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SAXTON CORE II FUEL PERFORMANCE EVALUATION

PART II

EVALUATION OF MASS SPECTROMETRIC
AND RADIOCHEMICAL ANALYSES OF
IRRADIATED SAXTON PLUTONIUM FUEL

By

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SECTION 1

INTRODUCTION

This report discusses the mass spectrometric and radiochemical analyses of the mixed oxide fuel irradiated in Saxton Core II. Another report, WCAP 3385-56, Part I, covers the materials evaluation of the same fuel. As part of a continuing program to evaluate $\text{PuO}_2\text{-UO}_2$ fuel at higher burnups, selected rods from Core II were reinserted into the Saxton reactor and are currently being irradiated as part of Core III. The results of these extended burnup tests will be presented in future reports.

Nineteen Zircaloy-clad fuel rods, containing pelletized and vibratory compacted $\text{PuO}_2\text{-UO}_2$ fuel, were removed from the central region of Saxton Core II and subjected to various post-irradiation hot cell examinations,^[1] including gamma activity measurements and analyses for isotopic content of the fuel. The measured burnup ranged from approximately 7,000 to 29,000 MWD/MTM for pellet-sized samples and from approximately 9,000 to 21,000 MWD/MTM for values of rod-average burnup.

The analysis included mass spectrometry for isotopic abundance of U-234, U-235, U-236, U-238, Pu-238, Pu-239, Pu-240, Pu-241, and Pu-242, and the Pu-239/U-238 and Nd-148/U-238 atom ratios in each of thirty-seven axial samples (one-inch segments) and ten radial micro-samples (concentric annuli of fuel drilled from a fuel pellet cross section); alpha spectrometric analysis for Pu-236 and Pu-238 in fourteen axial samples; alpha spectrometry for Cm-242 and Cm-244 and radiochemical analysis for Np-237, Am-241, and Am-243 in six axial samples; and radiochemical analysis for Cs-137 in seven axial samples and ten radial microsamples.

For each sample, the internal consistency of the mass spectrometric data was checked by comparing the values of total fissions determined by two independent methods: 1) the Heavy Element (HE) method, based on conservation of heavy nuclei and 2) the Nd Method, from the concentration of the Nd-148 fission product.

In addition to the analyses on irradiated fuel, unirradiated archive (retainer) samples were analyzed for initial U and Pu isotopic abundances and the initial plutonium concentration.

Unit cell calculations were performed with modified versions of the LEOPARD and LASER computer programs. Comparison of results of these calculations with isotopic measurements provided an excellent opportunity to evaluate the model and the basic nuclear data used in

the calculations. Subsequent to the preparation of the final draft of this report, an error was discovered in the Americium 241 n, γ cross section in the library used in the modified Leopard-HIC unit cell calculation. The value used in this study is approximately 70 percent of the correct value documented in WCAP-6086. As a consequence, the calculated values of the concentration of Americium 241, Curium 242, and Plutonium 238 reported herein are in error. The discrepancies between calculation and measurement for these isotopes (summarized in Table 8-2) would be considerably reduced when the correct value is used for the Americium 241 capture cross section.

SECTION 2

DESCRIPTION OF SAXTON CORE II

As shown in Figure 2-1, the Saxton Core II fuel loading consisted of nine central mixed-oxide ($\text{PuO}_2\text{-UO}_2$) fuel assemblies and twelve outer UO_2 fuel assemblies. The mixed-oxide contained 6.6 w/o PuO_2 in natural UO_2 .

The UO_2 assemblies were enriched to 5.7 w/o U-235. Of the nine plutonium assemblies, two contained vibratory compacted (vipac) fuel and were installed on the flats in positions D-2 and D-4. The remaining seven assemblies contained pelletized fuel. With the exception of some thirty fuel rods which were clad with 304 stainless steel, the plutonium fuel rods were clad with Zircaloy-4. These special stainless steel rods were distributed in the central plutonium region to meet specific irradiation objectives. All of the plutonium assemblies contained Inconel-718 grids. Details of the Saxton Core II nuclear design are given in Reference 2.

Initial criticality was achieved on December 6, 1965, and the core reached rated power of 23.5 MWT on February 7, 1966. Core II end-of-life (EOL) was October 18, 1968. The irradiation history^[3] for Core II is summarized in Table 2-1. Of a total elapsed time of 966 days between the beginning and end of Core II, the core was at zero power for 533 days, or 55 percent of the time. Accurate representation of the irradiation history is essential in the calculation of any isotopes which have relatively short half-lives or whose precursors have short half-lives, e.g., Pu-236, Pu-238, and Cm-242.

Figure 2-1. Saxton Core II Fuel Configuration

TABLE 2-1
SUMMARY OF SAXTON CORE II IRRADIATION HISTORY

Time Interval No.	No. of Days	Average Reactor Power, MWt	Time Interval No.	No. of Days	Average Reactor Power, MWt
1	5	6.3	28	207	0.0
2	10	17.4	29	2	15.2
3	1	0.0	30	2	0.0
4	20	18.4	31	6	19.3
5	21	21.5	32	16	0.0
6	2	0.0	33	3	6.8
7	5	12.4	34	1	0.0
8	31	22.3	35	5	10.0
9	24	0.0	36	20	0.0
10	6	20.0	37	10	21.4
11	31	23.4	38	19	21.0
12	4	20.1	39	41	0.0
13	2	0.0	40	2	5.9
14	21	21.3	41	12	22.1
15	3	0.0	42	42	0.0
16	22	22.2	43	5	14.0
17	31	0.0	44	30	25.2
18	9	22.2	45	31	0.0
19	30	23.4	46	10	19.9
20	14	22.3	47	28	0.0
21	38	0.0	48	3	14.1
22	10	18.9	49	1	0.0
23	12	0.0	50	11	21.9
24	8	21.5	51	10	0.0
25	11	24.2	52	21	23.1
26	31	23.4	53	21	0.0
27	1	10.1	54	4	18.0

Summary:

(1) Total Energy Generated	=	9190 Megawatt-days
(2) Total Operating Time	=	433 days
(3) Average Operating Power	=	21.3 MWt
(4) Total Shutdown Time	=	533 days

SECTION 3

SAMPLING PLAN

Sample locations for the post-irradiation physics evaluations were chosen to provide: 1) a wide range of burnups for isotopic depletion and production versus burnup correlations; 2) information on fuel characteristics in the vicinity of grid locations; and 3) sufficient samples along the lengths of some fuel rods for more accurate gross gamma scan normalization.

Figure 3-1 shows the locations of the physics evaluation rods within the two assemblies, C3 and D4.

Eleven sample zones were selected along the lengths of the rods. The locations of these axial sample zones with respect to the bottom of a fuel rod are shown on Figure 3-2. For reference, the normalized gamma activity (corrected for hot cell background) of a typical fuel rod also is shown on Figure 3-2.

The physics sampling plan is shown in detail in Table 3-1. In addition to the samples obtained for physics evaluations, burnups samples were taken from selected materials evaluation rods. Note that the analyses indicated for the Zone 6 sample in Rod JF were transferred to the Zone 7 sample. Also, the Zone 9 sample from Rod RI and the Zone 2 sample from Rod JF were not analyzed. Additional analyses, for Cm-242 and Cm-244, were performed on those six samples in Table 3-1 for which Np-237, Am-241, and Am-243 analyses are indicated.

One sample of Saxton pelletized $\text{UO}_2\text{-PuO}_2$ fuel was selected for micro-sampling from the fuel rod RI as indicated in Table 3-1. The technique used to obtain the Saxton radial micro-samples is the same as that employed in the Yankee Core Evaluation (EYC) Program;^[4] ten radial microsamples were taken from the fuel sample. The first nine radial microsamples were obtained from nine successive drillings, using successively larger diameter drills, working out from the center of the mounted fuel sample; the tenth microsample is that annulus of fuel which remained after the first nine radial microsamples were drilled. The drill sizes for each of these microsamples are listed in Table 3-2.

Radial microsamples consisting of annuli of fuel are preferred to microsamples obtained from drilling at discrete positions along the radii of the fuel sample specimen for the following reasons:

1. The effects of gross core burnup gradients across the fuel sample are minimized, or averaged out, in the radial microsample annulus, and the U and Pu isotopic measurements subsequently obtained are more amenable to comparisons with unit cell calculations.

2. The effects of the presence of radial cracks in the fuel material are minimized. Microdrilling at discrete positions along the radii of the fuel sample specimen may result in a microsample which is, for example, 10 percent fuel and 90 percent epoxy (which fills a hidden crack beneath the surface of the mounted fuel sample).
3. The success of the annuli method (in terms of sample acquisition and subsequent evaluation of unit cell calculations) has been demonstrated in the EYC Program.

Figure 3-1. Plan View Showing Locations of Fuel Rods
Selected for Physics Sampling

Figure 3-2. Axial Locations of SAXTON Physics Samples

TABLE 3-1
SAMPLING PLAN FOR SAXTON POST-IRRADIATION PHYSICS EVALUATIONS

Rod No.	Assm. Loc.	Rod Loc.	Fuel Type	Physics Sample Zone	Inches From Bottom Of Bottom End Plug		Heavy Element Isotopes	Nd-148	Pu-236 Pu-238	Np-237 Am-241 Am-243	Cs-137	Multi-Channel γ -Scan	Single Channel Gross γ -Scan	Macro-Photograph and Auto-radiograph
					Sample Mid-Pt.	Sample Cut								
TE	C3	D1	Pellet	2	29.25	28.75-29.75	1	1						
				6	19.25	18.75-19.75	1	1						
				8	17.25	16.75-17.75	(Reserve Sample)							
RI	C3	E4	Pellet	10	9.25	8.75-9.75	1	1						
				1	35.65	35.30-36.00	1	1			1			
				2	29.25	28.75-29.75	1	1	1	1	1			
				3	24.25	23.75-24.75	1	1			1			
				4	21.25	20.75-21.75 (a)						2	2	
				5	20.25	19.75-20.75	(Reserve Sample)							
				6	19.25	18.75-19.75	1	1	1	1	1	1		
				7	18.25	17.75-18.75 (b)	10	10			10			1
				8	17.25	16.75-17.75	1	1			1			
				9	14.25	13.75-14.75	1	1			1			
MY	C3	D5	Pellet	10	9.25	8.75-9.75	1	1	1	1	1	1		
				11	2.375	2.00-2.75	1	1			1			
				1	35.65	35.30-36.00	(Reserve Sample)							
				2	29.25	28.75-29.75	1	1	1	1				
				3	24.25	23.75-24.75	(Reserve Sample)							
				5	20.25	19.75-20.75	(Reserve Sample)							
				6	19.25	18.75-19.75	1	1	1	1				
				7	18.25	17.75-18.75	(Reserve Sample)							
				9	14.25	13.75-14.75	(Reserve Sample)							
				10	9.25	8.75-9.75	1	1	1	1				
				11	2.375	2.00-2.75	(Reserve Sample)							
JF	C3	E5	Pellet	2	29.25	28.75-29.75	1	1	1					
				5	20.25	19.75-20.75	(Reserve Sample)							
				6	19.25	18.75-19.75	1	1	1					
				7	18.25	17.75-18.75	(Reserve Sample)							
				10	9.25	8.75-9.75	1	1	1					
S1	C4	D5	Vipac	1	35.65	35.30-36.00	1	1						
				2	29.25	28.75-29.75	1	1	1					
				6	19.25	18.75-19.75	1	1	1					
				7	18.25	17.75-18.75	(Reserve Sample)							
				8	17.25	16.75-17.75	(Reserve Sample)							
				10	9.75	8.75-9.75	1	1	1					

TABLE 3-1 (continued)
SAMPLING PLAN FOR SAXTON POST-IRRADIATION PHYSICS EVALUATIONS

Rod No.	Assm. Loc.	Rod Loc.	Fuel Type	Physics Sample Zone	Inches From Bottom Of Bottom End Plug		Heavy Element Isotopics	Nd-148	Pu-236 Pu-238	Np-237 Am-241 Am-243	Cs-137	Multi-Channel γ-Scan	Single Channel Gross γ-Scan	Macro-Photograph and Auto-radiograph
					Sample Mid-Pt.	Sample Cut								
SI PO	D4 D4	D5 E5	Vipac Vipac	11	2.375	2.00- 2.75	1	1						
				2	29.25	28.75-29.75	1	1	1					
				5	20.25	19.75-20.75	(Reserve Sample)							
				6	19.25	18.75-19.75	1	1	1		1			
				7	18.25	17.75-18.75							1	
				8	17.25	16.75-17.75	1	1						
				10	9.25	8.75- 9.75	1	1	1		1			
				Monitor Sample							4	4		
Unirradiated archive samples (pelletized)							3		3					
Unirradiated archive samples (vipac)							3		3					
Totals							46	40	21	6	18	6	2	2

NOTES: (a) Single channel gross gamma scan and multi-channel gamma scan to be performed first on cladding and fuel, and then on cladding only.

(b) Radial micro samples.

TABLE 3-2

DRILL SIZES FOR SAXTON MICROSAMPLING PROGRAM

Sample Number	Drill Size	Hole Radius (mils)	Effective Radius (mils)	Fractional Effective Radius
1	53	29.8	21.0	0.124
2	43	44.5	37.8	0.224
3	31	60.0	52.8	0.313
4	25	74.8	67.8	0.402
5	15	90.0	82.7	0.490
6	4	104.5	97.5	0.578
7	B	119.0	112.0	0.664
8	I	136.0	127.8	0.758
9	N	151.0	143.7	0.852
10	(a)	168.7	160.1	0.949

NOTE: (a) This sample is the annulus which forms the periphery of the pellet, i.e., the fuel which remains after the inner microsamples have been drilled.

SECTION 4

ANALYSES OF SPENT FUEL SAMPLES

Mass spectrometric analysis was used to determine the U and Pu isotopic distribution and the Pu-239/U-238 and Nd-148/U-238 atom ratios in each spent fuel sample. The analyses were performed by the Technical Service Laboratories of the Westinghouse Advanced Reactors Division (WARD) at Waltz Mill, Pennsylvania. Inter-laboratory cross check analyses were performed on solutions of two of the burnup samples by the mass spectrometric laboratory of General Electric-Vallecitos (GE).

The results from mass spectrometric analyses for all samples are documented in Appendices A, B, C, and D as follows:

<u>Appendix</u>	<u>Type of Fuel Sample</u>
A	Axial, Asymptotic Spectrum
B	Axial, Non-asymptotic Spectra
C	Ten Radial Microsamples
D	Composite of Radial Microsamples

The results of radiochemical analysis for Cs-137 are discussed in Section 6, while those of alpha spectrometric and radiochemical analyses for Pu-236, Pu-238, Np-237, Am-241, Am-243, Cm-242, and Cm-244 are given in Section 8. These analyses were performed by WARD.

SECTION 5

TREATMENT OF DATA

A material balance, performed with pre- and post-irradiation fuel composition data is used to infer the various fuel characteristics and nuclear parameters of interest (e.g., burnup, specific production of uranium and plutonium isotopes and U-235 capture-to-fission ratio). However, the required computations are somewhat long and laborious, and they involve several correction factors which are dependent upon the parameters to be calculated. For these reasons, and due to the number of spent fuel analyses performed, the REBUF^[5] computer code was written to facilitate the reduction of the mass spectrometric data. Provisions have been included in the code to process Cs-137, Sr-90, Nd-148, and X-ray fluorescence Pu/U data. The data reduction methods used to infer fuel burnup are similar to those outlined in Reference 6.

The treatment accorded the mass spectrometric and radiochemical data is given in detail in References 5, 7, and 8. For the Saxton Core II fuel, the REBUF code was modified to process data from spent fuel which contained initial concentrations of plutonium isotopes. A general outline of the methods is given in Section 5.1. The main chain uranium and plutonium isotopes and the out-of-core decay corrections made to the measurements for the elapsed time between core end-of-life and the time of the analysis are discussed.

5.1 End-Of-Life Isotopic Inventory Equations

When considering the composition of spent reactor fuel, the relationship between the abundances of the various isotopes of uranium and plutonium and their fission products can be expressed through a number of comparatively simple equations. Since the preponderant mode of fission is binary, i.e., since a fission-product pair results from one fission, the fission-product nuclei from one fission can be counted as one hypothetical nucleus, and the total number of nuclei can be conserved.

The symbols and equations defined below are equally valid when applied to any unit volume of fuel to represent atom densities, or when applied to the total core volume to represent total core inventories of the uranium and plutonium isotopes or fission-product pairs.

Some material balance equations are:

$$\begin{aligned}
 N_0^{24} + N_0^{25} + N_0^{26} + N_0^{28} + N_0^{49} + N_0^{40} + N_0^{41} + N_0^{42} &= N^{24} + N^{25} + N^{26} + N^{28} \\
 &+ N^{49} + N^{40} + N^{41} + N^{42} \\
 &+ F^{25} + F^{28} + F^{49} + F^{41} \\
 &+ A^{26} + A^{42} + D^{41} \quad (1)
 \end{aligned}$$

$$F^{25} = N_0^{24} + N_0^{25} + N_0^{26} - N^{24} - N^{25} - N^{26} - A^{26} \quad (2)$$

$$F^{49} = (N_0^{40} + N_0^{41} + N_0^{42} - N_0^{40} - N_0^{41} - N_0^{42} + F^{41} + A^{42} + D^{41})/a^{49} \quad (3)$$

$$F^{41} = (N_0^{42} - N_0^{42} + A^{42})/a^{41} \quad (4)$$

$$F^{28} = \delta^{28} (F^{25} + F^{49} + F^{41}) \quad (5)$$

$$A^{26} = (N^{26} - N_0^{26}) (\text{COR26} - 1) \quad (6)$$

$$A^{42} = (N^{42} - N_0^{42}) (\text{COR42} - 1) \quad (7)$$

$$D^{41} = (N^{41} - N_0^{41}) (\text{COR41} - 1) \quad (8)$$

The symbols N^i and F^i denote, respectively, the density of isotope i (atoms/cm³) and of pairs of products from the fission of isotope i (atom pairs/cm³); the symbols A^i and D^i account for losses due to absorption and decay in isotope i . The standard indexing system is used; the two-digit index consists of the last digits of the respective atomic and mass numbers of the nuclide in question. Subscript 0 signifies the beginning-of-life value of parameter.

Note that the right-hand side of equation (1) should include an additional term made up of just that portion of the Pu-238 production due to n, 2n reaction in U-238* and that portion of the initial Pu-238 that was not converted to Pu-239; the approximation is made that these two contributions are roughly equivalent to the initial Pu-238 concentration, which justifies the omission of the N_0^{48} term on the left-hand side of equation (1).

To relate the final (i.e. end-of-life) isotopic concentrations to the initial U-238 concentration, Equations (1) through (8) are divided by N_0^{28} .

From unit cell calculations of the Saxton fuel, the following parameters were obtained as functions of U-235 fractional depletion and input to the REBUF code:

$$a^{49} = f(D25) = \text{ratio of total captures to total fissions in Pu-239}$$

$$a^{41} = f(D25) = \text{ratio of total captures to total fissions in Pu-241}$$

$$\delta^{28} = f(D25) = \text{total fissions in U-238 relative to sum of total fissions in U-235, Pu-239, and Pu-241}$$

$$COR26 = f(D25) = \text{ratio of gross to net U-236 production}$$

$$COR42 = f(D25) = \text{ratio of gross to net Pu-242 production}$$

$$COR41 = 1.1165 = \text{ratio of net production plus decay of Pu-241 to net production of Pu-241 in Saxton Core 2 fuel}$$

The fractional depletion of U-235 is obtained with:

$$D25 = 1 - \frac{N^{25}}{N^{28}} \times \frac{N^{28}}{N_0^{28}} \times \frac{N_0^{28}}{N_0^{25}} \quad (9)$$

5.2 Isotopic Decay Corrections

The measurements on spent fuel samples are made after various intervals of cooling time after core shutdown. To place the results obtained for those isotopes of relatively short half-life on the same basis with the results obtained for those isotopes of relatively long half-life, and to make meaningful comparisons with the results of calculations, it is necessary to decay-correct the measured data to some given reference time. In this study, the reference time is taken to be the core end-of-life, October 18, 1968.

* In mixed-oxide fuel, most of the Pu-238 production is accounted for in the A^{26} and D^{41} terms in equation (1); due to relatively high initial Pu concentration and the many shut-downs which occurred during the irradiation of Saxton Core II, approximately 75 percent of the Pu-238 production was due to β -decay of Pu-241, (n, γ) reaction in Am-241, β -decay of Am-242, and α -decay of Cm-242.

The equations used to account for radioactive decay from the core end-of-life (EOL) to the sample time-of-analysis (TOA) are:

$$A_0 = A e^{\lambda_a T_a}$$

$$R_0 = B e^{\lambda_b T_b} - \frac{\lambda_a}{\lambda_b - \lambda_a} A e^{\lambda_a T_a} [e^{(\lambda_b - \lambda_a) T_b} - 1]$$

where isotope A decays to isotope B, and isotope B itself undergoes decay, and:

A_0 = concentration of isotope A at EOL

A = concentration of isotope A at TOA

λ_a = decay constant for isotope A

T_a = time interval from EOL to TOA for isotope A,

B_0 = concentration of isotope B at EOL

B = concentration of isotope B at TOA

λ_b = decay constant for isotope B

T_b = time interval from EOL to TOA for isotope B

In the actual application of the above equations, A and B are atomic ratios, relative to some constant, rather than absolute values of atoms/cm³. For example, in the case of Cm-242 and Pu-238, A would be N^{62}/N_o^{28} and B would be N^{48}/N_o^{28} .

SECTION 6

DETERMINATION OF FUEL BURNUP

In obtaining the specific energy release for each sample, the total accumulated fissions is determined first, and then converted to burnup with appropriate values of MeV/fission. In this study, the parameter F_{0}^{TOT}/N_{0}^{28} , the total accumulated fissions relative to the initial U-238 atoms, is used as the independent variable to evaluate uranium depletion and plutonium buildup. As will be shown in later sections of this report, the comparisons between experiment and theory are at about the two to three percent level for the main chain uranium and plutonium isotopes. For these comparisons to be valid, the values of burnup, or total fissions, with which the uranium and plutonium isotopic data are correlated must be accurate and free from bias.

In the following paragraphs, several methods for obtaining fuel burnup are described and compared.

6.1 Methods of Fuel Burnup Determination

Two basic methods can be used to determine the fuel burnup from the destructive analysis of spent fuel. One is based on the reduction of isotopic composition of spent fuel (heavy element or HE method) and the other on concentration of fission products for example, cesium-137 and neodymium-148.

The parameters necessary to calculate the burnup with the HE method are the energy-conversion factors (MeV/fission), δ^{28} , α^{49} , α^{41} . In addition, the initial composition of the pre-irradiated fuel must be known. The parameters necessary to determine the burnup using cesium-137 or neodymium-148 are MeV/fission, the decay constant (zero in the case of the stable fission product neodymium-148), and the isotopic fission yields. The values of these parameters used in this study are summarized in Table 6-1. This is a reproduced page of input to the REBUF code and is given as a typical sample.

The values of δ^{28} for the samples from the non-asymptotic neutron spectra were estimated by multiplying the asymptotic value of δ^{28} by reduction factors. These reduction factors are the inverse ratio of the rod-average burnup in the non-asymptotic spectrum to the rod-average burnup in the asymptotic neutron spectrum. These factors are based on the assumption that the fast flux distribution (U-238 fission rate) is constant across the fuel assembly, while the thermal flux (fission rate in U-235, Pu-239, and Pu-241) is peaked in the regions of perturbed spectra. The effective values of energy release per fission and the values of δ^{28} , α^{49} , and α^{41} are from a modified LEOPARD^[9] calculation. The fission product yield data shown in

TABLE 6-1. SUMMARY OF TYPICAL DATA INPUT TO REBUF
DATA-REDUCING CODE

WAND RI-3 ,ROD RI, ASMRY C3, WCU LOC E4, ASYMP PELLET,ZONE 6 Y/03/69

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SUMMARY OF INPUT VARIABLES AND ASSUMED PARAMETERS PERTURBED IN ERROR ANALYSIS

DESCRIPTION	FORTRAN NAME	INDEX	VALUE	ABSOLUTE ERROR	RELATIVE ERROR(PCT)
INITIAL DUMMY	DUM1	1	1.00000E+00	1.00000E-01	10.0000
ASSUMED ROL U-234/U-235 ATOM RATIO	R4R5H	2	7.51715E-03	3.84088E-04	5.1095
ASSUMED ROL U-235 LOADING(KG)	H25AIP	3	7.19862E+00	1.97493E-02	.2743
ASSUMED ROL U-236/U-235 ATOM RATIO	H6H5H	4	1.37174E-07	1.37174E-08	10.0000
ASSUMED ROL TOTAL U LOADING(KG)	HUAIP	5	1.00000E+03	1.00000E+00	.1000
ASSUMED ROL PU-238 ATOM PERCENT	A4RH	60	1.40000E-02	2.00000E-03	12.5000
ASSUMED ROL PU-239 ATOM PERCENT	A4QH	61	9.04720E+01	4.00000E-02	.0508
ASSUMED ROL PU-240 ATOM PERCENT	A4OR	62	8.59300E+00	3.10000E-02	.3608
ASSUMED ROL PU-241 ATOM PERCENT	A41H	63	8.75000E-01	1.30000E-02	1.4857
ASSUMED ROL PU-242 ATOM PERCENT	A42H	64	4.41000E-02	2.40000E-03	4.9887
ASSUMED ROL PU-239/U-238 ATOM RATIO	H9R9H	65	6.40000E-02	2.00000E-04	.3125
MEASURED U-234 A/O	A24	6	4.48000E-03	1.32880E-03	29.6607
MEASURED U-235 A/O	A25	7	5.69000E-01	4.99742E-03	.8783
MEASURED U-236 A/O	A26	8	3.63000E-02	2.01295E-03	5.5453
MEASURED U-238 A/O	A28	9	9.93900E+01	1.41469E-02	.0142
MEASURED PU-238 A/O	A4R	10	1.20000E-01	2.00027E-03	2.2658
MEASURED PU-239 A/O	A4Q	11	7.39340E+01	2.37158E-02	.0321
MEASURED PU-240 A/O	A4O	12	1.92970E+01	2.42363E-02	.1515
MEASURED PU-241 A/O	A41	13	6.05300E+00	1.51737E-02	.2507
MEASURED PU-242 A/O	A42	14	5.88000E-01	5.06455E-03	.8613
MEASURED U-238 ATOMS PER ML	A2RML	24	7.77777E+18	7.77777E+16	1.0000
MEASURED PU-239/U-238 ATOM RATIO	A4Q8	25	4.11000E-02	2.11000E-04	.6640
ASSUMED PU-241 HALF-LIFE(YEARS)	XPUL	26	1.36000E+01	2.04000E-01	1.5000
ESTIMATED PU-241 IN-CORE DECAY CORR.	CO1T2	27	8.95704E-01	2.08592E-02	2.3288
CALCULATED U-236 GROSS/NET PRODUCTION	CO2BILI	28	1.04159E+00	4.15883E-03	.3993
CALCULATED PU-242 GROSS/NET PRODUCTION	CO242	29	1.13853E+00	2.77061E-02	2.4335
ESTIMATED EOL CM-242/U-238 ATOM RATIO	RCMU8	30	2.50202E-05	5.00405E-06	20.0000
ASSUMED CM-242 HALF-LIFE(YEARS)	XCML	31	7.20030E+01	1.08904E-02	1.5000
ASSUMED PU-238 HALF-LIFE(YEARS)	XPCHL	32	8.90000E+01	1.33500E+00	1.5000
CALCULATED EFFECTIVE DELTA-28	DE128	33	5.80423E+02	5.80423E-03	10.0000
CALCULATED EFFECTIVE ALPHA-49	A4	34	5.29267E-01	2.04633E-02	5.0000
CALCULATED EFFECTIVE ALPHA-41	A1	35	3.16354E-01	3.16354E-02	10.0000
CALCULATED U-235 MEV/FISSION	AVFF5	36	2.01192E+02	4.02303E+00	2.0000
CALCULATED U-238 MEV/FISSION	AVFF8	37	1.98704E+02	3.97409E+00	2.0000
CALCULATED PU-239 MEV/FISSION	AVFF9	38	2.08602E+02	4.17204E+00	2.0000
CALCULATED PU-241 MEV/FISSION	AVFF1	39	2.10730E+02	4.21460E+00	2.0000
MEASURED CS-137 DPM/GU	COGU	40	1.49300E+11	1.19000E+10	7.9705
ASSUMED CS-137 HALF-LIFE(YEARS)	CHL	41	7.05000E+01	6.10000E-01	2.0000
ESTIMATED CS-137 IN-CORE DECAY CORR.	CIFD	42	9.65409E-01	8.91820E-03	.7166
ASSUMED CS-137 YIELD*ATOMS/ U-235 FISSION	CY25	43	6.28000E-02	1.32104E-03	2.1036
ASSUMED CS-137 YIELD*ATOMS/ U-238 FISSION	CY28	44	6.30000E-02	4.06452E-03	6.4516
ASSUMED CS-137 YIELD*ATOMS/PU-239 FISSION	CY49	45	6.74000E-02	2.05488E-03	3.0488
ASSUMED CS-137 YIELD*ATOMS/PU-241 FISSION	CY41	46	6.60000E-02	3.26935E-03	4.9536
MEASURED ND-148/U-238 ATOM RATIO	AH0RH	54	3.79520E-04	2.67182E-06	.7040
ESTIMATED ND-148 BURNOUT CORR. FACTOR	CO208	55	1.01164E+00	2.42736E-03	.2301
ASSUMED ND-148 YIELD*ATOMS/ U-235 FISSION	Y25NU	56	1.69000E-02	3.05422E-04	1.8072
ASSUMED ND-148 YIELD*ATOMS/ U-238 FISSION	Y28NU	57	1.93000E-02	1.01579E-03	5.2632
ASSUMED ND-148 YIELD*ATOMS/PU-239 FISSION	Y49ND	58	1.45000E-02	5.00000E-04	3.0303
ASSUMED ND-148 YIELD*ATOMS/PU-241 FISSION	Y41NU	59	1.88000E-02	9.00000E-04	4.7872
FINAL DUMMY	DUM2	66	1.00000E+00	1.00000E-01	10.0000

SUMMARY OF INPUT VARIABLES AND ASSUMED PARAMETERS PERTURBED IN ERROR ANALYSIS

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SAXTON CORE 2: ZR-CLAD UO2=PUO2 PELLET FUEL

Table 6-1 are from References 10, 11, and 12. The values of Cs-137 and Pu-241 half-lives are from References 13 and 14, respectively.

The accumulated fissions relative to initial U-238 atoms (F_{HE}^i / N_0^{28}) and the burnup (Bu_{HE}^i in GWD/MTM) due to fissions in each of the fissionable isotopes can be calculated from:

$$F_{HE}^i / N_0^{28} = \frac{F_{HE}^i}{N_0^{28}}$$

$$Bu_{HE}^i = K E^i \frac{N_0^{28}}{\rho} \frac{F_{HE}^i}{N_0^{28}}$$

where E^i is given in Table 6-1. The quantity ρ is the density of uranium and plutonium feed in MTM/cm³, and $K = 1.854 \times 10^{-27}$ GWD/MeV, an energy unit conversion factor. The method of calculating the ratios F_{HE}^i / N_0^{28} was shown previously in Section 5. The quantity N_0^{28} / ρ is evaluated explicitly from the initial fuel composition on a unit mass basis with:

$$\frac{N_0^{28}}{\rho} = \frac{A_0 (a/o)_0^{28} \times 10^6}{A_u + A_p}$$

$$A_u = W^{24} (a/o)_0^{24} + W^{25} (a/o)_0^{25} + W^{26} (a/o)_0^{26} + W^{28} (a/o)_0^{28}$$

$$A_p = \frac{N_0^{49}}{N_0^{28}} \frac{(a/o)_0^{28}}{(a/o)_0^{49}} \left(W^{48} (a/o)_0^{48} + W^{49} (a/o)_0^{49} + W^{40} (a/o)_0^{40} \right. \\ \left. + W^{41} (a/o)_0^{41} + W^{42} (a/o)_0^{42} \right)$$

where $(a/o)_0^i$ is the isotopic composition of the pre-irradiated fuel in atom percent, N_0^{49} / N_0^{28} is the initial Pu-239/U-238 atom ratio, W^i is the atomic weight of isotope i , and A_0 is the Avogadro number. The total accumulated fissions relative to initial U-238

atoms and fuel burnup determined from the heavy element is:

$$F_{HE}^{TOT}/N_0^{28} = \sum_i F_{HE}^i/N_0^{28}$$

$$BU_{HE} = \sum_i BU_{HE}^i$$

where i includes the fissionable isotopes uranium-235, uranium-238, plutonium-239 and plutonium-241.

