



Lawrence Livermore National Laboratory and Sandia National Laboratory Nuclear Accident Dosimetry Support of IER 252 and the Dose Characterization of the Flattop Reactor at the DAF

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INTRODUCTION

In support of IER 252 “Characterization of the Flattop Reactor at the NCERC”, LLNL performed ROSPEC measurements of the neutron spectrum and deployed 129 Personnel Nuclear Accident Dosimeters (PNAD) to establish the need for height corrections and verification of neutron spectrum evaluation of the fluences and dose. A very limited number of heights (typically only one or two heights) can be measured using neutron spectrometers, therefore it was important to determine if any height correction would be needed in future intercomparisons and studies. Specific measurement positions around the Flattop reactor are provided in Figure 1. Table 1 provides run and position information for LLNL measurements. The LLNL ROSPEC (R2) was used for run numbers 1 – 7, and vi. PNADs were positioned on trees during run numbers 9, 11, and 13.

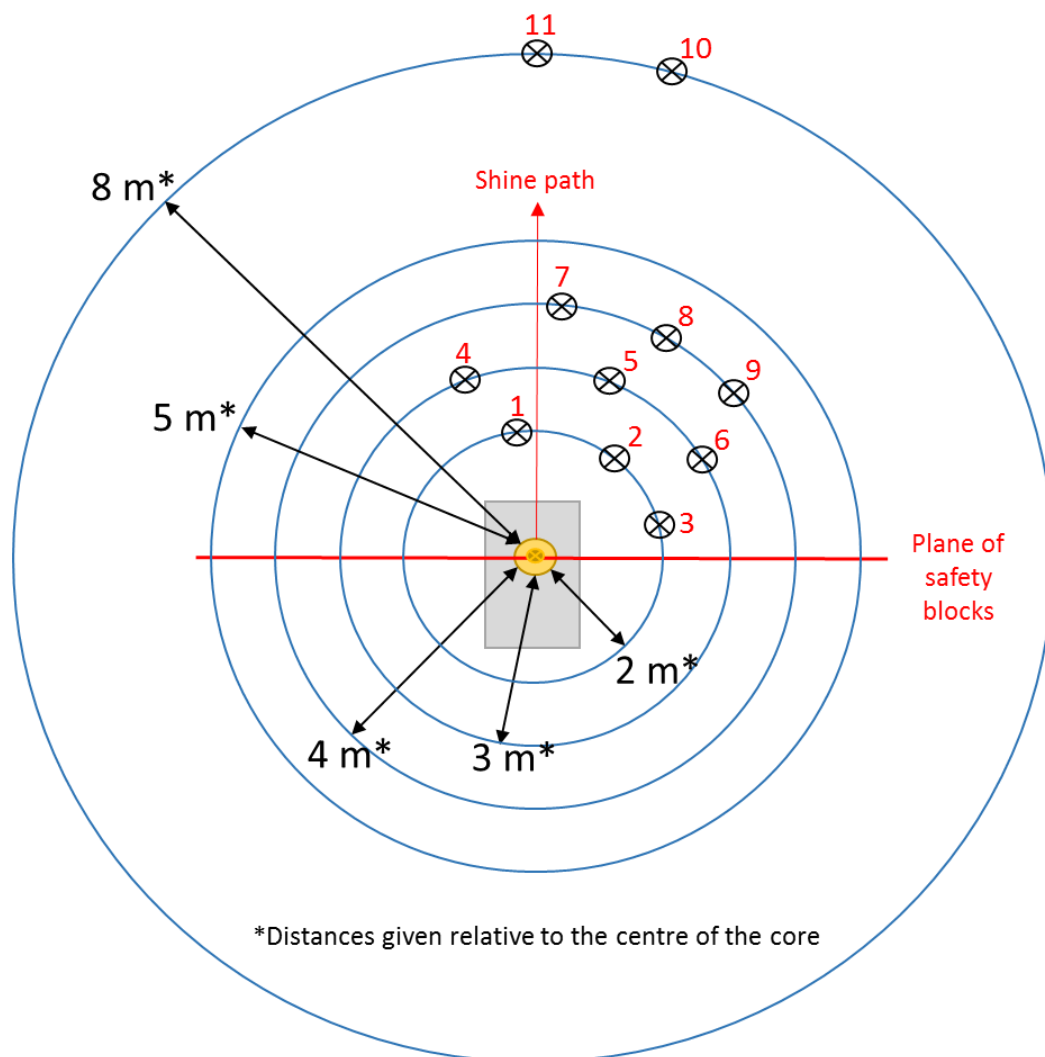


Fig 1. Layout for IER 252 Flattop spectral, fluence, and dose characterization evaluations.

Table 1. Run and position information for LLNL measurements of Flattop.

Run	LLNL Run ID	Date	Start	Stop	Charge (As)	Position										
						1	2	3	4	5	6	7	8	9	10	11
1	N1	15/05/17	13:14:10	14:20:50	2.21E-08	SSS	FNS		BGO 1				BGO 2		R1	R2
3	N4	16/05/17	12:23:14	13:23:14	1.77E-08		BGO 1					R2	SSS	R1	FNS	BGO 2
4	N5	16/05/17	14:53:52	16:03:52	2.72E-07	R1	BGO 1	R2		BGO 2		SSS	FNS			
5	N9	17/05/17	9:37:17	11:07:17	2.99E-07	R2	SSS	R1	BGO 1	FNS			BGO 2			
6	N10	17/05/17	12:33:08	13:33:08	4.14E-07		FNS		R1	BGO 1	R2		BGO 2			SSS
7	N13	17/05/17	14:47:33	15:32:33	5.36E-07					BGO 1		R1	BGO 2	R2		FNS
vi	N15	18/05/17	10:25:28	11:15:28	3.50E-06		BGO 2						BGO 1	FNS	R1	R2
13	13	22/05/17	11:26:00	13:42:00	2.90E-02	ARAMIS	TREE		ATHOS	TREE		D'ART	TREE		TREE	TREE
11	11	23/05/17	9:38:00	10:22:00	2.00E-02		TREE	ARAMIS		TREE	ATHOS		TREE	D'ART	TREE	TREE
9	9	24/05/17	9:22:20	10:06:00	2.05E-02	TREE	ARAMIS		TREE	ATHOS		TREE	D'ART		TREE	TREE

PERSONNEL NUCLEAR ACCIDENT DOSIMETRY MEASUREMENTS

The deployment of the LLNL Personnel Nuclear Accident Dosimeters (PNADs) and SNL photon dosimeters was designed to assess the variability of the dose at distances 2, 3, 4, and 8 meters from the core of the Flattop reactor. Heights ranged from 103 to 197 cm above the floor. LLNL NADs were mounted vertically down the centerline of removable aluminum plates (Fig 2) that were then mounted on a movable stand (Fig 3). SNL CaF_2 dosimeters were mounted across the top of each plate.

