08	9.61E-06	1.14E-04	5.57E-04
	10	94242.50C	pu242	2.55E+00	2.47E+01	6.91E+01	1.42E+02
	11	93237.55C	np237	4.84E+01	1.68E+02	2.91E+02	3.67E+02
Group of Fuel Rods # 1 (Table 5.1.1.2)	12	60143.50C	nd143	6.15E+01	1.17E+02	1.53E+02	1.74E+02
	13	60145.50C	nd145	4.33E+01	8.79E+01	1.23E+02	1.58E+02
	14	62147.50C	sm147	2.22E+01	3.84E+01	4.57E+01	5.02E+01
	15	62149.50C	sm149	7.45E-01	8.17E-01	8.70E-01	8.13E-01
	16	62150.50C	sm150	1.43E+01	3.47E+01	5.45E+01	7.61E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	6.85E+00	1.54E+01	2.19E+01	2.91E+01
	19	63153.55C	eu153	3.49E+00	1.08E+01	1.94E+01	2.96E+01
	20	64155.50C	gd155	1.63E-01	4.59E-01	9.04E-01	1.50E+00
	21	63151.55C	eu151	1.97E+00	2.46E+00	2.99E+00	3.09E+00
	22	42095.50C	mo95	4.75E+01	9.82E+01	1.39E+02	1.83E+02
	23	43099.50C	tc99	4.74E+01	9.84E+01	1.40E+02	1.85E+02
	24	44101.50C	ru101	4.30E+01	9.31E+01	1.38E+02	1.90E+02
	25	44103.50C	rh103	2.84E+01	5.97E+01	8.44E+01	1.06E+02
	26	95241.50c	am241	6.28E-06	3.04E-04	3.47E-03	1.68E-02
	27	95242.50c	am242m	1.45E-24	1.54E-23	3.91E-23	5.21E-23
	28	95243.50C	am243	5.61E-02	1.27E+00	5.65E+00	1.52E+01
	29	47109.50C	ag109	1.76E+00	6.02E+00	1.14E+01	1.84E+01

No new entries on this page

P= **10** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	6.77E-03	2.51E-02	5.88E-02	1.06E-01
	2	92234.50C	u234	6.51E+01	6.34E+01	6.18E+01	6.05E+01
	3	92235.50C	u235	7.40E+03	6.95E+03	6.56E+03	6.10E+03
	4	92236.50C	u236	1.21E+02	2.20E+02	3.13E+02	4.16E+02
	5	92238.50C	u238	1.65E+05	1.65E+05	1.65E+05	1.64E+05
	6	94238.50C	pu238	7.34E-27	2.48E-25	1.55E-24	5.43E-24
	7	94239.50C	pu239	1.20E+02	2.30E+02	3.30E+02	4.03E+02
	8	94240.50C	pu240	1.85E+00	7.21E+00	1.46E+01	2.38E+01
	9	94241.50C	pu241	8.03E-13	1.49E-10	2.87E-09	2.19E-08
	10	94242.50C	pu242	5.78E-03	1.04E-01	4.78E-01	1.42E+00
	11	93237.55C	np237	2.18E+00	8.24E+00	1.95E+01	3.55E+01
Group of Fuel Rods #2 (Table 5.1.1.2)	12	60143.50C	nd143	1.34E+01	2.86E+01	4.20E+01	5.75E+01
	13	60145.50C	nd145	9.13E+00	1.97E+01	2.92E+01	4.04E+01
	14	62147.50C	sm147	5.21E+00	1.09E+01	1.58E+01	2.13E+01
	15	62149.50C	sm149	4.69E-01	4.76E-01	4.99E-01	4.87E-01
	16	62150.50C	sm150	2.25E+00	5.52E+00	8.60E+00	1.23E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	9.49E-01	2.50E+00	4.12E+00	6.19E+00
	19	63153.55C	eu153	4.64E-01	1.13E+00	1.90E+00	2.95E+00
	20	64155.50C	gd155	6.00E-02	9.26E-02	1.17E-01	1.49E-01
	21	63151.55C	eu151	8.40E-01	1.41E+00	1.77E+00	1.98E+00
	22	42095.50C	mo95	9.83E+00	2.13E+01	3.16E+01	4.39E+01
	23	43099.50C	tc99	9.75E+00	2.11E+01	3.15E+01	4.40E+01
	24	44101.50C	ru101	8.60E+00	1.88E+01	2.83E+01	3.97E+01
	25	44103.50C	rh103	5.46E+00	1.20E+01	1.81E+01	2.53E+01
	26	95241.50c	am241	5.51E-08	4.43E-07	1.39E-06	3.30E-06
	27	95242.50c	am242m	5.47E-27	1.85E-25	1.16E-24	4.04E-24
	28	95243.50C	am243	1.98E-05	7.88E-04	5.92E-03	2.45E-02
	29	47109.50C	ag109	1.39E-01	4.38E-01	8.53E-01	1.42E+00

No new entries on this page

P= **20** MW/MTU

	#	MCNP ID	/ SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	2.25E-02	9.73E-02	2.20E-01	3.68E-01
	2	92234.50C	u234	6.35E+01	6.06E+01	5.87E+01	5.81E+01
	3	92235.50C	u235	7.02E+03	6.18E+03	5.50E+03	4.69E+03
	4	92236.50C	u236	2.06E+02	3.97E+02	5.68E+02	7.47E+02
	5	92238.50C	u238	1.65E+05	1.64E+05	1.64E+05	1.63E+05
	6	94238.50C	pu238	9.07E-26	2.27E-24	1.10E-23	2.96E-23
	7	94239.50C	pu239	2.23E+02	3.94E+02	5.31E+02	6.03E+02
	8	94240.50C	pu240	6.38E+00	2.21E+01	4.07E+01	6.26E+01
	9	94241.50C	pu241	9.66E-11	1.61E-08	2.74E-07	1.89E-06
	10	94242.50C	pu242	7.98E-02	1.21E+00	4.73E+00	1.24E+01
	11	93237.55C	np237	7.36E+00	3.24E+01	7.37E+01	1.23E+02
Group of Fuel Rods #2 (Table 5.1.1.2)	12	60143.50C	nd143	2.63E+01	5.47E+01	7.86E+01	1.05E+02
	13	60145.50C	nd145	1.80E+01	3.83E+01	5.61E+01	7.68E+01
	14	62147.50C	sm147	1.01E+01	2.02E+01	2.80E+01	3.64E+01
	15	62149.50C	sm149	5.41E-01	5.66E-01	6.03E-01	5.84E-01
	16	62150.50C	sm150	5.00E+00	1.19E+01	1.85E+01	2.65E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	2.23E+00	5.80E+00	9.12E+00	1.31E+01
	19	63153.55C	eu153	1.02E+00	2.74E+00	4.93E+00	7.97E+00
	20	64155.50C	gd155	8.88E-02	1.45E-01	2.16E-01	3.30E-01
	21	63151.55C	eu151	1.36E+00	1.97E+00	2.33E+00	2.47E+00
	22	42095.50C	mo95	1.95E+01	4.17E+01	6.14E+01	8.44E+01
	23	43099.50C	tc99	1.94E+01	4.16E+01	6.16E+01	8.51E+01
	24	44101.50C	ru101	1.72E+01	3.75E+01	5.64E+01	7.89E+01
	25	44103.50C	rh103	1.11E+01	2.42E+01	3.63E+01	5.00E+01
	26	95241.50c	am241	3.73E-07	2.87E-06	1.42E-05	6.73E-05
	27	95242.50c	am242m	6.75E-26	1.69E-24	8.18E-24	2.20E-23
	28	95243.50C	am243	5.68E-04	1.96E-02	1.28E-01	4.70E-01
	29	47109.50C	ag109	3.90E-01	1.31E+00	2.58E+00	4.32E+00