The burnup of the fuel can also be calculated from the density of any fission product whose yield in fission and half life are reasonably well known and which has a low enough neutron-capture cross section to require relatively small or negligible corrections for its subsequent destruction by neutron captures. In the case of a fuel sample which represents but one or several fuel pellets, the fission product must be non-volatile or its use must be restricted to samples of fuel which has not been subjected to severe temperature gradients during irradiation. Where a fuel sample represents a whole fuel rod or bundle of rods, the migration of the fission product is not a problem. To a greater or lesser degree, cesium-137 and neodymium-148 satisfy these conditions. However, for the Saxton radial microsamples, comparison of values of burnup determined with the HE method, the Nd-148 method, the Cs-137 method and LASER calculations clearly indicates a high degree of Cs-137 migration in the radial direction of the fuel pellet.

The total accumulated fissions relative to initial U-238 atoms and the fuel burnup can be obtained from cesium-137 concentration by application of the following equations:

$$F_{Cs}^{TOT}/N_0^{28} = \frac{A_{Cs} t_2 \times 10^6}{Y_{Cs}^{eff}} \frac{\exp(\lambda^{57} t_1)}{1 - \exp(-\lambda^{57} t_2)} \frac{N_0^{28}}{p}$$

$$BU_{Cs} = \frac{K E^{eff} A_{Cs} t_2}{Y_{Cs}^{eff}} \frac{\exp(\lambda^{57} t_1)}{1 - \exp(-\lambda^{57} t_2)}$$

where t_1 is the time between core shutdown and cesium-137 analysis (min), t_2 is the in-core irradiation time (min), A_{Cs} is the cesium-137 activity dis/(min MTU) at the time of analysis, λ^{57} is the cesium-137 decay constant (min^{-1}), and Y_{Cs}^{eff} is the effective fission yield of cesium-137, weighted by isotope (fission^{-1}). The symbol E^{eff} denotes the effective energy per fission, weighted by isotope (MeV/fission). K and ρ/N_0^{28} were defined earlier.

To determine the total accumulated fissions and the fuel burnup from the neodymium-148 data, the following expressions can be used:

$$F_{ND}^{\text{TOT}}/N_0^{28} = \frac{N^{08}}{N^{28}} \frac{N^{28}}{N_0^{28}} \frac{C}{Y_{Nd}^{\text{eff}}}$$

$$BU_{Nd} = K C \frac{N_0^{28}}{\rho} \frac{N^{08}}{N^{28}} \frac{N^{28}}{N_0^{28}} \frac{E^{\text{eff}}}{Y_{Nd}^{\text{eff}}}$$

where N^{08}/N^{28} is the measured Nd-148/U-238 atom ratio*; N^{28}/N_0^{28} is the final to initial uranium-238 atom ratio, determined from isotopic data as outlined in the previous section; N_0^{28}/ρ is the initial uranium-238 atoms per metric ton of uranium and plutonium loading; E^{eff} is the effective energy release per fission (including kinetic energy of fission fragments and neutrons, energy of beta and gamma decay, and energy of radiative capture) weighted by isotope, MeV/fission; Y_{Nd}^{eff} is the effective fission yield of neodymium-148, weighted by isotope, atom/fission; C is a burnup-dependent correction factor for neodymium-148 burnout; and BU_{Nd} is the fuel burnup inferred from neodymium-148 concentration, GWD/MTM.

The correction for neodymium-148 burnout ranges up to about two percent at 40 GWD/MTM burnup. The correction factor C , was determined for uranium fuel as outlined in Reference 15.

*Corrected for natural neodymium contamination.

The correction factor is used in an iterative procedure in the REBUF code with the following quadratic expression:

$$C = 1.0 + C_1 (BU) + C_2 (BU)^2$$

where:

$$C_1 = 5.019 \times 10^{-4}$$

$$C_2 = 2.275 \times 10^{-6}, \text{ and}$$

$$BU = \text{fuel burnup inferred from measured Nd-148/U-238 data, in units of GWD/MTM}$$

With the methods described above, the values of total accumulated fissions and fuel burnup were determined for each sample. The results are documented in Appendices A, B, C, D and E.

The values used for initial isotopic composition of the unirradiated fuel and the initial plutonium concentration are listed in Appendix F. These values have been input to the REBUF data-reducing code for processing the measured data obtained for Saxton Core II samples.

6.2 Fuel Pellet Burnup

The results of burnup analyses for all axial samples are summarized in Table 6-2. Since essentially the same values of MeV/fission are used in each method of burnup determination for a given sample, a comparison of burnups in Table 6-2 is actually a comparison of total fissions inferred from the measurements. The Nd, He and Cs methods give burnup results which agree to within the uncertainties assigned to the data; however, relative to the burnup values determined with the Nd method, the results of the HE method show a positive two-percent systematic difference while the results of the Cs method show a negative four-percent systematic difference.

The Cs/Nd and Cs/HE burnup ratios along the length of fuel rod RI indicate that slight Cs-137 migration may have occurred axially (i.e., the ratios generally are relatively high at the cooler ends of the rod, and low in the hotter middle portion of the rod). However, due to the uncertainties assigned to the burnup values (± 3 percent on Nd burnup, ± 5 percent on HE burnup, and ± 8 percent on Cs burnup), the results are inconclusive.

6.3 Radial Microsample Burnup

The radial microsampling plan was outlined earlier in Section 3. The values of burnup determined with the methods used in this study are documented in Appendix C. The results are summarized in Table 6-3.

A set of composite U, Pu, Nd, and Cs isotopic data were calculated by volume weighting the isotopic data obtained from measurements on the individual microsamples. The results are documented in Appendix D, and the burnup values, as determined with the REBUF code, are included in Table 6-3.

With the exception of sample RD-01, the Nd and HE methods show statistical agreement, with somewhat more scatter in the data than was observed for the axial samples. The Cs/Nd and Cs/HE burnup ratios in Table 6-3 indicate significant Cs-137 migration; in fact, the concentration of Cs-137 at the center of the pellet is about 70 percent less than that which would have been expected had no Cs-137 migration occurred.

6.4 Fuel Rod Average Burnup

As a means of determining rod average burnup and axial burnup distribution, the burnups of individual one-inch samples were correlated with gross gamma activities as shown in Figure 6-1. The resulting rod average and peak burnups for each fuel rod are given in Table 6-4. Except for fuel rods LA and A, the burnup-gamma activity correlations reproduce the maximum burnup for each rod in Table 6-2 to within the uncertainties assigned to the Table 6-2 data.

Note that fuel rods A, B, and D were not irradiated for the full term of Core II, as were the other fuel rods listed in Table 6-4. After about two-thirds of Core II life, rods A, B, and D were removed from the core. Rod A had occupied lattice position A5 in assembly E4, rod B lattice position E1 in assembly C2, and Rod D was in lattice position E1 in assembly E3. After some additional operation of Core II, rods A and B were returned to the core (in the overpower test 2 x 2 subassembly in the center of assembly D3), while rod D was sent directly to the Westinghouse Post-Irradiation Facility for examination.

TABLE 6-2
SUMMARY OF FUEL BURNUP

Assembly	Fuel Rod Lattice Position	Fuel Rod No.	Fuel ^(a) Type	Neutron ^(b) Spectrum	Axial Sample Zone	Axial ^(c) Location (Inches)	Sample ^(d) I.D.	Fuel Burnup (MWD/MTM) ^(e)		Cs Method	Ratio of Burnup by Two Methods		
								Nd Method	HE Method		HE Nd	Cs Nd	Cs HE
C3	E4	RI	P	Asymp.	1	35.6	RI-18	7,240 ± 230	7,360 ± 430	6,910 ± 610	1.016	0.954	0.939
					2	29.3	RI-19	14,550 ± 460	14,920 ± 750	13,960 ± 1,230	1.025	0.959	0.936
					3	24.3	RI-20	16,760 ± 530	17,370 ± 880	16,380 ± 1,440	1.036	0.977	0.943
					4	21.3	RI-21	19,670 ± 620	20,200 ± 1,020	-----	1.027	-----	-----
					6	19.3	RI-3	20,450 ± 640	21,060 ± 1,060	19,480 ± 1,710	1.030	0.952	0.925
					8	17.3	RI-22	20,560 ± 640	21,170 ± 1,070	18,960 ± 1,670	1.030	0.922	0.896
					10	9.3	RI-24	17,600 ± 550	18,240 ± 920	16,680 ± 1,470	1.036	0.948	0.914
					11	2.4	RI-25	9,350 ± 300	9,690 ± 510	9,210 ± 820	1.036	0.985	0.950
C3	E5	JF	P	Asymp.	7	18.3	JF-1	20,110 ± 630	20,640 ± 1,040	-----	1.026	-----	-----
					10	9.3	JF-27	17,620 ± 550	18,040 ± 910	-----	1.024	-----	-----
C3	D5	MY	P	Asymp.	2	29.3	MY-16	14,600 ± 460	14,960 ± 760	-----	1.025	-----	-----
					6	19.3	MY-2	20,230 ± 630	20,740 ± 1,050	-----	1.025	-----	-----
					10	9.3	MY-17	16,700 ± 530	17,880 ± 910	-----	1.071	-----	-----
C3	D1	TE	P	FW/WS	2	29.3	TE-14	20,070 ± 640	20,770 ± 1,050	-----	1.035	-----	-----
					6	19.3	TE-4	27,730 ± 870	28,660 ± 1,450	-----	1.034	-----	-----
					10	9.3	TE-15	24,460 ± 770	24,970 ± 1,260	-----	1.021	-----	-----
C3	A1	QE	P	WS/WS	6	19.3	7405	27,550 ± 860	28,810 ± 1,450	-----	1.046	-----	-----
					640	27,720 ± 870	26,250 ± 1,410	-----	0.947	-----	-----		
E2	A1	LA	P	WS/WS	6	19.3	LA-11	24,070 ± 760	24,710 ± 1,250	-----	1.026	-----	-----
D3	A1	TI	P	WS/WS	6	19.3	TI-8	25,980 ± 810	26,560 ± 1,340	-----	1.022	-----	-----
D3	A6	TT	P	FW	6	19.3	TT-10	27,180 ± 860	28,170 ± 1,430	-----	1.036	-----	-----
D3	D1	TP	P	FW/WS	6	19.3	TP-9	26,990 ± 850	27,590 ± 1,390	-----	1.022	-----	-----
D3	D9	CH	P	FW/WS	6	19.0	7403	27,960 ± 880	28,150 ± 1,420	-----	1.007	-----	-----
					680	28,180 ± 880	27,250 ± 1,460	-----	0.967	-----	-----		

TABLE 6-2 (Cont)
SUMMARY OF FUEL BURNUP

Assembly	Fuel Rod Lattice Position	Fuel Rod No.	Fuel ^(a) Type	Neutron ^(b) Spectrum	Axial Sample Zone	Axial ^(c) Location (Inches)	Sample ^(d) I.D.	Fuel Burnup (MWS/MTM) ^(e)			Ratio of Burnup by Two Methods		
								Nd Method	HE Method	Cs Method	HE Nd	Cs Nd	Cs HE
D4	D5	S1	V	Asymp.	1	35.5	S1-28	7,520 ± 240	7,450 ± 400	-----	0.991	-----	-----
					2	29.3	S1-29	14,820 ± 470	15,060 ± 770	-----	1.016	-----	-----
					6	19.3	S1-7	21,150 ± 660	21,860 ± 1,100	-----	1.034	-----	-----
					10	9.3	S1-30	18,710 ± 590	19,120 ± 970	-----	1.022	-----	-----
					11	2.4	S1-31	9,840 ± 310	10,160 ± 530	-----	1.032	-----	-----
D4	E5	PO	V	Asymp.	2	29.3	PO-32	15,320 ± 480	15,840 ± 810	-----	1.034	-----	-----
					6	19.3	PO-6	20,780 ± 650	21,120 ± 1,070	-----	1.016	-----	-----
					8	17.3	PO-33	21,080 ± 660	21,630 ± 1,090	-----	1.026	-----	-----
					10	9.3	PO-34	18,200 ± 570	18,860 ± 950	-----	1.036	-----	-----
D4	A1	K4	V	WS/WS	6	19.3	K4-5	27,160 ± 850	28,080 ± 1,420	-----	1.034	-----	-----
D4	A2	N3	V	WS	6	19.3	N3-13	25,710 ± 810	26,540 ± 1,340	-----	1.032	-----	-----
D4	A4	N1	V	FW/WS	6	19.3	N1-12	28,900 ± 910	27,620 ± 1,400	-----	0.956	-----	-----
D3	2 x 2	A	P	Pert	6	19.5	7401	21,170 ± 670	20,510 ± 1,040	-----	0.969	-----	-----
D3	2 x 2	B	P	Pert	6	19.5	7402	19,700 ± 620	19,790 ± 1,000	-----	1.004	-----	-----
E3	E1	D	P	FW/WS	6	19.5	7404	13,890 ± 440	13,180 ± 680	-----	0.949	-----	-----
		Average Ratio for Pellet Samples									1.018	0.957	0.929
		Average Ratio for Vipac Samples									1.019	-----	-----
		Average Ratio for all Samples									1.018	-----	-----

- Notes:
- (a) Pelletized and vibratory compacted fuel indicated by P and V, respectively.
 - (b) Asymp indicates that the fuel rod was located in the asymptotic neutron spectrum in the inner region of the fuel assembly; FW and WS indicate non-asymptotic neutron spectra adjacent to a flux-wire thimble and/or a water slot; and Pert indicates perturbed neutron spectrum in 2 x 2 Overpower Test subassembly.
 - (c) Distance from bottom fuel rod to mid-point of one-inch sample segment. Subtract 0.75 inches to obtain distance from bottom of fuel column.
 - (d) All measured data used in burnup determination obtained from WARD, except mass spectrometric data from cross check analyses by GE-Vallacitos on samples QE-640 and CH-680.
 - (e) Units are megawatt-days per 10⁶ grams initial loading of U and Pu metal. Values of MeV/fission used to convert fissions to energy units include kinetic energy of fission fragments and neutrons, energy of prompt and delayed gamma and beta decay, and energy of radiative capture in fuel, cladding, and moderator.

TABLE 6-3
SUMMARY OF RADIAL MICROSAMPLE BURNUP

Sample Number	Effective Radius (mils)	Fractional Effective Radius	Sample ^(a) I.D.	Fuel Burnup (MWD/MTM) ^(b)			Ratio of Burnup by Two Methods		
				Nd Method	HE Method	Cs Method	$\frac{HE}{Nd}$	$\frac{Cs}{Nd}$	$\frac{Cs}{HE}$
1	21.0	0.24	RD-01	20,910 ± 660	16,630 ± 840	4,610 ± 400	0.795	0.220	0.277
2	37.8	0.224	RD-02	17,010 ± 530	16,660 ± 840	5,420 ± 480	0.979	0.319	0.325
3	52.8	0.313	RD-03	17,400 ± 540	17,380 ± 870	7,860 ± 690	0.999	0.452	0.452
4	67.8	0.402	RD-04	15,920 ± 500	17,590 ± 880	10,660 ± 940	1.105	0.670	0.606
5	82.7	0.490	RD-05	18,300 ± 570	18,430 ± 920	15,280 ± 1,350	1.007	0.835	0.829
6	97.5	0.578	RD-06	18,660 ± 580	18,560 ± 930	18,540 ± 1,640	0.995	0.994	0.999
7	112.0	0.564	RD-07	19,560 ± 620	19,900 ± 1,000	20,000 ± 1,770	1.017	1.026	1.009
8	127.8	0.758	RD-08	20,360 ± 640	20,690 ± 1,040	20,880 ± 1,840	1.016	1.026	1.009
9	143.7	0.852	RD-09	22,170 ± 690	23,190 ± 1,170	25,450 ± 2,250	1.046	1.148	1.097
10	160.1	0.949	RD-10	24,680 ± 780	25,960 ± 1,340	29,340 ± 2,590	1.052	1.189	1.131
Average (or composite) ^(c)				20,450 ± 640	21,000 ± 1,060	20,070 ± 1,770	1.027	0.981	0.956

Notes: (a) Mass spectrometric and radiochemical analyses on ten radial microsamples performed by WARD. Samples drilled from axial Zone 7 sample in fuel rod RI.

(b) Units are megawatt-days per 10^6 grams initial loading of U and Pu metal. Values of MeV/fission used to convert fissions to energy units include kinetic energy of fission fragments and neutrons, energy of prompt and delayed gamma and beta decay, and energy of radiative capture in fuel, cladding, and moderator.

(c) Burnup values determined from U, Pu and Nd and Cs isotopic data calculated by volume weighting the isotopic data obtained from measurements on the ten radial microsamples.

Figure 6-1. Correlation of Burnup and Gamma Activity in Saxton Core II Fuel

TABLE 6-4
SUMMARY OF FUEL ROD BURNUP

Assembly	Fuel Rod Lattice Position	Fuel Rod I.D.	Fuel Type	Neutron Spectrum	Rod Average ^(a) Burnup (MWD/MTM)	Peak ^(a) Burnup (MWD/MTM)	Peak/Average ^(a) Burnup Ratio
C3	E4	RI	P	Asymp	14,900	20,170	1.35
C3	E5	JF	P	Asymp	14,770	19,880	1.34
C3	D5	MY	P	Asymp	14,890	20,340	1.37
C3	D1	TE	P	FW/WS	20,680	27,460	1.33
C3	A1	QE	P	WS/WS	20,680	27,300	1.32
E2	A1	LA	P	WS/WS	17,780	26,290	1.48
D3	A1	TI	P	WS/WS	17,420	25,580	1.47
D3	A4	EC	P	FW/WS	19,140	26,480	1.38
D3	A6	TT	P	FW	19,980	27,340	1.37
D3	D1	TP	P	FW/WS	19,680	27,530	1.40
D3	D9	CH	P	FW/WS	20,540	27,300	1.33
D4	D5	S1	V	Asymp	15,720	20,930	1.33
D4	E5	PO	V	Asymp	15,280	20,200	1.32
D4	A1	K4	V	WS/WS	20,440	26,870	1.31
D4	A2	N3	V	WS	19,290	25,480	1.32
D4	A4	N1	V	FW/WS	20,680	27,360	1.32
D3	2 x 2	A	P	Pert	15,400	20,350	1.32
D3	2 x 2	B	P	Pert	15,410	20,390	1.32
E3	E1	D	P	FW/WS	9,300	14,270	1.53

Notes: (a) Based on burnup-gamma activity correlations.

SECTION 7

UNIT CELL CALCULATIONS

Unit cell calculations were performed with modified versions of the LEOPARD^[9] and LASER^[17] computer programs: LEOPARD-HIC and LASER-HIC. The HIC (Higher Isotope Calculation) routine is described in Reference 15, along with the modified ENDF/3 (16) cross section library used in the calculations. The LEOPARD-HIC and LASER-HIC input and output data used in this report are from References 3 and 18.

7.1 Irradiation History for Unit Cell Calculations

The LEOPARD-HIC calculations consisted of 26 time steps with time varying values of temperature and power density, with 11 of these time steps at zero power. The LASER-HIC calculation consisted of 13 time steps at constant values of temperature and power density.

7.1.1 Irradiation History Used in LEOPARD-HIC Calculations

The LEOPARD-HIC unit cell calculations were set up to follow the irradiation history of pellet sample MY-2 and vipac sample PO-6, and include time steps at zero power to account for the many periods during which the reactor was shutdown. The irradiation history is summarized on a time step basis in Appendix G. For reference, some unit cell parameters after 120 hours are listed in Table G2. Boron was not included in the calculations.

7.1.2 Irradiation History Used in LASER-HIC Calculations

The LASER-HIC calculation was performed primarily to predict the radial distribution of main chain U and Pu isotopes in the fuel sample from rod R1, which was subjected to radial microdrilling. The calculation was performed at a constant linear power density of 7.5 kw/ft, with no shutdowns or zero power time steps.

7.2 Initial Isotopic Composition of Fuel

The initial fuel composition of the pre-irradiated Saxton Core II fuel was obtained from two sources: 1) manufacturer's records, and 2) mass spectrometric analysis of archive (retainer) samples believed to be representative of the Saxton Core II mixed oxide fuel. Unfortunately, these two sets of data show several inconsistencies which have not been completely resolved. The two sets of data, for pellet and vipac fuel, are summarized in Table 7-1.

TABLE 7-1
SUMMARY OF INITIAL COMPOSITION OF SAXTON CORE II PELLETS
AND VIPAC PuO₂-UO₂ FUEL^(a)

	Data From Measurement				REBUF ^(e)		LEOPARD-HIC		LASER-HIC
	Archive Samples ^(b)		Manufacturer's Records ^(c)		Pellet	Vipac	Pellet	Vipac	Pellet
	Pellet	Vipac	Pellet	Vipac					
U-234 Atom percent	0.00548 ± 0.00028	0.00527 ± 0.00014	0.00571	0.00570	0.00548	0.00548	0.00537	0.00558	0.00550
U-235 Atom percent	0.729 ± 0.002	0.728 ± 0.003	0.720	0.720	0.729	0.728	0.729	0.729	0.729
U-236 Atom Percent	-----	-----	0	0	0	0	0	0	0
U-238 Atom percent	99.265 ± 0.002	99.267 ± 0.003	99.274	99.274	99.266	99.267	99.266	99.265	99.265
Pu-238 Atom percent	0.0150 ± 0.0022	0.0146 ± 0.0010	0.0160 ^(d)	0.0146 ^(d)	0.0160	0.0146	0.0153	0.0160	0.0160
Pu-239 Atom percent	90.472 ± 0.046	90.454 ± 0.004	90.531 ± 0.025	90.316	90.472	90.455	90.465	90.465	90.470
Pu-240 Atom percent	8.593 ± 0.031	8.608 ± 0.008	8.559 ± 0.020	8.572	8.593	8.608	8.599	8.599	8.590
Pu-241 Atom percent	0.875 ± 0.013	0.877 ± 0.004	0.847 ± 0.006	1.030	0.875	0.877	0.876	0.876	0.880
Pu-242 Atom percent	0.0441 ± 0.0022	0.0457 ± 0.0011	0.0471 ± 0.0029	0.068	0.0441	0.0457	0.0449	0.0449	0.0440
Pu-239/U-238 Atom ratio	0.06311 ± 0.00060	0.06415 ± 0.00160	0.0640 ± 0.0002 0.0643 ± 0.0002	0.063 0.0623	0.0640	0.0630	0.06249	0.06249	0.06406
Pu/U Mass ratio	0.06957 ± 0.00066 0.06833	0.07072 ± 0.00176 0.00173	0.0705 ± 0.0002 0.0709 ± 0.0002	0.069 0.0688	0.0705	0.0695	0.06890	0.06890	0.0706

Notes: (a) All data referenced to Saxton Core II beginning-of-life on December 28, 1965.

(b) From WARD mass spectrometric analysis of unirradiated samples of archive fuel.

(c) Uranium isotopic analysis not reported in manufacturer's records; nominal values for natural uranium assumed here. Plutonium abundance data from mass spectrometric analysis; Pu/U data from chemical Pu assay, x-ray fluorescence analysis, and coulometric titration.

(d) Manufacturer's records do not include analysis for Pu-238; values of Pu-238 a/o shown here are from mass spectrometric analysis of unirradiated archive samples.

(e) Used in reduction of spent fuel data.

In the case of the uranium isotopic abundance, the analysis on the archive samples indicate an initial U-235 abundance somewhat higher, and a U-234 abundance somewhat lower, than the corresponding values assumed for natural uranium. In the case of the plutonium isotopic abundance, the analysis on the archive samples and the manufacturer's records show good agreement for the pellet fuel, but poor agreement for the vipac fuel. More recent analysis^[20,21] of one of the archive samples of unirradiated pellet fuel, tends to corroborate the results obtained from the manufacturer's records for pellet fuel, including the values assumed for initial uranium isotopic abundances.

Because of the continuing efforts to resolve the anomalies in the initial composition data, and since the calculations and the reduction of the data from spent fuel samples were performed at different stages of the program, a single consistent set of initial composition was not used throughout. The initial fuel compositions used in the various calculations are included in Table 7-1 for reference. (Initial composition input to the REBUF data-reducing code are also shown, in several forms, in Tables F1 and F2.

For the special isotopes (those not in the main U and Pu chains), the initial concentrations used in the LEOPARD-HIC calculations were obtained from measurement and calculations. The initial concentrations of Pu-236 and Pu-238 were determined from alpha spectrometric and mass spectrometric measurements, respectively, of the unirradiated archive samples. The initial concentration of Th-232 impurity was estimated from data in Reference 15 and the initial Pa-231 was calculated from α -decay of U-235 and β -decay of Th-231. The initial concentration of U-232 was calculated from α -decay of Pu-236; and the initial concentration of Am-241 was calculated from β -decay of Pu-241.

The initial fuel composition used in the LEOPARD-HIC calculations is summarized in Table 7-2, where the concentration of each isotope is given relative to the initial concentration of U-238. Note that these data are approximate since, to calculate the isotopic decay which occurred prior to Saxton Core II beginning-of-life, it was necessary to estimate the date of plutonium separation.

The values of plutonium concentration used in the LEOPARD-HIC calculations, shown on Table 7-1 and 7-2, are relatively low; these values are based on Pu/U results from initial analyses of the archive samples which were subsequently shown to be biased low by 1.82 percent.

TABLE 7-2
ESTIMATE OF INITIAL ISOTOPIC CONCENTRATIONS IN SAXTON CORE II FUEL^(a)

Isotope	Isotopic Concentration Relative to U-238	Data Source
Th-232	8.8×10^{-8}	Calc.
Pa-231	1.2×10^{-8}	Calc.
U-232	6.2×10^{-11}	Calc.
U-234	5.41×10^{-5}	Meas.
U-235	7.34×10^{-3}	Meas.
U-236	0	
U-238	1.00	Meas.
Pu-236	1.30×10^{-10}	Meas.
Pu-238	1.06×10^{-5}	Meas.
Pu-239	6.25×10^{-2}	Meas.
Pu-240	5.94×10^{-3}	Meas.
Pu-241	6.05×10^{-4}	Meas.
Pu-242	3.10×10^{-5}	Meas.
Am-241	5.21×10^{-5}	Calc.

Note: (a) Used in LEOPARD-HIC unit cell calculations.

SECTION 8

COMPARISON BETWEEN CALCULATED AND MEASURED ISOTOPIC BUILDUP AND DEPLETION IN SAXTON CORE II FUEL

The results obtained from the unit cell calculations described in Section 7 have been compared with the results obtained from mass spectrometric and alpha spectrometric analyses on the Saxton Core II spent fuel samples. For all isotopes in the pellet-size samples, the concentrations calculated with the matrix exponential method in the HIC portion of LEOPARD-HIC are used in the comparisons. The results from the LASER portion of the LASER-HIC calculation are compared with radial microsample measurements; in addition, a comparison is made between results from the HIC portion and results which represent a composite of a pellet sample, obtained by volume-weighting the data from individual radial microsamples.

The evaluations are made only for those isotopes which were measured; these include the main chain uranium and plutonium isotopes -- U-234, U-235, U-236, U-238, Pu-239, Pu-240, Pu-241, and Pu-242, and the special isotopes Np-237, Pu-236, Pu-238, Am-241, Am-243, Cm-242, and Cm-244. To place the calculated and measured data on the same basis, all measured and calculated data are referenced to core end-of-life by appropriately adjusting the measured and calculated data to account for radioactive decay during the intervals between core end-of-life and analysis. For the measured data, these corrections include:

Pu-236	Pu-236 α -decay
Pu-238	Pu-238 α -decay and Cm-242 α -decay
Pu-241	Pu-241 β -decay
Am-241	Am-241 α -decay and Pu-241 β -decay
Cm-242	Cm-242 α -decay
Cm-244	Cm-244 α -decay

The method used to decay-correct the measured data was outlined previously in Section 5.2.

Tables which summarize the measurements, the calculated values at the value of total fissions corresponding to the Nd-148 measurements, and the comparison of measurement and calculation, are included in Appendices A, B, C and D. The comparisons are discussed in detail in the following paragraphs.

8.1 Comparison Between Measurement and LEOPARD-HIC Calculation of Main Chain U and Pu Isotopes

The results of both the LEOPARD-HIC calculations and the measurements in Appendix A represent the asymptotic neutron spectrum; however, in Appendix B, results of the same LEOPARD-HIC asymptotic unit cell calculations are shown with measured data which represent the nonasymptotic neutron spectra (fuel from regions adjacent to water slots, flux

thimbles, etc.). Thus, the comparisons in Appendix A are valid, with only a few exceptions, while those given in Appendix B are for reference only. Since the irradiation history represented in the LEOPARD-HIC calculations corresponds to the Zone 6 samples, some caution should be used in evaluating Pu-238 and Pu-241 data of samples from other axial sample zones (i.e., zones 1, 2, 3, 10, and 11).

The differences between calculated and measured values of selected parameters representative of the asymptotic neutron spectrum are summarized in Table 8-1. These differences are the averages of the results from five samples of pellet fuel (from rod RI Zones 4, 6, 8, rod JF Zone 7, and rod MY Zone 6) and from three samples of vipac fuel (Rod SI Zone 6 and Rod PO Zones 6 and 8). Also shown in Table 8-1 are estimates of measurement uncertainty associated with each parameter.

The U and Pu isotopic abundances are shown on Figures 8-1 and 8-2, respectively; the Pu/U mass ratio data are shown on Figure 8-3. In terms of U and Pu production versus burnup, both calculated and measured, there is no apparent significant difference between pellet and vipac fuel. Note that on Figures 8-1, 8-2, and 8-3, the calculation represents Zone 6 (pellet and vipac), whereas the measured data are from all axial sample zones.

The LEOPARD-HIC calculations performed in this study underpredict the Pu/U ratio (i.e., overpredict the net plutonium depletion) by about four percent; approximately one-half of this discrepancy is attributed to the use of inaccurate values of plutonium concentration in the initialization of the calculations. A comparison between the LASER-HIC calculation and the composited results of the measurements on the ten radial microsamples (documented in Appendix D) shows that the calculation underpredicts the Pu/U ratio by about two percent, which is consistent with the LEOPARD-HIC calculations. (It is pointed out that the LASER-HIC calculations were initialized with higher values of plutonium concentrations than were the LEOPARD-HIC calculations.)

8.2 Comparison Between Measurement and LEOPARD-HIC Calculation of Special Isotopes of U, Np, Pu, Am, and Cm

The results of measurements for Np-237, Pu-236, Pu-238, Am-241, Am-243, Cm-242, and Cm-244 are documented in Appendix H. The differences between measurements and the LEOPARD-HIC calculation are given in Table 8-2; they are the averages of the results from two pellet samples from Zone 6 (fuel rod RI Zone 6 and fuel rod MY Zone 6). Also shown in Table 8-2 are estimates of measurement uncertainty associated with each parameter.

The concentration of Np-237 relative to U-238 is shown as a function of burnup on Figure 8-4. Figures 8-5 through 8-10 show the concentrations of Pu-236, Pu-238, Am-241, Cm-242, and Cm-244, each relative to Pu-239. The alpha spectrum resolution obtained for the set of Am-243 samples was not sufficient to detect the Am-243 peak in the presence of the relatively large Am-241 peak; therefore, only "less than" values can be reported.^[20] The discontinuities in the calculated curves are due to isotopic decay during the zero power time steps in the LEOPARD-HIC calculation (see Tables 2-1 and G1 for irradiation history).