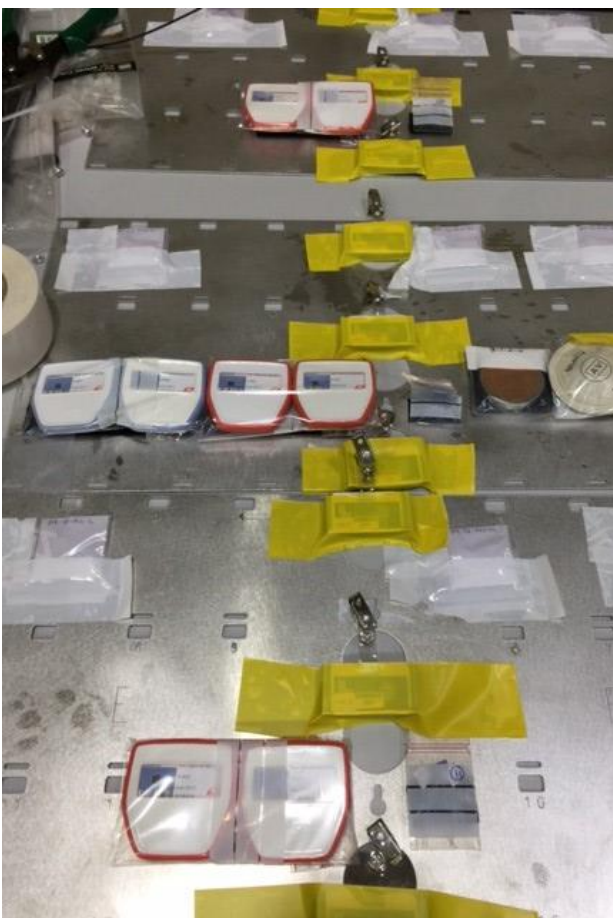


Fig. 2 Three aluminum plates with mounted LLNL NADs (under yellow tape) and SNL dosimeters (under white tape).



Fig. 3 Movable stand and mounts for the aluminum plates.

The three characterization irradiations (run numbers 9, 11, and 13) where LLNL NADs and Sandia CaF_2 TLDs were deployed spanned 22 – 24 May 2017. Each irradiation was performed at a slightly different total charge (Amp-s) and duration as summarized in Table 2.

Table 2. Total charge of irradiations performed for the characterization of Flattop where LLNL deployed NADs and SNL CaF₂ TLDs were used.

Date	Irradiation ID	Charge Start Time	Charge End Time	Amp-s
22May2017	Flattop-13	11:26	13:42	2.90E-2
23May2017	Flattop -11	09:38	10:22	2.00E-2
24May2017	Flattop -9	09:22	10:06	2.05E-2

Heights were converted to effective distances using the method provided in Figure 4.

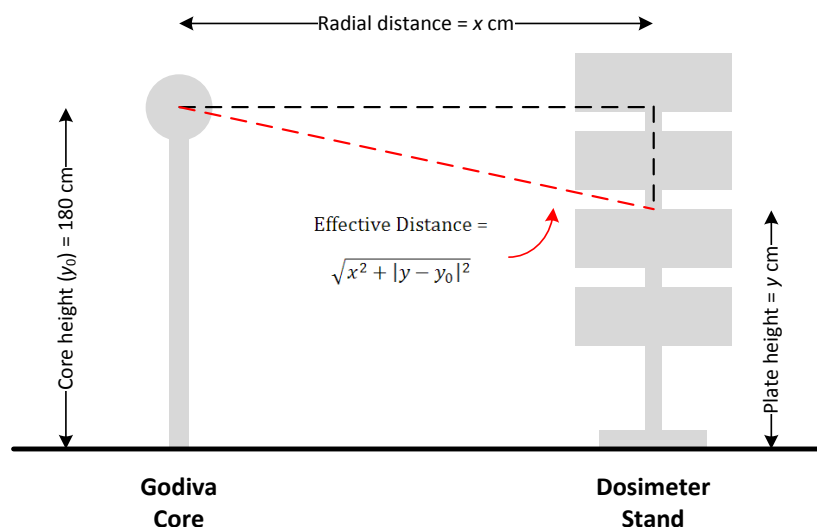


Fig. 4. Calculation of Effective Distance between Reactor Core and Dosimeter (from Tai, 2016).

LLNL personnel nuclear accident dosimeters provide determination of fluence and dose for four neutron energy regions: thermal (0.025 eV); 1eV to 1 MeV; 1MEV to 3 MeV; and greater than 3 MeV and is well suited for establishing correction of neutron spectra when variations are possible due to neutron field changes. Alternative dose evaluations (e.g., air kerma versus tissue kerma) are also possible.

Irradiations were performed at 2, 3, 4 and 8 meters from the core of the Flattop reactor at positions 2, 5, 8, 10, 11 as illustrated in Fig 1. Not shown in Figure 1 is the fact that Position 11 is obstructed from direct irradiation.

PNAD RESULTS

LLNL PNADs provided estimates of neutron fluence and tissue kerma dose as a function of the effective distance for each of the irradiations. These results are provided in Figs 5-10. Position 11 readings are not included with these results (unless otherwise noted) since the readings at Position 11 often contained undetermined valuations (typically for >3 MeV) and provided incomplete and inaccurate results.