No new entries on this page

P= **30** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	4.92E-02	2.08E-01	4.35E-01	6.65E-01
	2	92234.50C	u234	6.21E+01	5.87E+01	5.79E+01	6.07E+01
	3	92235.50C	u235	6.66E+03	5.48E+03	4.56E+03	3.52E+03
	4	92236.50C	u236	2.89E+02	5.63E+02	7.91E+02	1.02E+03
	5	92238.50C	u238	1.65E+05	1.64E+05	1.63E+05	1.62E+05
	6	94238.50C	pu238	3.54E-25	6.76E-24	2.65E-23	5.75E-23
	7	94239.50C	pu239	3.11E+02	5.13E+02	6.56E+02	7.00E+02
	8	94240.50C	pu240	1.25E+01	3.98E+01	6.93E+01	1.02E+02
	9	94241.50C	pu241	1.53E-09	2.28E-07	3.49E-06	2.20E-05
	10	94242.50C	pu242	3.46E-01	4.51E+00	1.57E+01	3.77E+01
	11	93237.55C	np237	1.63E+01	6.97E+01	1.46E+02	2.23E+02
Group of Fuel Rods #2 (Table 5.1.1.2)	12	60143.50C	nd143	3.86E+01	7.86E+01	1.11E+02	1.42E+02
	13	60145.50C	nd145	2.67E+01	5.61E+01	8.11E+01	1.09E+02
	14	62147.50C	sm147	1.46E+01	2.81E+01	3.73E+01	4.65E+01
	15	62149.50C	sm149	6.18E-01	6.62E-01	7.11E-01	6.81E-01
	16	62150.50C	sm150	7.86E+00	1.87E+01	2.94E+01	4.21E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	3.67E+00	9.14E+00	1.38E+01	1.92E+01
	19	63153.55C	eu153	1.68E+00	4.84E+00	8.92E+00	1.44E+01
	20	64155.50C	gd155	1.12E-01	2.15E-01	3.72E-01	6.23E-01
	21	63151.55C	eu151	1.71E+00	2.27E+00	2.68E+00	2.82E+00
	22	42095.50C	mo95	2.90E+01	6.15E+01	8.95E+01	1.22E+02
	23	43099.50C	tc99	2.89E+01	6.14E+01	9.02E+01	1.23E+02
	24	44101.50C	ru101	2.58E+01	5.62E+01	8.42E+01	1.18E+02
	25	44103.50C	rh103	1.67E+01	3.63E+01	5.39E+01	7.28E+01
	26	95241.50c	am241	1.09E-06	1.25E-05	1.18E-04	6.82E-04
	27	95242.50c	am242m	2.63E-25	5.03E-24	1.97E-23	4.28E-23
	28	95243.50C	am243	3.83E-03	1.16E-01	6.70E-01	2.24E+00
	29	47109.50C	ag109	7.33E-01	2.51E+00	4.93E+00	8.19E+00

No new entries on this page

P= **43** MW/MTU

	#	MCNP ID	/ SCALE ID	Years of Burnup:	0.551951	1.20493	1.81456	2.54511
	1	92233.50C	u233		9.97E-02	3.85E-01	7.26E-01	1.01E+00
	2	92234.50C	u234		6.05E+01	5.76E+01	6.10E+01	7.15E+01
	3	92235.50C	u235		6.22E+03	4.65E+03	3.52E+03	2.33E+03
	4	92236.50C	u236		3.95E+02	7.59E+02	1.03E+03	1.27E+03
	5	92238.50C	u238		1.64E+05	1.63E+05	1.62E+05	1.61E+05
	6	94238.50C	pu238		1.07E-24	1.50E-23	4.69E-23	7.91E-23
	7	94239.50C	pu239		4.07E+02	6.20E+02	7.50E+02	7.51E+02
	8	94240.50C	pu240		2.20E+01	6.43E+01	1.06E+02	1.47E+02
	9	94241.50C	pu241		1.70E-08	2.23E-06	3.01E-05	1.68E-04
	10	94242.50C	pu242		1.20E+00	1.33E+01	4.10E+01	9.08E+01
	11	93237.55C	np237		3.32E+01	1.29E+02	2.44E+02	3.38E+02
Group of Fuel Rods # 2 (Table 5.1.1.2)	12	60143.50C	nd143		5.41E+01	1.07E+02	1.45E+02	1.77E+02
	13	60145.50C	nd145		3.77E+01	7.79E+01	1.11E+02	1.47E+02
	14	62147.50C	sm147		1.99E+01	3.64E+01	4.59E+01	5.39E+01
	15	62149.50C	sm149		7.28E-01	7.95E-01	8.54E-01	8.06E-01
	16	62150.50C	sm150		1.18E+01	2.84E+01	4.48E+01	6.38E+01
	17	62151.50C	sm151		0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152		5.64E+00	1.33E+01	1.94E+01	2.63E+01
	19	63153.55C	eu153		2.70E+00	8.20E+00	1.51E+01	2.38E+01
	20	64155.50C	gd155		1.43E-01	3.43E-01	6.58E-01	1.13E+00
	21	63151.55C	eu151		2.01E+00	2.57E+00	3.08E+00	3.21E+00
	22	42095.50C	mo95		4.11E+01	8.62E+01	1.24E+02	1.66E+02
	23	43099.50C	tc99		4.10E+01	8.63E+01	1.25E+02	1.69E+02
	24	44101.50C	ru101		3.70E+01	8.03E+01	1.20E+02	1.67E+02
	25	44103.50C	rh103		2.42E+01	5.19E+01	7.54E+01	9.89E+01
	26	95241.50c	am241		2.95E-06	7.80E-05	9.28E-04	5.09E-03
	27	95242.50c	am242m		7.99E-25	1.12E-23	3.49E-23	5.88E-23
	28	95243.50C	am243		1.99E-02	5.17E-01	2.60E+00	7.75E+00
	29	47109.50C	ag109		1.30E+00	4.47E+00	8.65E+00	1.42E+01

No new entries on this page

P= **55** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	1.59E-01	5.56E-01	9.72E-01	1.24E+00
	2	92234.50C	u234	5.92E+01	5.81E+01	6.77E+01	8.73E+01
	3	92235.50C	u235	5.83E+03	3.97E+03	2.74E+03	1.54E+03
	4	92236.50C	u236	4.88E+02	9.18E+02	1.21E+03	1.43E+03
	5	92238.50C	u238	1.64E+05	1.63E+05	1.61E+05	1.59E+05
	6	94238.50C	pu238	2.13E-24	2.31E-23	6.00E-23	8.17E-23
	7	94239.50C	pu239	4.82E+02	6.85E+02	7.96E+02	7.66E+02
	8	94240.50C	pu240	3.17E+01	8.68E+01	1.36E+02	1.81E+02
	9	94241.50C	pu241	8.54E-08	9.98E-06	1.20E-04	5.94E-04
	10	94242.50C	pu242	2.70E+00	2.63E+01	7.43E+01	1.54E+02
	11	93237.55C	np237	5.31E+01	1.87E+02	3.26E+02	4.15E+02
Group of Fuel Rods # 2 (Table 5.1.1.2)	12	60143.50C	nd143	6.75E+01	1.29E+02	1.70E+02	1.96E+02
	13	60145.50C	nd145	4.75E+01	9.68E+01	1.36E+02	1.76E+02
	14	62147.50C	sm147	2.44E+01	4.24E+01	5.09E+01	5.64E+01
	15	62149.50C	sm149	8.36E-01	9.21E-01	9.85E-01	9.24E-01
	16	62150.50C	sm150	1.56E+01	3.80E+01	5.99E-01	8.41E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E-00	0.00E+00
	18	62152.50C	sm152	7.47E+00	1.69E+01	2.41E+01	3.22E+01
	19	63153.55C	eu153	3.80E+00	1.18E+01	2.12E+01	3.26E+01
	20	64155.50C	gd155	1.79E-01	5.00E-01	9.88E-01	1.65E+00
	21	63151.55C	eu151	2.22E+00	2.80E+00	3.41E+00	3.54E+00
	22	42095.50C	mo95	5.21E+01	1.08E+02	1.54E+02	2.03E+02
	23	43099.50C	tc99	5.20E+01	1.08E+02	1.55E+02	2.06E+02
	24	44101.50C	ru101	4.72E+01	1.02E+02	1.52E+02	2.10E+02
	25	44103.50C	rh103	3.12E+01	6.58E+01	9.35E+01	1.19E+02
	26	95241.50c	am241	6.72E-06	3.17E-04	3.65E-03	1.79E-02
	27	95242.50c	am242m	1.59E-24	1.72E-23	4.47E-23	6.08E-23
	28	95243.50C	am243	5.89E-02	1.35E+00	6.04E+00	1.63E+01
	29	47109.50C	ag109	1.93E+00	6.59E+00	1.26E+01	2.03E+01