TABLE 8-1

COMPARISON BETWEEN MEASUREMENT AND LEOPARD-HIC CALCULATION
OF MAIN CHAIN U AND Pu ISOTOPES IN SAXTON CORE II MIXED-OXIDE FUEL

Parameter	Percent ^(a) Relative Uncertainty In Measurement	Percent Difference Between Calculation And Measurement ^(b)	
		Pellet	Vipac
U-234 Atom Percent	29.4	2.9	6.1
U-235 Atom Percent	0.9	-0.8	0.2
U-236 Atom Percent	5.6	5.2	5.3
U-238 Atom Percent	0.01	0.00	0.00
Pu-238 Atom Percent	2.3	-24.6	-23.9
Pu-239 Atom Percent	0.03	0.86	-1.18
Pu-240 Atom Percent	0.2	2.2	3.3
Pu-241 Atom Percent	0.3	3.6	3.4
Pu-242 Atom Percent	0.9	0.4	0.9
Pu-239/U-238 Atom Ratio	0.7	-4.8	-4.9
Pu/U Mass Ratio	0.7	-3.9	-3.9

Notes: (a) Two standards deviation precision.

(b) $(\text{Calc}-\text{Meas})/\text{Meas} \times 100$ Percent; LEOPARD-HIC axial zone 6
calculation at about 20,000 MWD/MTM.

Figure 8-1. Calculated and Measured Uranium Isotopic Abundance versus Burnup in Saxton Core II Mixed-Oxide Fuel

Figure 8-2. Calculated and Measured Plutonium Isotopic Abundance versus Burnup in Saxton Core II Mixed-Oxide Fuel

Figure 8-3. Calculated and Measured Pu/U Mass Ratio versus Burnup in Saxton Core II Mixed-Oxide Fuel

TABLE 8-2
COMPARISON BETWEEN MEASUREMENT AND LEOPARD-HIC CALCULATION
OF Np, Pu, Am, AND Cm ISOTOPES IN SAXTON CORE II MIXED-OXIDE FUEL

Isotope	Measured Parameter	Percent ^[a] Relative Uncertainty in Measurement	Percent ^[b] Difference Between Calculation and Measurement
Np-237	Np-237 dpm/g U	±15	-34
Pu-236	Pu-236/Pu-239	±24	8
Pu-238	Pu-238/Pu-239	± 4	-28
Am-241	Am-241/Pu-239	±24	-4
Am-243	Am-243/Pu-239	[c]	--
Cm-242	Cm-242/Pu-239	±10	-24
Cm-244	Cm-244/Pu-239	±20	-38

- Notes: (a) Two standard deviations. Referenced to core end-of-life.
 (b) (Calc-Meas)/Meas x 100 percent; LEOPARD-HIC axial Zone 6 calculation at about 20,000 MWD/MTM.
 (c) Measured data not resolved.

Figure 8-4. Calculated and Measured Np-237/U-238 Atom Ratio versus Burnup in Saxton Core II Mixed-Oxide Fuel

Figure 8-5. Calculated and Measured Pu-236/Pu-239 Atom Ratio versus Burnup in Saxton Core II Mixed-Oxide Fuel

Figure 8-6. Calculated and Measured Pu-238/Pu-239 Atom Ratio versus Burnup in Saxton Core II Mixed-Oxide Fuel

Figure 8-7. Calculated and Measured Am-241/Pu-239 Atom Ratio versus Burnup in Saxton Core II Mixed-Oxide Fuel

Figure 8-8. Calculated and Measured Am-243/Pu-239 Atom Ratio versus Burnup in Saxton Core II Mixed-Oxide Fuel

Figure 8-9. Calculated and Measured Cm-242/Pu-239 Atom Ratio versus Burnup in Saxton Core II Mixed-Oxide Fuel

Figure 8-10. Calculated and Measured Cm-244/Pu-239 Atom Ratio versus Burnup in Saxton Core II Mixed-Oxide Fuel

The significance of the isotope Pu-236 is that it is the precursor for U-232, an undesirable by-product of irradiation. (U-232 and its daughter products are hard gamma-emitters which interfere in the fuel reprocessing). The primary reason for the measurement of Pu-236 in this study is to evaluate the adequacy of the calculational model and basic nuclear data used in the solution of the uranium-neptunium transmutation equations. Although, the scope of this program did not include measurements for U-232, estimates of its concentrations were obtained from the LEOPARD-HIC calculations. The calculated U-232/U-235 atom ratio is shown as a function of burnup on Figure 8-11.

8.3 Calculated and Measured Radial Distribution of U and Pu Isotopes in Saxton Pellet Sample

The measured and predicted results for the ten Saxton Core II radial microsamples are documented in Appendix C. The predicted data were obtained from the LASER calculation by integrating over that radial region of the pellet corresponding to the dimensions of the radial microdrilling. The LASER calculation consisted of 13 at-power time steps, with no zero-power time steps for reactor shutdown.

Figure 8-12 shows the radial burnup distribution in rod RI at a location 17.75 to 18.75 in. from the bottom of the rod (Axial Sample Zone 7). The agreement between the LASER calculation and measurements is good except for two data points near the center. The calculated data correspond to a volume average burnup of 20,600 MWD/MTM; the measured data are from analysis for Nd-148 concentration in the radial microsamples, and correspond to a volume average burnup of $20,450 \pm 640$ MWD/MTM.

Figure 8-13 shows the radial distribution of Pu-239/U-238 ratio. Again, the LASER calculation agrees well with measurements. A slight increase in Pu-239 concentration near the pellet surface is due to the buildup of Pu-239 converted from U-238. Figure 8-13 also shows no significant plutonium migration up the temperature gradient in this rod because the LASER code does not account for this phenomenon and the calculated plutonium distribution agrees with experimental data.

Figures 8-14, 8-15, and 8-16 show the radial distributions of uranium isotopic abundances. Considerable experimental scatter in U-235 data is seen in Figure 8-14. The LASER code does not predict the increase in U-235 abundance near the pellet surface, even though both U-235 and U-238 are depleted more at the surface than at the center. Figure 8-17 shows the radial distribution of the final-to-initial U-238 atom ratio.

Figures 8-18, 8-19, 8-20, and 8-21 show good agreement between calculated plutonium isotopic abundances and measurements. The experimental confirmation of Pu-240 distribution shown in Figure 8-19 is interesting from the viewpoint of reactivity coefficient calculation because the information on the variation of the radial Pu-240 distribution with burnup is required in the accurate calculation of Doppler coefficients. The LASER code predicts that the Pu-240 concentration is higher at the pellet surface than at the center at low burnups and the distribution reverses direction above $\sim 10,000$ MWD/MTM. More Pu-240 buildup at the surface during low burnup irradiation is due to the higher Pu-239 capture rates at the

surface. After a significant Pu-240 buildup, however, the spatial self-shielding of the large Pu-240 resonance becomes important and results in more depletion at the surface.

The measured distributions of U-234 and Pu-238 abundance are shown on Figures 8-22 and 8-23. The LASER-HIC code does not include these isotopes in the radial distribution calculation; however, the HIC routine does calculate the pellet average concentrations of these isotopes. For reference, the calculated pellet-average abundance of U-234 and Pu-238 are included on Figures 8-22 and 8-23. The LASER-HIC calculation tends to overpredict U-234 abundance and underpredict Pu-238 abundance, consistent with the results of the LEOPARD-HIC calculations described earlier in this section. The LASER-HIC calculation was performed at a constant power density, with no zero power time steps to account for reactor shutdowns during the irradiation of Core II. Thus, all of the Cm-242 which would have decayed to Pu-238 is not accounted for, and the final value of calculated Pu-238 is considerably lower than that obtained from the LEOPARD-HIC calculations.

Figure 8-11. Calculated U-232/U-235 Atom Ratio versus Burnup in Saxton Core II Mixed-Oxide Fuel

Figure 8-12. Calculated and Measured Radial Burnup Distribution in SAXTON Core II Mixed-Oxide Fuel Pellet

Figure 8-13. Calculated and Measured Radial Distribution of Pu-239/U-238 Atom Ratio in a SAXTON Core II Irradiated Mixed-Oxide Fuel Pellet

Figure 8-14. Calculated and Measured Radial Distribution of U-235 Abundance in a SAXTON[®] Core II Irradiated Mixed-Oxide Fuel Pellet

Figure 8-15. Calculated and Measured Radial Distribution of U-236 Abundance in a SAXTON Core II Irradiated Mixed-Oxide Fuel Pellet

Figure 8-16.. Calculated and Measured Radial Distribution of U-238 Abundance in a SAXTON Core II Irradiated Mixed-Oxide Fuel Pellet

Figure 8-17. Calculated and Measured Radial Distribution of U-238 Concentration in a SAXTON Core II Irradiated Mixed-Oxide Fuel Pellet

Figure 8-18. Calculated and Measured Radial Distribution of Pu-239 Abundance in a SAXTON Core II Irradiated Mixed-Oxide Fuel Pellet

Figure 8-19. Calculated and Measured Radial Distribution of Pu-240 Abundance in a SAXTON Core 11 Irradiated Mixed-Oxide Fuel Pellet

Figure 8-20. Calculated and Measured Radial Distribution of Pu-241 Abundance in a SAXTON Core II Irradiated Mixed-Oxide Fuel Pellet

Figure 8-21. Calculated and Measured Radial Distribution of Pu-242 Abundance in a SAXION Core II Irradiated Mixed-Oxide-Fuel Pellet

Figure 8-22. Measured Radial Distribution of U-234 Abundance in a SAXTON Core II Irradiated Mixed-Oxide Fuel Pellet

Figure 8-23. Measured Radial Distribution of Pu-238 Abundance in a SAXTON Core II Irradiated Mixed-Oxide Fuel Pellet

SECTION 9

SUMMARY AND CONCLUSIONS

Physics evaluations were performed with mass spectrometric, alpha spectrometric, and radio-chemical data obtained from analysis of 47 samples (including 10 radial microsamples) removed from Saxton Core II Zr-clad $\text{PuO}_2\text{-UO}_2$ fuel rods; these rods consisted of both pelletized and vibratory compacted fuel and represented both asymptotic and non-asymptotic neutron spectra. The maximum measured values of axial samples (one-inch segments) and rod-average burnup were about 29,000 MWD/MTM and 20,700 MWD/MTM, respectively.

Comparisons of burnup values determined with two independent methods – the Heavy Element method and the Nd-148 fission product method – showed agreement to within two percent, thus verifying the internal consistency of the mass spectrometric data and the validity of the data-reduction methods.

Pellet burnups inferred from Cs-137 activity showed a negative four percent bias and indicated the possibility of a few percent Cs axial migration from the center to the ends of the fuel rod. Evaluation of Cs-137 data from radial microsamples showed a high degree of radial migration within the pellet, with burnups inferred from Cs being seventy percent lower at the center and fifteen to twenty percent higher at the periphery than the burnups determined by the Heavy Element and Nd-148 methods.

Comparisons between unit cell calculations and measurements for the main chain U and Pu isotopes showed agreement to within about three percent. The calculations tend to underpredict the plutonium concentration by two percent.

In the case of the special isotopes (i.e., those not included in the U and Pu main chains), the unit cell calculations were in good agreement with measured values of Pu-236 and Am-241, and showed gross discrepancies for Np-237, Pu-238, Cm-242 and Cm-244. The calculations overpredicted Pu-236 by eight percent and underpredicted Am-241 by four percent, both differences being well within the uncertainties of the measurements. The calculations underpredicted Np-237 and Pu-238 by about thirty percent, and underpredicted the Cm-242 and Cm-244 isotopes by approximately twenty and forty percent respectively.

SECTION 10

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APPENDIX A

MEASURED AND LEOPARD-HIC CALCULATED ISOTOPIC DATA FOR SAXTON CORE II ZIRCALOY-CLAD $\text{PuO}_2\text{-UO}_2$ FUEL SAMPLES FROM ASYMPTOTIC NEUTRON SPECTRUM

The following 22 pages summarize the measured and calculated U and Pu isotopic data for the asymptotic neutron spectrum in Saxton Core II pellet-type fuel rods RI, JF and MY, and vipac fuel rods S1 and PO. The calculations were performed with a modified version of the LEOPARD-HIC code, which provided a reasonably accurate representation of the irradiation history of the Zone 6 samples. However, the calculations were initialized with a value of plutonium concentration approximately two to three percent lower than that which was actually loaded in Core II. The basis for the comparisons are total calculated fission product pairs.

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNIT-CELL CALCULATION, SAXTON ROD MY, ZON 5, PELLET PH02-U02
VERSUS

WARD RI-18, ROD RI, ASMPY C3, ROD LOC E4, ASYMP PELLET, ZONE 1 11/04/69

PARAMETER	MEASURED RESULTS				CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-235 ATOM RATIO	1.3360E-04	+/-	9.405E-07	.7		
TOTAL FISSIONS/U-238(POL), ND	7.9931E-03	+/-	2.136E-04	2.7	7.9931E-03	-0.0
TOTAL FISSIONS/U-238(POL), HE	8.1271E-03	+/-	4.130E-04	5.1	7.9931E-03	-1.6
U-234 ATOM PERCENT	4.9000E-03	+/-	1.316E-03	27.5	5.0906E-03	3.9
U-235 ATOM PERCENT	6.6700E-01	+/-	5.334E-03	.8	6.7264E-01	.8
U-236 ATOM PERCENT	1.3500E-02	+/-	1.606E-03	11.9	1.3951E-02	3.3
U-238 ATOM PERCENT	9.9315E+01	+/-	1.417E-02	.0	9.9308E+01	-0.0
PU-238 ATOM PERCENT	3.4551E-02	+/-	1.796E-03	5.2	1.9949E-02	-42.3
PU-239 ATOM PERCENT	8.4801E+01	+/-	1.902E-02	.0	8.4515E+01	-.3
PU-240 ATOM PERCENT	1.2529E+01	+/-	2.269E-02	.2	1.2552E+01	.2
PU-241 ATOM PERCENT	2.5052E+00	+/-	9.938E-03	.4	2.7852E+00	11.2
PU-242 ATOM PERCENT	1.2984E-01	+/-	2.911E-03	2.2	1.2835E-01	-1.1
PU-239/U-238 ATOM RATIO	5.6180E-02	+/-	3.730E-04	.7	5.4894E-02	-2.3
PU/U MASS RATIO	6.6127E-02	+/-	4.394E-04	.7	6.4830E-02	-2.0
TOT PU NET PRODUCTION KG/MTM	-4.3544E+00	+/-	4.219E-01	9.7	-5.1613E+00	18.5
FISS PU NET PRODUCTION KG/MTM	-6.4704E+00	+/-	3.713E-01	5.7	-7.1158E+00	10.0
U-235 EFFECTIVE CAP/FIS RATIO	2.6562E-01	+/-	5.261E-02	19.8	3.1360E-01	18.1
NET GM FIS MATL DESTROYED/MWD	9.5926E+01	+/-	7.966E-02	8.3	1.0647E+00	11.0
FISS ATOMS DISCH/LOADED RATIO	8.9431E-01	+/-	5.413E-03	.6	8.8134E-01	-1.5
U-235 FRACTIONAL DEPLETION	8.8317E-02	+/-	7.789E-03	8.8	9.7940E-02	10.9
BURNUP, HE METHOD, MWD/MTM	7.3643E+03	+/-	3.958E+02	5.4	7.3028E+03	-.8
BURNUP, ND-148 METHOD, MWD/MTM	7.2428E+03	+/-	2.308E+02	3.2	7.3028E+03	.8

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PU02-U02
VERSUS

WARD RT-19, ROD RT, ASY C3, ROD LOC E4, ASYM PELLET, ZONE 2

11/10/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE +/-	2-STD DEV	PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	2.6950E-04	+/- 1.897E-06	.7		
TOTAL FISSIONS/U-238(POL), ND	1.6090E-02	+/- 4.272E-04	2.7	1.6090E-02	-0.0
TOTAL FISSIONS/U-238(POL), HF	1.6503E-02	+/- 7.916E-04	4.8	1.6090E-02	-2.5
U-234 ATOM PERCENT	4.5400E-03	+/- 1.331E-03	29.3	4.8278E-03	6.3
U-235 ATOM PERCENT	6.1500E-01	+/- 5.158E-03	.8	6.1570E-01	.1
U-236 ATOM PERCENT	2.6800E-02	+/- 1.867E-03	7.0	2.7441E-02	2.4
U-238 ATOM PERCENT	9.9354E+01	+/- 1.416E-02	.0	9.9352E+01	-0.0
PU-238 ATOM PERCENT	7.6004E-02	+/- 2.201E-03	2.9	4.4099E-02	-42.0
PU-239 ATOM PERCENT	7.8751E+01	+/- 2.143E-02	.0	7.8405E+01	-.4
PU-240 ATOM PERCENT	1.6289E+01	+/- 2.642E-02	.2	1.6462E+01	1.1
PU-241 ATOM PERCENT	4.5554E+00	+/- 1.340E-02	.3	4.7640E+00	4.6
PU-242 ATOM PERCENT	3.2826E-01	+/- 4.026E-03	1.2	3.2443E-01	-1.2
PU-239/U-238 ATOM RATIO	4.9400E-02	+/- 3.280E-04	.7	4.7683E-02	-3.5
PU/U MASS RATIO	6.2660E-02	+/- 4.165E-04	.7	6.0749E-02	-3.0
TOT PU NET PRODUCTION KG/MTM	-7.8561E+00	+/- 4.034E-01	5.1	-8.9031E+00	13.3
FISS PU NET PRODUCTION KG/MTM	-1.1853E+01	+/- 3.430E-01	2.9	-1.2681E+01	7.0
U-235 EFFECTIVE CAP/FIS RATIO	2.9498E-01	+/- 3.292E-02	11.2	3.1049E-01	5.3
NET GR FIS MATL DESTROYED/MWD	8.6794E-01	+/- 5.171E-02	6.0	9.4202E-01	8.5
FISS ATOMS DISCH/LOADED RATIO	8.0620E-01	+/- 4.886E-03	.6	7.8853E-01	-2.2
U-235 FRACTIONAL DEPLETION	1.6335E-01	+/- 7.476E-03	4.6	1.7445E-01	6.8
BURNUP, HE METHOD, MWD/MTM	1.4922E+04	+/- 7.611E+02	5.1	1.4708E+04	-1.4
BURNUP, ND-148 METHOD, MWD/MTM	1.4548E+04	+/- 4.602E+02	3.2	1.4708E+04	1.1

* PERCENT DIFFER = 100 * (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC LATTICE CALCULATION, SAXTON ROD MY, ZON 6, PELLET PU02-U02
VERSUS

WARD RI-20, ROD FI, ASY (3-ROD LOC E4, ASYM (GRID) PELLET ZONE 3 11/10/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE +/- 2-STD DEV		PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.1130E-04 +/- 2.192E-06		.7		
TOTAL FISSIONS/U-238(POL): ND	1.8556E-02 +/- 4.908E-04		2.6	1.8556E-02	-0.0
TOTAL FISSIONS/U-238(POL): HE	1.9227E-02 +/- 9.180E-04		4.8	1.8556E-02	-3.5
U-234 ATOM PERCENT	4.5600E-03 +/- 1.332E-03		29.2	4.7509E-03	4.2
U-235 ATOM PERCENT	5.9700E-01 +/- 5.096E-03		.9	5.9821E-01	.2
U-236 ATOM PERCENT	3.1200E-02 +/- 1.938E-03		6.2	3.1439E-02	.8
U-238 ATOM PERCENT	9.9366E+01 +/- 1.415E-02		.0	9.9366E+01	-0.0
PU-238 ATOM PERCENT	8.4341E-02 +/- 2.231E-03		2.6	5.5575E-02	-34.1
PU-239 ATOM PERCENT	7.7083E+01 +/- 2.214E-02		.0	7.6484E+01	-0.8
PU-240 ATOM PERCENT	1.7080E+01 +/- 2.716E-02		.2	1.7664E+01	3.4
PU-241 ATOM PERCENT	5.3381E+00 +/- 1.455E-02		.3	5.3848E+00	.9
PU-242 ATOM PERCENT	4.1490E-01 +/- 4.402E-03		1.1	4.1130E-01	-0.9
PU-239/U-238 ATOM RATIO	4.8130E-02 +/- 3.196E-04		.7	4.5544E-02	-5.4
PU/U MASS RATIO	6.2386E-02 +/- 4.147E-04		.7	5.9497E-02	-4.6
TOT PU NET PRODUCTION KG/MTM	-8.2465E+00 +/- 4.015E-01		4.9	-1.0261E+01	24.4
FISS PU NET PRODUCTION KG/MTM	-1.2690E+01 +/- 3.388E-01		2.7	-1.4515E+01	14.4
U-235 EFFECTIVE CAP/FIS RATIO	2.9735E-01 +/- 2.914E-02		9.8	3.0932E-01	4.0
NET GM FIS MAIL DESTROYED/MWD	8.0400E-01 +/- 4.630E-02		5.8	9.3481E-01	16.3
FISS ATOMS DISCH/LOADED RATIO	7.9095E-01 +/- 4.805E-03		.6	7.5780E-01	-4.2
U-235 FRACTIONAL DEPLETION	1.8976E-01 +/- 7.363E-03		3.9	2.0104E-01	5.9
BURNUP, HE METHOD, MWD/MTM	1.7370E+04 +/- 8.818E+02		5.1	1.6976E+04	-2.3
BURNUP, ND-148 METHOD, MWD/MTM	1.6764E+04 +/- 5.281E+02		3.2	1.6976E+04	1.3

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PH02-U02
 VERSUS
 WARD RI-21, ROD RI, ASY C3, ROD LOC E4, ASYM PELLET, ZONE 4 (NOT SCH) 11/10/69

PARAMETER	M E A S U R E D R E S U L T S			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR		AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER
ND-148/U-238 ATOM RATIO	3.6520E-04 +/- 2.571E-06	.7			
TOTAL FISSIONS/U-238 (POL), ND	2.1774E-02 +/- 5.744E-04	2.6		2.1774E-02	-0.0
TOTAL FISSIONS/U-238 (POL), HE	2.2352E-02 +/- 1.066E-03	4.8		2.1774E-02	-2.6
U-234 ATOM PERCENT	4.3700E-03 +/- 1.324E-03	30.3		4.6473E-03	6.3
U-235 ATOM PERCENT	5.8000E-01 +/- 5.036E-03	.9		5.7472E-01	-0.9
U-236 ATOM PERCENT	3.5400E-02 +/- 2.000E-03	5.7		3.6697E-02	3.7
U-238 ATOM PERCENT	9.9380E+01 +/- 1.415E-02	.0		9.9384E+01	.0
PU-238 ATOM PERCENT	9.9139E-02 +/- 2.321E-03	2.3		7.2422E-02	-26.9
PU-239 ATOM PERCENT	7.4410E+01 +/- 2.332E-02	.0		7.3822E+01	-0.8
PU-240 ATOM PERCENT	1.8856E+01 +/- 2.880E-02	.2		1.9277E+01	2.2
PU-241 ATOM PERCENT	6.0825E+00 +/- 1.558E-02	.3		6.2789E+00	3.2
PU-242 ATOM PERCENT	5.5235E-01 +/- 4.929E-03	.9		5.4902E-01	-0.6
PU-239/U-238 ATOM RATIO	4.4740E-02 +/- 2.971E-04	.7		4.2725E-02	-4.5
PU/U MASS RATIO	6.0091E-02 +/- 3.995E-04	.7		5.7846E-02	-3.7
TOT PU NET PRODUCTION KG/MTM	-1.0413E+01 +/- 3.909E-01	3.8		-1.2334E+01	18.4
FISS PU NET PRODUCTION KG/MTM	-1.5546E+01 +/- 3.246E-01	2.1		-1.7135E+01	10.2
U-235 EFFECTIVE CAP/FIS RATIO	3.0190E-01 +/- 2.671E-02	8.8		3.0756E-01	1.9
NET GM FIS MATL DESTROYED/MWD	8.4089E-01 +/- 4.602E-02	5.5		9.3988E-01	11.8
FISS ATOMS DISCH/LOADED RATIO	7.4588E-01 +/- 4.536E-03	.6		7.1374E-01	-4.3
U-235 FRACTIONAL DEPLETION	2.1349E-01 +/- 7.268E-03	3.4		2.4071E-01	12.8
BURNUP, HE METHOD, MWD/MTM	2.0195E+04 +/- 1.023E+03	5.1		1.9955E+04	-1.2
BURNUP, ND-148 METHOD, MWD/MTM	1.9673E+04 +/- 6.177E+02	3.1		1.9955E+04	1.4

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PUC2-U02
 VERSUS
 WARD RT-3, ROD RT, ASMEY C3, ROD LOC E4, ASYMP PELLET, ZONE 6 9/03/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	PERCENT DIFFER*	
ND-148/U-238 ATOM RATIO	3.7952E-04 +/- 2.672E-06	.7			
TOTAL FISSIONS/U-238 (FOL), ND	2.2622E-02 +/- 5.949E-04	2.6	2.2622E-02	-0.0	
TOTAL FISSIONS/U-238 (FOL), HE	2.3292E-02 +/- 1.107E-03	4.8	2.2622E-02	-2.9	
U-234 ATOM PERCENT	4.4800E-03 +/- 1.329E-03	29.7	4.6193E-03	3.1	
U-235 ATOM PERCENT	5.6900E-01 +/- 4.997E-03	.9	5.6836E-01	-0.1	
U-236 ATOM PERCENT	3.6300E-02 +/- 2.013E-03	5.5	3.8100E-02	5.0	
U-238 ATOM PERCENT	9.9390E+01 +/- 1.415E-02	.0	9.9389E+01	-0.0	
PU-238 ATOM PERCENT	1.0451E-01 +/- 2.368E-03	2.3	7.7363E-02	-26.0	
PU-239 ATOM PERCENT	7.3747E+01 +/- 2.366E-02	.0	7.3086E+01	-0.9	
PU-240 ATOM PERCENT	1.9248E+01 +/- 2.916E-02	.2	1.9715E+01	2.4	
PU-241 ATOM PERCENT	6.3137E+00 +/- 1.583E-02	.3	6.5308E+00	3.4	
PU-242 ATOM PERCENT	5.8451E-01 +/- 5.052E-03	.9	5.9053E-01	.7	
PU-239/U-238 ATOM RATIO	4.4100E-02 +/- 2.928E-04	.7	4.1971E-02	-4.8	
PU/U MASS RATIO	5.9773E-02 +/- 3.974E-04	.7	5.7403E-02	-4.0	
TOT PU NET PRODUCTION KG/MTM	-1.0741E-01 +/- 3.893E-01	3.6	-1.2932E+01	20.4	
FISS PU NET PRODUCTION KG/MTM	-1.6048E-01 +/- 3.222E-01	2.0	-1.7863E+01	11.3	
U-235 EFFECTIVE CAP/FIS RATIO	2.8622E-01 +/- 2.414E-02	8.4	3.0705E-01	7.3	
NET GM FIS MATL DESTROYED/MWD	8.3524E+01 +/- 4.523E-02	5.4	9.4292E-01	12.9	
FISS ATOMS DISCH/LOADED RATIO	7.3680E-01 +/- 4.488E-03	.6	7.0147E-01	-4.8	
U-235 FRACTIONAL DEPLETION	2.2887E-03 +/- 7.201E-03	3.1	2.5200E-01	10.1	
BURNUP, HE METHOD, MWD/MTM	2.1057E+04 +/- 1.064E+03	5.1	2.0744E+04	-1.5	
BURNUP, ND-148 METHOD, MWD/MTM	2.0451E+04 +/- 6.401E+02	3.1	2.0744E+04	1.4	

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZGN 6, PELLET PH02-U02
 VERSUS
 WARD RI-22, ROD RI, ASY C3, ROD LOC E4, ASYM PELLET, ZONE 8 11/10/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	PERCENT DIFFER*	
ND-148/U-238 ATOM RATIO	3.8160E-04 +/- 2.686E-06	.7			
TOTAL FISSIONS/U-238(POL), ND	2.2742E-02 +/- 5.986E-04	2.6	2.2742E-02	-0.0	
TOTAL FISSIONS/U-238(POL), HE	2.3420E-02 +/- 1.114E-03	4.8	2.2742E-02	-2.9	
U-234 ATOM PERCENT	4.4400E-03 +/- 1.327E-03	29.9	4.6153E-03	3.9	
U-235 ATOM PERCENT	5.7100E-01 +/- 5.005E-03	.9	5.6746E-01	-0.6	
U-236 ATOM PERCENT	3.6000E-02 +/- 2.009E-03	5.6	3.8299E-02	6.4	
U-238 ATOM PERCENT	9.9389E+01 +/- 1.415E-02	.0	9.9390E+01	.0	
PU-238 ATOM PERCENT	1.0428E-01 +/- 2.338E-03	2.2	7.8078E-02	-25.1	
PU-239 ATOM PERCENT	7.3704E+01 +/- 2.364E-02	.0	7.2981E+01	-1.0	
PU-240 ATOM PERCENT	1.9284E+01 +/- 2.919E-02	.2	1.9777E+01	2.6	
PU-241 ATOM PERCENT	6.3177E+00 +/- 1.590E-02	.3	6.5670E+00	3.9	
PU-242 ATOM PERCENT	5.9018E-01 +/- 5.063E-03	.9	5.9658E-01	1.1	
PU-239/U-238 ATOM RATIO	4.4170E-02 +/- 2.933E-04	.7	4.1864E-02	-5.2	
PU/U MASS RATIO	5.9902E-02 +/- 3.983E-04	.7	5.7340E-02	-4.3	
TOT PU NET PRODUCTION KG/MTM	-1.0636E+01 +/- 3.899E-01	3.7	-1.3019E+01	22.4	
FISS PU NET PRODUCTION KG/MTM	-1.5986E+01 +/- 3.225E-01	2.0	-1.7967E+01	12.4	
U-235 EFFECTIVE CAP/FIS RATIO	2.8687E-01 +/- 2.440E-02	8.5	3.0698E-01	7.0	
NET GM FIS MATL DESTROYED/MWD	8.2700E-01 +/- 4.482E-02	5.4	9.4340E-01	14.1	
FISS ATOMS DISCH/LOADED RATIO	7.3799E-01 +/- 4.494E-03	.6	6.9971E-01	-5.2	
U-235 FRACTIONAL DEPLETION	2.2635E-01 +/- 7.212E-03	3.2	2.5362E-01	12.0	
BURNUP, HE METHOD, MWD/MTM	2.1170E+04 +/- 1.070E+03	5.1	2.0855E+04	-1.5	
BURNUP, ND-148 METHOD, MWD/MTM	2.0557E+04 +/- 6.440E+02	3.1	2.0855E+04	1.5	

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET P102-U02
 VERSUS
 WARD RI-24, ROD RI, ASMPY C3, ROD LOC E, ASYMP PELLET, ZONE 10 11/17/69