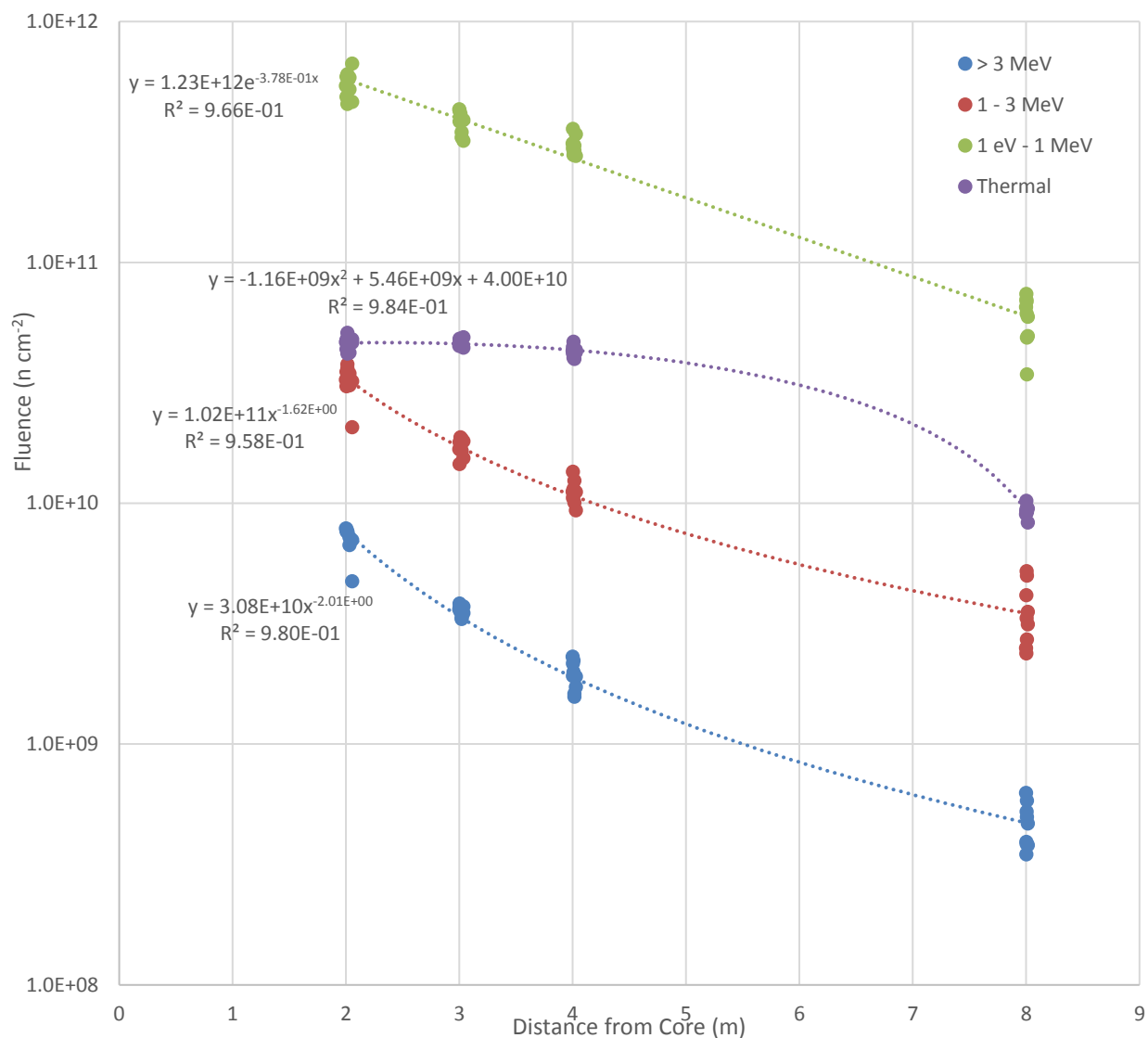


Fig. 5. LLNL PNAD neutron fluence results as a function of effective distance from the reactor core for IER 252 Flattop irradiation #13.

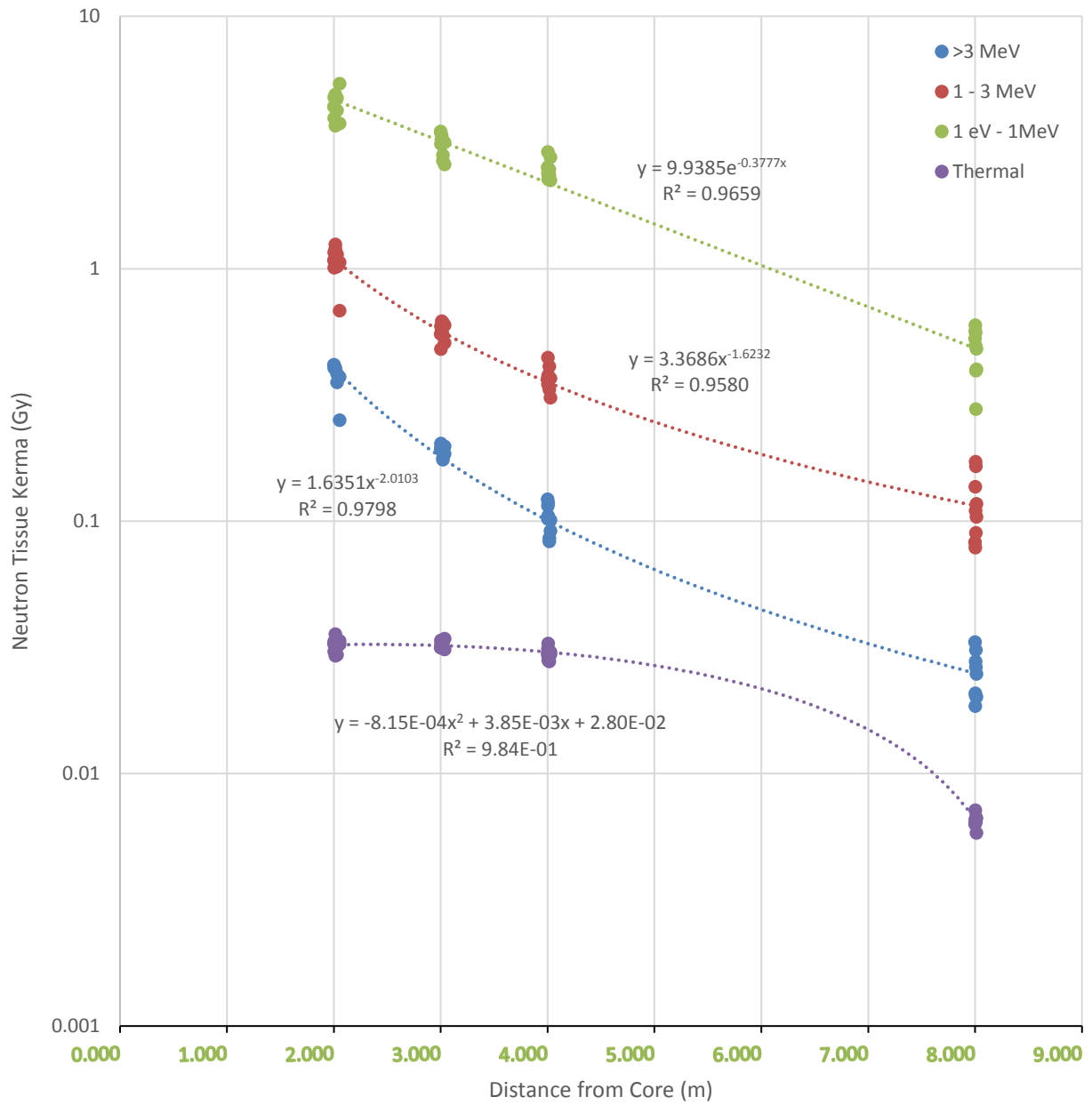


Fig. 6. LLNL PNAD neutron tissue kerma results as a function of effective distance from the reactor core for IER 252 Flattop irradiation #13.