No new entries on this page

P= **10** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	5.16E-03	1.90E-02	4.45E-02	8.04E-02
	2	92234.50C	u234	5.06E+01	4.93E+01	4.81E+01	4.71E+01
	3	92235.50C	u235	5.76E+03	5.43E+03	5.13E+03	4.78E+03
	4	92236.50C	u236	9.21E+01	1.67E+02	2.38E+02	3.16E+02
	5	92238.50C	u238	1.28E+05	1.28E+05	1.28E+05	1.28E+05
	6	94238.50C	pu238	5.39E-27	1.83E-25	1.16E-24	4.05E-24
	7	94239.50C	pu239	9.23E+01	1.77E+02	2.55E+02	3.12E+02
	8	94240.50C	pu240	1.39E+00	5.42E+00	1.10E+01	1.79E+01
	9	94241.50C	pu241	5.62E-13	1.04E-10	2.02E-09	1.54E-08
	10	94242.50C	pu242	4.19E-03	7.55E-02	3.47E-01	1.03E+00
	11	93237.55C	np237	1.66E+00	6.23E+00	1.47E+01	2.68E+01
Group of Fuel Rods # 3 (Table 5.1.1.2)	12	60143.50C	nd143	1.01E+01	2.16E+01	3.18E+01	4.35E+01
	13	60145.50C	nd145	6.89E+00	1.49E+01	2.21E+01	3.06E+01
	14	62147.50C	sm147	3.94E+00	8.26E+00	1.19E+01	1.61E+01
	15	62149.50C	sm149	3.67E-01	3.73E-01	3.91E-01	3.82E-01
	16	62150.50C	sm150	1.69E+00	4.15E+00	6.48E+00	9.29E+00
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	7.11E-01	1.87E+00	3.09E+00	4.65E+00
	19	63153.55C	eu153	3.50E-01	8.47E-01	1.43E+00	2.21E+00
	20	64155.50C	gd155	4.58E-02	7.07E-02	8.93E-02	1.13E-01
	21	63151.55C	eu151	6.41E-01	1.09E+00	1.37E+00	1.54E+00
	22	42095.50C	mo95	7.42E+00	1.61E+01	2.39E+01	3.32E+01
	23	43099.50C	tc99	7.36E+00	1.59E+01	2.38E+01	3.32E+01
	24	44101.50C	ru101	6.49E+00	1.42E+01	2.14E+01	3.00E+01
	25	44103.50C	rh103	4.12E+00	9.04E+00	1.37E+01	1.91E+01
	26	95241.50c	am241	4.11E-08	3.31E-07	1.04E-06	2.45E-06
	27	95242.50c	am242m	4.01E-27	1.36E-25	8.59E-25	3.02E-24
	28	95243.50C	am243	1.43E-05	5.67E-04	4.28E-03	1.77E-02
	29	47109.50C	ag109	1.05E-01	3.30E-01	6.43E-01	1.07E+00

No new entries on this page

P= **20** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	1.70E-02	7.35E-02	1.67E-01	2.80E-01
	2	92234.50C	u234	4.94E+01	4.72E+01	4.57E+01	4.52E+01
	3	92235.50C	u235	5.48E+03	4.85E+03	4.33E+03	3.71E+03
	4	92236.50C	u236	1.57E+02	3.02E+02	4.32E+02	5.70E+02
	5	92238.50C	u238	1.28E+05	1.28E+05	1.27E+05	1.27E+05
	6	94238.50C	pu238	6.70E-26	1.70E-24	8.29E-24	2.25E-23
	7	94239.50C	pu239	1.72E+02	3.05E+02	4.13E+02	4.71E+02
	8	94240.50C	pu240	4.79E+00	1.66E+01	3.08E+01	4.74E+01
	9	94241.50C	pu241	6.78E-11	1.13E-08	1.93E-07	1.34E-06
	10	94242.50C	pu242	5.78E-02	8.77E-01	3.45E+00	9.10E+00
	11	93237.55C	np237	5.58E+00	2.45E+01	5.59E+01	9.39E+01
Group of Fuel Rods # 3 (Table 5.1.1.2)	12	60143.50C	nd143	1.98E+01	4.14E+01	5.97E+01	7.96E+01
	13	60145.50C	nd145	1.36E+01	2.90E+01	4.25E+01	5.82E+01
	14	62147.50C	sm147	7.60E+00	1.53E+01	2.13E+01	2.77E+01
	15	62149.50C	sm149	4.22E-01	4.41E-01	4.71E-01	4.57E-01
	16	62150.50C	sm150	3.76E+00	8.93E+00	1.39E+01	2.00E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	1.67E+00	4.35E+00	6.87E+00	9.89E+00
	19	63153.55C	eu153	7.68E-01	2.06E+00	3.70E+00	5.97E+00
	20	64155.50C	gd155	6.78E-02	1.10E-01	1.63E-01	2.48E-01
	21	63151.55C	eu151	1.05E+00	1.53E+00	1.82E+00	1.94E+00
	22	42095.50C	mo95	1.47E+01	3.15E+01	4.65E+01	6.40E+01
	23	43099.50C	tc99	1.46E+01	3.14E+01	4.66E+01	6.45E+01
	24	44101.50C	ru101	1.30E+01	2.84E+01	4.27E+01	5.98E+01
	25	44103.50C	rh103	8.35E+00	1.83E+01	2.75E+01	3.79E+01
	26	95241.50c	am241	2.79E-07	2.13E-06	1.03E-05	4.81E-05
	27	95242.50c	am242m	4.98E-26	1.26E-24	6.17E-24	1.68E-23
	28	95243.50C	am243	4.09E-04	1.42E-02	9.26E-02	3.42E-01
	29	47109.50C	ag109	2.94E-01	9.84E-01	1.95E+00	3.25E+00

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P= **30** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	3.72E-02	1.58E-01	3.31E-01	5.10E-01
	2	92234.50C	u234	4.84E+01	4.57E+01	4.51E+01	4.71E+01
	3	92235.50C	u235	5.21E+03	4.32E+03	3.61E+03	2.82E+03
	4	92236.50C	u236	2.20E+02	4.29E+02	6.04E+02	7.78E+02
	5	92238.50C	u238	1.28E+05	1.27E+05	1.27E+05	1.26E+05
	6	94238.50C	pu238	2.63E-25	5.10E-24	2.03E-23	4.45E-23
	7	94239.50C	pu239	2.40E+02	3.99E+02	5.13E+02	5.51E+02
	8	94240.50C	pu240	9.43E+00	3.00E+01	5.25E+01	7.75E+01
	9	94241.50C	pu241	1.07E-09	1.61E-07	2.48E-06	1.57E-05
	10	94242.50C	pu242	2.51E-01	3.29E+00	1.15E+01	2.78E+01
	11	93237.55C	np237	1.23E+01	5.28E+01	1.11E+02	1.71E+02
Group of Fuel Rods # 3 (Table 5.1.1.2)	12	60143.50C	nd143	2.92E+01	5.96E+01	8.41E+01	1.09E+02
	13	60145.50C	nd145	2.02E+01	4.25E+01	6.16E+01	8.33E+01
	14	62147.50C	sm147	1.10E+01	2.13E+01	2.85E+01	3.56E+01
	15	62149.50C	sm149	4.81E-01	5.16E-01	5.55E-01	5.33E-01
	16	62150.50C	sm150	5.92E+00	1.41E+01	2.22E+01	3.18E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	2.75E+00	6.88E+00	1.05E+01	1.46E+01
	19	63153.55C	eu153	1.26E+00	3.63E+00	6.69E+00	1.08E+01
	20	64155.50C	gd155	8.50E-02	1.62E-01	2.79E-01	4.68E-01
	21	63151.55C	eu151	1.32E+00	1.78E+00	2.10E+00	2.22E+00
	22	42095.50C	mo95	2.19E+01	4.65E+01	6.79E+01	9.26E+01
	23	43099.50C	tc99	2.18E+01	4.65E+01	6.84E+01	9.38E+01
	24	44101.50C	ru101	1.95E+01	4.25E+01	6.39E+01	8.93E+01
	25	44103.50C	rh103	1.27E+01	2.75E+01	4.09E+01	5.55E+01
	26	95241.50c	am241	8.14E-07	9.07E-06	8.40E-05	4.88E-04
	27	95242.50c	am242m	1.95E-25	3.79E-24	1.51E-23	3.31E-23
	28	95243.50C	am243	2.76E-03	8.40E-02	4.88E-01	1.64E+00
	29	47109.50C	ag109	5.52E-01	1.89E+00	3.71E+00	6.19E+00

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P= **43** MW/MTU

	#	MCNP ID	/ SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	7.54E-02	2.93E-01	5.57E-01	7.78E-01
	2	92234.50C	u234	4.71E+01	4.48E+01	4.73E+01	5.53E+01
	3	92235.50C	u235	4.87E+03	3.69E+03	2.82E+03	1.89E+03
	4	92236.50C	u236	3.01E+02	5.79E+02	7.92E+02	9.81E+02
	5	92238.50C	u238	1.28E+05	1.27E+05	1.26E+05	1.25E+05
	6	94238.50C	pu238	8.02E-25	1.15E-23	3.63E-23	6.22E-23
	7	94239.50C	pu239	3.16E+02	4.85E+02	5.90E+02	5.93E+02
	8	94240.50C	pu240	1.66E+01	4.87E+01	8.06E+01	1.13E+02
	9	94241.50C	pu241	1.20E-08	1.58E-06	2.15E-05	1.21E-04
	10	94242.50C	pu242	8.75E-01	9.75E+00	3.03E+01	6.75E+01
	11	93237.55C	np237	2.51E+01	9.82E+01	1.87E+02	2.61E+02
Group of Fuel Rods # 3 (Table 5.1.1.2)	12	60143.50C	nd143	4.09E+01	8.11E+01	1.11E+02	1.37E+02
	13	60145.50C	nd145	2.85E+01	5.91E+01	8.44E+01	1.12E+02
	14	62147.50C	sm147	1.51E+01	2.77E+01	3.52E+01	4.16E+01
	15	62149.50C	sm149	5.65E-01	6.18E-01	6.66E-01	6.30E-01
	16	62150.50C	sm150	8.89E+00	2.14E+01	3.39E+01	4.85E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	4.23E+00	1.01E+01	1.48E+01	2.01E+01
	19	63153.55C	eu153	2.03E+00	6.15E+00	1.13E+01	1.80E+01
	20	64155.50C	gd155	1.09E-01	2.58E-01	4.94E-01	8.53E-01
	21	63151.55C	eu151	1.57E+00	2.01E+00	2.42E+00	2.53E+00
	22	42095.50C	mo95	3.11E+01	6.53E+01	9.43E+01	1.27E+02
	23	43099.50C	tc99	3.10E+01	6.54E+01	9.52E+01	1.29E+02
	24	44101.50C	ru101	2.79E+01	6.09E+01	9.12E+01	1.27E+02
	25	44103.50C	rh103	1.83E+01	3.94E+01	5.75E+01	7.59E+01
	26	95241.50c	am241	2.19E-06	5.58E-05	6.64E-04	3.67E-03
	27	95242.50c	am242m	5.96E-25	8.53E-24	2.70E-23	4.63E-23
	28	95243.50C	am243	1.44E-02	3.76E-01	1.91E+00	5.74E+00
	29	47109.50C	ag109	9.78E-01	3.37E+00	6.54E+00	1.08E+01