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PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV		PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.2660E-04	+/- 2.299E-06	.7		
TOTAL FISSIONS/U-238 (POL), ND	1.9482E-02	+/- 5.135E-04	2.6	1.9482E-02	-0.0
TOTAL FISSIONS/U-238 (POL), HE	2.0199E-02	+/- 9.600E-04	4.8	1.9482E-02	-3.6
U-234 ATOM PERCENT	3.9800E-03	+/- 1.307E-03	32.8	4.7214E-03	18.6
U-235 ATOM PERCENT	5.8800E-01	+/- 5.065E-03	.9	5.9154E-01	.6
U-236 ATOM PERCENT	3.0800E-02	+/- 1.932E-03	6.3	3.2944E-02	7.0
U-238 ATOM PERCENT	9.9378E+01	+/- 1.415E-02	.0	9.9371E+01	-0.0
PU-238 ATOM PERCENT	1.1473E-01	+/- 2.508E-03	2.2	6.0137E-02	-47.6
PU-239 ATOM PERCENT	7.4005E+01	+/- 2.261E-02	.0	7.5737E+01	-4.4
PU-240 ATOM PERCENT	1.7959E+01	+/- 2.798E-02	.2	1.8122E+01	.9
PU-241 ATOM PERCENT	5.4651E+00	+/- 1.473E-02	.3	5.6336E+00	3.1
PU-242 ATOM PERCENT	4.5675E-01	+/- 4.570E-03	1.0	4.4793E-01	-1.9
PU-239/U-238 ATOM RATIO	4.639CE-02	+/- 3.080E-04	.7	4.4738E-02	-3.6
PU/U MASS RATIO	6.0993E-02	+/- 4.055E-04	.7	5.9024E-02	-3.2
TOT PU NET PRODUCTION KG/MTM	-9.5114E+00	+/- 3.952E-01	4.2	-1.0824E+01	13.8
FISS PU NET PRODUCTION KG/MTM	-1.4269E+01	+/- 3.309E-01	2.3	-1.5244E+01	6.8
U-235 EFFECTIVE CAP/FIS RATIO	2.7024E-01	+/- 2.553E-02	9.4	3.0884E-01	14.3
NET GM FIS MATL DESTROYED/MWD	8.5642E-01	+/- 4.782E-02	5.6	9.3504E-01	9.2
FISS ATOMS DISCH/LOADED RATIO	7.6618E-01	+/- 4.655E-03	.6	7.4553E-01	-2.7
U-235 FRACTIONAL DEPLETION	2.0166E-01	+/- 7.316E-03	3.6	2.1194E-01	5.1
BURNUP, HE METHOD, MWD/MTM	1.8244E+04	+/- 9.220E+02	5.1	1.7831E+04	-2.3
BURNUP, ND-148 METHOD, MWD/MTM	1.7597E+04	+/- 5.523E+02	3.1	1.7831E+04	1.3

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PH02-U02
 VERSUS
 WARD RT-25, ROD RT, ASMPY C3, ROD LOC E4, ASYMP PELLET, ZONE 11 11/11/69

PARAMETER	MEASURED RESULTS				CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	1.7260E-04	+/-	1.215E-06	.7		
TOTAL FISSIONS/U-238 (ROL), ND	1.0316E-02	+/-	2.767E-04	2.7	1.0316E-02	-0.0
TOTAL FISSIONS/U-238 (ROL), HE	1.0693E-02	+/-	5.285E-04	4.9	1.0316E-02	-3.5
U-234 ATOM PERCENT	5.2200E-03	+/-	1.359E-03	26.0	5.0114E-03	-4.0
U-235 ATOM PERCENT	6.5500E-01	+/-	5.294E-03	.8	6.5618E-01	.2
U-236 ATOM PERCENT	1.7400E-02	+/-	1.693E-03	9.7	1.7923E-02	3.0
U-238 ATOM PERCENT	9.9323E+01	+/-	1.417E-02	.0	9.9321E+01	-0.0
PU-238 ATOM PERCENT	4.1929E-02	+/-	1.875E-03	4.5	2.4285E-02	-42.1
PU-239 ATOM PERCENT	8.3038E+01	+/-	1.970E-02	.0	8.2752E+01	-0.3
PU-240 ATOM PERCENT	1.3723E+01	+/-	2.391E-02	.2	1.3682E+01	-0.3
PU-241 ATOM PERCENT	3.0255E+00	+/-	1.090E-02	.4	3.3694E+00	11.4
PU-242 ATOM PERCENT	1.7173E-01	+/-	3.194E-03	1.9	1.7217E-01	.3
PU-239/U-238 ATOM RATIO	5.4570E-02	+/-	3.623E-04	.7	5.2769E-02	-3.3
PU/U MASS RATIO	6.5607E-02	+/-	4.360E-04	.7	6.3662E-02	-3.0
TOT PU NET PRODUCTION KG/MTM	-4.9567E+00	+/-	4.184E-01	8.4	-6.2885E+00	26.9
FISS PU NET PRODUCTION KG/MTM	-7.7553E+00	+/-	3.643E-01	4.7	-8.7866E+00	13.3
U-235 EFFECTIVE CAP/FIS RATIO	2.9198E-01	+/-	4.815E-02	16.5	3.1298E-01	7.2
NET GM FIS MATL DESTROYED/MWD	8.7414E-01	+/-	6.401E-02	7.3	1.0183E+00	16.5
FISS ATOMS DISCH/LOADED RATIO	8.7325E-01	+/-	5.283E-03	.6	8.5347E-01	-2.3
U-235 FRACTIONAL DEPLETION	1.0646E-01	+/-	7.712E-03	7.2	1.2090E-01	13.6
BURNUP, HE METHOD, MWD/MTM	9.6909E+03	+/-	5.082E+02	5.2	9.4280E+03	-2.7
BURNUP, ND-148 METHOD, MWD/MTM	9.3490E+03	+/-	2.990E+02	3.2	9.4280E+03	.8

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET P1102-U02
VERSUS

WARD JF-1, ROD JF, ASMPY C3, ROD LOC ES, ASYMP PELLET, ZONE 7 8/20/69

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PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.7330E-04	+/- 2.628E-06	.7		
TOTAL FISSIONS/U-238(POL), ND	2.2254E-02	+/- 5.872E-04	2.6	2.2254E-02	-0.0
TOTAL FISSIONS/U-238(POL), HE	2.2847E-02	+/- 1.089E-03	4.8	2.2254E-02	-2.6
U-234 ATOM PERCENT	4.6700E-03	+/- 1.337E-03	28.6	4.6315E-03	-0.8
U-235 ATOM PERCENT	5.7800E-01	+/- 5.029E-03	.9	5.7113E-01	-1.2
U-236 ATOM PERCENT	3.5800E-02	+/- 2.006E-03	5.6	3.7490E-02	4.7
U-238 ATOM PERCENT	9.9382E+01	+/- 1.415E-02	.0	9.9387E+01	.0
PU-238 ATOM PERCENT	8.8569E-02	+/- 2.239E-03	2.5	7.5189E-02	-15.1
PU-239 ATOM PERCENT	7.4051E+01	+/- 2.352E-02	.0	7.3408E+01	-0.9
PU-240 ATOM PERCENT	1.9131E+01	+/- 2.906E-02	.2	1.9524E+01	2.1
PU-241 ATOM PERCENT	6.1594E+00	+/- 1.561E-02	.3	6.4205E+00	4.2
PU-242 ATOM PERCENT	5.6964E-01	+/- 4.993E-03	.9	5.7221E-01	.5
PU-239/U-238 ATOM RATIO	4.4430E-02	+/- 2.950E-04	.7	4.2299E-02	-4.8
PU/U MASS RATIO	5.9967E-02	+/- 3.987E-04	.7	5.7596E-02	-4.0
TOT PU NET PRODUCTION KG/MTM	-1.0549E+01	+/- 3.902E-01	3.7	-1.2670E+01	20.1
FISS PU NET PRODUCTION KG/MTM	-1.5812E+01	+/- 3.233E-01	2.0	-1.7545E+01	11.0
U-235 EFFECTIVE CAP/FIS RATIO	3.0166E-01	+/- 2.642E-02	8.8	3.0727E-01	1.9
NET GM FIS MATL DESTROYED/MWD	8.3640E-01	+/- 4.558E-02	5.4	9.4153E-01	12.6
FISS ATOMS DISCH/LOADED RATIO	7.4160E-01	+/- 4.511E-03	.6	7.0684E-01	-4.7
U-235 FRACTIONAL DEPLETION	2.1649E-01	+/- 7.255E-03	3.4	2.4706E-01	14.1
BURNUP, HE METHOD, MWD/MTM	2.0645E+04	+/- 1.046E+03	5.1	2.0401E+04	-1.2
BURNUP, ND-148 METHOD, MWD/MTM	2.0109E+04	+/- 6.315E+02	3.1	2.0401E+04	1.5

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PU02-U02
VERSUS

WARD JF-27, ROD JF, ASMBY C3, ROD LOC E5, ASYMP PELLET, ZONE 10 11/18/69

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PARAMETER	MEASURED		RESULTS		CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.2690E-04	+/-	2.301E-06	.7		
TOTAL FISSIONS/U-238(EOL), ND	1.9507E-02	+/-	5.156E-04	2.6	1.9507E-02	-0.0
TOTAL FISSIONS/U-238(EOL), HE	1.9966E-02	+/-	9.513E-04	4.8	1.9507E-02	-2.3
U-234 ATOM PERCENT	4.3900E-03	+/-	1.325E-03	30.2	4.7207E-03	7.5
U-235 ATOM PERCENT	5.9300E-01	+/-	5.082E-03	.9	5.9134E-01	-.3
U-236 ATOM PERCENT	3.1200E-02	+/-	1.938E-03	6.2	3.2984E-02	5.7
U-238 ATOM PERCENT	9.9371E+01	+/-	1.415E-02	.0	9.9371E+01	-0.0
PU-238 ATOM PERCENT	8.5828E-02	+/-	2.226E-03	2.6	6.0261E-02	-29.8
PU-239 ATOM PERCENT	7.6105E+01	+/-	2.257E-02	.0	7.5717E+01	-.5
PU-240 ATOM PERCENT	1.7950E+01	+/-	2.797E-02	.2	1.8134E+01	1.0
PU-241 ATOM PERCENT	5.4100E+00	+/-	1.466E-02	.3	5.6397E+00	4.2
PU-242 ATOM PERCENT	4.4977E-01	+/-	4.542E-03	1.0	4.4894E-01	-.2
PU-239/U-238 ATOM RATIO	4.6400E-02	+/-	3.081E-04	.7	4.4714E-02	-3.6
PU/U MASS RATIO	6.0922E-02	+/-	4.050E-04	.7	5.9013E-02	-3.1
TOT PU NET PRODUCTION KG/MTM	-9.5613E+00	+/-	3.950E-01	4.1	-1.0841E+01	13.4
FISS PU NET PRODUCTION KG/MTM	-1.4284E+01	+/-	3.308E-01	2.3	-1.5265E+01	6.9
U-235 EFFECTIVE CAP/FIS RATIO	2.8800E-01	+/-	2.776E-02	9.6	3.0883E-01	7.2
NET GW FIS MATL DESTROYED/MWD	8.6457E-01	+/-	4.842E-02	5.6	9.3507E-01	8.2
FISS ATOMS DISCH/LOADED RATIO	7.6667E-01	+/-	4.655E-03	.6	7.4520E-01	-2.8
U-235 FRACTIONAL DEPLETION	1.9463E-01	+/-	7.346E-03	3.8	2.1224E-01	9.0
BURNUP, HE METHOD, MWD/MTM	1.8036E+04	+/-	9.138E+02	5.1	1.7854E+04	-1.0
BURNUP, ND-148 METHOD, MWD/MTM	1.7621E+04	+/-	5.547E+02	3.1	1.7854E+04	1.3

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PU02-U02
VERSUS

WARD MY-16, ROD MY, ASMPY C3, ROD LOC DE, ASYMP PELLET, ZONE 2 10/21/69

PARAMETER	MEASURED RESULTS				CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	2.7830E-04	+/-	1.903E-06	.7		
TOTAL FISSIONS/U-238 (POL), ND	1.6143E-02	+/-	4.288E-04	2.7	1.6143E-02	-0.0
TOTAL FISSIONS/U-238 (POL), HE	1.6543E-02	+/-	7.942E-04	4.8	1.6143E-02	-2.4
U-234 ATOM PERCENT	4.7200E-03	+/-	1.338E-03	28.5	4.8262E-03	2.7
U-235 ATOM PERCENT	6.1600E-01	+/-	5.162E-03	.8	6.1532E-01	-.1
U-236 ATOM PERCENT	2.6700E-02	+/-	1.866E-03	7.0	2.7527E-02	3.1
U-238 ATOM PERCENT	9.9353E+01	+/-	1.416E-02	.0	9.9352E+01	-.0
PU-238 ATOM PERCENT	1.1024E-01	+/-	2.566E-03	2.3	4.4321E-02	-59.8
PU-239 ATOM PERCENT	7.8581E+01	+/-	2.151E-02	.0	7.8365E+01	-.3
PU-240 ATOM PERCENT	1.6398E+01	+/-	2.652E-02	.2	1.6488E+01	.5
PU-241 ATOM PERCENT	4.5779E+00	+/-	1.341E-02	.3	4.7771E+00	4.4
PU-242 ATOM PERCENT	3.3328E-01	+/-	4.049E-03	1.2	3.2614E-01	-2.1
PU-239/U-238 ATOM RATIO	4.9020E-02	+/-	3.255E-04	.7	4.7637E-02	-2.8
PU/U MASS RATIO	6.2312E-02	+/-	4.142E-04	.7	6.0722E-02	-2.6
TOT PU NET PRODUCTION KG/MTM	-8.1603E+00	+/-	4.019E-01	4.9	-8.9321E+00	9.5
FISS PU NET PRODUCTION KG/MTM	-1.2192E+01	+/-	3.413E-01	2.8	-1.2720E+01	4.3
U-235 EFFECTIVE CAP/FIS RATIO	2.9785E-01	+/-	3.353E-02	11.3	3.1045E-01	4.2
NET GM FIS MATL DESTROYED/MWD	8.8769E-01	+/-	5.256E-02	5.9	9.4186E-01	6.1
FISS ATOMS DISCH/LOADED RATIO	8.0131E-01	+/-	4.855E-03	.6	7.8787E-01	-1.7
U-235 FRACTIONAL DEPLETION	1.4174E-01	+/-	7.484E-03	4.6	1.7502E-01	8.2
BURNUP, HE METHOD, MWD/MTM	1.4959E+04	+/-	7.636E+02	5.1	1.4757E+04	-1.4
BURNUP, ND-148 METHOD, MWD/MTM	1.4597E+04	+/-	4.621E+02	3.2	1.4757E+04	1.1

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SEXTON ROD MY, ZON 6, PELLET PU02-U02
VERSUS
WARD MY-2, ROD MY, ASMEY C3, ROD LOC D5, ASYMP PELLET, ZONE 6 9/20/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	PERCENT DIFFER*	
ND-148/U-238 ATOM RATIO	3.7525E-04 +/- 2.642E-06	.7			
TOTAL FISSIONS/U-238(FOL), ND	2.2381E-02 +/- 5.895E-04	2.6	2.2381E-02	-0.0	
TOTAL FISSIONS/U-238(FOL), HE	2.2946E-02 +/- 1.092E-03	4.8	2.2381E-02	-2.5	
U-234 ATOM PERCENT	4.6500E-03 +/- 1.336E-03	28.7	4.6273E-03	-0.5	
U-235 ATOM PERCENT	5.7400E-01 +/- 5.015E-03	.9	5.7018E-01	-0.7	
U-236 ATOM PERCENT	3.5500E-02 +/- 2.002E-03	5.6	3.7701E-02	6.2	
U-238 ATOM PERCENT	9.9386E+01 +/- 1.415E-02	.0	9.9387E+01	.0	
PU-238 ATOM PERCENT	1.0914E-01 +/- 2.422E-03	2.2	7.5936E-02	-30.4	
PU-239 ATOM PERCENT	7.3774E+01 +/- 2.364E-02	.0	7.3297E+01	-0.6	
PU-240 ATOM PERCENT	1.9251E+01 +/- 2.916E-02	.2	1.9590E+01	1.8	
PU-241 ATOM PERCENT	6.2869E+00 +/- 1.581E-02	.3	6.4585E+00	2.7	
PU-242 ATOM PERCENT	5.7945E-01 +/- 5.027E-03	.9	5.7849E-01	-0.2	
PU-239/U-238 ATOM RATIO	4.3830E-02 +/- 2.910E-04	.7	4.2186E-02	-3.8	
PU/U MASS RATIO	5.9382E-02 +/- 3.949E-04	.7	5.7529E-02	-3.1	
TOT PU NET PRODUCTION KG/MTM	-1.1063E+01 +/- 3.877E-01	3.5	-1.2760E+01	15.3	
FISS PU NET PRODUCTION KG/MTM	-1.6306E+01 +/- 3.209E-01	2.0	-1.7654E+01	8.3	
U-235 EFFECTIVE CAP/FIS RATIO	2.9011E-01 +/- 2.510E-02	8.7	3.0719E-01	5.9	
NET GM FIS MATL DESTROYED/MWD	8.5817E-01 +/- 4.650E-02	5.4	9.4200E-01	9.8	
FISS ATOMS DISCH/LOADED RATIO	7.3371E-01 +/- 4.464E-03	.6	7.0499E-01	-3.9	
U-235 FRACTIONAL DEPLETION	2.2155E-01 +/- 7.235E-03	3.3	2.4876E-01	12.3	
BURNUP, HE METHOD, MWD/MTM	2.0737E+04 +/- 1.049E+03	5.1	2.0520E+04	-1.0	
BURNUP, ND-148 METHOD, MWD/MTM	2.0226E+04 +/- 6.341E+02	3.1	2.0520E+04	1.5	

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PU02-U02
 VERSUS
 WARD MY-17, ROD MY, ASMPY C3, ROD LOC DE, ASYMP PELLET, ZONE 10 11/04/69

PARAMETER	MEASURED RESULTS				CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE +/-	2-STD DEV	PERCENT ERROR		CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.0980E-04	+/- 2.181E-06	.7			
TOTAL FISSIONS/U-238(POL), ND	1.8481E-02	+/- 4.894E-04	2.6		1.8481E-02	-0.0
TOTAL FISSIONS/U-238(POL), HE	1.9791E-02	+/- 9.448E-04	4.8		1.8481E-02	-6.6
U-234 ATOM PERCENT	4.5900E-03	+/- 1.333E-03	29.0		4.7533E-03	3.6
U-235 ATOM PERCENT	5.9700E-01	+/- 5.096E-03	.9		5.9875E-01	.3
U-236 ATOM PERCENT	3.1400E-02	+/- 1.941E-03	6.2		3.1316E-02	-.3
U-238 ATOM PERCENT	9.9367E+01	+/- 1.415E-02	.0		9.9365E+01	-.0
PU-238 ATOM PERCENT	8.5182E-02	+/- 2.238E-03	2.6		5.5213E-02	-35.2
PU-239 ATOM PERCENT	7.6166E+01	+/- 2.255E-02	.0		7.6544E+01	.5
PU-240 ATOM PERCENT	1.7940E+01	+/- 2.796E-02	.2		1.7627E+01	-1.7
PU-241 ATOM PERCENT	5.3654E+00	+/- 1.458E-02	.3		5.3649E+00	-.0
PU-242 ATOM PERCENT	4.4384E-01	+/- 4.519E-03	1.0		4.0842E-01	-8.0
PU-239/U-238 ATOM RATIO	4.6420E-02	+/- 3.082E-04	.7		4.5610E-02	-1.7
PU/U MASS RATIO	6.0896E-02	+/- 4.049E-04	.7		5.9536E-02	-2.2
TOT PU NET PRODUCTION KG/MTM	-9.5741E+00	+/- 3.949E-01	4.1		-1.0216E+01	6.7
FISS PU NET PRODUCTION KG/MTM	-1.4286E+01	+/- 3.308E-01	2.3		-1.4457E+01	1.2
U-235 EFFECTIVE CAP/FIS RATIO	3.0167E-01	+/- 2.961E-02	9.8		3.0936E-01	2.5
NET GM FIS MATL DESTROYED/MWD	8.7803E-01	+/- 4.885E-02	5.6		9.3484E-01	7.4
FISS ATOMS DISCH/LOADED RATIO	7.6723E-01	+/- 4.655E-03	.6		7.5878E-01	-1.1
U-235 FRACTIONAL DEPLETION	1.8905E-01	+/- 7.371E-03	3.9		2.0017E-01	5.9
BURNUP, HE METHOD, MWD/MTM	1.7881E+04	+/- 9.077E+02	5.1		1.6906E+04	-5.5
BURNUP, ND-148 METHOD, MWD/MTM	1.6697E+04	+/- 5.267E+02	3.2		1.6906E+04	1.3

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SEXTON ROD P0, ZONE 6, VIPAC PU02-U02
VERSUS

WARD S1-28, ROD S1, ASMPY D4, ROD LOC D5, ASYMP VIPAC, ZONE 1 11/20/69

PARAMETER	MEASURED RESULTS			PERCENT ERROR	CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE	+/-	2-STD DEV		CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	1.3860E-04	+/-	9.757E-07	.7		
TOTAL FISSIONS/U-238 (POL), ND	8.3000E-03	+/-	2.230E-04	2.7	8.3000E-03	-0.0
TOTAL FISSIONS/U-238 (POL), HE	8.2274E-03	+/-	4.205E-04	5.1	8.3000E-03	.9
U-234 ATOM PERCENT	5.0600E-03	+/-	1.352E-03	26.7	5.2893E-03	4.5
U-235 ATOM PERCENT	6.6700E-01	+/-	5.334E-03	.8	6.7061E-01	.5
U-236 ATOM PERCENT	1.3600E-02	+/-	1.608E-03	11.8	1.4301E-02	5.2
U-238 ATOM PERCENT	9.9314E+01	+/-	1.417E-02	.0	9.9310E+01	-0.0
PU-238 ATOM PERCENT	3.7962E-02	+/-	1.854E-03	4.9	2.0938E-02	-44.8
PU-239 ATOM PERCENT	8.4440E+01	+/-	1.916E-02	.0	8.4194E+01	-.3
PU-240 ATOM PERCENT	1.2934E+01	+/-	2.311E-02	.2	1.2785E+01	-1.2
PU-241 ATOM PERCENT	2.4558E+00	+/-	9.855E-03	.4	2.8651E+00	16.7
PU-242 ATOM PERCENT	1.3283E-01	+/-	2.933E-03	2.2	1.3488E-01	1.5
PU-239/U-238 ATOM RATIO	5.4640E-02	+/-	3.628E-04	.7	5.4472E-02	-.3
PU/U MASS RATIO	6.4590E-02	+/-	4.292E-04	.7	6.4579E-02	-.0
TOT PU NET PRODUCTION KG/MTM	-4.7531E+00	+/-	5.300E-01	11.2	-4.9959E+00	5.1
FISS PU NET PRODUCTION KG/MTM	-7.0178E+00	+/-	4.727E-01	6.7	-7.1143E+00	1.4
U-235 EFFECTIVE CAP/FIS RATIO	2.7689E-01	+/-	5.693E-02	20.6	3.0951E-01	11.8
NET GM FIS MATL DESTROYED/MWD	1.0197E+00	+/-	9.475E-02	9.3	1.0169E+00	-.3
FISS ATOMS DISCH/LOADED RATIO	8.8480E-01	+/-	6.671E-03	.8	8.8170E-01	-.4
U-235 FRACTIONAL DEPLETION	8.6747E-02	+/-	8.299E-03	9.6	9.4646E-02	9.1
BURNUP, HE METHOD, MWD/MTM	7.4544E+03	+/-	4.032E+02	5.4	7.6226E+03	2.3
BURNUP, ND-148 METHOD, MWD/MTM	7.5201E+03	+/-	2.409E+02	3.2	7.6226E+03	1.4

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SEXTON ROD P1, ZONE 6, VIPAC PH02-U02
 VERSUS
 WARD S1-29, ROD S1, ASMEY D4, ROD LOC DE, ASYMP VIPAC, ZONE 2 12/01/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	CALCULATED VALUE	PERCENT DIFFER
ND-148/U-238 ATOM RATIO	2.7390E-04 +/- 1.928E-06	.7			
TOTAL FISSIONS/U-238 (POL), ND	1.6355E-02 +/- 4.339E-04	2.7	1.6355E-02		-.0
TOTAL FISSIONS/U-238 (POL), HE	1.6627E-02 +/- 7.959E-04	4.8	1.6355E-02		-1.6
U-234 ATOM PERCENT	4.8500E-03 +/- 1.344E-03	27.7	5.0219E-03		3.5
U-235 ATOM PERCENT	6.0900E-01 +/- 5.138E-03	.8	6.1407E-01		.8
U-236 ATOM PERCENT	2.6800E-02 +/- 1.867E-03	7.0	2.7534E-02		2.7
U-238 ATOM PERCENT	9.9359E+01 +/- 1.416E-02	.0	9.9353E+01		-.0
PU-238 ATOM PERCENT	6.7941E-02 +/- 2.070E-03	3.0	4.5364E-02		-33.2
PU-239 ATOM PERCENT	7.8467E+01 +/- 2.155E-02	.0	7.8009E+01		-.6
PU-240 ATOM PERCENT	1.4516E+01 +/- 2.663E-02	.2	1.6768E+01		1.5
PU-241 ATOM PERCENT	4.6114E+00 +/- 1.350E-02	.3	4.8394E+00		4.9
PU-242 ATOM PERCENT	3.3718E-01 +/- 4.066E-03	1.2	3.3750E-01		.1
PU-239/U-238 ATOM RATIO	4.8500E-02 +/- 3.220E-04	.7	4.7179E-02		-2.7
PU/U MASS RATIO	6.1745E-02 +/- 4.104E-04	.7	6.0614E-02		-2.2
TOT PU NET PRODUCTION KG/MTM	-7.7113E+00 +/- 5.180E-01	6.7	-8.9093E+00		15.5
FISS PU NET PRODUCTION KG/MTM	-1.1777E+01 +/- 4.539E-01	3.9	-1.2864E+01		9.2
U-235 EFFECTIVE CAP/FIS RATIO	2.8159E-01 +/- 3.126E-02	11.1	3.0627E-01		8.8
NET GM FIS MATL DESTROYED/MWD	8.5803E-01 +/- 5.604E-02	6.5	9.3389E-01		8.8
FISS ATOMS DISCH/LOADED RATIO	8.0403E-01 +/- 6.072E-03	.8	7.8597E-01		-2.2
U-235 FRACTIONAL DEPLETION	1.7061E-01 +/- 7.879E-03	4.6	1.7217E-01		.9
BURNUP, HE METHOD, MWD/MTM	1.5062E+04 +/- 7.672E+02	5.1	1.5016E+04		-.3
BURNUP, ND-148 METHOD, MWD/MTM	1.4816E+04 +/- 4.683E+02	3.2	1.5016E+04		1.3

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD P0, ZONE 6, VIPAC PU02-U02
VERSUS

WARD S1-7, ROD S1, ASMPY D4, ROD LOC D6, ASYMP VIPAC, ZONE 6 10/11/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	PERCENT DIFFER*	
ND-148/U-238 ATOM RATIO	3.9350E-04 +/- 2.770E-06	.7			
TOTAL FISSIONS/U-238(POL), ND	2.3436E-02 +/- 6.167E-04	2.6	2.3436E-02	-0.0	
TOTAL FISSIONS/U-238(POL), HE	2.4218E-02 +/- 1.150E-03	4.7	2.3436E-02	-3.2	
U-234 ATOM PERCENT	4.5400E-03 +/- 1.331E-03	29.3	4.7915E-03	5.5	
U-235 ATOM PERCENT	5.6200E-01 +/- 4.972E-03	.9	5.6297E-01	.2	
U-236 ATOM PERCENT	3.7000E-02 +/- 2.023E-03	5.5	3.8883E-02	5.1	
U-238 ATOM PERCENT	9.9396E+01 +/- 1.415E-02	.0	9.9393E+01	-0.0	
PU-238 ATOM PERCENT	1.0741E-01 +/- 2.348E-03	2.2	8.1980E-02	-23.7	
PU-239 ATOM PERCENT	7.2989E+01 +/- 2.399E-02	.0	7.2145E+01	-1.2	
PU-240 ATOM PERCENT	1.9755E+01 +/- 2.961E-02	.1	2.0371E+01	3.1	
PU-241 ATOM PERCENT	6.5147E+00 +/- 1.613E-02	.2	6.7621E+00	3.8	
PU-242 ATOM PERCENT	6.3315E-01 +/- 5.211E-03	.8	6.4024E-01	1.1	
PU-239/U-238 ATOM RATIO	4.3230E-02 +/- 2.870E-04	.7	4.0930E-02	-5.3	
PU/U MASS RATIO	5.9208E-02 +/- 3.937E-04	.7	5.6715E-02	-4.2	
TOT PU NET PRODUCTION KG/MTM	-1.0332E+01 +/- 5.084E-01	4.9	-1.2822E+01	24.1	
FISS PU NET PRODUCTION KG/MTM	-1.5909E+01 +/- 4.390E-01	2.8	-1.8142E+01	14.0	
U-235 EFFECTIVE CAP/FIS RATIO	2.7965E-01 +/- 2.338E-02	8.4	3.0246E-01	8.2	
NET GM FIS MATL DESTROYED/MWD	8.0115E-01 +/- 4.604E-02	5.7	9.1771E-01	14.5	
FISS ATOMS DISCH/LOADED RATIO	7.3443E-01 +/- 5.566E-03	.8	6.9757E-01	-5.0	
U-235 FRACTIONAL DEPLETION	2.3836E-01 +/- 7.541E-03	3.2	2.4851E-01	4.3	
BURNUP, HE METHOD, MWD/MTM	2.1857E+04 +/- 1.103E+03	5.0	2.1592E+04	-1.2	
BURNUP, ND-148 METHOD, MWD/MTM	2.1152E+04 +/- 6.623E+02	3.1	2.1592E+04	2.1	

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD P0, ZONE 5, VIPAC PH02-U02
 VERSUS
 WARD S1-30, ROD S1, ASMPY D4, ROD L02 D5, ASYMP VIPAC, ZONE 10 12/01/69

A-18

PARAMETER	M E A S U R E D R E S U L T S			C A L C U L A T E D R E S U L T S	
	VALUE +/- 2-STD DEV		PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.4690E-04 +/- 2.442E-06		.7		
TOTAL FISSIONS/U-238(POL), ND	2.0687E-02 +/- 5.469E-04		2.6	2.0687E-02	-0.0
TOTAL FISSIONS/U-238(POL), HE	2.1141E-02 +/- 1.005E-03		4.8	2.0687E-02	-2.1
U-234 ATOM PERCENT	4.6300E-03 +/- 1.335E-03		28.8	4.8821E-03	5.4
U-235 ATOM PERCENT	5.8300E-01 +/- 5.047E-03		.9	5.8307E-01	.0
U-236 ATOM PERCENT	3.3000E-02 +/- 1.965E-03		6.0	3.4488E-02	4.5
U-238 ATOM PERCENT	9.9379E+01 +/- 1.415E-02		.0	9.9378E+01	-0.0
PU-238 ATOM PERCENT	8.9543E-02 +/- 2.222E-03		2.5	6.6489E-02	-25.7
PU-239 ATOM PERCENT	7.5137E+01 +/- 2.299E-02		.0	7.4502E+01	-0.8
PU-240 ATOM PERCENT	1.8564E+01 +/- 2.853E-02		.2	1.8954E+01	2.1
PU-241 ATOM PERCENT	5.7111E+00 +/- 1.509E-02		.3	5.9706E+00	4.5
PU-242 ATOM PERCENT	4.9853E-01 +/- 4.730E-03		.9	5.0661E-01	1.6
PU-239/U-238 ATOM RATIO	4.5200E-02 +/- 3.001E-04		.7	4.3351E-02	-4.1
PU/U MASS RATIO	6.0119E-02 +/- 3.997E-04		.7	5.8152E-02	-3.3
TOT PU NET PRODUCTION KG/MTM	-9.3750E+00 +/- 5.117E-01		5.5	-1.1254E+01	20.1
FISS PU NET PRODUCTION KG/MTM	-1.4400E+01 +/- 4.443E-01		3.1	-1.6073E+01	11.6
U-235 EFFECTIVE CAP/FIS RATIO	2.8608E-01 +/- 2.668E-02		9.3	3.0409E-01	6.3
NET GM FIS MATL DESTROYED/MWD	8.2619E-01 +/- 4.934E-02		6.0	9.2174E-01	11.6
FISS ATOMS DISCH/LOADED RATIO	7.6040E-01 +/- 5.751E-03		.8	7.3229E-01	-3.7
U-235 FRACTIONAL DEPLETION	2.0824E-01 +/- 7.692E-03		3.7	2.1788E-01	4.6
BURNUP, HE METHOD, MWD/MTM	1.9124E+04 +/- 9.676E+02		5.1	1.9029E+04	-0.5
BURNUP, ND-148 METHOD, MWD/MTM	1.8713E+04 +/- 5.890E+02		3.1	1.9029E+04	1.7

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SEXTON ROD P0, ZONE 6, VIPAC PU02-U02
 VERSUS
 WARD S1-31, ROD S1, ASMPY D4, ROD LOC 05, ASYMP VIPAC, ZONE 11 12/01/69