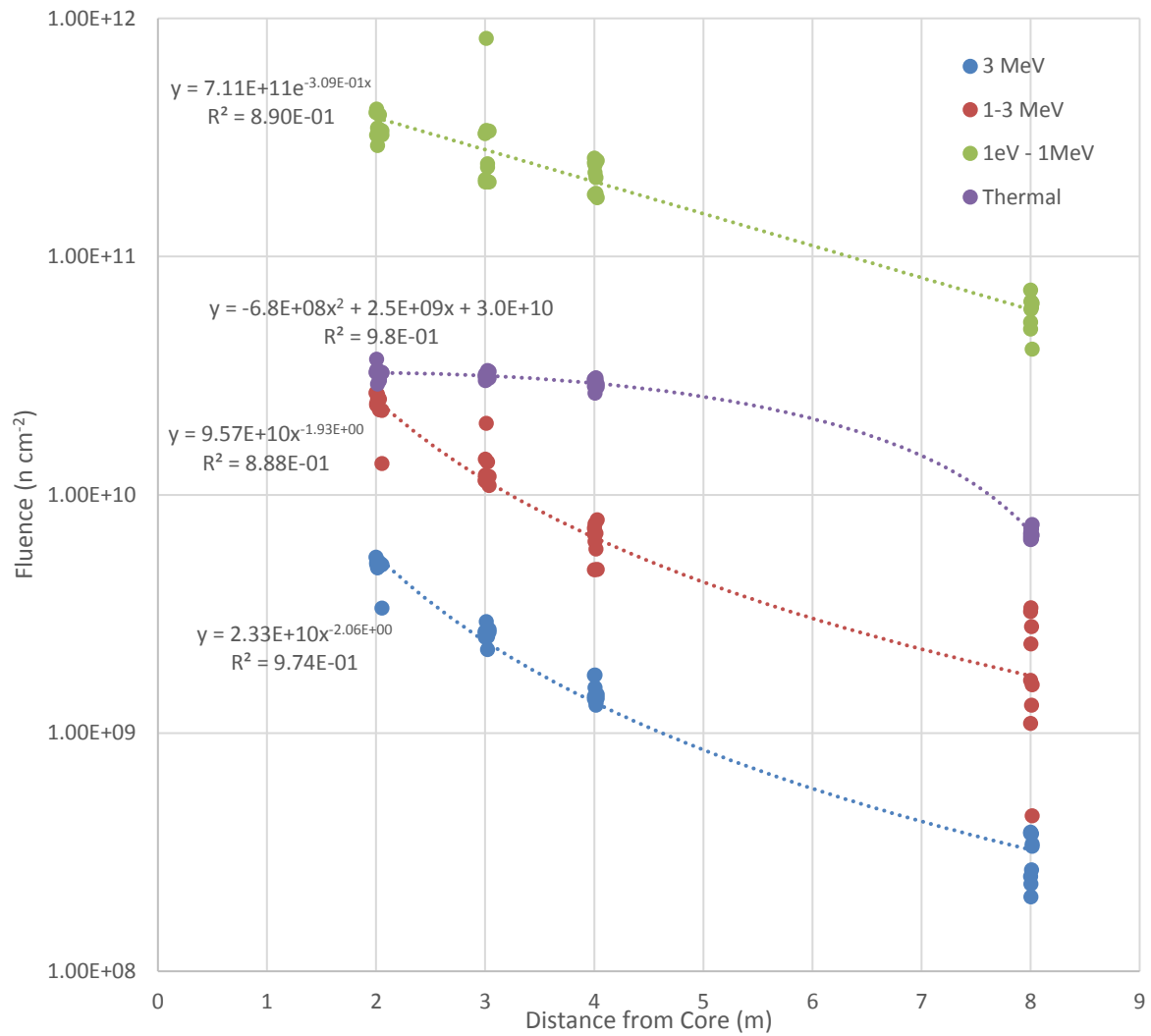


Fig. 7. LLNL PNAD neutron fluence results as a function of effective distance from the reactor core for IER 252 Flattop irradiation #11.

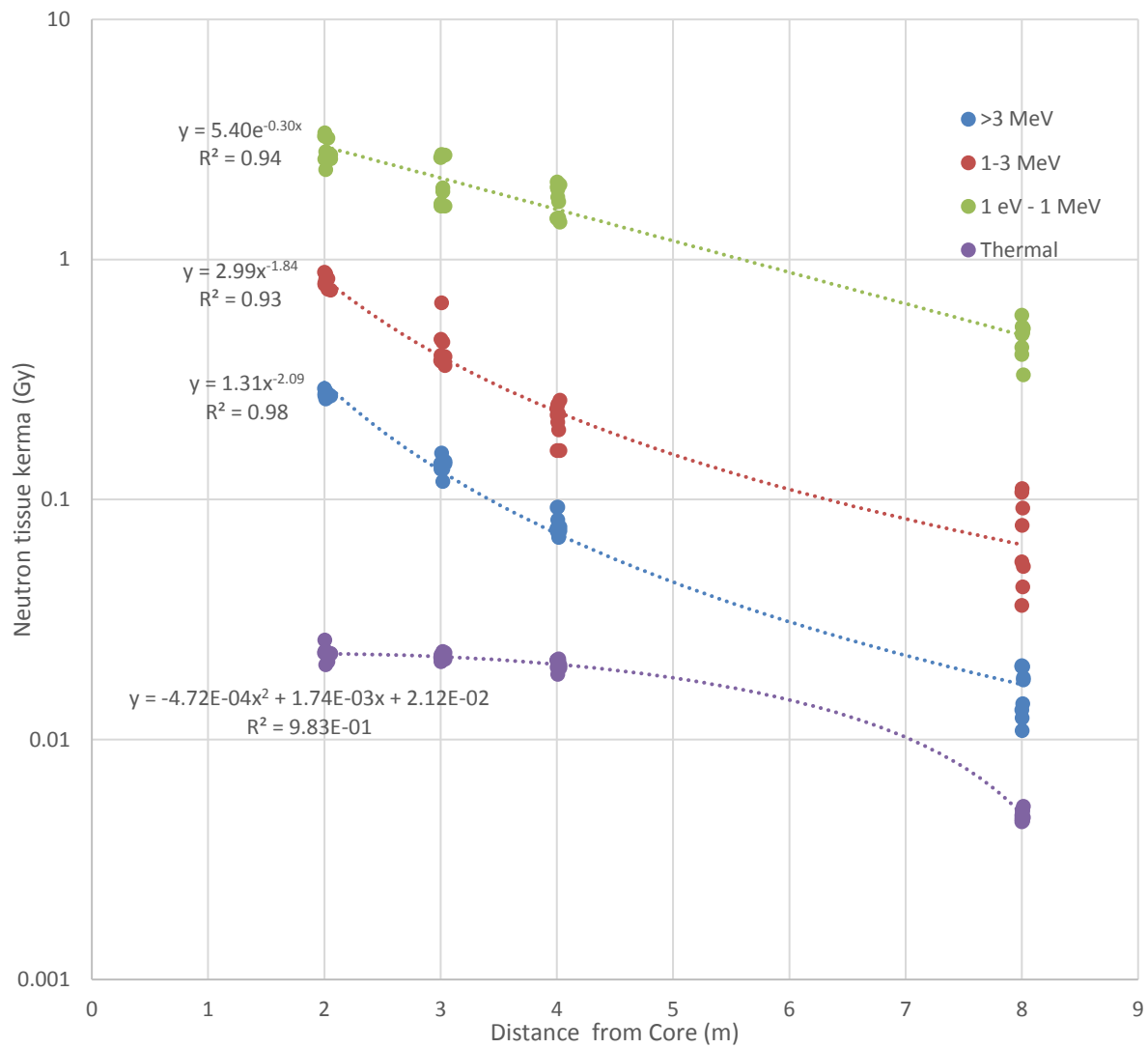


Fig. 8. LLNL PNAD neutron tissue kerma results as a function of effective distance from the reactor core for IER 252 Flatop irradiation #11.