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P= **55** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	1.20E-01	4.25E-01	7.50E-01	9.63E-01
	2	92234.50C	u234	4.62E+01	4.52E+01	5.23E+01	6.73E+01
	3	92235.50C	u235	4.58E+03	3.16E+03	2.21E+03	1.26E+03
	4	92236.50C	u236	3.72E+02	7.02E+02	9.30E+02	1.10E+03
	5	92238.50C	u238	1.28E+05	1.27E+05	1.25E+05	1.24E+05
	6	94238.50C	pu238	1.60E-24	1.78E-23	4.71E-23	6.51E-23
	7	94239.50C	pu239	3.74E+02	5.37E+02	6.29E+02	6.05E+02
	8	94240.50C	pu240	2.39E+01	6.60E+01	1.04E+02	1.40E+02
	9	94241.50C	pu241	6.01E-08	7.09E-06	8.65E-05	4.33E-04
	10	94242.50C	pu242	1.97E+00	1.94E+01	5.51E+01	1.16E+02
	11	93237.55C	np237	4.02E+01	1.43E+02	2.52E+02	3.23E+02
Group of Fuel Rods # 3 (Table 5.1.1.2)	12	60143.50C	nd143	5.12E+01	9.85E+01	1.31E+02	1.53E+02
	13	60145.50C	nd145	3.60E+01	7.35E+01	1.03E+02	1.35E+02
	14	62147.50C	sm147	1.85E+01	3.24E+01	3.92E+01	4.38E+01
	15	62149.50C	sm149	6.47E-01	7.15E-01	7.68E-01	7.21E-01
	16	62150.50C	sm150	1.18E+01	2.87E+01	4.55E+01	6.42E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	5.62E+00	1.28E+01	1.84E+01	2.47E+01
	19	63153.55C	eu153	2.85E+00	8.82E+00	1.60E+01	2.48E+01
	20	64155.50C	gd155	1.35E-01	3.75E-01	7.43E-01	1.26E+00
	21	63151.55C	eu151	1.73E+00	2.20E+00	2.69E+00	2.78E+00
	22	42095.50C	mo95	3.94E+01	8.19E+01	1.17E+02	1.55E+02
	23	43099.50C	tc99	3.93E+01	8.22E+01	1.18E+02	1.58E+02
	24	44101.50C	ru101	3.57E+01	7.76E+01	1.16E+02	1.61E+02
	25	44103.50C	rh103	2.36E+01	5.00E+01	7.16E+01	9.15E+01
	26	95241.50c	am241	4.94E-06	2.26E-04	2.63E-03	1.31E-02
	27	95242.50c	am242m	1.19E-24	1.32E-23	3.50E-23	4.84E-23
	28	95243.50C	am243	4.26E-02	9.83E-01	4.46E+00	1.22E+01
	29	47109.50C	ag109	1.45E+00	4.98E+00	9.52E+00	1.55E+01

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P= **10** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	1.46E-02	5.30E-02	1.24E-01	2.24E-01
	2	92234.50C	u234	1.45E+02	1.41E+02	1.38E+02	1.35E+02
	3	92235.50C	u235	1.65E+04	1.56E+04	1.47E+04	1.38E+04
	4	92236.50C	u236	2.59E+02	4.68E+02	6.67E+02	8.85E+02
	5	92238.50C	u238	3.67E+05	3.66E+05	3.66E+05	3.65E+05
	6	94238.50C	pu238	1.46E-26	4.97E-25	3.16E-24	1.11E-23
	7	94239.50C	pu239	2.62E+02	5.05E+02	7.29E+02	8.94E+02
	8	94240.50C	pu240	3.84E+00	1.50E+01	3.05E+01	4.98E+01
	9	94241.50C	pu241	1.47E-12	2.71E-10	5.28E-09	4.00E-08
	10	94242.50C	pu242	1.12E-02	2.01E-01	9.32E-01	2.76E+00
	11	93237.55C	np237	4.69E+00	1.74E+01	4.11E+01	7.47E+01
Group of Fuel Rods # 4 (Table 5.1.1.2)	12	60143.50C	nd143	2.82E+01	6.00E+01	8.85E+01	1.21E+02
	13	60145.50C	nd145	1.92E+01	4.13E+01	6.14E+01	8.50E+01
	14	62147.50C	sm147	1.10E+01	2.30E+01	3.33E+01	4.49E+01
	15	62149.50C	sm149	1.06E+00	1.07E+00	1.13E+00	1.10E+00
	16	62150.50C	sm150	4.67E+00	1.15E+01	1.80E+01	2.58E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	1.97E+00	5.16E+00	8.53E+00	1.28E+01
	19	63153.55C	eu153	9.76E-01	2.35E+00	3.96E+00	6.12E+00
	20	64155.50C	gd155	1.29E-01	1.99E-01	2.51E-01	3.17E-01
	21	63151.55C	eu151	1.80E+00	3.08E+00	3.90E+00	4.42E+00
	22	42095.50C	mo95	2.07E+01	4.46E+01	6.65E+01	9.22E+01
	23	43099.50C	tc99	2.05E+01	4.43E+01	6.64E+01	9.24E+01
	24	44101.50C	ru101	1.81E+01	3.94E+01	5.95E+01	8.33E+01
	25	44103.50C	rh103	1.15E+01	2.52E+01	3.82E+01	5.33E+01
	26	95241.50c	am241	1.13E-07	9.11E-07	2.87E-06	6.72E-06
	27	95242.50c	am242m	1.09E-26	3.70E-25	2.35E-24	8.29E-24
	28	95243.50C	am243	3.77E-05	1.50E-03	1.14E-02	4.68E-02
	29	47109.50C	ag109	2.93E-01	9.15E-01	1.79E+00	2.96E+00

No new entries on this page

P= **20** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	4.76E-02	2.05E-01	4.67E-01	7.87E-01
	2	92234.50C	u234	1.41E+02	1.35E+02	1.31E+02	1.29E+02
	3	92235.50C	u235	1.57E+04	1.40E+04	1.25E+04	1.08E+04
	4	92236.50C	u236	4.40E+02	8.46E+02	1.21E+03	1.60E+03
	5	92238.50C	u238	3.66E+05	3.65E+05	3.64E+05	3.63E+05
	6	94238.50C	pu238	1.82E-25	4.66E-24	2.31E-23	6.34E-23
	7	94239.50C	pu239	4.89E+02	8.73E+02	1.19E+03	1.36E+03
	8	94240.50C	pu240	1.33E+01	4.62E+01	8.58E+01	1.32E+02
	9	94241.50C	pu241	1.77E-10	2.94E-08	5.08E-07	3.51E-06
	10	94242.50C	pu242	1.55E-01	2.35E+00	9.30E+00	2.45E+01
	11	93237.55C	np237	1.56E+01	6.83E+01	1.56E+02	2.64E+02
Group of Fuel Rods # 4 (Table 5.1.1.2)	12	60143.50C	nd143	5.53E+01	1.15E+02	1.67E+02	2.23E+02
	13	60145.50C	nd145	3.79E+01	8.06E+01	1.19E+02	1.62E+02
	14	62147.50C	sm147	2.12E+01	4.26E+01	5.94E+01	7.74E+01
	15	62149.50C	sm149	1.21E+00	1.27E+00	1.36E+00	1.32E+00
	16	62150.50C	sm150	1.04E+01	2.48E+01	3.88E+01	5.55E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	4.61E+00	1.20E+01	1.91E+01	2.74E+01
	19	63153.55C	eu153	2.14E+00	5.69E+00	1.03E+01	1.65E+01
	20	64155.50C	gd155	1.91E-01	3.08E-01	4.56E-01	6.88E-01
	21	63151.55C	eu151	2.96E+00	4.37E+00	5.23E+00	5.61E+00
	22	42095.50C	mo95	4.09E+01	8.76E+01	1.29E+02	1.78E+02
	23	43099.50C	tc99	4.07E+01	8.74E+01	1.30E+02	1.80E+02
	24	44101.50C	ru101	3.62E+01	7.89E+01	1.19E+02	1.66E+02
	25	44103.50C	rh103	2.33E+01	5.09E+01	7.68E+01	1.06E+02
	26	95241.50c	am241	7.69E-07	5.86E-06	2.79E-05	1.28E-04
	27	95242.50c	am242m	1.36E-25	3.46E-24	1.72E-23	4.72E-23
	28	95243.50C	am243	1.09E-03	3.75E-02	2.47E-01	9.11E-01
	29	47109.50C	ag109	8.17E-01	2.73E+00	5.41E+00	9.03E+00