PARAMETER	MEASURED RESULTS			PERCENT ERROR	CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE	+/-	2-STD DEV		CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	1.8170E-04	+/-	1.279E-06	.7		
TOTAL FISSIONS/U-238(POL), ND	1.0859E-02	+/-	2.894E-04	2.7	1.0859E-02	-0.0
TOTAL FISSIONS/U-238(POL), HE	1.1207E-02	+/-	5.490E-04	4.9	1.0859E-02	-3.1
U-234 ATOM PERCENT	4.8300E-03	+/-	1.343E-03	27.8	5.2008E-03	7.7
U-235 ATOM PERCENT	6.4300E-01	+/-	5.253E-03	.8	6.5261E-01	1.5
U-236 ATOM PERCENT	1.8000E-02	+/-	1.705E-03	9.5	1.8590E-02	3.3
U-238 ATOM PERCENT	9.9334E+01	+/-	1.416E-02	.0	9.9324E+01	-0.0
PU-238 ATOM PERCENT	4.1943E-02	+/-	1.824E-03	4.3	2.5949E-02	-38.1
PU-239 ATOM PERCENT	8.2579E+01	+/-	1.987E-02	.0	8.2229E+01	-.4
PU-240 ATOM PERCENT	1.4071E+01	+/-	2.426E-02	.2	1.4053E+01	-.1
PU-241 ATOM PERCENT	3.1235E+00	+/-	1.109E-02	.4	3.5063E+00	12.3
PU-242 ATOM PERCENT	1.8470E-01	+/-	3.275E-03	1.8	1.8553E-01	.5
PU-239/U-238 ATOM RATIO	5.3350E-02	+/-	3.542E-04	.7	5.2104E-02	-2.3
PU/U MASS RATIO	6.4506E-02	+/-	4.287E-04	.7	6.3263E-02	-1.9
TOT PU NET PRODUCTION KG/MTM	-4.9968E+00	+/-	5.287E-01	10.6	-6.2541E+00	25.2
FISS PU NET PRODUCTION KG/MTM	-7.9465E+00	+/-	4.687E-01	5.9	-8.9814E+00	13.0
U-235 EFFECTIVE CAP/FIS RATIO	2.5710E-01	+/-	3.889E-02	15.1	3.0874E-01	20.1
NET GM FIS MATL DESTROYED/MWD	8.6329E-01	+/-	7.065E-02	8.2	9.8163E-01	13.7
FISS ATOMS DISCH/LOADED RATIO	8.6706E-01	+/-	6.542E-03	.8	8.5062E-01	-1.9
U-235 FRACTIONAL DEPLETION	1.2203E-01	+/-	8.119E-03	6.7	1.1967E-01	-1.9
BURNUP, HE METHOD, MWD/MTM	1.0155E+04	+/-	5.285E+02	5.2	9.9704E+03	-1.8
BURNUP, ND-148 METHOD, MWD/MTM	9.8396E+03	+/-	3.127E+02	3.2	9.9704E+03	1.3

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SEXTON ROD P0, ZONE A, VIPAC PH02-U02
 VERSUS
 WARD P0-32, ROD P0, ASMPY 04, ROD LOC EE, ASYMP VIPAC, ZONE 2 12/03/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE +/- 2-STD DEV		PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	2.8340E-04	+/- 1.995E-06	.7		
TOTAL FISSIONS/L-238(POL), ND	1.6908E-02	+/- 4.495E-04	2.7	1.6908E-02	-0.0
TOTAL FISSIONS/L-238(POL), HE	1.7479E-02	+/- 8.366E-04	4.8	1.6908E-02	-3.3
U-234 ATOM PERCENT	4.6400E-03	+/- 1.335E-03	28.8	5.0041E-03	7.8
U-235 ATOM PERCENT	6.0900E-01	+/- 5.138E-03	.8	6.1015E-01	.2
U-236 ATOM PERCENT	2.7300E-02	+/- 1.876E-03	6.9	2.8425E-02	4.1
U-238 ATOM PERCENT	9.9359E+01	+/- 1.416E-02	.0	9.9356E+01	-0.0
PU-238 ATOM PERCENT	7.1754E-02	+/- 2.118E-03	3.0	4.7756E-02	-33.4
PU-239 ATOM PERCENT	7.7999E+01	+/- 2.175E-02	.0	7.7573E+01	-0.5
PU-240 ATOM PERCENT	1.6797E+01	+/- 2.690E-02	.2	1.7045E+01	1.5
PU-241 ATOM PERCENT	4.7760E+00	+/- 1.375E-02	.3	4.9784E+00	4.2
PU-242 ATOM PERCENT	3.5710E-01	+/- 4.156E-03	1.2	3.5644E-01	-0.2
PU-239/U-238 ATOM RATIO	4.9466E-02	+/- 3.218E-04	.7	4.6688E-02	-3.7
PU/U MASS RATIO	6.2061E-02	+/- 4.126E-04	.7	6.0126E-02	-3.1
TOT PU NET PRODUCTION KG/MTM	-7.4773E+00	+/- 5.189E-01	6.9	-9.2021E+00	23.1
FISS PU NET PRODUCTION KG/MTM	-1.1758E+01	+/- 4.539E-01	3.9	-1.3271E+01	12.9
U-235 EFFECTIVE CAP/FIS RATIO	2.8539E-01	+/- 3.140E-02	11.0	3.0601E-01	7.2
NET GM FIS MATL DESTROYED/MWD	8.1533E-01	+/- 5.303E-02	6.5	9.3193E-01	14.3
FISS ATOMS DISCH/LOADED RATIO	8.0420E-01	+/- 6.073E-03	.8	7.7917E-01	-3.1
U-235 FRACTIONAL DEPLETION	1.7154E-01	+/- 7.873E-03	4.6	1.7786E-01	3.7
BURNUP, HE METHOD, MWD/MTM	1.5835E+04	+/- 8.066E+02	5.1	1.5525E+04	-2.0
BURNUP, ND-148 METHOD, MWD/MTM	1.5317E+04	+/- 4.852E+02	3.2	1.5525E+04	1.4

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SEXTON ROD P0, ZONE 6, VIPAC PU02-U02
VERSUS

WARD P0-6, ROD P0, ASMPY D4, ROD LOC F5, ASYMP VIPAC, ZONE 6 9/20/69

PARAMETER	MEASURED RESULTS				CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.8600E-04	+/-	2.717E-06	.7		
TOTAL FISSIONS/U-238 (POL), ND	2.3017E-02	+/-	6.052E-04	2.6	2.3017E-02	-0.0
TOTAL FISSIONS/U-238 (POL), HE	2.3390E-02	+/-	1.112E-03	4.8	2.3017E-02	-1.6
U-234 ATOM PERCENT	4.6400E-03	+/-	1.335E-03	28.8	4.8054E-03	3.6
U-235 ATOM PERCENT	5.6500E-01	+/-	4.983E-03	.9	5.6606E-01	.2
U-236 ATOM PERCENT	3.6400E-02	+/-	2.014E-03	5.5	3.8213E-02	5.0
U-238 ATOM PERCENT	9.9398E+01	+/-	1.414E-02	.0	9.9391E+01	-0.0
PU-238 ATOM PERCENT	1.0425E-01	+/-	2.337E-03	2.2	7.9492E-02	-23.7
PU-239 ATOM PERCENT	7.3277E+01	+/-	2.386E-02	.0	7.2511E+01	-1.0
PU-240 ATOM PERCENT	1.9528E+01	+/-	2.941E-02	.2	2.0153E+01	3.2
PU-241 ATOM PERCENT	6.4705E+00	+/-	1.605E-02	.2	6.6377E+00	2.6
PU-242 ATOM PERCENT	6.2031E-01	+/-	5.168E-03	.8	6.1843E-01	-0.3
PU-239/U-238 ATOM RATIO	4.2890E-02	+/-	2.848E-04	.7	4.1299E-02	-3.7
PU/U MASS RATIO	5.8509E-02	+/-	3.891E-04	.7	5.6935E-02	-2.7
TOT PU NET PRODUCTION KG/MTM	-1.0898E+01	+/-	5.062E-01	4.6	-1.2579E+01	15.4
FISS PU NET PRODUCTION KG/MTM	-1.6226E+01	+/-	4.379E-01	2.7	-1.7825E+01	9.8
U-235 EFFECTIVE CAP/FIS RATIO	2.8201E-01	+/-	2.400E-02	8.5	3.0272E-01	7.3
NET GM FIS MATL DESTROYED/MWD	8.4253E-01	+/-	4.842E-02	5.7	9.1818E-01	9.0
FISS ATOMS DISCH/LOADED RATIO	7.3016E-01	+/-	5.530E-03	.8	7.0290E-01	-3.7
U-235 FRACTIONAL DEPLETION	2.3322E-01	+/-	7.569E-03	3.2	2.4376E-01	4.5
BURNUP, HE METHOD, MWD/MTM	2.1120E+04	+/-	1.068E+03	5.1	2.1201E+04	.4
BURNUP, ND-148 METHOD, MWD/MTM	2.0783E+04	+/-	6.503E+02	3.1	2.1201E+04	2.0

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SEXTON ROD P0, ZONE 6, VIPAC PH02-U02
 VERSUS
 WARD P0-33, ROD P0, ASMBY D4, ROD LOC EE, ASYMP VIPAC, ZONE 8 12/09/69

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PARAMETER	MEASURED RESULTS			CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE +/- 2-STD DEV		PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.9220E-04 +/- 2.761E-06		.7		
TOTAL FISSIONS/U-238(RQL), ND	2.3366E-02 +/- 6.143E-04		2.6	2.3366E-02	-0.0
TOTAL FISSIONS/U-238(RQL), HE	2.3966E-02 +/- 1.137E-03		4.7	2.3366E-02	-2.5
U-234 ATOM PERCENT	4.3900E-03 +/- 1.325E-03		30.2	4.7938E-03	9.2
U-235 ATOM PERCENT	5.6100E-01 +/- 4.969E-03		.9	5.6348E-01	.4
U-236 ATOM PERCENT	3.6700E-02 +/- 2.019E-03		5.5	3.8771E-02	5.6
U-238 ATOM PERCENT	9.9397E+01 +/- 1.414E-02		.0	9.9393E+01	-0.0
PU-238 ATOM PERCENT	1.0858E-01 +/- 2.327E-03		2.1	8.1562E-02	-24.9
PU-239 ATOM PERCENT	7.3122E+01 +/- 2.390E-02		.0	7.2206E+01	-1.3
PU-240 ATOM PERCENT	1.9643E+01 +/- 2.951E-02		.2	2.0335E+01	3.5
PU-241 ATOM PERCENT	6.5009E+00 +/- 1.617E-02		.2	6.7413E+00	3.7
PU-242 ATOM PERCENT	6.2488E-01 +/- 5.182E-03		.8	6.3657E-01	1.9
PU-239/U-238 ATOM RATIO	4.3230E-02 +/- 2.870E-04		.7	4.0991E-02	-5.2
PU/U MASS RATIO	5.9101E-02 +/- 3.930E-04		.7	5.6751E-02	-4.0
TOT PU NET PRODUCTION KG/MTM	-1.0412E+01 +/- 5.081E-01		4.9	-1.2782E+01	22.8
FISS PU NET PRODUCTION KG/MTM	-1.5907E+01 +/- 4.390E-01		2.8	-1.8089E+01	13.7
U-235 EFFECTIVE CAP/FIS RATIO	2.7504E-01 +/- 2.297E-02		8.4	3.0256E-01	10.0
NET GM FIS MATL DESTROYED/MWD	8.0996E-01 +/- 4.656E-02		5.7	9.1778E-01	13.3
FISS ATOMS DISCH/LOADED RATIO	7.3434E-01 +/- 5.565E-03		.8	6.9845E-01	-4.9
U-235 FRACTIONAL DEPLETION	2.3944E-01 +/- 7.535E-03		3.1	2.4772E-01	3.5
BURNUP, HE METHOD, MWD/MTM	2.1627E+04 +/- 1.091E+03		5.0	2.1527E+04	-0.5
BURNUP, ND-148 METHOD, MWD/MTM	2.1085E+04 +/- 6.596E+02		3.1	2.1527E+04	2.1

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD P0, ZONE 6, VIPAC PH02-U02
VERSUS
WARD P0-34, ROD P0, ASMBY D4, ROD LOC E5, ASYMP VIPAC, ZONE 10 12/04/69

PARAMETER	M E A S U R E D R E S U L T S				CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.3760E-04	+/-	2.377E-06	.7		
TOTAL FISSIONS/U-238(POL), ND	2.0127E-02	+/-	5.309E-04	2.6	2.0127E-02	-0.0
TOTAL FISSIONS/U-238(POL), HE	2.0855E-02	+/-	9.897E-04	4.7	2.0127E-02	-3.5
U-234 ATOM PERCENT	4.7900E-03	+/-	1.342E-03	28.0	4.9003E-03	2.3
U-235 ATOM PERCENT	5.8100E-01	+/-	5.040E-03	.9	5.8713E-01	1.1
U-236 ATOM PERCENT	3.1600E-02	+/-	1.944E-03	6.2	3.3592E-02	6.3
U-238 ATOM PERCENT	9.9383E+01	+/-	1.415E-02	.0	9.9374E+01	-0.0
PU-238 ATOM PERCENT	8.4982E-02	+/-	2.162E-03	2.5	6.3563E-02	-25.2
PU-239 ATOM PERCENT	7.5466E+01	+/-	2.285E-02	.0	7.4969E+01	-.7
PU-240 ATOM PERCENT	1.8342E+01	+/-	2.833E-02	.2	1.8669E+01	1.8
PU-241 ATOM PERCENT	5.6218E+00	+/-	1.497E-02	.3	5.8163E+00	3.5
PU-242 ATOM PERCENT	4.8459E-01	+/-	4.678E-03	1.0	4.8201E-01	-.5
PU-239/U-238 ATOM RATIO	4.5630E-02	+/-	3.030E-04	.7	4.3845E-02	-3.9
PU/U MASS RATIO	6.0427E-02	+/-	4.018E-04	.7	5.8444E-02	-3.3
TOT PU NET PRODUCTION KG/MTM	-9.0912E+00	+/-	5.128E-01	5.6	-1.0945E+01	20.4
FISS PU NET PRODUCTION KG/MTM	-1.4037E+01	+/-	4.456E-01	3.2	-1.5655E+01	11.5
U-235 EFFECTIVE CAP/FIS RATIO	2.6674E-01	+/-	2.495E-02	9.4	3.0440E-01	14.1
NET GM FIS MATL DESTROYED/MWD	8.1941E-01	+/-	4.924E-02	6.0	9.2287E-01	12.6
FISS ATOMS DISCH/LOADED RATIO	7.6562E-01	+/-	5.792E-03	.8	7.3930E-01	-3.4
U-235 FRACTIONAL DEPLETION	2.1097E-01	+/-	7.677E-03	3.6	2.1180E-01	.4
BURNUP, HE METHOD, MWD/MTM	1.8861E+04	+/-	9.524E+02	5.0	1.8509E+04	-1.9
BURNUP, ND-148 METHOD, MWD/MTM	1.8202E+04	+/-	5.717E+02	3.1	1.8509E+04	1.7

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

APPENDIX B

MEASURED ISOTOPIC DATA FOR SAXTON CORE II ZIRCALOY-CLAD $\text{PuO}_2\text{-UO}_2$ FUEL SAMPLES FROM NON-ASYMPTOTIC NEUTRON SPECTRA

The following 17 pages summarize measured U and Pu isotopic data for the non-asymptotic neutron spectra. Included are samples from pellet fuel rods TE, QE, LA, TI, TT, TP, and CH, and vipac fuel rods K4, N3, and N1. Results are also shown for overpower rods A and B and reference rod D. The data obtained from interlaboratory cross check analyses on samples from rods CH and QE are also listed.

The results of the LEOPARD-HIC unit cell calculations listed in the following pages are for the asymptotic neutron spectrum; since the measured data are from the non-asymptotic neutron spectra, the comparisons given on each page are not necessarily valid, and are shown for reference only.

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PU02-U02

VERSUS

WARD TE-14, ROD TE, ASMEY C3, ROD LOC D1, FW/WS PELLET, ZONE 2 10/21/69

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PARAMETER	M E A S U R E D R E S U L T S			CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE +/- 2-STD DEV		PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.7110E-04	+/- 2.613E-06	.7		
TOTAL FISSIONS/U-238(20L), ND	2.2199E-02	+/- 5.937E-04	2.7	2.2199E-02	-0.0
TOTAL FISSIONS/U-238(20L), HE	2.2947E-02	+/- 1.086E-03	4.7	2.2199E-02	-3.3
U-234 ATOM PERCENT	4.7100E-03	+/- 1.338E-03	28.4	4.6333E-03	-1.6
U-235 ATOM PERCENT	5.7700E-01	+/- 5.026E-03	.9	5.7154E-01	-.9
U-236 ATOM PERCENT	3.2900E-02	+/- 1.964E-03	6.0	3.7399E-02	13.7
U-238 ATOM PERCENT	9.9385E+01	+/- 1.415E-02	.0	9.9386E+01	.0
PU-238 ATOM PERCENT	8.8582E-02	+/- 2.198E-03	2.5	7.4870E-02	-15.5
PU-239 ATOM PERCENT	7.3158E+01	+/- 2.392E-02	.0	7.3455E+01	.4
PU-240 ATOM PERCENT	2.0322E+01	+/- 3.012E-02	.1	1.9496E+01	-4.1
PU-241 ATOM PERCENT	5.8615E+00	+/- 1.526E-02	.3	6.4042E+00	9.3
PU-242 ATOM PERCENT	5.7045E-01	+/- 4.995E-03	.9	5.6953E-01	-.2
PU-239/U-238 ATOM RATIO	4.3150E-02	+/- 2.865E-04	.7	4.2348E-02	-1.9
PU/U MASS RATIO	5.8954E-02	+/- 3.920E-04	.7	5.7625E-02	-2.3
TOT PU NET PRODUCTION KG/MTM	-1.1436E+01	+/- 3.858E-01	3.4	-1.2631E+01	10.5
FISS PU NET PRODUCTION KG/MTM	-1.7174E+01	+/- 3.166E-01	1.8	-1.7498E+01	1.9
U-235 EFFECTIVE CAP/FIS RATIO	2.6999E-01	+/- 2.410E-02	8.9	3.0730E-01	13.8
NET GM FIS MATL DESTROYED/MWD	8.9731E-01	+/- 4.816E-02	5.4	9.4133E-01	4.9
FISS ATOMS DISCH/LOADED RATIO	7.2124E-01	+/- 4.381E-03	.6	7.0763E-01	-1.9
U-235 FRACTIONAL DEPLETION	2.1716E-01	+/- 7.254E-03	3.3	2.4633E-01	13.4
BURNUP, HE METHOD, MWD/MTM	2.0767E+04	+/- 1.047E+03	5.0	2.0350E+04	-2.0
BURNUP, ND-148 METHOD, MWD/MTM	2.0073E+04	+/- 6.392E+02	3.2	2.0350E+04	1.4

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SXTON ROD MY, ZON 6, PELLET PH02-U02
VERSUS

WARD TE-4, ROD TE, ASMPY C3, ROD LOC D1, FW/WS PELLET, ZONE 6 10/08/60

PARAMETER	MEASURED RESULTS			PERCENT ERROR	CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE +/-	2-STD DEV			CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	5.0810E-04	+/-	3.577E-06	.7		
TOTAL FISSIONS/U-238(POL), ND	3.0343E-02	+/-	8.039E-04	2.6	3.0343E-02	-0.0
TOTAL FISSIONS/U-238(POL), HE	3.1363E-02	+/-	1.493E-03	4.8	3.0343E-02	-3.3
U-234 ATOM PERCENT	4.3400E-03	+/-	1.323E-03	30.5	4.3432E-03	.1
U-235 ATOM PERCENT	5.2600E-01	+/-	4.842E-03	.9	5.0526E-01	-3.9
U-236 ATOM PERCENT	4.4300E-02	+/-	2.120E-03	4.8	5.1621E-02	16.5
U-238 ATOM PERCENT	9.9425E+01	+/-	1.414E-02	.0	9.9439E+01	.0
PU-238 ATOM PERCENT	1.4198E-01	+/-	2.500E-03	1.8	1.3538E-01	-4.7
PU-239 ATOM PERCENT	6.6426E+01	+/-	2.716E-02	.0	6.5375E+01	-1.6
PU-240 ATOM PERCENT	2.4336E+01	+/-	3.359E-02	.1	2.4112E+01	-.9
PU-241 ATOM PERCENT	8.0394E+00	+/-	1.807E-02	.2	9.2764E+00	15.4
PU-242 ATOM PERCENT	1.0573E+00	+/-	6.479E-03	.6	1.1013E+00	4.2
PU-239/U-238 ATOM RATIO	3.6670E-02	+/-	2.435E-04	.7	3.4690E-02	-5.4
PU/U MASS RATIO	5.5222E-02	+/-	3.674E-04	.7	5.3093E-02	-3.9
TOT PU NET PRODUCTION KG/MTM	-1.5117E+01	+/-	3.690E-01	2.4	-1.9366E+01	28.1
FISS PU NET PRODUCTION KG/MTM	-2.2396E+01	+/-	2.921E-01	1.3	-2.5223E+01	12.6
U-235 EFFECTIVE CAP/FIS RATIO	2.7542E-01	+/-	1.934E-02	7.0	3.0160E-01	9.5
NET GM FIS MATL DESTROYED/MWD	8.4926E-01	+/-	4.379E-02	5.2	9.9044E-01	16.6
FISS ATOMS DISCH/LOADED RATIO	6.3581E-01	+/-	3.897E-03	.6	5.7695E-01	-9.3
U-235 FRACTIONAL DEPLETION	2.8962E-01	+/-	6.951E-03	2.4	3.7084E-01	28.0
BURNUP, HE METHOD, MWD/MTM	2.8664E+04	+/-	1.451E+03	5.1	2.7988E+04	-2.4
BURNUP, ND-148 METHOD, MWD/MTM	2.7732E+04	+/-	8.731E+02	3.1	2.7988E+04	.9

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PH02-U02
 VERSUS
 WARD TE-15, ROD TE, ASMPY C3, ROD LOC D1, FW/WS PELLET, ZONE 10 10/21/69

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PARAMETER	MEASURED RESULTS				CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	4.5020E-04	+/-	3.169E-06	.7		
TOTAL FISSIONS/U-238 (ROL), ND	2.6924E-02	+/-	7.160E-04	2.7	2.6924E-02	-0.0
TOTAL FISSIONS/U-238 (ROL), HE	2.7489E-02	+/-	1.302E-03	4.7	2.6924E-02	-2.1
U-234 ATOM PERCENT	4.6100E-03	+/-	1.334E-03	28.9	4.4711E-03	-3.0
U-235 ATOM PERCENT	5.4400E-01	+/-	4.908E-03	.9	5.3458E-01	-1.7
U-236 ATOM PERCENT	4.3200E-02	+/-	2.106E-03	4.9	4.5424E-02	5.1
U-238 ATOM PERCENT	9.9408E+01	+/-	1.414E-02	.0	9.9416E+01	.0
PU-238 ATOM PERCENT	1.0857E-01	+/-	2.262E-03	2.1	1.0637E-01	-2.0
PU-239 ATOM PERCENT	6.9294E+01	+/-	2.575E-02	.0	6.9057E+01	-.3
PU-240 ATOM PERCENT	2.2711E+01	+/-	3.221E-02	.1	2.2051E+01	-2.9
PU-241 ATOM PERCENT	7.0707E+00	+/-	1.687E-02	.2	7.9434E+00	12.3
PU-242 ATOM PERCENT	8.1639E-01	+/-	5.795E-03	.7	8.4158E-01	3.1
PU-239/U-238 ATOM RATIO	3.9070E-02	+/-	2.594E-04	.7	3.8031E-02	-2.7
PU/U MASS RATIO	5.6382E-02	+/-	3.750E-04	.7	5.5078E-02	-2.3
TOT PU NET PRODUCTION KG/MTM	-1.3914E+01	+/-	3.741E-01	2.7	-1.6297E+01	17.1
FISS PU NET PRODUCTION KG/MTM	-2.0512E+01	+/-	3.007E-01	1.5	-2.1802E+01	6.3
U-235 EFFECTIVE CAP/FIS RATIO	3.0135E-01	+/-	2.248E-02	7.5	3.0420E-01	.9
NET GM FIS MATL DESTROYED/MWD	8.9235E-01	+/-	4.651E-02	5.2	9.6587E-01	8.2
FISS ATOMS DISCH/LOADED RATIO	6.6665E-01	+/-	4.068E-03	.6	6.3493E-01	-4.8
U-235 FRACTIONAL DEPLETION	2.6337E-01	+/-	7.061E-03	2.7	3.1465E-01	19.5
BURNUP, HE METHOD, MWD/MTM	2.4971E+04	+/-	1.259E+03	5.0	2.4766E+04	-.8
BURNUP, ND-148 METHOD, MWD/MTM	2.4457E+04	+/-	7.737E+02	3.2	2.4766E+04	1.3

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET P102-U02
VERSUS

GE, ASY C3, ROD LOC A1, WS/WS ZONE 6 WARD 5/05/69, ND RE-CAL, PU RE-ANAL

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	5.0030E-04	+/-	3.522E-06	.7	
TOTAL FISSIONS/U-238(POL), ND	2.9926E-02	+/-	7.874E-04	2.6	2.9926E-02 -0.0
TOTAL FISSIONS/U-238(POL), HE	3.1294E-02	+/-	1.484E-03	4.7	2.9926E-02 -4.4
U-234 ATOM PERCENT	3.0000E-03	+/-	1.261E-03	42.0	4.3594E-03 45.3
U-235 ATOM PERCENT	5.0900E-01	+/-	4.778E-03	.9	5.0898E-01 -0.0
U-236 ATOM PERCENT	4.5000E-02	+/-	2.129E-03	4.7	5.0842E-02 13.0
U-238 ATOM PERCENT	9.9443E+01	+/-	1.413E-02	.0	9.9436E+01 -0.0
PU-238 ATOM PERCENT	9.2637E-02	+/-	2.077E-03	2.2	1.3150E-01 41.9
PU-239 ATOM PERCENT	6.5583E+01	+/-	2.768E-02	.0	6.5853E+01 .4
PU-240 ATOM PERCENT	2.5009E+01	+/-	3.417E-02	.1	2.3848E+01 -4.6
PU-241 ATOM PERCENT	8.2047E+00	+/-	1.810E-02	.2	9.1015E+00 10.9
PU-242 ATOM PERCENT	1.1109E+00	+/-	6.628E-03	.6	1.0662E+00 -4.0
PU-239/U-238 ATOM RATIO	3.4900E-02	+/-	2.317E-04	.7	3.5110E-02 .6
PU/U MASS RATIO	5.3244E-02	+/-	3.543E-04	.7	5.3343E-02 .2
TOT PU NET PRODUCTION KG/MTM	-1.6842E+01	+/-	3.603E-01	2.1	-1.8973E+01 12.7
FISS PU NET PRODUCTION KG/MTM	-2.4012E+01	+/-	2.845E-01	1.2	-2.4792E+01 3.2
U-235 EFFECTIVE CAP/FIS RATIO	2.5610E-01	+/-	1.721E-02	6.7	3.0193E-01 17.9
NET GM FIS MATL DESTROYED/MWD	9.0624E-01	+/-	4.641E-02	5.1	9.8722E-01 8.9
FISS ATOMS DISCH/LOADED RATIO	6.0948E-01	+/-	3.740E-03	.6	5.8424E-01 -4.1
U-235 FRACTIONAL DEPLETION	3.1127E-01	+/-	6.856E-03	2.2	3.6369E-01 16.8
BURNUP, HE METHOD, MWD/MTM	2.8806E+04	+/-	1.452E+03	5.0	2.7594E+04 -4.2
BURNUP, ND-148 METHOD, MWD/MTM	2.7547E+04	+/-	8.612E+02	3.1	2.7594E+04 .2

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MYZON 6, PELLET P 02-U02
 VERSUS
 GE XCK 640-QE SAX U02-FU02, ASY C3, ROD LOC A1, 18.75-19.75 IN. 5/29/69

PARAMETER	MEASURED RESULTS				CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM MD-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	5.0450E-04	+/-	3.552E-06	.7		
TOTAL FISSIONS/U-238 (PCL), ND	3.0336E-02	+/-	7.982E-04	2.6	3.0336E-02	-0.0
TOTAL FISSIONS/U-238 (PCL), HE	2.8722E-02	+/-	1.461E-03	5.1	3.0336E-02	5.6
U-234 ATOM PERCENT	5.3700E-03	+/-	1.365E-03	25.4	4.3435E-03	-19.1
U-235 ATOM PERCENT	5.2200E-01	+/-	4.827E-03	.9	5.0532E-01	-3.2
U-236 ATOM PERCENT	4.2000E-02	+/-	2.091E-03	5.0	5.1607E-02	22.9
U-238 ATOM PERCENT	9.9431E+01	+/-	1.414E-02	.0	9.9439E+01	.0
PU-239 ATOM PERCENT	1.3435E-01	+/-	1.612E-02	12.0	1.3531E-01	.7
PU-239 ATOM PERCENT	6.5689E+01	+/-	2.751E-02	.0	6.5383E+01	-.5
PU-240 ATOM PERCENT	2.4938E+01	+/-	3.409E-02	.1	2.4107E+01	-3.3
PU-241 ATOM PERCENT	8.1413E+00	+/-	1.804E-02	.2	9.2735E+00	13.9
PU-242 ATOM PERCENT	1.0968E+00	+/-	6.583E-03	.6	1.1007E+00	.4
PU-239/U-238 ATOM RATIO	3.2987E-02	+/-	4.948E-04	1.5	3.4697E-02	5.2
PU/U MASS RATIO	5.0237E-02	+/-	7.539E-04	1.5	5.3097E-02	5.7
TOT PU NET PRODUCTION KG/MTM	-1.9365E+01	+/-	6.703E-01	3.5	-1.9359E+01	-.0
FISS PU NET PRODUCTION KG/MTM	-2.5852E+01	+/-	5.046E-01	2.0	-2.5216E+01	-2.5
U-235 EFFECTIVE CAP/FIS RATIO	2.6114E-01	+/-	1.875E-02	7.2	3.0161E-01	15.5
NET GM FIS MATL DESTROYED/MWD	1.0592E+10	+/-	6.438E-02	6.1	9.9038E-01	-6.5
FISS ATOMS DISCH/LOADED RATIO	5.8425E-01	+/-	7.169E-03	1.2	5.7707E-01	-1.2
U-235 FRACTIONAL DEPLETION	2.8989E-01	+/-	7.008E-03	2.4	3.7072E-01	27.9
BURNUP, HE METHOD, MWD/MTM	2.6248E+04	+/-	1.409E+03	5.4	2.7981E+04	6.6
BURNUP, ND-148 METHOD, MWD/MTM	2.7723E+04	+/-	8.665E+02	3.1	2.7981E+04	.9

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SEXTON ROD MY, ZON 6, PELLETT PU02-U02
VERSUS