Fluence as a function of distance from reactor core

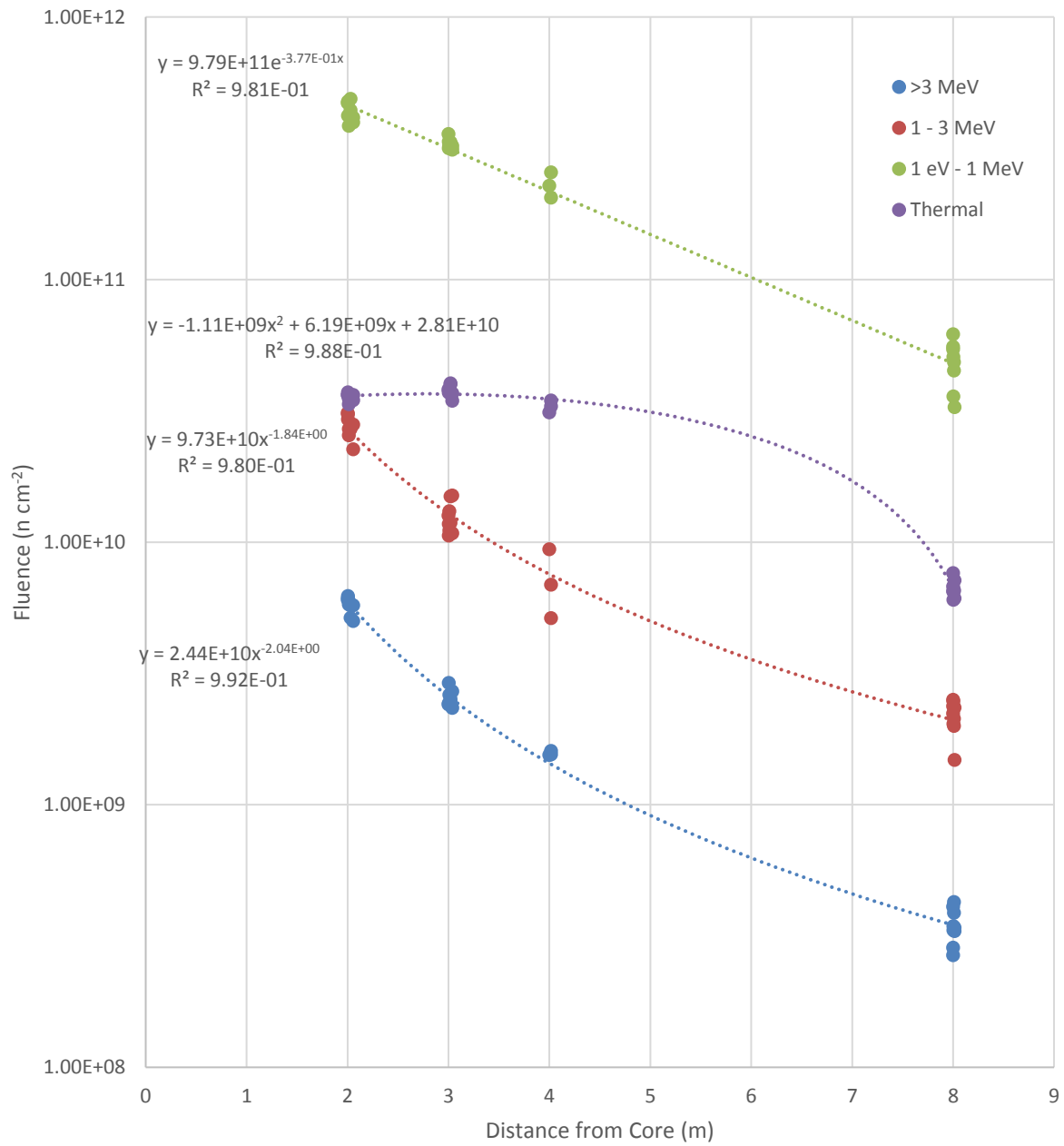


Fig. 9. LLNL PNAD neutron fluence results as a function of effective distance from the reactor core for IER 252 Flattop irradiation #9.