No new entries on this page

P= **30** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	1.04E-01	4.42E-01	9.33E-01	1.44E+00
	2	92234.50C	u234	1.38E+02	1.31E+02	1.29E+02	1.34E+02
	3	92235.50C	u235	1.50E+04	1.25E+04	1.05E+04	8.29E+03
	4	92236.50C	u236	6.18E+02	1.20E+03	1.70E+03	2.19E+03
	5	92238.50C	u238	3.66E+05	3.64E+05	3.62E+05	3.61E+05
	6	94238.50C	pu238	7.18E-25	1.42E-23	5.72E-23	1.28E-22
	7	94239.50C	pu239	6.85E+02	1.15E+03	1.48E+03	1.61E+03
	8	94240.50C	pu240	2.62E+01	8.36E+01	1.47E+02	2.17E+02
	9	94241.50C	pu241	2.80E-09	4.20E-07	6.55E-06	4.16E-05
	10	94242.50C	pu242	6.73E-01	8.82E+00	3.11E+01	7.53E+01
	11	93237.55C	np237	3.43E+01	1.48E+02	3.13E+02	4.85E+02
Group of Fuel Rods # 4 (Table 5.1.1.2)	12	60143.50C	nd143	8.14E+01	1.66E+02	2.36E+02	3.06E+02
	13	60145.50C	nd145	5.62E+01	1.18E+02	1.72E+02	2.33E+02
	14	62147.50C	sm147	3.07E+01	5.94E+01	7.97E-01	9.99E+01
	15	62149.50C	sm149	1.38E+00	1.48E+00	1.60E-00	1.54E+00
	16	62150.50C	sm150	1.64E+01	3.91E+01	6.17E-01	8.85E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E-00	0.00E+00
	18	62152.50C	sm152	7.60E+00	1.91E+01	2.91E-01	4.07E+01
	19	63153.55C	eu153	3.51E+00	1.00E+01	1.86E-01	3.00E+01
	20	64155.50C	gd155	2.39E-01	4.51E-01	7.74E-01	1.29E+00
	21	63151.55C	eu151	3.75E+00	5.11E+00	6.07E+00	6.45E+00
	22	42095.50C	mo95	6.09E+01	1.29E+02	1.89E+02	2.58E+02
	23	43099.50C	tc99	6.07E+01	1.29E+02	1.91E+02	2.62E+02
	24	44101.50C	ru101	5.43E+01	1.18E+02	1.78E+02	2.49E+02
	25	44103.50C	rh103	3.53E+01	7.67E+01	1.15E+02	1.56E+02
	26	95241.50c	am241	2.25E-06	2.45E-05	2.24E-04	1.30E-03
	27	95242.50c	am242m	5.34E-25	1.05E-23	4.26E-23	9.51E-23
	28	95243.50C	am243	7.34E-03	2.23E-01	1.31E+00	4.40E+00
	29	47109.50C	ag109	1.53E+00	5.24E+00	1.03E+01	1.72E+01

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P= **43** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	2.11E-01	8.23E-01	1.58E+00	2.23E+00
	2	92234.50C	u234	1.35E+02	1.28E+02	1.35E+02	1.57E+02
	3	92235.50C	u235	1.40E+04	1.07E+04	8.27E+03	5.66E+03
	4	92236.50C	u236	8.43E+02	1.62E+03	2.23E+03	2.77E+03
	5	92238.50C	u238	3.65E+05	3.63E+05	3.60E+05	3.57E+05
	6	94238.50C	pu238	2.21E-24	3.23E-23	1.04E-22	1.83E-22
	7	94239.50C	pu239	9.03E+02	1.40E+03	1.72E+03	1.74E+03
	8	94240.50C	pu240	4.62E+01	1.36E+02	2.26E+02	3.18E+02
	9	94241.50C	pu241	3.14E-08	4.15E-06	5.73E-05	3.25E-04
	10	94242.50C	pu242	2.35E+00	2.62E+01	8.22E+01	1.84E+02
	11	93237.55C	np237	7.01E+01	2.76E+02	5.30E+02	7.47E+02
Group of Fuel Rods # 4 (Table 5.1.1.2)	12	60143.50C	nd143	1.14E+02	2.27E+02	3.12E+02	3.88E+02
	13	60145.50C	nd145	7.94E+01	1.65E+02	2.36E+02	3.14E+02
	14	62147.50C	sm147	4.21E+01	7.75E+01	9.89E+01	1.18E+02
	15	62149.50C	sm149	1.62E+00	1.78E+00	1.92E+00	1.83E+00
	16	62150.50C	sm150	2.47E+01	5.95E+01	9.45E+01	1.35E+02
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	1.17E+01	2.79E+01	4.12E+01	5.62E+01
	19	63153.55C	eu153	5.63E+00	1.70E+01	3.15E+01	5.01E+01
	20	64155.50C	gd155	3.06E-01	7.14E-01	1.37E+00	2.37E+00
	21	63151.55C	eu151	4.47E+00	5.82E+00	7.01E+00	7.39E+00
	22	42095.50C	mo95	8.65E+01	1.82E+02	2.63E+02	3.55E+02
	23	43099.50C	tc99	8.63E+01	1.82E+02	2.66E+02	3.61E+02
	24	44101.50C	ru101	7.78E+01	1.69E+02	2.55E+02	3.55E+02
	25	44103.50C	rh103	5.12E+01	1.10E+02	1.61E+02	2.14E+02
	26	95241.50c	am241	6.04E-06	1.48E-04	1.77E-03	9.86E-03
	27	95242.50c	am242m	1.64E-24	2.40E-23	7.76E-23	1.36E-22
	28	95243.50C	am243	3.82E-02	1.00E+00	5.14E+00	1.55E+01
	29	47109.50C	ag109	2.72E+00	9.34E+00	1.82E+01	3.00E+01

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P= **55** MW/MTU

	#	MCNP ID	/ SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	3.37E-01	1.20E+00	2.14E+00	2.78E+00
	2	92234.50C	u234	1.32E+02	1.29E+02	1.49E+02	1.91E+02
	3	92235.50C	u235	1.32E+04	9.26E+03	6.54E+03	3.85E+03
	4	92236.50C	u236	1.04E+03	1.97E+03	2.63E+03	3.13E+03
	5	92238.50C	u238	3.65E+05	3.62E+05	3.58E+05	3.54E+05
	6	94238.50C	pu238	4.43E-24	5.07E-23	1.37E-22	1.95E-22
	7	94239.50C	pu239	1.07E+03	1.56E+03	1.84E+03	1.79E+03
	8	94240.50C	pu240	6.65E+01	1.85E+02	2.94E+02	3.96E+02
	9	94241.50C	pu241	1.58E-07	1.87E-05	2.32E-04	1.18E-03
	10	94242.50C	pu242	5.28E+00	5.23E+01	1.50E+02	3.16E+02
	11	93237.55C	np237	1.13E+02	4.03E+02	7.18E+02	9.32E+02
Group of Fuel Rods # 4 (Table 5.1.1.2)	12	60143.50C	nd143	1.43E+02	2.76E+02	3.70E+02	4.36E+02
	13	60145.50C	nd145	1.00E+02	2.05E+02	2.90E+02	3.79E+02
	14	62147.50C	sm147	5.16E+01	9.08E+01	1.11E+02	1.25E+02
	15	62149.50C	sm149	1.85E+00	2.05E+00	2.22E+00	2.09E+00
	16	62150.50C	sm150	3.27E+01	7.98E+01	1.27E+02	1.80E+02
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	1.56E+01	3.56E+01	5.14E+01	6.92E+01
	19	63153.55C	eu153	7.90E+00	2.44E+01	4.46E+01	6.92E+01
	20	64155.50C	gd155	3.78E-01	1.04E+00	2.06E+00	3.51E+00
	21	63151.55C	eu151	4.96E+00	6.38E+00	7.82E+00	8.16E+00
	22	42095.50C	mo95	1.10E+02	2.28E+02	3.28E+02	4.36E+02
	23	43099.50C	tc99	1.10E+02	2.29E+02	3.31E+02	4.43E+02
	24	44101.50C	ru101	9.94E+01	2.16E+02	3.24E+02	4.51E+02
	25	44103.50C	rh103	6.59E+01	1.40E+02	2.01E+02	2.59E+02
	26	95241.50c	am241	1.35E-05	5.99E-04	7.06E-03	3.56E-02
	27	95242.50c	am242m	3.30E-24	3.77E-23	1.02E-22	1.45E-22
	28	95243.50C	am243	1.14E-01	2.63E+00	1.21E+01	3.33E+01
	29	47109.50C	ag109	4.03E+00	1.38E+01	2.65E+01	4.32E+01