WARD LA-11, ROD LA, ASMPY F2, ROD LOC A1, WS/WS PELLETT, ZONE 6 10/20/69

PARAMETER	MEASURED RESULTS				CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	4.4350E-04	+/-	3.122E-06	.7		
TOTAL FISSIONS/U-238(POL), ND	2.6525E-02	+/-	7.008E-04	2.6	2.6525E-02	-0.0
TOTAL FISSIONS/U-238(POL), HE	2.7231E-02	+/-	1.293E-03	4.7	2.6525E-02	-2.6
U-234 ATOM PERCENT	5.1300E-03	+/-	1.355E-03	26.4	4.4854E-03	-12.6
U-235 ATOM PERCENT	5.4600E-01	+/-	4.915E-03	.9	5.3784E-01	-1.5
U-236 ATOM PERCENT	4.1800E-02	+/-	2.088E-03	5.0	4.4727E-02	7.0
U-238 ATOM PERCENT	9.9407E+01	+/-	1.414E-02	.0	9.9413E+01	.0
PU-238 ATOM PERCENT	1.1796E-01	+/-	2.361E-03	2.0	1.0337E-01	-12.4
PU-239 ATOM PERCENT	6.8991E+01	+/-	2.589E-02	.0	6.9455E+01	.7
PU-240 ATOM PERCENT	2.2926E+01	+/-	3.239E-02	.1	2.1825E+01	-4.8
PU-241 ATOM PERCENT	7.1325E+00	+/-	1.694E-02	.2	7.8015E+00	9.4
PU-242 ATOM PERCENT	8.3232E-01	+/-	5.843E-03	.7	8.1512E-01	-2.1
PU-239/U-238 ATOM RATIO	3.8010E-02	+/-	2.524E-04	.7	3.8407E-02	1.0
PU/U MASS RATIO	5.5093E-02	+/-	3.665E-04	.7	5.5300E-02	.4
TOT PU NET PRODUCTION KG/MTM	-1.5027E+01	+/-	3.685E-01	2.5	-1.5962E+01	6.2
FISS PU NET PRODUCTION KG/MTM	-2.1484E+01	+/-	2.960E-01	1.4	-2.1419E+01	-.3
U-235 EFFECTIVE CAP/FIS RATIO	2.9560E-01	+/-	2.246E-02	7.6	3.0448E-01	3.0
NET GM FIS MATL DESTROYED/MWD	9.3997E-01	+/-	4.892E-02	5.2	9.6331E-01	2.5
FISS ATOMS DISCH/LOADED RATIO	6.5254E-01	+/-	3.977E-03	.6	6.4140E-01	-1.7
U-235 FRACTIONAL DEPLETION	2.5957E-01	+/-	7.082E-03	2.7	3.0847E-01	18.8
BURNUP, HE METHOD, MWD/MTM	2.4713E+04	+/-	1.248E+03	5.1	2.4391E+04	-1.3
BURNUP, ND-148 METHOD, MWD/MTM	2.4072E+04	+/-	7.564E+02	3.1	2.4391E+04	1.3

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PH02-U02
 VERSUS
 WARD T1-8, ROD T1, ASMPY D3, ROD LOC A1, WS/WS PELLET, ZONE 6 10/16/69

PARAMETER	MEASURED RESULTS			PERCENT ERROR	CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE	+/-	2-STD DEV		CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	4.7770E-04	+/-	3.363E-06	.7		
TOTAL FISSIONS/U-238 (POL), ND	2.8540E-02	+/-	7.523E-04	2.6	2.8540E-02	-0.0
TOTAL FISSIONS/U-238 (POL), HE	2.9176E-02	+/-	1.385E-03	4.7	2.8540E-02	-2.2
U-234 ATOM PERCENT	4.3400E-03	+/-	1.323E-03	30.5	4.4120E-03	1.7
U-235 ATOM PERCENT	5.3500E-01	+/-	4.875E-03	.9	5.2104E-01	-2.6
U-236 ATOM PERCENT	4.1900E-02	+/-	2.089E-03	5.0	4.8302E-02	15.3
U-238 ATOM PERCENT	9.9419E+01	+/-	1.414E-02	.0	9.9426E+01	.0
PU-238 ATOM PERCENT	1.2712E-01	+/-	2.402E-03	1.9	1.1931E-01	-6.1
PU-239 ATOM PERCENT	6.7856E+01	+/-	2.645E-02	.0	6.7381E+01	-0.7
PU-240 ATOM PERCENT	2.3540E+01	+/-	3.291E-02	.1	2.2997E+01	-2.3
PU-241 ATOM PERCENT	7.5511E+00	+/-	1.747E-02	.2	8.5458E+00	13.2
PU-242 ATOM PERCENT	9.2551E-01	+/-	6.116E-03	.7	9.5664E-01	3.3
PU-239/U-238 ATOM RATIO	3.7430E-02	+/-	2.485E-04	.7	3.6481E-02	-2.5
PU/U MASS RATIO	5.5171E-02	+/-	3.670E-04	.7	5.4158E-02	-1.8
TOT PU NET PRODUCTION KG/MTM	-1.5055E+01	+/-	3.687E-01	2.4	-1.7705E+01	17.6
FISS PU NET PRODUCTION KG/MTM	-2.1870E+01	+/-	2.943E-01	1.3	-2.3387E+01	6.9
U-235 EFFECTIVE CAP/FIS RATIO	2.7297E-01	+/-	1.998E-02	7.3	3.0301E-01	11.0
NET GR FIS MATL DESTROYED/MWD	8.9322E-01	+/-	4.621E-02	5.2	9.7694E-01	9.4
FISS ATOMS DISCH/LOADED RATIO	6.4508E-01	+/-	3.943E-03	.6	6.0808E-01	-5.7
U-235 FRACTIONAL DEPLETION	2.7590E-01	+/-	7.010E-03	2.5	3.4051E-01	23.4
BURNUP, HE METHOD, MWD/MTM	2.6561E+04	+/-	1.341E+03	5.0	2.6284E+04	-1.0
BURNUP, ND-148 METHOD, MWD/MTM	2.5982E+04	+/-	8.142E+02	3.1	2.6284E+04	1.2

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLETT PU02-U02
 VERSUS
 WARD TT-10, ROD TT, ASMPY D3, ROD LOC A6, FW PELLETT, ZONE 6 10/11/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM NO-148 FISSION PRODUCT	PERCENT DIFFER*	
ND-148/U-238 ATOM RATIO	4.9900E-04 +/- 3.513E-06	.7			
TOTAL FISSIONS/U-238(POL), ND	2.9785E-02 +/- 7.884E-04	2.6	2.9785E-02	-0.0	
TOTAL FISSIONS/U-238(POL), HE	3.0866E-02 +/- 1.470E-03	4.8	2.9785E-02	-3.5	
U-234 ATOM PERCENT	4.3800E-03 +/- 1.325E-03	30.2	4.3649E-03	-0.3	
U-235 ATOM PERCENT	5.3000E-01 +/- 4.856E-03	.9	5.1023E-01	-3.7	
U-236 ATOM PERCENT	4.4000E-02 +/- 2.116E-03	4.8	5.0579E-02	15.0	
U-238 ATOM PERCENT	9.9422E+01 +/- 1.414E-02	.0	9.9435E+01	.0	
PU-238 ATOM PERCENT	1.4104E-01 +/- 2.510E-03	1.8	1.3020E-01	-7.7	
PU-239 ATOM PERCENT	6.7026E+01 +/- 2.686E-02	.0	6.6013E+01	-1.5	
PU-240 ATOM PERCENT	2.3854E+01 +/- 3.318E-02	.1	2.3759E+01	-.4	
PU-241 ATOM PERCENT	7.9557E+00 +/- 1.797E-02	.2	9.0430E+00	13.7	
PU-242 ATOM PERCENT	1.0234E+00 +/- 6.387E-03	.6	1.0545E+00	3.0	
PU-239/U-238 ATOM RATIO	3.7300E-02 +/- 2.477E-04	.7	3.5252E-02	-5.5	
PU/U MASS RATIO	5.5665E-02 +/- 3.703E-04	.7	5.3428E-02	-4.0	
TOT PU NET PRODUCTION KG/MTM	-1.4707E+01 +/- 3.709E-01	2.5	-1.8841E+01	28.1	
FISS PU NET PRODUCTION KG/MTM	-2.1826E+01 +/- 2.948E-01	1.4	-2.4647E+01	12.9	
U-235 EFFECTIVE CAP/FIS RATIO	2.7954E-01 +/- 1.987E-02	7.1	3.0204E-01	8.0	
NET GM FIS MATL DESTROYED/MWD	8.4275E-01 +/- 4.358E-02	5.2	9.8614E-01	17.0	
FISS ATOMS DISCH/LOADED RATIO	6.4486E-01 +/- 3.951E-03	.6	5.8672E-01	-9.0	
U-235 FRACTIONAL DEPLETION	2.8418E-01 +/- 6.974E-03	2.5	3.6128E-01	27.1	
BURNUP, HE METHOD, MWD/MTM	2.8166E+04 +/- 1.426E+03	5.1	2.7460E+04	-2.5	
BURNUP, NO-148 METHOD, MWD/MTM	2.7179E+04 +/- 8.550E+02	3.1	2.7460E+04	1.0	

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PH02-U02
 VERSUS
 WARD TP-9, ROD TF, ASMPY D3, ROD LOC D1, FW/WS PELLET, ZONE 6 10/15/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR		AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	4.9470E-04 +/- 3.483E-06	.7			
TOTAL FISSIONS/U-238 (ROL), ND	2.9569E-02 +/- 7.817E-04	2.6		2.9569E-02	-0.0
TOTAL FISSIONS/U-238 (ROL), HE	3.0225E-02 +/- 1.437E-03	4.8		2.9569E-02	-2.2
U-234 ATOM PERCENT	4.5200E-03 +/- 1.330E-03	29.4		4.3731E-03	-3.2
U-235 ATOM PERCENT	5.2800E-01 +/- 4.849E-03	.9		5.1213E-01	-3.0
U-236 ATOM PERCENT	4.3600E-02 +/- 2.111E-03	4.8		5.0181E-02	15.1
U-238 ATOM PERCENT	9.9424E-01 +/- 1.414E-02	.0		9.9433E-01	.0
PU-238 ATOM PERCENT	1.3545E-01 +/- 2.445E-03	1.8		1.2826E-01	-5.3
PU-239 ATOM PERCENT	6.6977E-01 +/- 2.688E-02	.0		6.6255E-01	-1.1
PU-240 ATOM PERCENT	2.3998E-01 +/- 3.330E-02	.1		2.3625E-01	-1.6
PU-241 ATOM PERCENT	7.8817E-00 +/- 1.788E-02	.2		8.9547E-00	13.6
PU-242 ATOM PERCENT	1.0075E-00 +/- 6.344E-03	.6		1.0370E-00	2.9
PU-239/U-238 ATOM RATIO	3.6690E-02 +/- 2.436E-04	.7		3.5467E-02	-3.3
PU/U MASS RATIO	5.4795E-02 +/- 3.645E-04	.7		5.3555E-02	-2.3
TOT PU NET PRODUCTION KG/MTM	-1.5435E+01 +/- 3.671E-01	2.4		-1.8641E+01	20.8
FISS PU NET PRODUCTION KG/MTM	-2.2433E+01 +/- 2.918E-01	1.3		-2.4426E+01	8.9
U-235 EFFECTIVE CAP/FIS RATIO	2.7507E-01 +/- 1.955E-02	7.1		3.0221E-01	9.9
NET GW FIS MATL DESTROYED/MWD	8.8270E-01 +/- 4.557E-02	5.2		9.8451E-01	11.5
FISS ATOMS DISCH/LOADED RATIO	6.3565E-01 +/- 3.891E-03	.6		5.9046E-01	-7.1
U-235 FRACTIONAL DEPLETION	2.8565E-01 +/- 6.968E-03	2.4		3.5763E-01	25.1
BURNUP, HE METHOD, MWD/MTM	2.7592E+04 +/- 1.395E+03	5.1		2.7257E+04	-1.2
BURNUP, ND-148 METHOD, MWD/MTM	2.6993E+04 +/- 8.481E+02	3.1		2.7257E+04	1.0

* PERCENT DIFFER = 100 * (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLETT PU02-U02
 VERSUS
 CH. ASY D3, ROD LOC D9, FW/WS ZONE 6- WARD 4/29/69, ND RE-ANAL, PU RE-ANA

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT
					PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	5.1040E-04	+/-	3.593E-06	.7	
TOTAL FISSIONS/U-238 (POL), ND	3.0532E-02	+/-	8.057E-04	2.6	3.0532E-02
TOTAL FISSIONS/U-238 (POL), HE	3.0743E-02	+/-	1.464E-03	4.8	3.0532E-02
U-234 ATOM PERCENT	4.4300E-03	+/-	1.327E-03	29.9	4.3358E-03
U-235 ATOM PERCENT	5.2000E-01	+/-	4.819E-03	.9	5.0356E-01
U-236 ATOM PERCENT	4.4300E-02	+/-	2.120E-03	4.8	5.1977E-02
U-238 ATOM PERCENT	9.9431E+01	+/-	1.414E-02	.0	9.9440E+01
PU-238 ATOM PERCENT	1.4107E-01	+/-	2.614E-03	1.9	1.3718E-01
PU-239 ATOM PERCENT	6.6353E+01	+/-	2.729E-02	.0	6.5155E+01
PU-240 ATOM PERCENT	2.4222E+01	+/-	3.351E-02	.1	2.4233E+01
PU-241 ATOM PERCENT	8.2029E+00	+/-	1.810E-02	.2	9.3572E+00
PU-242 ATOM PERCENT	1.0810E+00	+/-	6.548E-03	.6	1.1176E+00
PU-239/U-238 ATOM RATIO	3.5800E-02	+/-	2.377E-04	.7	3.4498E-02
PU/U MASS RATIO	5.3975E-02	+/-	3.591E-04	.7	5.2978E-02
TOT PU NET PRODUCTION KG/MTM	-1.6176E+01	+/-	3.635E-01	2.2	-1.9546E+01
FISS PU NET PRODUCTION KG/MTM	-2.3138E+01	+/-	2.886E-01	1.2	-2.5420E+01
U-235 EFFECTIVE CAP/FIS RATIO	2.6841E-01	+/-	1.863E-02	6.9	3.0145E-01
NET GW FIS MATL DESTROYED/MWD	8.9269E-01	+/-	4.602E-02	5.2	9.9192E-01
FISS ATOMS DISCH/LOADED RATIO	6.2403E-01	+/-	3.825E-03	.6	5.7360E-01
U-235 FRACTIONAL DEPLETION	2.9648E-01	+/-	6.922E-03	2.3	3.7412E-01
BURNUP, HE METHOD, MWD/MTM	2.8153E+04	+/-	1.425E+03	5.1	2.8167E+04
BURNUP, ND-148 METHOD, MWD/MTM	2.7960E+04	+/-	8.767E+02	3.1	2.8167E+04

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD MY, ZON 6, PELLET PU02-U02
 VERSUS
 GE XCK 6R0-CH SAX U02-PU02, ASY. D3, ROD LOC D9, 18.5-19.5 IN. 5/29/69

PARAMETER	MEASURED RESULTS				CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	5.1460E-04	+/-	3.623E-06	.7		
TOTAL FISSIONS/U-238(FOL), ND	3.0846E-02	+/-	8.147E-04	2.6	3.0846E-02	-0.0
TOTAL FISSIONS/U-238(FOL), HE	2.9826E-02	+/-	1.515E-03	5.1	3.0846E-02	3.4
U-234 ATOM PERCENT	5.3800E-03	+/-	1.365E-03	25.4	4.3234E-03	-19.6
U-235 ATOM PERCENT	5.2440E-01	+/-	4.836E-03	.9	5.0071E-01	-4.5
U-236 ATOM PERCENT	4.3510E-02	+/-	2.110E-03	4.8	5.2571E-02	20.8
U-238 ATOM PERCENT	9.9427E+01	+/-	1.414E-02	.0	9.9442E+01	.0
PU-238 ATOM PERCENT	1.4535E-01	+/-	1.744E-02	12.0	1.4021E-01	-3.5
PU-239 ATOM PERCENT	6.6368E+01	+/-	2.716E-02	.0	6.4785E+01	-2.4
PU-240 ATOM PERCENT	2.4234E+01	+/-	3.349E-02	.1	2.4436E+01	.8
PU-241 ATOM PERCENT	8.1761E+00	+/-	1.808E-02	.2	9.4930E+00	16.1
PU-242 ATOM PERCENT	1.0757E+00	+/-	6.527E-03	.6	1.1452E+00	6.5
PU-239/U-238 ATOM RATIO	3.5058E-02	+/-	5.259E-04	1.5	3.4177E-02	-2.5
PU/U MASS RATIO	5.2842E-02	+/-	7.929E-04	1.5	5.2787E-02	-.1
TOT PU NET PRODUCTION KG/MTM	-1.7125E+01	+/-	6.979E-01	4.1	-1.9848E+01	15.9
FISS PU NET PRODUCTION KG/MTM	-2.3851E+01	+/-	5.291E-01	2.2	-2.5748E+01	8.0
U-235 EFFECTIVE CAP/FIS RATIO	2.7271E-01	+/-	1.939E-02	7.1	3.0119E-01	10.4
NET GM FIS MATL DESTROYED/MWD	9.4647E-01	+/-	5.854E-02	6.2	9.9440E-01	5.1
FISS ATOMS DISCH/LOADED RATIO	6.1416E-01	+/-	7.559E-03	1.2	5.6803E-01	-7.5
U-235 FRACTIONAL DEPLETION	2.8914E-01	+/-	7.008E-03	2.4	3.7959E-01	31.3
BURNUP, HE METHOD, MWD/MTM	2.7254E+04	+/-	1.461E+03	5.4	2.8464E+04	4.4
BURNUP, ND-148 METHOD, MWD/MTM	2.8186E+04	+/-	8.843E+02	3.1	2.8464E+04	1.0

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD P0, ZONE 6, VIPAC PU02-U02
 VERSUS
 WARD K4-5, ROD K4, ASMEY D4, ROD LOC A1, WS/WS VIPAC, ZONE 6 9/20/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE +/- 2-STD DEV		PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	5.0810E-04 +/- 3.577E-06		.7		
TOTAL FISSIONS/U-238 (FOL), ND	3.0330E-02 +/- 8.017E-04		2.6	3.0330E-02	-0.0
TOTAL FISSIONS/U-238 (FOL), HE	3.1356E-02 +/- 1.489E-03		4.8	3.0330E-02	-3.3
U-234 ATOM PERCENT	4.1800E-03 +/- 1.316E-03		31.5	4.5570E-03	9.0
U-235 ATOM PERCENT	5.1900E-01 +/- 4.816E-03		.9	5.1044E-01	-1.7
U-236 ATOM PERCENT	4.3600E-02 +/- 2.111E-03		4.8	4.9967E-02	14.6
U-238 ATOM PERCENT	9.9433E+01 +/- 1.413E-02		.0	9.9435E+01	.0
PU-238 ATOM PERCENT	1.3544E-01 +/- 2.418E-03		1.8	1.3047E-01	-3.7
PU-239 ATOM PERCENT	6.5924E+01 +/- 2.743E-02		.0	6.5659E+01	-.4
PU-240 ATOM PERCENT	2.4770E+01 +/- 3.395E-02		.1	2.4085E+01	-2.8
PU-241 ATOM PERCENT	8.0927E+00 +/- 1.811E-02		.2	9.0417E+00	11.7
PU-242 ATOM PERCENT	1.0775E+00 +/- 6.534E-03		.6	1.0844E+00	.6
PU-239/U-238 ATOM RATIO	3.5730E-02 +/- 2.372E-04		.7	3.4814E-02	-2.6
PU/U MASS RATIO	5.4222E-02 +/- 3.608E-04		.7	5.3050E-02	-2.2
TOT PU NET PRODUCTION KG/MTM	-1.5041E+01 +/- 4.920E-01		3.3	-1.7030E+01	13.2
FISS PU NET PRODUCTION KG/MTM	-2.2392E+01 +/- 4.176E-01		1.9	-2.3457E+01	4.8
U-235 EFFECTIVE CAP/FISS RATIO	2.6068E-01 +/- 1.841E-02		7.1	2.9755E-01	14.1
NET GM FIS MATL DESTROYED/MWD	8.6877E-01 +/- 4.641E-02		5.3	9.1503E-01	5.3
FISS ATOMS DISCH/LOADED RATIO	6.3015E-01 +/- 4.794E-03		.8	6.0794E-01	-3.5
U-235 FRACTIONAL DEPLETION	2.9817E-01 +/- 7.249E-03		2.4	3.3092E-01	11.0
BURNUP, HE METHOD, MWD/MTM	2.8082E+04 +/- 1.419E+03		5.1	2.8070E+04	-0.0
BURNUP, ND-148 METHOD, MWD/MTM	2.7162E+04 +/- 8.531E+02		3.1	2.8070E+04	3.3

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD P0, ZONE 6, VIPAC PU02-U02
VERSUS

WARD N3-13, ROD N3, ASMPY D4, ROD LOC A2, WS VIPAC, ZONE 6 10/21/69

PARAMETER	MEASURED RESULTS				CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	4.79E-04	+/-	3.378E-06	.7		
TOTAL FISSIONS/U-238(RGL), ND	2.8616E-02	+/-	7.571E-04	2.6	2.8616E-02	-0.0
TOTAL FISSIONS/U-238(RGL), HE	2.9543E-02	+/-	1.403E-03	4.7	2.8616E-02	-3.1
U-234 ATOM PERCENT	4.6300E-03	+/-	1.335E-03	28.8	4.6166E-03	-0.3
U-235 ATOM PERCENT	5.3300E-01	+/-	4.867E-03	.9	5.2383E-01	-1.7
U-236 ATOM PERCENT	4.2300E-02	+/-	2.095E-03	5.0	4.7192E-02	11.6
U-238 ATOM PERCENT	9.9420E+01	+/-	1.414E-02	.0	9.9424E+01	.0
PU-239 ATOM PERCENT	1.3030E-01	+/-	2.424E-03	1.9	1.1696E-01	-10.2
PU-239 ATOM PERCENT	6.8016E+01	+/-	2.636E-02	.0	6.7361E+01	-1.0
PU-240 ATOM PERCENT	2.3265E+01	+/-	3.268E-02	.1	2.3134E+01	-0.6
PU-241 ATOM PERCENT	7.6534E+00	+/-	1.760E-02	.2	8.4294E+00	10.1
PU-242 ATOM PERCENT	9.3480E-01	+/-	6.141E-03	.7	9.5761E-01	2.4
PU-239/U-238 ATOM RATIO	3.8080E-02	+/-	2.529E-04	.7	3.6344E-02	-4.6
PU/U MASS RATIO	5.5997E-02	+/-	3.725E-04	.7	5.3973E-02	-3.6
TOT PU NET PRODUCTION KG/MTM	-1.3403E+01	+/-	4.977E-01	3.7	-1.5944E+01	19.0
FISS PU NET PRODUCTION KG/MTM	-2.0328E+01	+/-	4.242E-01	2.1	-2.2118E+01	8.8
U-235 EFFECTIVE CAP/FIS RATIO	2.7269E-01	+/-	2.014E-02	7.4	2.9888E-01	9.6
NET GW FIS MATL DESTROYED/MWD	8.3656E-01	+/-	4.538E-02	5.4	9.1499E-01	9.4
FISS ATOMS DISCH/LOADED RATIO	6.6333E-01	+/-	5.040E-02	.8	6.3059E-01	-4.9
U-235 FRACTIONAL DEPLETION	2.7919E-01	+/-	7.342E-03	2.6	3.0968E-01	10.9
BURNUP, HE METHOD, MWD/MTM	2.6543E+04	+/-	1.341E+03	5.1	2.6453E+04	-0.3
BURNUP, ND-148 METHOD, MWD/MTM	2.5710E+04	+/-	8.086E+02	3.1	2.6453E+04	2.9

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROD, P6, ZONE A, VIPAC PU02-1102
 VERSUS
 WARD A1-12, ROD A1, ASSEMBLY D4, ROD LOC A4, FW/WS VIPAC, ZONE A 10/20/69

PARAMETER	MEASURED		RESULTS		CALCULATED RESULTS	
	VALUE	+/- 2-STD DEV	PERCENT ERROR		AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFERENCE
ND-148/U-238 ATOM RATIO	5.3930E-04	+/-	3.797E-06	.7		
TOTAL FISSIONS/U-238 (FOL), ND	3.2248E-02	+/-	8.530E-04	2.6	3.2248E-02	-5.0
TOTAL FISSIONS/U-238 (FOL), HF	3.0810E-02	+/-	1.467E-03	4.8	3.2248E-02	4.7
U-234 ATOM PERCENT	4.0000E-03	+/-	1.308E-03	32.7	4.4891E-03	12.2
U-235 ATOM PERCENT	5.2200E-01	+/-	4.827E-03	.9	4.9512E-01	-5.1
U-236 ATOM PERCENT	4.4100E-02	+/-	2.118E-03	4.8	5.3098E-02	20.4
U-238 ATOM PERCENT	9.9430E+01	+/-	1.414E-02	.0	9.9447E+01	.0
PU-239 ATOM PERCENT	1.3849E-01	+/-	2.438E-03	1.8	1.4693E-01	6.1
PU-239 ATOM PERCENT	6.6239E+01	+/-	2.725E-02	.0	6.7667E+01	-3.9
PU-240 ATOM PERCENT	2.4407E+01	+/-	3.364E-02	.1	2.5176E+01	3.1
PU-241 ATOM PERCENT	8.1420E+00	+/-	1.821E-02	.2	9.7684E+00	20.0
PU-242 ATOM PERCENT	1.0731E+00	+/-	6.521E-03	.4	1.2413E+00	15.7
PU-239/U-238 ATOM RATIO	3.5740E-02	+/-	2.373E-04	.7	3.3085E-02	-7.4
PU/L MASS RATIO	5.3977E-02	+/-	3.591E-04	.7	5.2004E-02	-3.7
TOT PU NET PRODUCTION KG/MTM	-1.5229E+01	+/-	4.912E-01	3.2	-1.8272E+01	20.0
FISS PU NET PRODUCTION KG/MTM	-2.2350E+01	+/-	4.177E-01	1.9	-2.4968E+01	11.7
U-235 EFFECTIVE CAP/FIS RATIO	2.6952E-01	+/-	1.913E-02	7.1	2.9598E-01	9.8
NET GR FIS MAT DESTROYED/MWD	8.8076E-01	+/-	4.719E-02	5.4	9.1550E-01	3.9
FISS ATOMS DISCH/LOADED RATIO	6.3126E-01	+/-	4.800E-03	.8	5.9240E-01	-7.7
U-235 FRACTIONAL DEPLETION	2.9259E-01	+/-	7.273E-03	2.5	3.8520E-01	21.0
RODNUD, HF METHOD, MWD/MTM	2.7616E+04	+/-	1.398E+03	5.1	2.9884E+04	8.2
RODNUF, ND-148 METHOD, MWD/MTM	2.8906E+04	+/-	9.083E+02	3.1	2.9884E+04	3.4

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON ROLL HY. 700, A. PELLETT D102-H102
VERSUS

ROLL A. CASSEM 2Y2, 10.0-20.0 IN. WARD 7401 5/02/69, NO RE-CAL, PU RE-ANAL

PARAMETER	MEASUREMENT		RESULTS		CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM NO-148 FISSION PRODUCT	
	VALUE	+/- 2-STD DEV	PERCENT ERROR		CALCULATED VALUE	PERCENT DIFFER
NO-148/U-238 ATOM RATIO	3.9060E-04	+/- 2.750E-06	.7			
TOTAL FISSIONS/U-238 (POLY), AD	2.3411E-02	+/- 6.250E-04	2.7		2.3411E-02	-0.0
TOTAL FISSIONS/U-238 (POLY), HF	2.2690E-02	+/- 1.076E-03	4.7		2.3411E-02	3.2
U-234 ATOM PERCENT	1.0000E-03	+/- 1.143E-03	114.3		4.5930E-03	359.3
U-235 ATOM PERCENT	5.8000E-01	+/- 5.036E-03	.9		5.6237E-01	-3.0
U-236 ATOM PERCENT	3.5000E-02	+/- 1.904E-03	5.7		3.0416E-02	12.6
U-238 ATOM PERCENT	9.9784E+01	+/- 1.415E-02	.0		9.9794E+01	.0
PU-234 ATOM PERCENT	8.7073E-02	+/- 2.303E-03	2.6		8.2168E-02	-5.6
PU-235 ATOM PERCENT	7.2452E+01	+/- 2.414E-02	.0		7.2387E+01	-.6
PU-240 ATOM PERCENT	2.0677E+01	+/- 3.045E-02	.1		2.0128E+01	-2.7
PU-241 ATOM PERCENT	5.7750E+00	+/- 1.498E-02	.3		6.7722E+00	17.3
PU-242 ATOM PERCENT	6.0914E-01	+/- 5.134E-03	.8		6.3131E-01	3.6
PU-239/U-238 ATOM RATIO	4.1890E-02	+/- 2.731E-04	.7		4.1265E-02	-1.5
P/U MASS RATIO	5.7472E-02	+/- 3.822E-04	.7		5.6987E-02	-.8
TOT PU NET PRODUCTION KG/MTM	-1.2717E+01	+/- 3.724E-01	3.0		-1.3508E+01	6.2
FISS PU NET PRODUCTION KG/MTM	-1.8394E+01	+/- 3.106E-01	1.7		-1.8555E+01	.9
U-235 EFFECTIVE CAP/FIS RATIO	2.9312E-01	+/- 2.576E-02	8.8		3.0654E-01	4.6
NET GR FIS MATL DESTROYED/MWD	9.6605E-01	+/- 5.159E-02	5.3		9.6624E-01	-2.0
FISS ATOMS DISCH/LOADED RATIO	7.0360E-01	+/- 4.268E-03	.6		6.9980E-01	-2.0
U-235 FRACTIONAL DEPLETION	2.1178E-01	+/- 7.283E-03	3.4		2.6282E-01	24.1
RUOAHU, HF METHOD, MWD/MTM	2.0514E+04	+/- 1.037E+03	5.1		2.1473E+04	4.7
RUOAHU, NO-148 METHOD, MWD/MTM	2.1166E+04	+/- 6.727E+02	3.2		2.1470E+04	1.5

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC UNITCELL CALCULATION, SAXTON RD, MY. 70N 6, PELLET PROD-002
VERSUS

RDD H. ASSEM 2X2, 19.0-20.0 IN. WARD 7402 5/27/69, NR RE-CAL, PU RE-ANAL

PARAMETER	MEASURED		RESULTS		CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM NO-148 FISSION PRODUCT	
	VALUE	+/- 2-STD DEV		PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER
NO-148/U-238 ATOM RATIO	3.6340E-04	+/-	2.558E-06	.7		
TOTAL FISSIONS/U-238 (HOL), NO	2.1784E-02	+/-	5.797E-04	2.7	2.1784E-02	-0.0
TOTAL FISSIONS/U-238 (HOL), HF	2.1984E-02	+/-	1.034E-03	4.7	2.1784E-02	-0.5
U-234 ATOM PERCENT	5.3900E-03	+/-	1.365E-03	25.3	4.4669E-03	-13.8
U-235 ATOM PERCENT	5.7400E-01	+/-	5.015E-03	.9	5.7463E-01	.1
U-236 ATOM PERCENT	3.1900E-02	+/-	1.948E-03	6.1	3.4716E-02	15.1
U-238 ATOM PERCENT	9.9389E+01	+/-	1.415E-02	.0	9.9388E+01	-0.0
PU-238 ATOM PERCENT	7.6472E-02	+/-	2.140E-03	2.8	7.2688E-02	-5.2
PU-239 ATOM PERCENT	7.3333E+01	+/-	2.391E-02	.0	7.3812E+01	.7
PU-240 ATOM PERCENT	2.0373E+01	+/-	3.018E-02	.1	1.9283E+01	-5.3
PU-241 ATOM PERCENT	5.6450E+00	+/-	1.482E-02	.3	6.2923E+00	11.3
PU-242 ATOM PERCENT	5.7312E-01	+/-	5.007E-03	.9	5.4957E-01	-4.1
PU-239/U-238 ATOM RATIO	4.2030E-02	+/-	2.791E-04	.7	4.2715E-02	1.6
PU/L MASS RATIO	5.7287E-02	+/-	3.809E-04	.7	5.7868E-02	1.0
TOT PU NET PRODUCTION KG/MTM	-1.2838E+01	+/-	3.787E-01	2.9	-1.2362E+01	-3.9
FISS PU NET PRODUCTION KG/MTM	-1.8703E+01	+/-	3.111E-01	1.7	-1.7164E+01	-6.3
U-235 EFFECTIVE CAP/FIS RATIO	2.5898E-01	+/-	2.328E-02	9.0	3.0755E-01	18.8
NET GR FIS RATE DESTROYED/MWD	9.0946E-01	+/-	5.336E-02	5.3	9.2002E-01	-6.0
FISS ATOMS DISCH/LOADED RATIO	7.0421E-01	+/-	4.275E-03	.4	7.1358E-01	1.3
U-235 FRACTIONAL DEPLETION	2.1920E-01	+/-	7.250E-03	3.3	2.4084E-01	9.9
RURRUE, HF METHOD, MWD/MTM	1.9787E+04	+/-	9.966E+02	5.0	1.9966E+04	.9
RURRUE, NO-148 METHOD, MWD/MTM	1.9698E+04	+/-	6.241E+02	3.2	1.9966E+04	1.4

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LEOPARD-HIC ASYMPTOTIC HATCHELL CALCULATION, SEXTON RD. MY. ZON 6, PELLET PH02-1102
VERSUS

D. ASY F3. RDD 100 F1, FW/AS 19-201N, JARD 5/13/69, NO RE-CAL, PL RE-ANAL

PARAMETER	MEASURED		RESULTS		CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM NO-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER
NO-148/U-238 ATOM RATIO	2.5480E-04	+/-	1.794E-06	.7		
TOTAL FISSIONS/U-238 (POL), NO	1.5350E-02	+/-	4.116E-04	2.7	1.5351E-02	-0.0
TOTAL FISSIONS/U-238 (POL), HE	1.4568E-02	+/-	7.004E-04	4.8	1.5351E-02	5.4
U-234 ATOM PERCENT	4.9900E-03	+/-	1.350E-03	27.0	4.9511E-03	-2.8
U-235 ATOM PERCENT	6.1800E-01	+/-	5.164E-03	.8	6.2091E-01	.5
U-236 ATOM PERCENT	2.4500E-02	+/-	1.828E-03	7.5	2.5234E-02	7.1
U-238 ATOM PERCENT	9.9353E+01	+/-	1.416E-02	.0	9.9348E+01	-0.0
PU-234 ATOM PERCENT	3.7625E-02	+/-	1.494E-03	4.0	4.1082E-02	9.2
PU-236 ATOM PERCENT	7.8100E+01	+/-	2.144E-02	.0	7.9973E+01	1.1
PU-240 ATOM PERCENT	1.6902E+01	+/-	2.695E-02	.2	1.6104E+01	-4.7
PU-241 ATOM PERCENT	4.6408E+00	+/-	1.618E-02	.3	4.5811E+00	-1.3
PU-242 ATOM PERCENT	3.1991E-01	+/-	3.977E-03	1.2	3.2111E-01	-5.9
PU-239/U-238 ATOM RATIO	4.4674E-02	+/-	2.956E-04	.7	4.9327E-02	8.2
PU/U MASS RATIO	5.7134E-02	+/-	3.798E-04	.7	6.1123E-02	7.0
TOT PL NET PRODUCTION KG/MTM	-1.2603E+01	+/-	3.798E-01	3.0	-8.5044E+00	-32.5
FISS PL NET PRODUCTION KG/MTM	-1.6107E+01	+/-	3.223E-01	2.0	-1.7133E+01	-24.7
U-235 EFFECTIVE CAP/FIS RATIO	2.8825E-01	+/-	3.438E-02	11.9	3.1080E-01	7.8
NET GW FIS MATL DESTROYED/MWD	1.2998E+00	+/-	7.359E-02	5.7	9.4487E-01	-27.3
FISS ATOMS DISCH/LOADED RATIO	7.4376E-01	+/-	4.495E-03	.4	7.9768E-01	7.3
U-235 FRACTIONAL REFLECTION	1.5336E-01	+/-	7.538E-03	4.9	1.4662E-01	8.6
RUNTIME, HE METHOD, MWD/MTM	1.3185E+04	+/-	6.750E+02	5.1	1.4029E+04	6.4
RUNTIME, NO-148 METHOD, MWD/MTM	1.7894E+04	+/-	4.442E+02	3.2	1.4029E+04	1.0

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

APPENDIX C

MEASURED AND LASER CALCULATED ISOTOPIC DATA FOR SAXTON CORE II RADIAL MICROSAMPLES

The following 10 pages summarize the measured and calculated U and Pu isotopic data for the radial microsamples from pellet fuel rod RI, axial sample Zone 7. The calculations were performed with the LASER code, and were run with no zero-power time steps to account for isotopic decay during reactor shutdown. Consequently, the LASER calculation grossly overpredicts Pu-241 production. Note also that U-234 and Pu-238 are not included in the LASER point-wise depletion calculations.