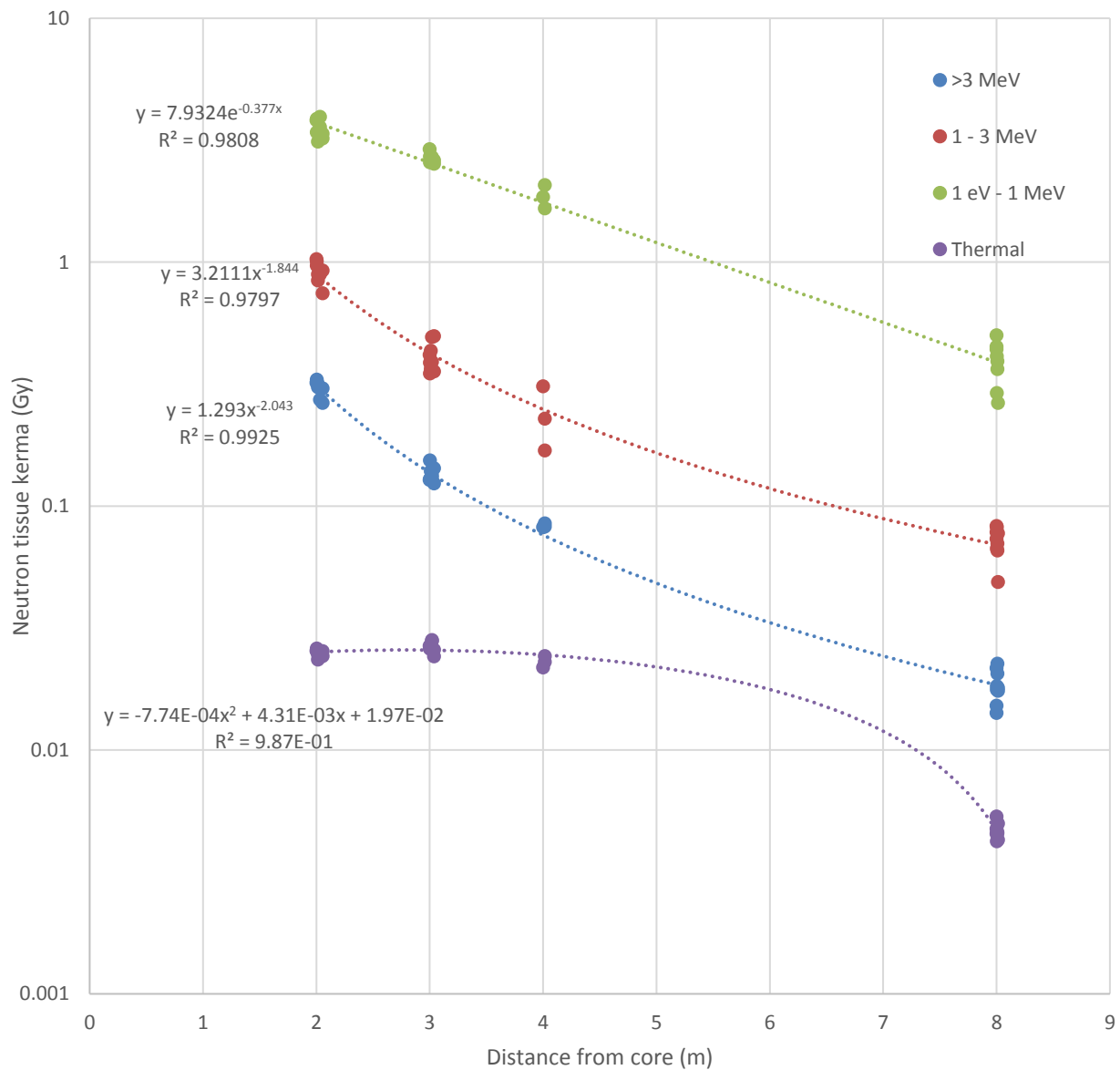


Fig. 10. LLNL PNAD neutron tissue kerma results as a function of effective distance from the reactor core for IER 252 Flattop irradiation #9.

The fluence and tissue kerma dose by as a function of distance from the core of the Flattop reactor had similar response regardless of the exposure level. Neutrons with energy greater than 3 MeV strictly followed an inverse square relationship, however neutrons in the 1 MeV to 3 MeV energy range demonstrated less than an inverse square relationship (typically $x^{-1.6}$ to $x^{-1.9}$, where x is the distance from the core). Neutrons with energies between 1 eV and 1 MeV

demonstrated an exponential relationship ($e^{-0.3}$ to $e^{-0.4}$) of fluence and tissue kerma dose with distance from the core of the reactor. Thermal neutron energy response as a function of distance is best described by a polynomial relationship.

Values for fluence and tissue kerma dose by neutron energy range with increasing distance from the Flattop core are a function of neutron energy as demonstrated Figures 5 - 10. Fluence measurements for neutron energies greater than 1 MeV at 2 meters repeatedly demonstrated low fluence values for measurements at the 103-cm measurement height as illustrated in Figure 11. (see also Figures 5, 7, and 9). Given a total charge (in A·s), the predictive functions provided in Figures 11 and 12 will reasonably predict the fluence and tissue kerma dose respectively. These functions are derive using the LLNL PNAD results for 2, 3, and 4 meters. Positions 10 and 11 (both at 8 meters) are not well predicted by these functions. There are observable differences between Position 10 and Position 11, as evidenced by the spread of the data at 8 meters in Figures 11 and 12. When predicting the fluence and tissue dose at Positions 10 and 11 the values in Table 3 should be used to predict the fluence and kerma dose.

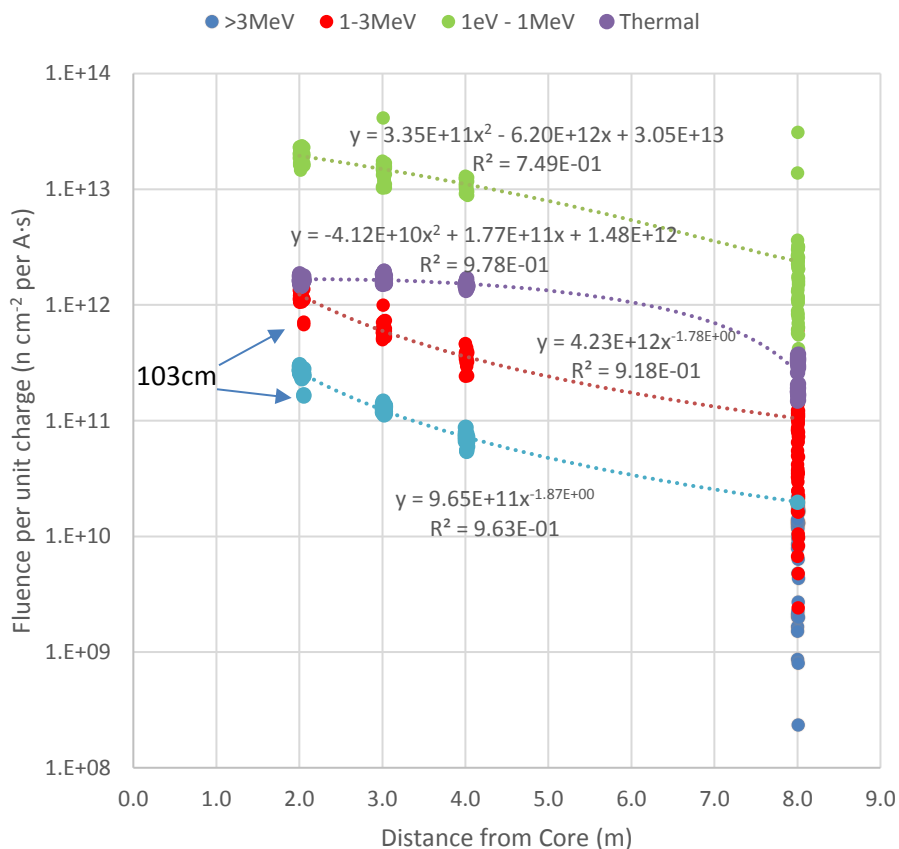


Fig. 11. Neutron fluence per unit charge as a function of distance from the Flattop reactor core using PNADs.