No new entries on this page

P= **10** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	5.76E-03	2.09E-02	4.89E-02	8.82E-02
	2	92234.50C	u234	5.79E+01	5.64E+01	5.51E+01	5.39E+01
	3	92235.50C	u235	6.60E+03	6.24E+03	5.91E+03	5.54E+03
	4	92236.50C	u236	1.03E+02	1.85E+02	2.64E+02	3.50E+02
	5	92238.50C	u238	1.47E+05	1.46E+05	1.46E+05	1.46E+05
	6	94238.50C	pu238	5.63E-27	1.92E-25	1.23E-24	4.35E-24
	7	94239.50C	pu239	1.05E+02	2.02E+02	2.92E+02	3.59E+02
	8	94240.50C	pu240	1.51E+00	5.89E+00	1.20E+01	1.96E+01
	9	94241.50C	pu241	5.53E-13	1.02E-10	2.00E-09	1.51E-08
	10	94242.50C	pu242	4.28E-03	7.68E-02	3.58E-01	1.06E+00
	11	93237.55C	np237	1.86E+00	6.85E+00	1.62E+01	2.94E+01
Group of Fuel Rods # 5 (Table 5.1.1.2)	12	60143.50C	nd143	1.11E+01	2.36E+01	3.49E+01	4.76E+01
	13	60145.50C	nd145	7.55E+00	1.62E+01	2.42E+01	3.34E+01
	14	62147.50C	sm147	4.32E+00	9.03E+00	1.31E+01	1.77E+01
	15	62149.50C	sm149	4.25E-01	4.33E-01	4.55E-01	4.45E-01
	16	62150.50C	sm150	1.83E+00	4.51E+00	7.07E+00	1.01E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	7.71E-01	2.02E+00	3.34E+00	5.02E+00
	19	63153.55C	eu153	3.84E-01	9.23E-01	1.56E+00	2.40E+00
	20	64155.50C	gd155	5.10E-02	7.89E-02	9.97E-02	1.25E-01
	21	63151.55C	eu151	7.12E-01	1.22E+00	1.56E+00	1.77E+00
	22	42095.50C	mo95	8.12E+00	1.75E+01	2.61E+01	3.62E+01
	23	43099.50C	tc99	8.06E+00	1.74E+01	2.61E+01	3.63E+01
	24	44101.50C	ru101	7.11E+00	1.55E+01	2.34E+01	3.27E+01
	25	44103.50C	rh103	4.52E+00	9.89E+00	1.50E+01	2.10E+01
	26	95241.50c	am241	4.41E-08	3.56E-07	1.12E-06	2.62E-06
	27	95242.50c	am242m	4.19E-27	1.43E-25	9.15E-25	3.23E-24
	28	95243.50C	am243	1.44E-05	5.69E-04	4.33E-03	1.78E-02
	29	47109.50C	ag109	1.15E-01	3.59E-01	7.03E-01	1.16E+00

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P= **20** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	1.88E-02	8.07E-02	1.85E-01	3.11E-01
	2	92234.50C	u234	5.66E+01	5.41E+01	5.23E+01	5.17E+01
	3	92235.50C	u235	6.29E+03	5.61E+03	5.03E+03	4.37E+03
	4	92236.50C	u236	1.74E+02	3.34E+02	4.80E+02	6.31E+02
	5	92238.50C	u238	1.47E+05	1.46E+05	1.46E+05	1.45E+05
	6	94238.50C	pu238	7.05E-26	1.82E-24	9.07E-24	2.51E-23
	7	94239.50C	pu239	1.95E+02	3.50E+02	4.78E+02	5.50E+02
	8	94240.50C	pu240	5.23E+00	1.81E+01	3.38E+01	5.20E+01
	9	94241.50C	pu241	6.69E-11	1.11E-08	1.93E-07	1.33E-06
	10	94242.50C	pu242	5.93E-02	8.99E-01	3.58E+00	9.41E+00
	11	93237.55C	np237	6.15E+00	2.69E+01	6.18E+01	1.04E+02
Group of Fuel Rods # 5 (Table 5.1.1.2)	12	60143.50C	nd143	2.17E+01	4.53E+01	6.57E+01	8.77E+01
	13	60145.50C	nd145	1.49E+01	3.17E+01	4.67E+01	6.38E+01
	14	62147.50C	sm147	8.33E+00	1.68E+01	2.34E+01	3.05E+01
	15	62149.50C	sm149	4.87E-01	5.11E-01	5.48E-01	5.35E-01
	16	62150.50C	sm150	4.09E+00	9.71E+00	1.52E+01	2.18E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	1.80E+00	4.69E+00	7.47E+00	1.08E+01
	19	63153.55C	eu153	8.40E-01	2.23E+00	4.03E+00	6.47E+00
	20	64155.50C	gd155	7.58E-02	1.22E-01	1.80E-01	2.70E-01
	21	63151.55C	eu151	1.18E+00	1.75E+00	2.10E+00	2.26E+00
	22	42095.50C	mo95	1.61E+01	3.44E+01	5.09E+01	7.00E+01
	23	43099.50C	tc99	1.60E+01	3.43E+01	5.12E+01	7.06E+01
	24	44101.50C	ru101	1.42E+01	3.10E+01	4.68E+01	6.54E+01
	25	44103.50C	rh103	9.17E+00	2.00E+01	3.03E+01	4.17E+01
	26	95241.50c	am241	3.01E-07	2.28E-06	1.08E-05	4.89E-05
	27	95242.50c	am242m	5.25E-26	1.35E-24	6.75E-24	1.87E-23
	28	95243.50C	am243	4.13E-04	1.43E-02	9.45E-02	3.48E-01
	29	47109.50C	ag109	3.21E-01	1.07E+00	2.13E-00	3.54E+00

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P= **30** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	4.09E-02	1.74E-01	3.70E-01	5.75E-01
	2	92234.50C	u234	5.54E+01	5.24E+01	5.15E+01	5.36E+01
	3	92235.50C	u235	6.00E+03	5.03E+03	4.25E+03	3.38E+03
	4	92236.50C	u236	2.44E+02	4.74E+02	6.71E+02	8.65E+02
	5	92238.50C	u238	1.46E+05	1.46E+05	1.45E+05	1.44E+05
	6	94238.50C	pu238	2.79E-25	5.56E-24	2.27E-23	5.14E-23
	7	94239.50C	pu239	2.74E+02	4.61E+02	6.00E+02	6.52E+02
	8	94240.50C	pu240	1.03E+01	3.29E+01	5.80E+01	8.57E+01
	9	94241.50C	pu241	1.06E-09	1.59E-07	2.50E-06	1.59E-05
	10	94242.50C	pu242	2.58E-01	3.38E+00	1.20E+01	2.90E+01
	11	93237.55C	np237	1.35E+01	5.83E+01	1.24E+02	1.93E+02
Group of Fuel Rods # 5 (Table 5.1.1.2)	12	60143.50C	nd143	3.20E+01	6.55E+01	9.30E+01	1.21E+02
	13	60145.50C	nd145	2.21E+01	4.64E+01	6.77E+01	9.15E+01
	14	62147.50C	sm147	1.21E+01	2.34E+01	3.14E+01	3.94E+01
	15	62149.50C	sm149	5.54E-01	5.97E-01	6.47E-01	6.25E-01
	16	62150.50C	sm150	6.45E+00	1.53E+01	2.43E+01	3.47E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	2.97E+00	7.45E+00	1.14E+01	1.60E+01
	19	63153.55C	eu153	1.38E+00	3.93E+00	7.29E+00	1.18E+01
	20	64155.50C	gd155	9.49E-02	1.78E-01	3.04E-01	5.05E-01
	21	63151.55C	eu151	1.50E+00	2.05E+00	2.45E+00	2.61E+00
	22	42095.50C	mo95	2.40E+01	5.08E+01	7.46E+01	1.02E+02
	23	43099.50C	tc99	2.39E+01	5.08E+01	7.52E+01	1.03E+02
	24	44101.50C	ru101	2.13E+01	4.65E+01	7.01E+01	9.79E+01
	25	44103.50C	rh103	1.39E+01	3.02E+01	4.52E+01	6.13E+01
	26	95241.50c	am241	8.79E-07	9.44E-06	8.56E-05	4.95E-04
	27	95242.50c	am242m	2.08E-25	4.14E-24	1.69E-23	3.82E-23
	28	95243.50C	am243	2.80E-03	8.51E-02	5.02E-01	1.68E+00
	29	47109.50C	ag109	6.03E-01	2.06E+00	4.06E+00	6.74E+00