The basis for the comparisons is total fissions for the pellet, and not total fissions at each point. The total number of fissions for the pellet was determined by appropriately volume-weighting the individual microsample results to produce a set of composite data for input to the REBUF data-reducing code. The results are documented in Appendix D.

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-HIC ASYMPTOTIC UNIT CELL CALCULATION ROD R1, ZONE 7, RADIAL REGION 01
VERSUS
WARD RD-01, ROD R1, ASMEY C3, ROD LOC E4, PELLETT, ZONE 7 DRILL 53, 12/11/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.8720E-04 +/- 2.726E-06	.7			
TOTAL FISSIONS/U-238 (POL), MD	2.3165E-02 +/- 6.096E-04	2.6	1.8502E-02		-20.1
TOTAL FISSIONS/U-238 (POL), HE	1.8423E-02 +/- 8.711E-04	4.7	1.8502E-02		.4
U-234 ATOM PERCENT	4.7800E-03 +/- 1.341E-03	28.1			
U-235 ATOM PERCENT	5.8800E-01 +/- 5.065E-03	.9	5.9199E-01		.7
U-236 ATOM PERCENT	3.3200E-02 +/- 1.968E-03	5.9	3.4028E-02		2.5
U-238 ATOM PERCENT	9.9374E+01 +/- 1.415E-02	.0	9.9369E+01		-.0
PU-238 ATOM PERCENT	7.6658E-02 +/- 2.093E-13	2.7			
PU-239 ATOM PERCENT	7.7094E+01 +/- 2.215E-12	.0	7.6899E+01		-.3
PU-240 ATOM PERCENT	1.8095E+01 +/- 2.811E-12	.2	1.7929E+01		-.9
PU-241 ATOM PERCENT	4.3816E+00 +/- 1.316E-12	.3	4.7103E+00		7.5
PU-242 ATOM PERCENT	3.5319E-01 +/- 4.139E-13	1.2	3.2478E-01		-8.0
PU-239/U-238 ATOM RATIO	4.7360E-02 +/- 3.145E-04	.7	4.6418E-02		-2.0
PU/U MASS RATIO	6.1380E-02 +/- 4.081E-04	.7	6.0310E-02		-1.7
TOT PU NET PRODUCTION KG/MTM	-9.0755E+00 +/- 3.973E-01	4.4	-1.0149E+01		11.8
FISS PU NET PRODUCTION KG/MTM	-1.3911E+01 +/- 3.325E-01	2.4	-1.4640E+01		5.2
U-235 EFFECTIVE CAP/FIS RATIO	3.0223E-01 +/- 2.826E-02	9.4	3.2893E-01		8.8
NET GW FIS MATL DESTROYED/MWD	9.1757E-01 +/- 5.166E-02	5.6	9.4309E-01		2.8
FISS ATOMS DISCH/LOADED RATIO	7.7170E-01 +/- 4.686E-03	.6	7.6166E-01		-1.3
U-235 FRACTIONAL DEPLETION	2.0056E-01 +/- 7.319E-03	3.6	1.9405E-01		-3.2
BURNUP, HE METHOD, MWD/MTM	1.6531E+04 +/- 8.363E+02	5.0	1.6907E+04		1.7
BURNUP, ND-148 METHOD, MWD/MTM	2.0911E+04 +/- 6.550E+02	3.1	1.6907E+04		-19.2

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-WIC ASYMPTOTIC UNIT CELL CALCULATION ROD RI, ZONE 7, RADIAL REGION 02
 VERSUS
 WARD RD-02, ROD RI, ASMBY C3, ROD LOC E4, PELLETT, ZONE 7 DRILL 43, 12/12/69

PARAMETER	M E A S U R E D R E S U L T S			CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE +/- 2-STD DEV		PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.1560E-04	+/- 2.222E-06	.7		
TOTAL FISSIONS/U-238(POL), ND	1.8837E-02	+/- 4.960E-04	2.6	1.8502E-02	-1.8
TOTAL FISSIONS/U-238(POL), HE	1.8459E-02	+/- 8.757E-04	4.7	1.8502E-02	.2
U-234 ATOM PERCENT	4.8000E-03	+/- 1.342E-03	28.0		
U-235 ATOM PERCENT	5.9200E-01	+/- 5.079E-03	.9	5.9199E-01	-.0
U-236 ATOM PERCENT	3.4100E-02	+/- 1.981E-03	5.8	3.4028E-02	-.2
U-238 ATOM PERCENT	9.9369E+01	+/- 1.415E-02	.0	9.9369E+01	.0
PU-238 ATOM PERCENT	8.0262E-02	+/- 2.152E-03	2.7		
PU-239 ATOM PERCENT	7.7025E+01	+/- 2.218E-02	.0	7.6899E+01	-.2
PU-240 ATOM PERCENT	1.8127E+01	+/- 2.814E-02	.2	1.7929E+01	-1.1
PU-241 ATOM PERCENT	4.4043E+00	+/- 1.319E-02	.3	4.7103E+00	6.9
PU-242 ATOM PERCENT	3.6316E-01	+/- 4.183E-03	1.2	3.2478E-01	-10.6
PU-239/U-238 ATOM RATIO	4.7220E-02	+/- 3.135E-04	.7	4.6418E-02	-1.7
PU/U MASS RATIO	6.1251E-02	+/- 4.072E-04	.7	6.0310E-02	-1.5
TOT PU NET PRODUCTION KG/MTM	-9.1904E+00	+/- 3.967E-01	4.3	-1.0149E+01	10.4
FISS PU NET PRODUCTION KG/MTM	-1.4031E+01	+/- 3.319E-01	2.4	-1.4640E+01	4.3
U-235 EFFECTIVE CAP/FIS RATIO	3.2429E-01	+/- 3.075E-02	9.5	3.2893E-01	1.4
NET GV FIS MATL DESTROYED/MWD	9.2063E-01	+/- 5.188E-02	5.6	9.4309E-01	2.4
FISS ATOMS DISCH/LOADED RATIO	7.7048E-01	+/- 4.676E-03	.6	7.6166E-01	-1.1
U-235 FRACTIONAL DEPLETION	1.9505E-01	+/- 7.343E-03	3.8	1.9405E-01	-.5
BURNUP, HE METHOD, MWD/MTM	1.6665E+04	+/- 8.406E+02	5.0	1.6907E+04	1.4
BURNUP, ND-148 METHOD, MWD/MTM	1.7007E+04	+/- 5.332E+02	3.1	1.6907E+04	-.6

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-FIC ASYMPTOTIC UNIT CELL CALCULATION ROD RI, ZONE 7, RADIAL REGION 03
 VERSUS
 WARD RD-03, ROD RJ, ASMEY C3-ROD LOC E4, PELLETS, ZONE 7 DRILL 31, 12/15/60

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT		
	VALUE +/- 2-STD DEV		PERCENT ERROR	CALCULATED VALUE		PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.2320E-04	+/- 2.275E-06	.7			
TOTAL FISSIONS/U-238 (POL), ND	1.9276E-02	+/- 5.061E-04	2.6	1.8896E-02		-2.0
TOTAL FISSIONS/U-238 (POL), HE	1.9258E-02	+/- 9.097E-04	4.7	1.8896E-02		-1.9
U-234 ATOM PERCENT	4.5500E-03	+/- 1.332E-03	29.3			
U-235 ATOM PERCENT	5.8400E-01	+/- 5.051E-03	.9	5.9029E-01		1.1
U-236 ATOM PERCENT	3.4100E-02	+/- 1.981E-03	5.8	3.4272E-02		.5
U-238 ATOM PERCENT	9.9377E+01	+/- 1.415E-02	.0	9.9371E+01		-.0
PU-238 ATOM PERCENT	8.2993E-02	+/- 2.152E-03	2.6			
PU-239 ATOM PERCENT	7.6617E+01	+/- 2.236E-02	.0	7.6499E+01		-.2
PU-240 ATOM PERCENT	1.8396E+01	+/- 2.839E-02	.2	1.8180E+01		-1.2
PU-241 ATOM PERCENT	4.5233E+00	+/- 1.338E-02	.3	4.8447E+00		7.1
PU-242 ATOM PERCENT	3.8009E-01	+/- 4.256E-03	1.1	3.3940E-01		-10.7
PU-239/U-238 ATOM RATIO	4.7120E-02	+/- 3.129E-04	.7	4.5996E-02		-2.4
PU/U MASS RATIO	6.1453E-02	+/- 4.085E-04	.7	6.0076E-02		-2.2
TOT PU NET PRODUCTION KG/MTM	-9.8575E+00	+/- 3.974E-01	4.4	-1.0375E+01		14.5
FISS PU NET PRODUCTION KG/MTM	-1.4087E+01	+/- 3.316E-01	2.4	-1.4972E+01		6.3
U-235 EFFECTIVE CAP/FIS RATIO	3.0051E-01	+/- 2.737E-02	9.1	3.2676E-01		8.7
NET GM FIS MATL DESTROYED/MWD	8.9027E-01	+/- 4.978E-02	5.6	9.4363E-01		6.0
FISS ATOMS DISCH/LOADED RATIO	7.6844E-01	+/- 4.668E-03	.6	7.5645E-01		-1.6
U-235 FRACTIONAL DEPLETION	2.0668E-01	+/- 7.292E-03	3.5	1.9649E-01		-4.9
BURNUP, HE METHOD, MWD/MTM	1.7385E+04	+/- 8.734E+02	5.0	1.7266E+04		-.7
BURNUP, ND-148 METHOD, MWD/MTM	1.7401E+04	+/- 5.441E+02	3.1	1.7266E+04		-.8

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-HIC ASYMPTOTIC UNIT CELL CALCULATION ROD R1, ZONE 7, RADIAL REGION 04
VERSUS

WARD RD-04, ROD R1, ASMPY C3, ROD LOC E4, PELLETT, ZONE 7 DRILL 25, 12/15/69

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PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT
ND-148/U-238 ATOM RATIO	2.9580E-04	+/-	2.082E-06	.7	
TOTAL FISSIONS/U-238 (POL), ND	1.7632E-02	+/-	4.623E-04	2.6	1.9347E-02
TOTAL FISSIONS/U-238 (POL), HE	1.9486E-02	+/-	9.203E-04	4.7	1.9347E-02
U-234 ATOM PERCENT	4.4800E-03	+/-	1.329E-03	29.7	
U-235 ATOM PERCENT	5.8200E-01	+/-	5.043E-03	.9	5.8834E-01
U-236 ATOM PERCENT	3.4000E-02	+/-	1.980E-03	5.8	3.4551E-02
U-238 ATOM PERCENT	9.9380E+01	+/-	1.415E-02	.0	9.9372E+01
PU-238 ATOM PERCENT	8.8269E-02	+/-	2.203E-03	2.5	
PU-239 ATOM PERCENT	7.6257E+01	+/-	2.252E-02	.0	7.6037E+01
PU-240 ATOM PERCENT	1.8603E+01	+/-	2.858E-02	.2	1.8471E+01
PU-241 ATOM PERCENT	4.6563E+00	+/-	1.358E-02	.3	5.0004E+00
PU-242 ATOM PERCENT	3.9503E-01	+/-	4.319E-03	1.1	3.5634E-01
PU-239/U-238 ATOM RATIO	4.6370E-02	+/-	3.079E-04	.7	4.5511E-02
PU/U MASS RATIO	6.0763E-02	+/-	4.040E-04	.7	5.9807E-02
TOT PU NET PRODUCTION KG/MTM	-9.6714E+00	+/-	3.943E-01	4.1	-1.0635E+01
FISS PU NET PRODUCTION KG/MTM	-1.4713E+01	+/-	3.285E-01	2.2	-1.5353E+01
U-235 EFFECTIVE CAP/FIS RATIO	2.9513E-01	+/-	2.671E-02	9.0	3.2427E-01
NET GM FIS MATL DESTROYED/MWD	9.1632E-01	+/-	5.078E-02	5.5	9.4424E-01
FISS ATOMS DISCH/LOADED RATIO	7.5885E-01	+/-	4.610E-03	.6	7.5047E-01
U-235 FRACTIONAL DEPLETION	2.0906E-01	+/-	7.284E-03	3.5	1.9930E-01
BURNUP, HE METHOD, MWD/MTM	1.7591E+04	+/-	8.835E+02	5.0	1.7679E+04
BURNUP, ND-148 METHOD, MWD/MTM	1.5918E+04	+/-	4.970E+02	3.1	1.7679E+04

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-HIC ASYMPTOTIC UNIT CELL CALCULATION ROD R1, ZONE 7, RADIAL REGION 05
VERSUS

WARD RD-05, ROD R1, ASSEMBY C3, ROD LOC E4, PELLETT, ZONE 7 DRILL 15, 12/19/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM RD-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.3970E-04	+/- 2.391E-06	.7		
TOTAL FISSIONS/U-238 (POL), ND	2.0268E-02	+/- 5.322E-04	2.6	2.0022E-02	-1.2
TOTAL FISSIONS/U-238 (POL), HE	2.0409E-02	+/- 9.618E-04	4.7	2.0022E-02	-1.9
U-234 ATOM PERCENT	4.4900E-03	+/- 1.329E-03	29.6		
U-235 ATOM PERCENT	5.7600E-01	+/- 5.022E-03	.9	5.8561E-01	1.7
U-236 ATOM PERCENT	3.4800E-02	+/- 1.991E-03	5.7	3.4957E-02	.5
U-238 ATOM PERCENT	9.9385E+01	+/- 1.415E-02	.0	9.9375E+01	-.0
PU-238 ATOM PERCENT	8.3138E-02	+/- 2.115E-03	2.5		
PU-239 ATOM PERCENT	7.5584E+01	+/- 2.281E-02	.0	7.5415E+01	-.2
PU-240 ATOM PERCENT	1.9031E+01	+/- 2.896E-02	.2	1.8822E+01	-1.1
PU-241 ATOM PERCENT	4.8795E+00	+/- 1.392E-02	.3	5.2456E+00	7.5
PU-242 ATOM PERCENT	4.2290E-01	+/- 4.435E-03	1.0	3.8287E-01	-9.5
PU-239/U-238 ATOM RATIO	4.5800E-02	+/- 3.041E-04	.7	4.4959E-02	-1.8
PU/U MASS RATIO	6.0555E-02	+/- 4.026E-04	.7	5.0572E-02	-1.6
TOT PU NET PRODUCTION KG/MTM	-9.9017E+00	+/- 3.932E-01	4.0	-1.0874E+01	9.8
FISS PU NET PRODUCTION KG/MTM	-1.5152E+01	+/- 3.263E-01	2.2	-1.5755E+01	4.0
U-235 EFFECTIVE CAP/FIS RATIO	2.8898E-01	+/- 2.537E-02	8.8	3.2085E-01	11.0
NET GM FIS MATL DESTROYED/MWD	9.0158E-01	+/- 4.946E-02	5.5	9.3586E-01	3.8
FISS ATOMS DISCH/LOADED RATIO	7.5140E-01	+/- 4.568E-03	.6	7.4405E-01	-1.0
U-235 FRACTIONAL DEPLETION	2.1776E-01	+/- 7.246E-03	3.3	2.0333E-01	-6.6
BURNUP, HE METHOD, MWD/MTM	1.8430E+04	+/- 9.240E+02	5.0	1.8295E+04	-.7
BURNUP, ND-148 METHOD, MWD/MTM	1.8303E+04	+/- 5.722E+02	3.1	1.8295E+04	-.0

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-WIC ASYMPTOTIC UNIT CELL CALCULATION ROD RI, ZONE 7, RADIAL REGION 06
 VERSUS
 WARD RC-06, ROD RI, ASMPY C3, ROD LOC E4, PELLETT, ZONE 7 DRILL 4, 12/19/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	PERCENT DIFFER*	
ND-148/U-238 ATOM RATIO	3.4600E-04 +/- 2.436E-06	.7			
TOTAL FISSIONS/U-238(POL), ND	2.0660E-02 +/- 5.436E-04	2.6	2.0668E-02	.0	
TOTAL FISSIONS/U-238(POL), HE	2.0558E-02 +/- 9.715E-04	4.7	2.0668E-02	.5	
U-234 ATOM PERCENT	4.4600E-03 +/- 1.328E-03	29.8			
U-235 ATOM PERCENT	5.7900E-01 +/- 5.033E-03	.9	5.8295E-01	.7	
U-236 ATOM PERCENT	3.4900E-02 +/- 1.993E-03	5.7	3.5341E-02	1.3	
U-238 ATOM PERCENT	9.9382E+01 +/- 1.415E-02	.0	9.9377E+01	-.0	
PU-238 ATOM PERCENT	8.5849E-02 +/- 2.156E-03	2.5			
PU-239 ATOM PERCENT	7.5236E+01 +/- 2.296E-02	.0	7.4778E+01	-.6	
PU-240 ATOM PERCENT	1.9189E+01 +/- 2.911E-02	.2	1.9162E+01	-.1	
PU-241 ATOM PERCENT	5.0464E+00 +/- 1.416E-02	.3	5.5148E+00	9.3	
PU-242 ATOM PERCENT	4.4281E-01 +/- 4.515E-03	1.0	4.1171E-01	-7.0	
PU-239/U-238 ATOM RATIO	4.5070E-02 +/- 2.993E-04	.7	4.4316E-02	-1.7	
PU/U MASS RATIO	5.9866E-02 +/- 3.980E-04	.7	5.9224E-02	-1.1	
TOT PU NET PRODUCTION KG/MTM	-1.0512E+01 +/- 3.902E-01	3.7	-1.1212E+01	6.6	
FISS PU NET PRODUCTION KG/MTM	-1.5743E+01 +/- 3.235E-01	2.1	-1.6229E+01	3.1	
U-235 EFFECTIVE CAP/FIS RATIO	2.9770E-01 +/- 2.645E-02	8.9	3.1777E-01	6.7	
NET GM FIS MATL DESTROYED/MWD	9.2524E-01 +/- 5.055E-02	5.5	9.3310E-01	.8	
FISS ATOMS DISCH/LOADED RATIO	7.4303E-01 +/- 4.514E-03	.6	7.3657E-01	-.9	
U-235 FRACTIONAL DEPLETION	2.1329E-01 +/- 7.268E-03	3.4	2.0717E-01	-2.9	
BURNUP, HE METHOD, MWD/MTM	1.8565E+04 +/- 9.332E+02	5.0	1.8886E+04	1.7	
BURNUP, ND-148 METHOD, MWD/MTM	1.8657E+04 +/- 5.845E+02	3.1	1.8886E+04	1.2	

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-WIC ASYMPTOTIC UNIT CELL CALCULATION ROD RT, ZONE 7, RADIAL REGION 07
 VERSUS
 WARD RD-07, ROD RT, ASMBY C3, ROD LOC E4, PELLETT, ZONE 7 DRILL B, 12/22/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE	+/-	2-STD DEV	PERCENT ERROR	AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT CALCULATED VALUE PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.6290E-04	+/-	2.555E-06	.7	
TOTAL FISSIONS/U-238 (POL), ND	2.1651E-02	+/-	5.733E-04	2.6	2.1463E-02
TOTAL FISSIONS/U-238 (POL), HE	2.2035E-02	+/-	1.044E-03	4.7	2.1463E-02
U-234 ATOM PERCENT	4.6400E-03	+/-	1.335E-03	28.8	
U-235 ATOM PERCENT	5.8100E-01	+/-	5.040E-03	.9	5.7967E-01
U-236 ATOM PERCENT	3.6400E-02	+/-	2.014E-03	5.5	3.5811E-02
U-238 ATOM PERCENT	9.9378E+01	+/-	1.415E-02	.0	9.9380E+01
PU-238 ATOM PERCENT	9.6194E-02	+/-	2.277E-03	2.4	
PU-239 ATOM PERCENT	7.4264E+01	+/-	2.339E-02	.0	7.3974E+01
PU-240 ATOM PERCENT	1.9702E+01	+/-	2.957E-02	.2	1.9552E+01
PU-241 ATOM PERCENT	5.4494E+00	+/-	1.474E-02	.3	5.8900E+00
PU-242 ATOM PERCENT	4.8856E-01	+/-	4.693E-03	1.0	4.5161E-01
PU-239/U-238 ATOM RATIO	4.4430E-02	+/-	2.963E-04	.7	4.3492E-02
PU/U MASS RATIO	6.0059E-02	+/-	3.993E-04	.7	5.8760E-02
TOT PU NET PRODUCTION KG/MTM	-1.0423E+01	+/-	3.907E-01	3.7	-1.1658E+01
FISS PU NET PRODUCTION KG/MTM	-1.5988E+01	+/-	3.223E-01	2.0	-1.6821E+01
U-235 EFFECTIVE CAP/FIS RATIO	3.1703E-01	+/-	2.807E-02	8.9	3.1417E-01
NET GM FIS MATL DESTROYED/MWD	8.7473E-01	+/-	4.757E-02	5.4	9.3030E-01
FISS ATOMS DISCH/LOADED RATIO	7.3951E-01	+/-	4.492E-03	.6	7.2725E-01
U-235 FRACTIONAL DEPLETION	2.1184E-01	+/-	7.275E-03	3.4	2.1187E-01
BURNUP, HE METHOD, MWD/MTM	1.9905E+04	+/-	1.004E+03	5.0	1.9612E+04
BURNUP, ND-148 METHOD, MWD/MTM	1.9559E+04	+/-	6.166E+02	3.2	1.9612E+04

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-RIC ASYMPTOTIC UNIT CELL CALCULATION ROD RI, ZONE 7, RADIAL REGION OR
VERSUS

WARD RD-08, ROD RI, ASSEMBY C3, ROD LOC F4, PELLETT, ZONE 7 DRILL 1, 12/22/69

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS	
	VALUE +/- 2-STD DEV	PERCENT ERROR		AT VALUE OF TOTAL FISSIONS INFERRED FROM NO-148 FISSION PRODUCT CALCULATED VALUE	PERCENT DIFFER*
NO-148/U-238 ATOM RATIO	3.7730E-04 +/- 2.656E-06	.7			
TOTAL FISSIONS/U-238(POL), ND	2.2530E-02 +/- 5.943E-04	2.6		2.2774E-02	1.1
TOTAL FISSIONS/U-238(POL), HE	2.2894E-02 +/- 1.083E-03	4.7		2.2774E-02	-5.5
U-234 ATOM PERCENT	4.5400E-03 +/- 1.331E-03	29.3			
U-235 ATOM PERCENT	5.7000E-01 +/- 5.001E-03	.9		5.7446E-01	.8
U-236 ATOM PERCENT	3.6200E-02 +/- 2.012E-03	5.6		3.6561E-02	1.0
U-238 ATOM PERCENT	9.9389E+01 +/- 1.415E-02	.0		9.9384E+01	-0.0
PU-238 ATOM PERCENT	9.9194E-02 +/- 2.260E-03	2.3			
PU-239 ATOM PERCENT	7.3320E+01 +/- 2.381E-02	.0		7.2647E+01	-9.9
PU-240 ATOM PERCENT	2.0037E+01 +/- 2.986E-02	.1		2.0051E+01	.1
PU-241 ATOM PERCENT	5.9941E+00 +/- 1.550E-02	.3		6.6422E+00	10.8
PU-242 ATOM PERCENT	5.4923E-01 +/- 4.917E-03	.9		5.3015E-01	-3.5
PU-239/U-238 ATOM RATIO	4.3050E-02 +/- 2.859E-04	.7		4.2106E-02	-2.2
PU/U MASS RATIO	5.8689E-02 +/- 3.903E-04	.7		5.7934E-02	-1.3
TOT PU NET PRODUCTION KG/MTM	-1.1664E+01 +/- 3.846E-01	3.3		-1.2447E+01	6.7
FISS PU NET PRODUCTION KG/MTM	-1.7193E+01 +/- 3.165E-01	1.8		-1.7759E+01	3.3
U-235 EFFECTIVE CAP/FIS RATIO	2.8969E-01 +/- 2.462E-02	8.5		3.0893E-01	6.6
NET GM FIS MATL DESTROYED/MWD	9.0444E-01 +/- 4.849E-02	5.4		9.2414E-01	2.2
FISS ATOMS DISCH/LOADED RATIO	7.2000E-01 +/- 4.379E-03	.6		7.1246E-01	-1.0
U-235 FRACTIONAL DEPLETION	2.2641E-01 +/- 7.215E-03	3.2		2.1931E-01	-3.1
BURNUP, HE METHOD, MWD/MTM	2.0693E+04 +/- 1.042E+03	5.0		2.0812E+04	.6
BURNUP, NO-148 METHOD, MWD/MTM	2.0364E+04 +/- 6.394E+02	3.1		2.0812E+04	2.2

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-WIC ASYMPTOTIC UNIT CELL CALCULATION ROD RT, ZONE 7, RADIAL REGION 09
 VERSUS
 WARD RD-09, ROD RT, ASMBY C3, ROD LOC E4, PELLETT, ZONE 7 DRILL N, 12/22/69

PARAMETER	MEASURED RESULTS			PERCENT ERROR	CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM RD-14R FISSION PRODUCT	
	VALUE	+/-	2-STD DEV		CALCULATED VALUE	PERCENT DIFFER
RD-14R/U-238 ATOM RATIO	4.1040E-04	+/-	2.889E-06	.7		
TOTAL FISSIONS/U-238 (POL), ND	2.4479E-02	+/-	6.440E-04	2.6	2.4290E-02	-0.8
TOTAL FISSIONS/U-238 (POL), HE	2.5600E-02	+/-	1.217E-03	4.8	2.4290E-02	-5.1
U-234 ATOM PERCENT	4.5600E-03	+/-	1.332E-03	29.2		
U-235 ATOM PERCENT	5.5500E-01	+/-	4.947E-03	.9	5.6883E-01	2.5
U-236 ATOM PERCENT	3.7300E-02	+/-	2.027E-03	5.4	3.7391E-02	.2
U-238 ATOM PERCENT	9.9408E+01	+/-	1.414E-02	.0	9.9389E+01	-.0
PU-239 ATOM PERCENT	1.1798E-01	+/-	2.382E-03	2.0		
PU-239 ATOM PERCENT	7.1604E+01	+/-	2.458E-02	.0	7.1203E+01	-.6
PU-240 ATOM PERCENT	2.0286E+01	+/-	3.008E-02	.1	2.0318E+01	.2
PU-241 ATOM PERCENT	7.2825E+00	+/-	1.720E-02	.2	7.7108E+00	5.9
PU-242 ATOM PERCENT	7.6922E-01	+/-	5.459E-03	.8	6.4035E-01	-9.7
PU-239/U-238 ATOM RATIO	4.1530E-02	+/-	2.758E-04	.7	4.0648E-02	-2.1
PU/U MASS RATIO	5.7950E-02	+/-	3.856E-04	.7	5.7072E-02	-1.6
TOT PU NET PRODUCTION KG/MTM	-1.2416E+01	+/-	3.813E-01	3.1	-1.3278E+01	6.9
FISS PU NET PRODUCTION KG/MTM	-1.8018E+01	+/-	3.128E-01	1.7	-1.9615E+01	3.3
U-235 EFFECTIVE CAP/FIS RATIO	2.6824E-01	+/-	2.147E-02	8.0	3.0365E-01	13.2
NET GM FIS MATL DESTROYED/MWD	8.4900E-01	+/-	4.502E-02	5.3	9.0761E-01	6.9
FISS ATOMS DISCH/LOADED RATIO	7.0538E-01	+/-	4.305E-03	.6	6.9880E-01	-.9
U-235 FRACTIONAL DEPLETION	2.4830E-01	+/-	7.122E-03	2.9	2.2745E-01	-8.4
BURNUP, HE METHOD, MWD/MTM	2.3189E+04	+/-	1.171E+03	5.1	2.2195E+04	-4.3
BURNUP, ND-14R METHOD, MWD/MTM	2.2173E+04	+/-	6.940E+02	3.1	2.2195E+04	.1

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-WIC ASYMPTOTIC UNIT CELL CALCULATION ROD RI, ZONE 7, RADIAL REGION 10
 VERSUS
 WARD RD-10, ROD RI, ASMPY C3, ROD LOC E4, PELLETT, ZONE 7 (CLAD), 12/23/69

C-11

PARAMETER	MEASURED RESULTS			PERCENT ERROR	CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE	+/-	2-STD DEV		CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	4.5830E-04	+/-	3.226E-06	.7		
TOTAL FISSIONS/U-238(POL), ND	2.7246E-02	+/-	7.208E-04	2.6	2.7704E-02	1.7
TOTAL FISSIONS/U-238(POL), HE	2.8661E-02	+/-	1.391E-03	4.9	2.7704E-02	-3.3
U-234 ATOM PERCENT	4.5500E-03	+/-	1.332E-03	29.3		
U-235 ATOM PERCENT	5.6300E-01	+/-	4.976E-03	.9	5.6054E-01	-.4
U-236 ATOM PERCENT	3.9700E-02	+/-	2.060E-03	5.2	3.8988E-02	-1.8
U-238 ATOM PERCENT	9.9392E+01	+/-	1.415E-02	.0	9.9396E+01	.0
PU-238 ATOM PERCENT	1.4579E-01	+/-	2.661E-03	1.8		
PU-239 ATOM PERCENT	7.0762E+01	+/-	2.492E-02	.0	6.9469E+01	-1.8
PU-240 ATOM PERCENT	1.9106E+01	+/-	2.900E-02	.2	1.9316E+01	1.1
PU-241 ATOM PERCENT	9.0700E+00	+/-	1.939E-02	.2	1.0191E+01	12.4
PU-242 ATOM PERCENT	9.1641E-01	+/-	6.083E-03	.7	8.9945E-01	-1.9
PU-239/U-238 ATOM RATIO	4.2030E-02	+/-	2.791E-04	.7	4.0264E-02	-4.2
PU/U MASS RATIO	5.9388E-02	+/-	3.950E-04	.7	5.7959E-02	-2.4
TOT PU NET PRODUCTION KG/MTM	-1.1365E+01	+/-	3.874E-01	3.4	-1.2677E+01	11.6
FISS PU NET PRODUCTION KG/MTM	-1.6671E+01	+/-	3.200E-01	1.9	-1.7741E+01	6.4
U-235 EFFECTIVE CAP/FIS RATIO	3.0012E-01	+/-	2.404E-02	8.0	2.9547E-01	-1.5
NET GM FIS MATL DESTROYED/MWD	7.0462E-01	+/-	3.793E-02	5.4	7.6504E-01	8.6
FISS ATOMS DISCH/LOADED RATIO	7.2611E-01	+/-	4.447E-03	.6	7.1020E-01	-2.2
U-235 FRACTIONAL DEPLETION	2.4073E-01	+/-	7.159E-03	3.0	2.4182E-01	.5
BURNUP, HE METHOD, MWD/MTM	2.5957E+04	+/-	1.336E+03	5.1	2.5314E+04	-2.5
BURNUP, ND-148 METHOD, MWD/MTM	2.4675E+04	+/-	7.761E+02	3.1	2.5314E+04	2.6

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

APPENDIX D

MEASURED AND LASER-HIC CALCULATED ISOTOPIC DATA FOR PELLET COMPOSITE OF RADIAL MICROSAMPLES

The U and Pu isotopic data obtained for the radial microsamples were volume-weighted to form a set of composite data for input to the REBUF data-reducing code. The results are summarized on the following page. Note that the comparisons are made with results from the LASER-HIC calculation, which did not include zero-power time steps to account for isotopic decay during reactor shutdowns.