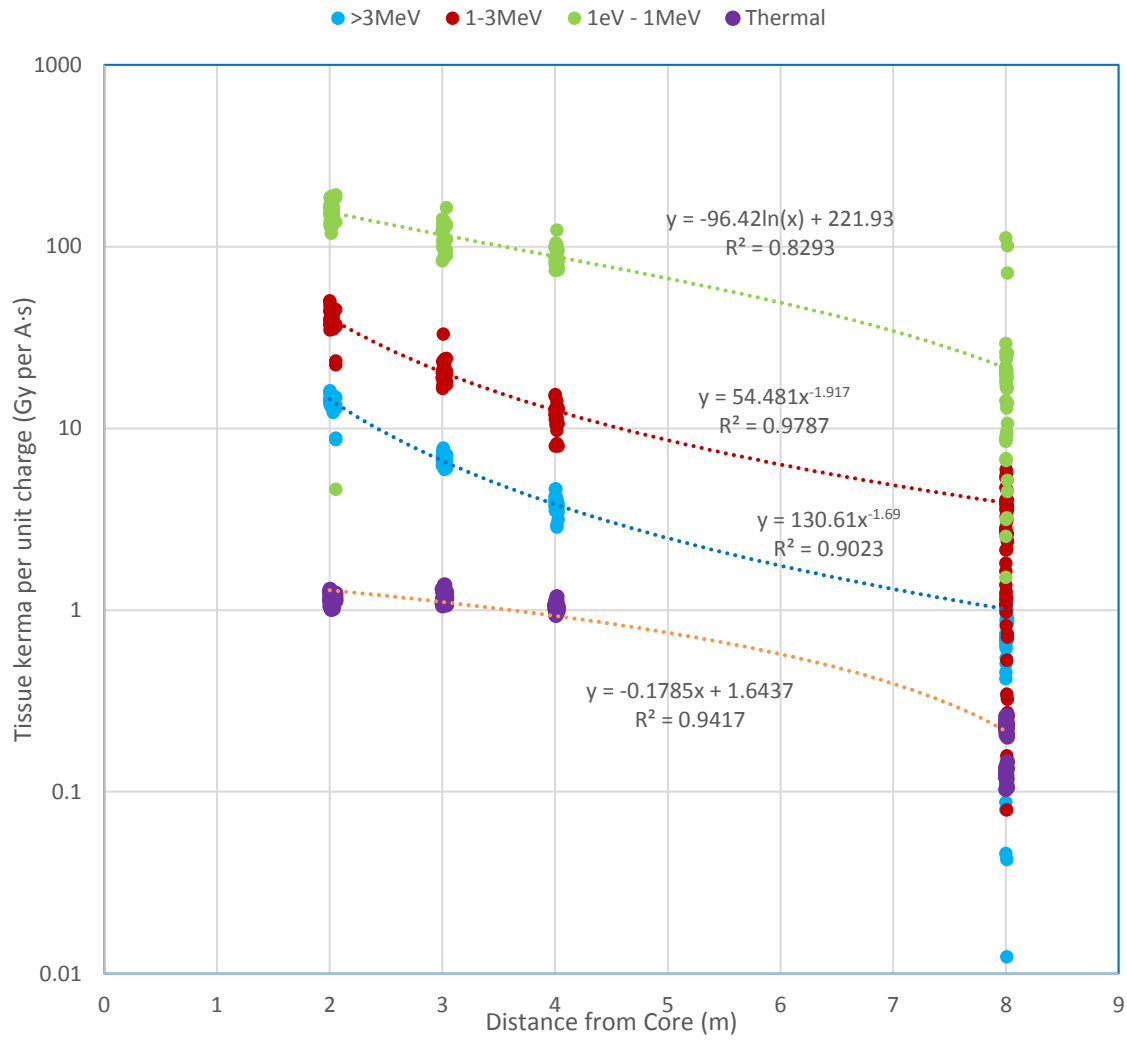


Fig. 12. Neutron tissue kerma per unit charge as a function of distance from the Flattop reactor core.

Table 3. Fluence and tissue kerma dose predictive values for 8 meters from the Flattop Core using PNAD results.

Energy Range	n cm ⁻² per A·s				Gy per A·s			
	Pos. 10 (@8m) ± 1s		Pos. 11 (@8m) ± 1s		Pos. 10 (@8m) ± 1s		Pos. 11 (@8m) ± 1s	
>3 MeV	1.62E+10	± 19%	4.85E+09	± 95%	8.53E-01	± 20%	2.20E-01	± 88%
1-3 MeV	1.09E+11	± 34%	6.87E+10	± 199%	3.771297	± 29%	2.261159	± 206%
1ev - 1 MeV	2.35E+12	± 32%	1.53E+12	± 203%	19.94112	± 24%	13.15493	± 197%
Thermal	3.31E+11	± 7%	1.86E+11	± 24%	0.229625	± 6%	0.123248	± 9%

HEIGHT CORRECTIONS

Evaluation of the change in fluence as a function of height indicates that a moderately strong correlation ($R^2 = 0.4177$, $p = 0.025$) with height for dosimeters positioned at 2 meters (i.e., effective distance at 2-meter locations). The correction for the fluence applies only to neutron energies greater than 1 MeV (1-3 plus > 3 MeV bins). At all other neutron energies and measurement distances other than 2 meters, there is no indication that a correction for the height (effective distance) is needed.

Figure 13 provides height correction factor information for the effective distance of dosimeters positioned two meters from the Flattop core and a neutron energy greater than 1 MeV (see Figure 4 for effective distance calculation method).

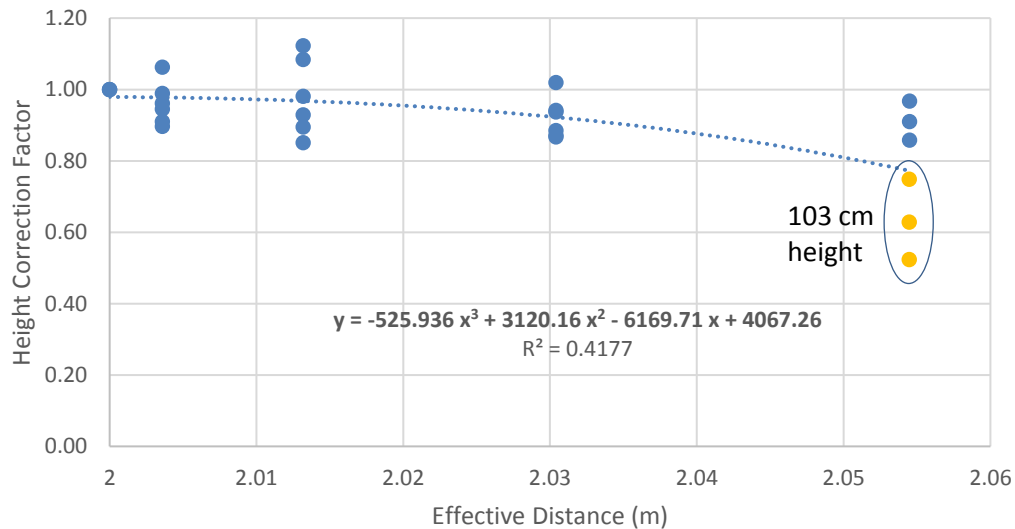


Fig. 13. Fluence height correction factors for neutron energies greater than 1MeV when positioned at the 2-meter radius from the core of the Flattop reactor (includes 103 cm heights).

However, when the 103-cm height measured fluence values at 2 meters are removed from the data set in Figure 13, the resulting functional corrections factors demonstrate a nonsignificant correction relative to height (effective distance) as shown in Figure 14.