No new entries on this page

P= **43** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	8.30E-02	3.26E-01	6.29E-01	8.94E-01
	2	92234.50C	u234	5.39E+01	5.13E+01	5.39E+01	6.26E+01
	3	92235.50C	u235	5.63E+03	4.34E+03	3.37E+03	2.34E+03
	4	92236.50C	u236	3.33E+02	6.41E+02	8.83E+02	1.10E+03
	5	92238.50C	u238	1.46E+05	1.45E+05	1.44E+05	1.43E+05
	6	94238.50C	pu238	8.62E-25	1.28E-23	4.20E-23	7.50E-23
	7	94239.50C	pu239	3.62E+02	5.65E+02	6.98E+02	7.14E+02
	8	94240.50C	pu240	1.82E+01	5.35E+01	8.95E+01	1.26E+02
	9	94241.50C	pu241	1.19E-08	1.58E-06	2.20E-05	1.25E-04
	10	94242.50C	pu242	9.02E-01	1.01E+01	3.18E+01	7.09E+01
	11	93237.55C	np237	2.76E+01	1.09E+02	2.11E+02	3.00E+02
Group of Fuel Rods # 5 (Table 5.1.1.2)	12	60143.50C	nd143	4.49E+01	8.93E+01	1.24E+02	1.54E+02
	13	60145.50C	nd145	3.12E+01	6.47E+01	9.31E+01	1.24E+02
	14	62147.50C	sm147	1.66E+01	3.05E+01	3.90E+01	4.65E+01
	15	62149.50C	sm149	6.48E-01	7.14E-01	7.77E-01	7.42E-01
	16	62150.50C	sm150	9.69E+00	2.33E+01	3.72E+01	5.32E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	4.59E+00	1.09E+01	1.62E+01	2.21E+01
	19	63153.55C	eu153	2.21E+00	6.66E+00	1.24E+01	1.97E+01
	20	64155.50C	gd155	1.21E-01	2.80E-01	5.37E-01	9.28E-01
	21	63151.55C	eu151	1.79E+00	2.34E+00	2.84E+00	3.01E+00
	22	42095.50C	mo95	3.40E+01	7.14E+01	1.04E+02	1.40E+02
	23	43099.50C	tc99	3.40E+01	7.16E+01	1.05E+02	1.42E+02
	24	44101.50C	ru101	3.06E+01	6.66E+01	1.00E+02	1.40E+02
	25	44103.50C	rh103	2.01E+01	4.33E+01	6.37E+01	8.45E+01
	26	95241.50c	am241	2.36E-06	5.67E-05	6.79E-04	3.80E-03
	27	95242.50c	am242m	6.41E-25	9.53E-24	3.12E-23	5.58E-23
	28	95243.50C	am243	1.46E-02	3.83E-01	1.98E+00	5.97E+00
	29	47109.50C	ag109	1.07E+00	3.67E+00	7.16E+00	1.18E+01

No new entries on this page

P= **55** MW/MTU

	#	MCNP ID /	SCALE ID				
			Years of Burnup:	**0.551951**	**1.20493**	**1.81456**	**2.54511**
	1	92233.50C	u233	1.33E-01	4.77E-01	8.56E-01	1.12E+00
	2	92234.50C	u234	5.29E+01	5.16E+01	5.94E+01	7.63E+01
	3	92235.50C	u235	5.31E+03	3.76E+03	2.68E+03	1.62E+03
	4	92236.50C	u236	4.12E+02	7.79E+02	1.04E+03	1.25E+03
	5	92238.50C	u238	1.46E+05	1.45E+05	1.43E+05	1.42E+05
	6	94238.50C	pu238	1.74E-24	2.03E-23	5.58E-23	8.14E-23
	7	94239.50C	pu239	4.31E+02	6.32E+02	7.51E+02	7.35E+02
	8	94240.50C	pu240	2.62E+01	7.28E+01	1.17E+02	1.58E+02
	9	94241.50C	pu241	5.99E-08	7.14E-06	8.94E-05	4.58E-04
	10	94242.50C	pu242	2.03E+00	2.01E+01	5.82E+01	1.23E+02
	11	93237.55C	np237	4.44E+01	1.60E+02	2.87E+02	3.77E+02
Group of Fuel Rods # 5 (Table 5.1.1.2)	12	60143.50C	nd143	5.62E+01	1.09E+02	1.47E+02	1.75E+02
	13	60145.50C	nd145	3.94E+01	8.07E+01	1.14E+02	1.50E+02
	14	62147.50C	sm147	2.03E+01	3.58E+01	4.37E+01	4.94E+01
	15	62149.50C	sm149	7.41E-01	8.26E-01	8.97E-01	8.50E-01
	16	62150.50C	sm150	1.28E+01	3.13E+01	4.99E+01	7.08E+01
	17	62151.50C	sm151	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	18	62152.50C	sm152	6.09E+00	1.40E+01	2.02E+01	2.72E+01
	19	63153.55C	eu153	3.10E+00	9.58E+00	1.75E+01	2.72E+01
	20	64155.50C	gd155	1.49E-01	4.05E-01	8.10E-01	1.38E+00
	21	63151.55C	eu151	1.99E+00	2.58E+00	3.17E+00	3.33E+00
	22	42095.50C	mo95	4.31E+01	8.97E+01	1.29E+02	1.72E+02
	23	43099.50C	tc99	4.31E+01	9.01E+01	1.31E+02	1.75E+02
	24	44101.50C	ru101	3.91E+01	8.50E+01	1.28E+02	1.78E+02
	25	44103.50C	rh103	2.59E+01	5.51E+01	7.97E+01	1.03E+02
	26	95241.50c	am241	5.23E-06	2.29E-04	2.72E-03	1.38E-02
	27	95242.50c	am242m	1.29E-24	1.51E-23	4.15E-23	6.06E-23
	28	95243.50C	am243	4.34E-02	1.01E+00	4.66E+00	1.29E+01
	29	47109.50C	ag109	1.58E+00	5.42E+00	1.04E+01	1.70E+01

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Critica Limits (CL) and Upper Subcritical Limits (USL) calculation results for the Loading Curve evaluation:

5% Enrichment (File Loading Curve December 2007.xlsx, sheet "5 % Enrichment"):

Postclosure Burnup (GWd/ MTU)	AENCF	CL(AENCF)	Preclosure Burnup (GWd/ MTU)	AENCF	USL (AENCF)
10	0.1689	0.981423	10	0.1689	0.931423
15	0.1755	0.98101	15	0.1741	0.931098
20	0.1824	0.980578	20	0.1812	0.930653
25	0.1874	0.980265	25	0.1864	0.930328
30	0.1936	0.979877	30	0.1928	0.929927
35	0.2004	0.979451	35	0.1994	0.929514
40	0.2047	0.979182	40	0.2036	0.929251
45	0.2125	0.978693	45	0.2101	0.928844

4.5% Enrichment: (File Loading Curve December 2007.xlsx, sheet "4.5 % Enrichment"):

Postclosure Burnup (GWd/ MTU)	AENCF	CL(AENCF)	Preclosure Burnup (GWd/ MTU)	AENCF	USL (AENCF)
5	0.1661	0.981599	5	0.1654	0.931643
10	0.1727	0.981186	10	0.172	0.931229
15	0.1793	0.980772	15	0.1786	0.930816
20	0.1863	0.980334	20	0.1855	0.930384
25	0.1918	0.979989	25	0.1918	0.929989
30	0.1982	0.979589	30	0.1977	0.92962
35	0.2067	0.979056	35	0.2044	0.9292
40	0.2107	0.978806	40	0.2104	0.928825
45	0.2187	0.978305	45	0.2188	0.928299

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4.2% Enrichment: (File Loading Curve December 2007.xlsx, sheet "4.2 % Enrichment"):

Postclosure Burnup (GWd/ MTU)	AENCF	CL(AENCF)	Preclosure Burnup (GWd/ MTU)	AENCF	USL (AENCF)
5	0.17	0.981355	5	0.1669	0.931549
10	0.1763	0.98096	10	0.1739	0.93111
15	0.1841	0.980472	15	0.1809	0.930672
20	0.1915	0.980008	20	0.18795	0.930231
25	0.1979	0.979608	25	0.1942	0.929839
30	0.2044	0.9792	30	0.2006	0.929438
35	0.2126	0.978687	35	0.20805	0.928972
40	0.218	0.978349	40	0.21375	0.928615
45	0.2257	0.977867	45	0.22195	0.928101

2.83% Enrichment: (File Loading Curve December 2007.xlsx, sheet "2.83 % Enrichment"):

Postclosure Burnup (GWd/ MTU)	AENCF	CL(AENCF)	Preclosure Burnup (GWd/ MTU)	AENCF	USL (AENCF)
			5	0.18225	0.930588
10	0.1885	0.980196	10	0.19205	0.929974
15	0.1983	0.979582	15	0.20185	0.92936
20	0.2067	0.979056	20	0.211	0.928787
25	0.2136	0.978624	25	0.21895	0.928289
30	0.2215	0.97813	30	0.2273	0.927766
35	0.231	0.977535	35	0.236	0.927222
40	0.2379	0.977103	40	0.2434	0.926758