SUMMARY OF THEORY-EXPERIMENT COMPARISON

LASER-WIC ASYMPTOTIC UNIT CELL CALCULATION ROD R1, ZONE 7, T_{EFF}=1600F, 7.5KW/FT
 VERSUS
 WEIGHTED COMPOSITE OF RESULTS FROM 10 RADIAL MICROSAMPLES, ROD R1, ZONE 7

D-2

PARAMETER	MEASURED RESULTS			CALCULATED RESULTS AT VALUE OF TOTAL FISSIONS INFERRED FROM ND-148 FISSION PRODUCT	
	VALUE +/- 2-STD DEV		PERCENT ERROR	CALCULATED VALUE	PERCENT DIFFER*
ND-148/U-238 ATOM RATIO	3.7950E-04 +/- 2.672E-06		.7		
TOTAL FISSIONS/U-238 (POL), ND	2.2625E-02 +/- 5.960E-04		2.6	2.2625E-02	-0.0
TOTAL FISSIONS/U-238 (POL), HE	2.3233E-02 +/- 1.105E-03		4.8	2.2625E-02	-2.6
U-234 ATOM PERCENT	4.5600E-03 +/- 1.332E-03		29.2	4.6962E-03	3.0
U-235 ATOM PERCENT	5.7200E-01 +/- 5.008E-03		.9	5.7703E-01	.9
U-236 ATOM PERCENT	3.6400E-02 +/- 2.014E-03		5.5	3.6413E-02	.0
U-238 ATOM PERCENT	9.9387E+01 +/- 1.415E-02		.0	9.9382E+01	-0.0
PU-238 ATOM PERCENT	1.0515E-01 +/- 2.334E-03		2.2	5.6834E-02	-46.0
PU-239 ATOM PERCENT	7.3701E+01 +/- 2.363E-02		.0	7.3111E+01	-0.8
PU-240 ATOM PERCENT	1.9352E+01 +/- 2.925E-02		.2	1.9407E+01	.3
PU-241 ATOM PERCENT	6.2583E+00 +/- 1.586E-02		.3	6.8581E+00	9.6
PU-242 ATOM PERCENT	5.8403E-01 +/- 5.041E-03		.9	5.6694E-01	-2.9
PU-239/U-238 ATOM RATIO	4.4006E-02 +/- 2.922E-04		.7	4.2834E-02	-2.6
PU/U MASS RATIO	5.9673E-02 +/- 3.968E-04		.7	5.8563E-02	-1.9
TOT PU NET PRODUCTION KG/MTM	-1.0825E+01 +/- 3.889E-01		3.6	-1.1801E+01	9.0
FISS PU NET PRODUCTION KG/MTM	-1.6172E+01 +/- 3.216E-01		2.0	-1.6954E+01	4.8
U-235 EFFECTIVE CAP/FIS RATIO	2.9408E-01 +/- 2.507E-02		8.5	3.1146E-01	5.9
NET GM FIS MATL DESTROYED/MWD	8.4205E-01 +/- 4.560E-02		5.4	8.9042E-01	5.7
FISS ATOMS DISCH/LOADED RATIO	7.3539E-01 +/- 4.477E-03		.6	7.2477E-01	-1.4
U-235 FRACTIONAL DEPLETION	2.2469E-01 +/- 7.220E-03		3.2	2.1625E-01	-3.8
BURNUP, HE METHOD, MWD/MTM	2.0999E+04 +/- 1.062E+03		5.1	2.0674E+04	-1.6
BURNUP, ND-148 METHOD, MWD/MTM	2.0450E+04 +/- 6.411E+02		3.1	2.0674E+04	1.1

* PERCENT DIFFER = 100 X (CALC-MEAS)/MEAS

APPENDIX E
SUMMARY OF Cs-137 MEASUREMENTS

The results of radiochemical analysis for Cs-137 are given in Table E-1. All samples are from pellet fuel rod RI, and include seven axial samples and 10 radial microsamples.

TABLE E-1

SUMMARY OF RADIOCHEMICAL ANALYSES FOR Cs-137 IN SAXTON FUEL ROD RI

Axial Sample Zone	Type of Sample	Cs-137 ^(a) dpm/gU ($\times 10^{-10}$)
1	Pellet	5.25
2	Pellet	10.73
3	Pellet	12.65
6	Pellet	15.07
8	Pellet	14.68
10	Pellet	12.87
11	Pellet	7.03
Radial ^(c) Region	Type of Sample	Cs-137 ^(b) dpm/gU ($\times 10^{-10}$)
1	Radial Microsample	3.55
2	Radial Microsample	4.18
3	Radial Microsample	6.06
4	Radial Microsample	8.22
5	Radial Microsample	11.8
6	Radial Microsample	14.3
7	Radial Microsample	15.5
8	Radial Microsample	16.1
9	Radial Microsample	19.7
10	Radial Microsample	22.9

Notes: (a) On October 23, 1969; uncertainty is $\pm 8\%$.

(b) On October 8, 1969; uncertainty is $\pm 8\%$.

(c) From axial sample Zone 7.

APPENDIX F

INITIAL FUEL COMPOSITION USED IN REDUCTION OF SAXTON CORE II MASS SPECTROMETRIC DATA

The initial fuel compositions used in the reduction of the mass spectrometric data (i.e., input to the REBUF data-reducing code) are summarized in Tables F1 and F2 for pellet and vipac fuel samples, respectively. The U and Pu isotopic abundance data were obtained from WARD analysis of unirradiated archive (retainer) samples; the values of initial Pu-239/U-238 atom ratio were obtained from manufacturer's records. Tables F1 and F2 are reproductions of pages from the REBUF code printout. Since the REBUF code is also used for accountability⁽⁸⁾, the absolute inventory data on Tables F1 and F2 are relative to some value of uranium input. In these cases, an arbitrary value of 1000 kg is used for uranium input.

WARD RI-3 .ROD RI, ASMBY C3, ROD LOC E4, ASYMP PELLETS, ZONE 6 9/33/69

REB U F - 5

INITIAL INVENTORY

	I N V E N T O R Y		A R R O U N D A N C E S				A T O M R A T I O		
	ABSOLUTE (KG)	SPECIFIC (KG/MIM)	RELATIVE-TO-FLEMENT WEIGHT PERCENT	ATOM PERCENT	RELATIVE-TO-METAL WEIGHT PERCENT	ATOM PERCENT	RELATIVE TO U-238	RELATIVE TO U-235	RELATIVE TO PU-239
U-234	.053882	.05033	.00539	.00548	.00503	.00512	.0000552	.007517	.000863
U-235	7.198620	6.72420	.71986	.72900	.67242	.68117	.0073440	1.000000	.114750
U-236	.000001	.00000	.00000	.00000	.00000	.00000	.0000000	.000000	.000000
U-238	992.747497	927.32172	99.27475	99.26552	92.73217	92.75239	1.0000000	136.166066	15.625000
TOTAL U	1000.000000	934.09626	100.00000	100.00000	93.40963	93.43868	1.0073992	137.173584	15.740612
PU-238	.011236	.01050	.01123	.01600	.00105	.00105	.0000113	.001541	.000177
PU-239	63.803114	59.59825	90.43227	90.47191	5.95982	5.93615	.0640000	8.714628	1.000000
PU-240	6.085394	5.68434	8.62522	8.59299	.56843	.56381	.0060787	.827712	.094980
PU-241	.622245	.58124	.88195	.87500	.05312	.05741	.0006190	.084284	.009672
PU-242	.031492	.02942	.04464	.04410	.00294	.00289	.0000312	.004248	.000487
TOTAL PU	70.553481	65.90374	100.00000	100.00000	6.59037	6.56132	.0707402	9.632413	1.095644
FISSILE PU	64.425359	60.17949	91.31422	91.34691	6.01795	5.99356	.0646190	8.798912	1.009672
TOTAL METAL	1070.553481	1000.00000	200.00000	200.00000	100.00000	100.00000	1.0781394	146.805997	16.836256
FISSILE METAL	71.623979	66.90369	92.03408	92.07591	6.69037	6.67474	.0719629	9.798912	1.124421
PU/U RATIO	.070553	.07055	1.00000	1.00000	.07055	.07022	.0702206	.070221	.069606

SAXTON CORE 2 ZR-CLAD UO2-PUO2 PELLETS FUEL

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TABLE F-1. BEGINNING-OF-LIFE ISOTOPIC COMPOSITION OF SAXTON
PELLET FUEL USED IN REDUCTION OF MASS SPECTROMETRIC DATA

K E B U F - 5

I N I T I A L I N V E N T U R Y

I N V E N T O R Y	A R R O U N D A N C E S						A T O M R A T I O		
	ABSOLUTE (KG)	SPECIFIC (KG/MIM)	RELATIVE-TO- WEIGHT PERCENT	FLUORENCE ATOM PERCENT	RELATIVE-TO- WEIGHT PERCENT	METAL ATOM PERCENT	RELATIVE TO U-238	RELATIVE TO U-235	RELATIVE TO PU-239
U-234	.051817	.04845	.00518	.00527	.00485	.00493	.0000531	.007239	.000843
U-235	7.188690	6.72176	.71887	.72800	.67218	.68092	.0073338	1.000000	.116409
U-236	.000001	.00000	.00000	.00000	.00000	.00000	.0000000	.000000	.000000
U-238	992.759492	928.27652	99.27595	99.26673	92.82765	92.84749	1.0000000	136.355805	15.873016
TOTAL U	1000.000000	935.04674	100.00000	100.00000	93.50467	93.53334	1.0073868	137.363044	15.990267
PU-238	.010095	.00944	.01453	.01460	.00094	.00094	.0000102	.001387	.000161
PU-239	62.806949	58.72743	90.41490	90.45463	5.87214	5.84939	.0630000	8.590416	1.000000
PU-240	6.002033	5.61218	8.64034	8.60806	.56122	.55665	.0059954	.817502	.095164
PU-241	.614052	.57417	.88397	.87701	.05742	.05671	.0006108	.083289	.009696
PU-242	.032131	.03004	.04625	.04570	.00300	.00296	.0000318	.004340	.000505
TOTAL PU	69.465260	64.95326	100.00000	100.00000	6.49533	6.46666	.0696482	9.496933	1.095831
FISSILE PU	63.421001	59.30160	91.29888	91.33164	5.93016	5.90610	.0636108	8.673704	1.009696
TOTAL METAL	1069.465260	1000.00000	200.00000	200.00000	100.00000	100.00000	1.0770350	146.859977	17.086098
FISSILE METAL	70.609691	66.02336	92.01174	92.05964	6.60234	6.58703	.0709446	9.673704	1.126104
PU/U RATIO	.069465	.06947	1.00000	1.00000	.06947	.06914	.0691375	.069137	.068531

SAXTON CORE 2 ZR-CLAD UO2-PUO2 VIPAC FUEL

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6TABLE F-2. BEGINNING-OF-LIFE ISOTOPIC COMPOSITION OF SAXTON
VIPAC FUEL USED IN REDUCTION OF MASS SPECTROMETRIC DATA

APPENDIX G

IRRADIATION HISTORY USED IN LEOPARD-HIC CALCULATIONS

The values of time step length, temperatures, and power density used in the LEOPARD-HIC unit cell calculations are given in Table G1. The values of resonance-effective (Res-eff) temperature listed in Table G1 were used for both U-238 and Pu-240. Unit cell parameters after 120 hours are listed in Table G2 for reference.

TABLE G-1
IRRADIATION HISTORY USED IN LEOPARD-HIC UNIT CELL CALCULATIONS

Time Step	ΔT (Hours)	Accum. (b) Time (Hours)	Pellet Rod MY, Zone 6						Vipac Rod PO, Zone 6					
			Fuel Average	Clad	Moderator	Res-eff	Power (a) Density (w/cc)	Accum. (b) Burnup (MWD/MTM)	Fuel Average	Clad	Moderator	Res-eff	Power (a) Density (w/cc)	Accum. (b) Burnup (MWD/MTM)
0	120	120	800	550	524	640	32.25	68	825	550	524	660	32.10	70
1	224	1344	1290	538	530	1032	93.80	2081	1270	635	530	1016	92.84	2151
2	72	1416	520	520	520	520	0.00	2081	520	520	520	520	0.00	2151
3	120	1536	1036	592	527	823	64.02	2216	1000	590	527	800	63.36	2289
4	744	2280	1500	664	532	1200	115.06	3719	1470	660	532	1176	113.85	3846
5	576	2856	100	100	100	100	0.00	3719	100	100	100	100	0.00	3846
6	144	3000	1400	650	531	125	103.18	3980	1340	645	531	1072	102.08	4115
7	1344	4344	1650	664	532	1320	115.50	6710	1475	660	532	1180	114.29	6939
8	120	4464	520	520	520	520	0.00	6710	520	520	520	520	0.00	6939
9	528	4992	1636	663	532	1309	114.51	7773	1470	665	532	1176	113.36	8039
10	744	5736	100	100	100	100	0.00	7773	100	100	100	100	0.00	8039
11	1272	7008	1833	666	533	1466	118.03	10,417	1550	670	533	1240	116.85	10,775
12	1152	8160	100	100	100	100	0.00	10,417	100	100	100	100	0.00	10,775
13	1464	9624	1813	664	532	1455	115.17	13,387	1475	663	532	1180	113.74	13,836
14	4868	14,492	100	100	100	100	0.00	13,387	100	100	100	100	0.00	13,836
15	384	14,876	1106	632	528	835	69.74	13,856	1124	622	528	899	68.97	14,320
16	936	15,812	100	100	100	100	0.00	13,856	100	100	100	100	0.00	14,320
17	696	16,508	1729	666	532	1382	109.01	15,191	1430	655	532	1143	107.90	15,699
18	984	17,492	100	100	100	100	0.00	15,191	100	100	100	100	0.00	15,699
19	336	17,828	1618	662	530	1294	101.97	15,793	1400	648	530	1120	100.87	16,321
20	1008	18,836	100	100	100	100	0.00	15,793	100	100	100	100	0.00	16,321
21	840	19,676	1900	660	522	1520	121.77	17,596	1640	660	522	1312	120.56	18,189
22	1440	21,116	100	100	100	100	0.00	17,596	100	100	100	100	0.00	18,189
23	576	21,692	1793	630	520	1434	103.62	18,646	1425	653	520	1140	102.52	19,273
24	744	22,436	100	100	100	100	0.00	18,646	100	100	100	100	0.00	19,273
25	676	23,112	1829	655	555	1463	114.84	20,014	1520	650	555	1216	113.63	20,687

Notes: (a) At beginning of time step.

(b) At end of time step.

TABLE G-2

DESCRIPTION OF LEOPARD-HIC UNIT CELL CALCULATIONS FOR SAXTON CORE II

	Pellet Rod MY Zone 6	Vipac Rod PO Zone 6
Dimensions, Inches (Cold)		
Fuel column radius	0.16870	0.17225
Clad IR	0.17225	0.17225
Clad OR	0.19550	0.19550
Pitch	0.580	0.580
Temperatures, °F		
Fuel average	1290	1270
Clad	638	635
Moderator	530	530
Resonance-effective	1032	1016
Hot Volume Fractions		
Fuel	0.2664	0.2756
Clad	0.0886	0.0794
Moderator	0.64496	0.64497
Water/Oxide Ratio, Hot	1.860	1.798
Water/Metal Ratio, Hot	3.894	4.066
U-238 L-Factor	0.74436	0.74796
Pu-240 L-Factor	0.70352	0.70730
P-28, Resonance Escape Probability	0.82583	0.82943
Theoretical Density, T.D.	10.99	10.99
Fraction of T.D.	0.94	0.87
Loading, g/cc	2.3759	2.2758

TABLE G-2 (Cont)

DESCRIPTION OF LEOPARD-HIC UNIT CELL CALCULATIONS FOR SAXTON CORE II

	Pellet Rod MY Zone 6	Vipac Rod PO Zone 6
Power Density, kw/liter Specific Power, kw/kg	93.800 39.4790	92.840 40.7941
Cell Average Flux, n/cm^2 -sec Fast, $E > 0.625$ eV Thermal, $E < 0.625$ eV	20.379×10^{13} 1.260×10^{13}	20.302×10^{13} 1.289×10^{13}
Fast-to-Thermal Flux Ratio	16.2	15.8
Thermal Disadvantage Factors H Zircaloy 2 U-235 U-238 Pu-239 Pu-240	1.155 0.867 0.656 0.669 0.545 0.683	1.152 0.869 0.670 0.682 0.560 0.695
Geometric Buckling, $cm^{-2} \times 10^2$	0.498	0.498

APPENDIX H

RESULTS OF MEASUREMENTS FOR Np-237, Pu-236, Pu-238, Am-241 Am-243, Cm-242, and Cm-244 IN SAXTON CORE II FUEL

The results of alpha spectrometric measurements for Pu-236 and Pu-238 in unirradiated and irradiated Saxton Core II mixed oxide fuel are documented in Table H1. Also included are estimates of the initial U-232/Pu-239 atom ratio in the unirradiated fuel at Core II beginning-of-life. The results of measurements for Np-237 and the isotopes of americium are given in Tables H2 and H3. Table H4 summarizes the results of measurements for Cm-242 and Cm-244.

TABLE H-1
SUMMARY OF ALPHA SPECTROMETRIC ANALYSES FOR Pu-236/Pu-239
AND Pu-238/Pu-239 ATOM RATIOS IN SAXTON CORE II FUEL

Fuel Rod	Type of Fuel	Axial Sample Zone	Corresponding Mass. Spec. Sample I.D.	At Time of Analysis ^(a)			At Reference Time ^(b)			
				Date of Analysis	Pu-236/Pu-239 Atom Ratio ($\times 10^5$)	Pu-238/Pu-239 Atom Ratio ($\times 10^3$)	Burnup (MWD/M ² -M)	Pu-236/Pu-239 Atom Ratio ($\times 10^9$)	Pu-238/Pu-239 Atom Ratio ($\times 10^3$)	U-232/PU-239 Atom Ratio ($\times 10^3$)
Archive	Pellet	Unirrad.	OR-1	10-27-69	1.13 $\pm$ 0.26	0.163 $\pm$ 0.0010	0	2.87 $\pm$ 0.66	0.168 $\pm$ 0.001	1.37 $\pm$ 0.32
Archive	Pellet	Unirrad.	3	10-22-69	0.782 $\pm$ 0.333	0.162 $\pm$ 0.0024	0	1.98 $\pm$ 0.84	0.167 $\pm$ 0.002	0.95 $\pm$ 0.40
Archive	Pellet	Unirrad.	1394-8409	10-30-69	0.783 $\pm$ 0.247	0.156 $\pm$ 0.0020	0	1.99 $\pm$ 0.63	0.161 $\pm$ 0.002	0.95 $\pm$ 0.30
Archive	Vipac	Unirrad.	SX-C	10-29-69	0.676 $\pm$ 0.328	0.171 $\pm$ 0.0012	0	1.72 $\pm$ 0.85	0.176 $\pm$ 0.001	0.82 $\pm$ 0.40
Archive	Vipac	Unirrad.	SX-C2	10-28-69	0.746 $\pm$ 0.385	0.166 $\pm$ 0.0011	0	1.90 $\pm$ 0.96	0.171 $\pm$ 0.001	0.91 $\pm$ 0.47
Archive	Vipac	Unirrad.	SX-D3	10-24-69	0.789 $\pm$ 0.395	0.163 $\pm$ 0.0012	0	2.00 $\pm$ 1.00	0.168 $\pm$ 0.001	0.96 $\pm$ 0.48
RI	Pellet	2	RI-19	12-2-69	2.11 $\pm$ 0.57	1.06 $\pm$ 0.0088	14,550	2.77 $\pm$ 0.75	0.828 $\pm$ 0.026	
		6	RI-3	10-20-69	3.02 $\pm$ 0.37	1.78 $\pm$ 0.0056	20,450	3.86 $\pm$ 0.97	1.36 $\pm$ 0.04	
		10	RI-24	12-1-69	3.77 $\pm$ 1.04	1.38 $\pm$ 0.0061	17,600	4.95 $\pm$ 1.36	0.955 $\pm$ 0.044	
MY	Pellet	2	MY-16	11-3-69	1.97 $\pm$ 0.64	1.02 $\pm$ 0.0057	14,600	2.54 $\pm$ 0.82	0.808 $\pm$ 0.023	
		6	MY-2	10-15-69	3.62 $\pm$ 0.81	1.75 $\pm$ 0.0070	20,230	4.61 $\pm$ 1.03	1.33 $\pm$ 0.04	
		10	MY-17	11-5-69	3.24 $\pm$ 0.95	1.32 $\pm$ 0.0077	16,700	4.18 $\pm$ 1.22	1.01 $\pm$ 0.03	
JF	Pellet	7	JF-1	10-16-69	2.51 $\pm$ 0.52	1.75 $\pm$ 0.0072	20,110	3.20 $\pm$ 0.66	1.34 $\pm$ 0.06	
		10	JF-27	12-3-69	2.19 $\pm$ 0.69	1.37 $\pm$ 0.0080	17,620	2.88 $\pm$ 0.91	0.964 $\pm$ 0.063	
S1	Vipac	2	S1-29	12-4-69	2.43 $\pm$ 0.77	1.05 $\pm$ 0.0077	14,820	3.20 $\pm$ 1.01	0.798 $\pm$ 0.040	
		6	S1-7	11-4-69	3.33 $\pm$ 0.80	1.85 $\pm$ 0.012	21,150	4.29 $\pm$ 1.03	1.38 $\pm$ 0.07	
		10	S1-30	12-8-69	2.15 $\pm$ 0.65	1.46 $\pm$ 0.0074	18,710	2.84 $\pm$ 0.66	1.11 $\pm$ 0.05	
PO	Vipac	2	PO-32	12-15-69	1.31 $\pm$ 0.59	1.11 $\pm$ 0.0097	15,320	1.74 $\pm$ 0.78	0.824 $\pm$ 0.045	
		6	PO-6	10-21-69	3.95 $\pm$ 1.04	1.80 $\pm$ 0.0067	20,780	5.05 $\pm$ 1.33	1.36 $\pm$ 0.07	
		10	PO-34	12-22-69	1.60 $\pm$ 0.80	1.43 $\pm$ 0.022	18,200	2.13 $\pm$ 1.06	1.11 $\pm$ 0.05	

Notes: (a) Alpha spectrometry; errors shown are $\pm$ two standard deviations, based on alpha counts.

(b) Results of alpha spectrometric analyses; unirradiated samples are referenced to Saxton Core II Beginning-of-life on December 28, 1965; irradiated samples are referenced to Core II end-of life on October 18, 1968.

TABLE H-2

SUMMARY OF RADIOCHEMICAL ANALYSIS FOR Np-237 IN SAXTON CORE II FUEL

Fuel Rod	Axial Sample Zone	Np-237 ^(a) Activity dpm/gU ($\times 10^{-5}$)	Corresponding Mass Spec. Sample No.	U-238 Weight Fraction in Total U	Np-237/U-238 ^(b) Atom Ratio ($\times 10^4$)
RI	2	1.34	RI-19	0.99362	0.865
	6	1.78	RI-3	0.99398	1.15
	10	1.16	RI-24	0.99375	0.749
MY	2	1.14	MY-16	0.99361	0.736
	6	1.76	MY-2	0.99393	1.14
	10	1.59	MY-17	0.99375	1.03

Notes: (a) Radiochemical analysis; all results $\pm 15\%$, on November 26, 1969.

$$(b) \quad N^{37}/N^{28} = A^{37} W^{28}/\lambda^{37} N_a (wf)^{28}$$

where:

$$A^{37} = \text{Np-237 dpm/gU}$$

$$W^{28} = \text{atomic weight U-238}$$

$$\lambda^{37} = \text{Np-237 decay constant } (6.16 \times 10^{-13} \text{ min}^{-1})$$

$$N_a = \text{Avogadro's Number}$$

$$(wf)^{28} = \text{U-238 weight fraction}$$

TABLE H-3

SUMMARY OF ANALYSES FOR AM-241 AND AM-243 IN SAXTON CORE II FUEL^(e)

Fuel Rod	Axial Sample Zone	Atom Ratio at Time of Analysis ($\times 10^2$)		Corresponding Mass Spectrometric Data			Am-241/Pu-239 ^(d) Atom Ratio ($\times 10^2$) at EOL
				Sample I.D.	Date of Analysis	Pu-241/Pu-239 ^(c) Atom Ratio ($\times 10^2$)	
RI	2	0.845	< 0.10	RI-19	11-10-69	5.48	0.535 $\pm$ 0.127
	6	1.27	< 0.80	RI-3	9-3-69	8.19	0.812 $\pm$ 0.191
	10	1.35	< 0.15	RI-24	11-17-69	6.80	0.965 $\pm$ 0.203
MY	2	0.840	< 0.23	MY-16	10-21-69	5.53	0.528 $\pm$ 0.126
	6	1.23	< 0.84	MY-2	9-20-69	8.13	0.774 $\pm$ 0.185
	10	1.04	< 0.59	MY-17	11-4-69	6.68	0.663 $\pm$ 0.156

Notes: (a) Alpha spectrometric analysis on November 18, 1969; uncertainties are $\pm$ 15%.

(b) Alpha spectrometric analysis on December 18, 1969. The alpha spectrum resolution obtained for this set of samples was not sufficient to detect the Am-243 peak in the presence of the relatively large Am-241 peak; therefore, only "less than" values can be given.

(c) At time of mass spectrometric analysis; relative error is approximately $\pm$ 0.3 percent.

(d) Referenced to Core II end-of-life on October 18, 1968; uncertainty is estimated two-standards deviation, and includes uncertainty in Pu-241 measurement.

(e) The atom ratio Am-241/Pu-239 in unirradiated fuel at Core II beginning of life on December 28, 1965, is estimated to be 8.34×10^{-4} , and is based on estimated value of Pu-241/Pu-239 atom ratio of 1.05×10^{-2} at time of plutonium separation on or about May 15, 1964.

TABLE H-4
SUMMARY OF ALPHA SPECTROMETRIC ANALYSIS FOR Cm-242/Pu-239 and Cm-244/Pu-239 ATOM
RATIOS IN SAXTON CORE II FUEL

Fuel Rod	Axial Sample Zone	Atom Ratio ($\times 10^4$) at Time of Analysis ^(a)		Corresp. Mass Spec. Sample I.D.	$\frac{N_{49}(b)}{N_{28}}$	$\frac{N_{28}(b)}{N_{628}}$	Burnup ^(c) (MWD/MTM)	Atom Ratio ($\times 10^4$) At Core II EOL ^(d)	
		Cm-242/Pu-239	Cm-244/Pu-239					Cm-242/Pu-239	Cm-244/Pu-239
RI	2	0.556	0.403	RI-19	0.04940	0.99262	14,550	2.88	0.420
	6	1.06	1.24	RI-3	0.04410	0.98921	20,450	5.48	1.29
	10	1.01	1.21	RI-24	0.04639	0.99091	17,600	5.23	1.26
MY	2	0.522	0.366	MY-16	0.04902	0.99292	14,600	2.70	0.381
	6	1.05	1.09	MY-2	0.04383	0.98986	20,230	5.43	1.14
	10	0.757	0.712	MY-17	0.04642	0.99127	16,700	3.92	0.742

Notes: (a) Alpha spectrometric analysis on November 11, 1969. Relative uncertainties are $\pm 10\%$ for Cm-242 and $\pm 20\%$ for Cm-244.

(b) Pu-239 and U-238 atom ratios shown here for reference.

(c) Determined from mass spectrometric analysis for Nd-148/U-238 atom ratio.

(d) Referenced to Core II end-of-life on October 18, 1968.

Please File in Master

WCAP-3385-56

Pt. II

March 9, 1971.

Mrs. Louise Vidal,
JE 3/20,
Commission of the European Communities,
200, rue de la Loi,
BRUSSELS.

Dear Mrs. Vidal:

Enclosed herewith are 42 copies of each of the following reports received from Westinghouse Electric Corporation on the Saxton Plutonium project:

WCAP-3385-55 - Saxton Core II Nuclear Operations Summary,
dated December, 1970. Report assigned
EURAEC-2108.

--WCAP-3385-56 - Saxton Core II Fuel Performance Evaluation -
Part II : Evaluation of Mass Spectrometric
and Radiochemical Analyses of Irradiated
Saxton Plutonium Fuel, by R.J. Nedvik.
Report dated July, 1970.

These documents have been patent-cleared by the USAEC., and may be generally distributed.

Sincerely yours,

R. Glenn Bradley,
Senior AEC Representative
and
Deputy for Euratom Affairs.

Enclosures:
as stated.

cc: R. L. Shannon, DTIC. OR w/copy ea. report.
R. H. Heitmuller, RDT. HQ.
W. Burke, DIA. HQ.
Operations Office: NY.