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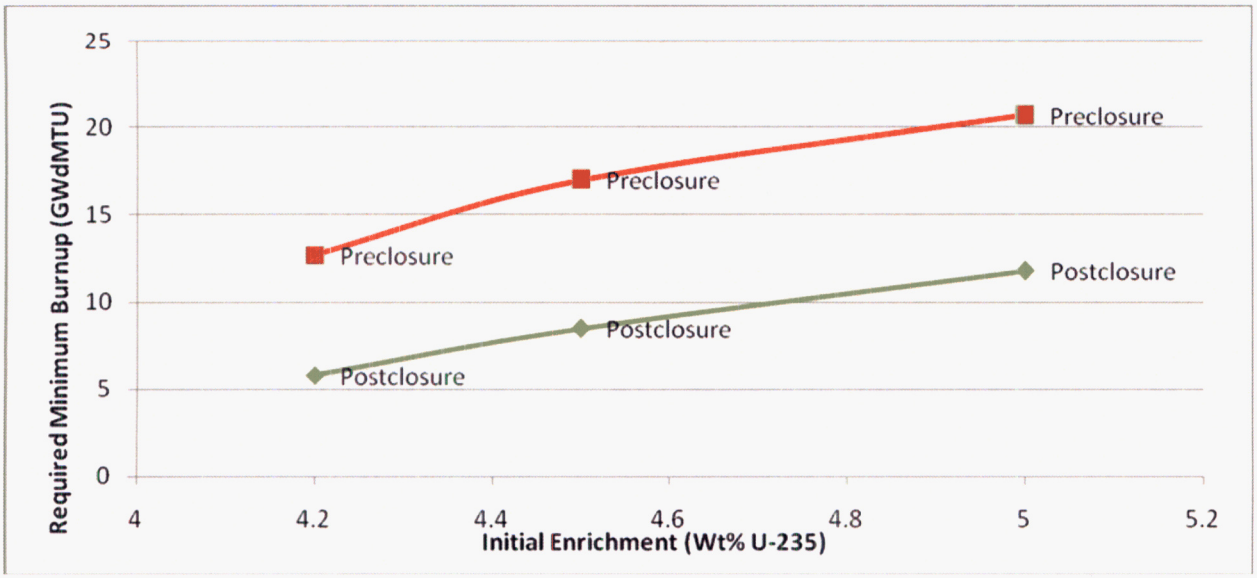
Loading Curve for the Postclosure and Preclosure periods (see Loading Curve December 2007.xlsx, sheet "Loading Curve")

Postclosure:

Initial Enrichment Wt% U-235	Required Minimum Burnup GWdMTU
4.2	5.8
4.5	8.5
5	11.8

Preclosure:

Initial Enrichment Wt% U-235	Required Minimum Burnup GWdMTU
4.2	12.7
4.5	17
5	20.7



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Assembly Misloading

MCNP Calculation Cases
Base case 1: All assemblies in a TAD are the same;
Base case 2: Additional Input for the Central Assembly
(Central assembly parameter is the same as others)

MCNP case	Enrichment	Burnup	Central Assembly Enrichment	Central Assembly Burnup
	Wt % U-235	gWd/MTU	Wt % U-235	gWd/MTU
5% Enrichment, Burnup 20.7 Gwd/MTU:				
TAD_A7_F5_W5_APB11_B20p7 (Base Case) All assemblies in a TAD are the same	5	20.7	-	-
TAD_A7_F5_W5_APB11_B20p7_Misload_ (Base Case) Additional Input for the Central Assembly	5	20.7	5	20.7
TAD_A7_F5_W5_APB11_B20p7_Misload_0B	5	20.7	5	0
TAD_A7_F5_W5_APB11_B20p7_Misload_9B	5	20.7	5	9
4.5% Enrichment, Burnup 17 Gwd/MTU:				
TAD_A7_F5_W45_APB11_B17 (Base Case) All assemblies in a TAD are the same	4.5	17	-	-
TAD_A7_F5_W45_APB11_B17_Misload_ (Base Case) Additional Input for the Central Assembly	4.5	17	4.5	17
TAD_A7_F5_W45_APB11_B17_Misload_0B	4.5	17	4.5	0
TAD_A7_F5_W45_APB11_B17_Misload_9B	4.5	17	4.5	9
4.2% Enrichment, Burnup 12.7 Gwd/MTU:				
TAD_A7_F5_W42_APB11_B12p7 (Base Case) All assemblies in a TAD are the same	4.2	12.7	-	-
TAD_A7_F5_W42_APB11_B12p7_Misload_ (Base Case) Additional Input for the Central Assembly	4.2	12.7	4.2	12.7
TAD_A7_F5_W42_APB11_B12p7_Misload_0B	4.2	12.7	4.2	0

No new entries on this page

Misloading Assembly Calculation Results
(see SN December 2007 Postclosure.xlsx, Sheet "Misloading Assembly")

MCNP case	K_{eff} (σ)	Reactivity ($*10^4$)
5% Enrichment, Burnup 20.7 Gwd/MTU:		
TAD_A7_F5_W5_APB11_B20p7	0.92478 (0.00243)	-
TAD_A7_F5_W5_APB11_B20p7_Misload_	0.92074 (0.00188)	-
TAD_A7_F5_W5_APB11_B20p7_Misload_0B	0.95872 (0.00203)	430
TAD_A7_F5_W5_APB11_B20p7_Misload_9B	0.93226 (0.00196)	134
4.5% Enrichment, Burnup 17 Gwd/MTU:		
TAD_A7_F5_W45_APB11_B17	0.92164 (0.00213)	-
TAD_A7_F5_W45_APB11_B17_Misload_	0.91872 (0.00215)	-
TAD_A7_F5_W45_APB11_B17_Misload_0B	0.94973 (0.00211)	355
TAD_A7_F5_W45_APB11_B17_Misload_9B	0.93065 (0.00250)	140
4.2% Enrichment, Burnup 12.7 Gwd/MTU:		
TAD_A7_F5_W42_APB11_B12p7	0.93603 (0.00194)	-
TAD_A7_F5_W42_APB11_B12p7_Misload_	0.93372 (0.00231)	-
TAD_A7_F5_W42_APB11_B12p7_Misload_0B	0.95466 (0.00196)	235

No new entries on this page

5/7/2009

I investigated reactivity effects of removal of Neutronit absorber plates for cases with burnt CSNF.

I. Assembly Operating Parameters

Assembly Type	Power per Assembly	MTU per Assembly	Power	Enrichment	Burnup Time	Burnup	Cooling Time
	MWt		kW/kg	%	Days	GWd/MTU	Years
15 × 15 for Babcock & Wilcox	14.50847	0.46363	31.29	5%	1438.2	45	5

ORIGEN-ARP output file: pwr_p31_w50_b45_y5_n.out

II. MCNP k-eff Calculation Results

MCNP calculations of 21-PWR pre-TAD WP geometry (file "18zone.txt"); unborated water; content of 0.35 cm absorber plates **BORATED SS; NEUTRONIT A 978; rho=7.745 g/cc; 8.8771E-2 at/ (barn*cm) Enrichment 5% Wt U-235**

Number of missing absorber plates	MCNP Output	k-eff	Standard Deviation
0	C21_A1_F1_W5_APB_PM0_FT0_B45_v	0.90922	0.00188
2	C21_A1_F1_W5_APB_PM2_FT0_B45_x	0.91084	0.00152
4	C21_A1_F1_W5_APB_PM4_FT0_B45_x	0.91268	0.00181
6	C21_A1_F1_W5_APB_PM6_FT0_B45_x	0.91875	0.00218

III. Principal Isotopes for Commercial SNF Burnup Credit

#	SCALE ID	Atomic Density
1	u233	8.56648E-11
2	u234	5.70838E-06
3	u235	3.58053E-04
4	u236	1.40009E-04
5	u238	2.10595E-02
6	pu238	2.60951E-06
7	pu239	1.41235E-04
8	pu240	5.00156E-05
9	pu241	2.56752E-05
10	pu242	1.29746E-05
11	np237	1.37045E-05
12	nd143	4.00319E-05
13	nd145	3.14421E-05
14	sm147	9.61544E-06
15	sm149	1.19306E-07

16	sm150	1.26888E-05
17	sm151	7.59397E-07
18	sm152	5.18930E-06
19	eu153	4.67304E-06
20	gd155	2.61352E-09
21	eu151	1.15864E-09
22	mo95	5.41241E-05
23	tc99	5.28018E-05
24	ru101	5.05821E-05
25	rh103	2.91657E-05
26	am241	1.41613E-06
27	am242m	3.11624E-08
28	am243	3.22143E-06
29	ag109	3.78010E-06
30	o16	4.55701E-02

It appears that the effect of plate removal is within statistical errors.

Notebook closed. No Further entries
JRW. 6/12/09

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