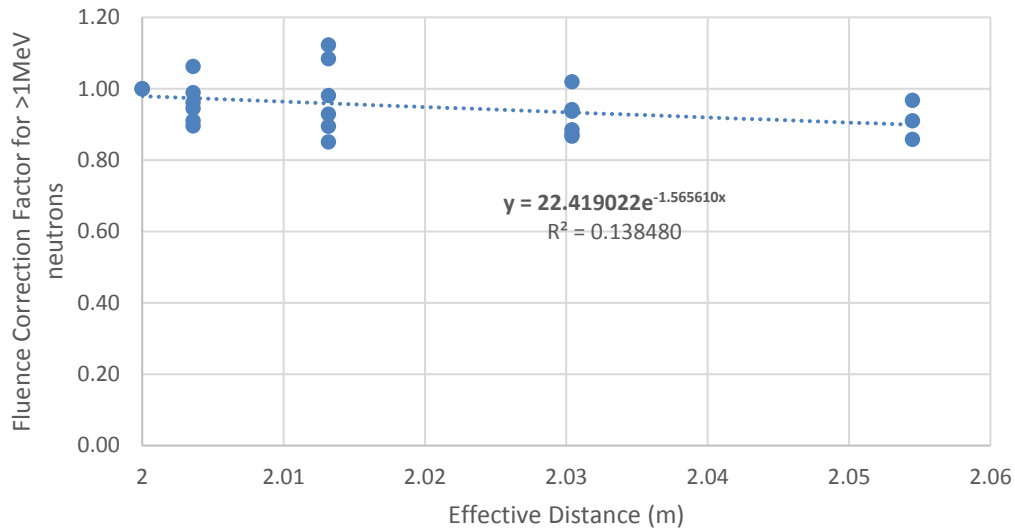


Fig. 14. Non-significant fluence height correction factors for neutron energies greater than 1 MeV when positioned at the 2-meter radius from the core of the Flattop reactor with the 103 cm height results removed.

As shown in Fig 15, the height correction for neutrons with energies between 1 eV and 1 MeV at the 2-meter radius is non-significant ($R^2 = 0.0108$, $p = 0.48$). This relationship holds for all neutron energies below 1 MeV and for all distances.

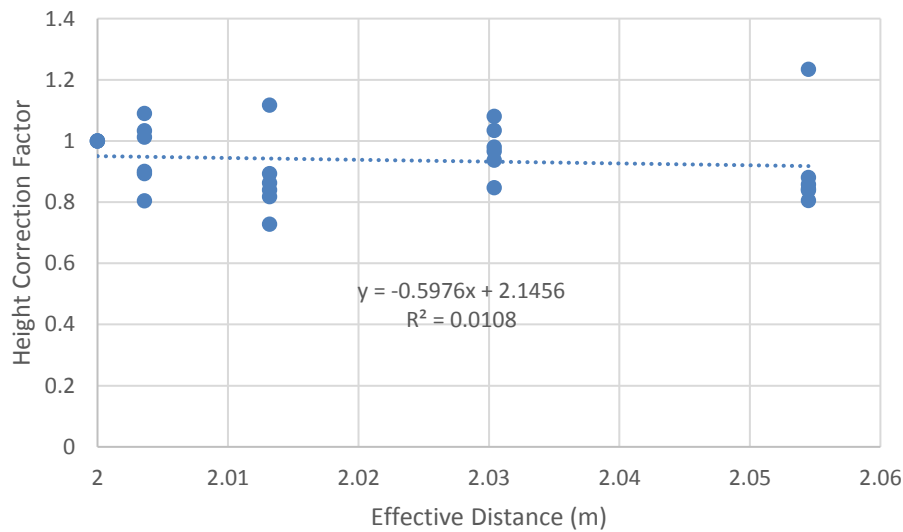


Fig 15. Non-significant fluence height correction factor for neutron energies between 1eV and 1 MeV at the 2-meter radius.

Likewise, there were non-significant correction factors for all neutron energies at when positioned at distances beyond 2 meters. For example, in Figure 16 demonstrates for greater than 1MeV neutrons at plate heights on the 3-meter radius there is a nonsignificant correction ($R^2 = 0.0014$, $p = 0.50$).

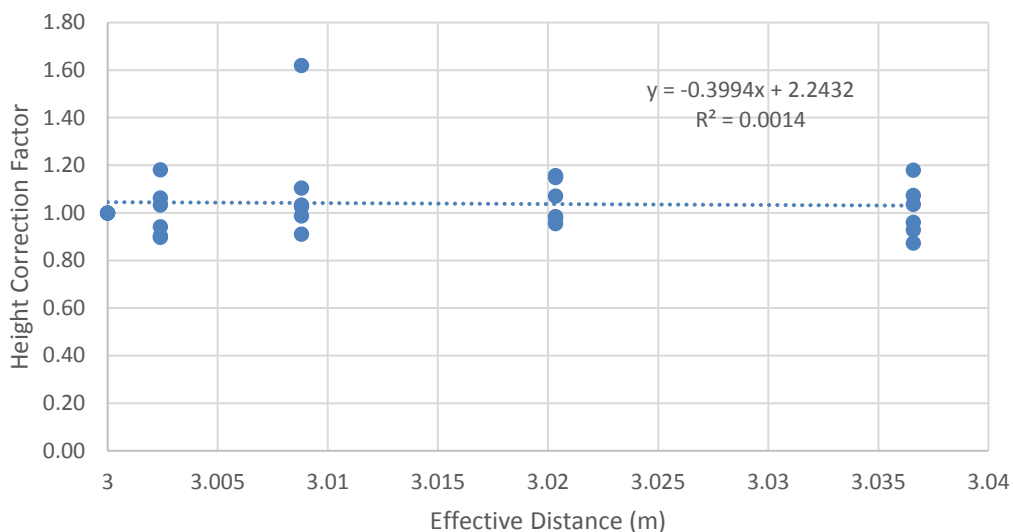


Fig. 16. Nonsignificant fluence height correction factor for neutron energies greater than 1 MeV at the 3-meter radius.

The LLNL PNAD height data demonstrated a consistent under response for both the >3 MeV and 1-3MeV neutron energies at 2 meters when the dosimeter height is at 103 cm. This height should not be used in routine studies evaluations that use predicted dosimetry methods.

GAMMA DOSIMETRY

Sandia National Laboratory (SNL) deployed 700 $\text{CaF}_2(\text{Mn})$ dosimeters (225 per irradiation plus 25 for controls) to evaluate the gamma dose field from the Flattop reactor. The CaF_2 dosimeters were grouped into sets of 5 dosimeters (45 sets per irradiation). Results represent the average and errors associated with each 5-dosimeter set per measurement location.

Using Pulse # 11 as an example, Figures 17 – 20 demonstrate that there is no significant variation of dose across the face of the plates where dosimeters were mounted. Figure 21 shows significant variation across the plates at Position 11 which is partially blocked from direct irradiation. These patterns are similar for Pulse 9 and 13.

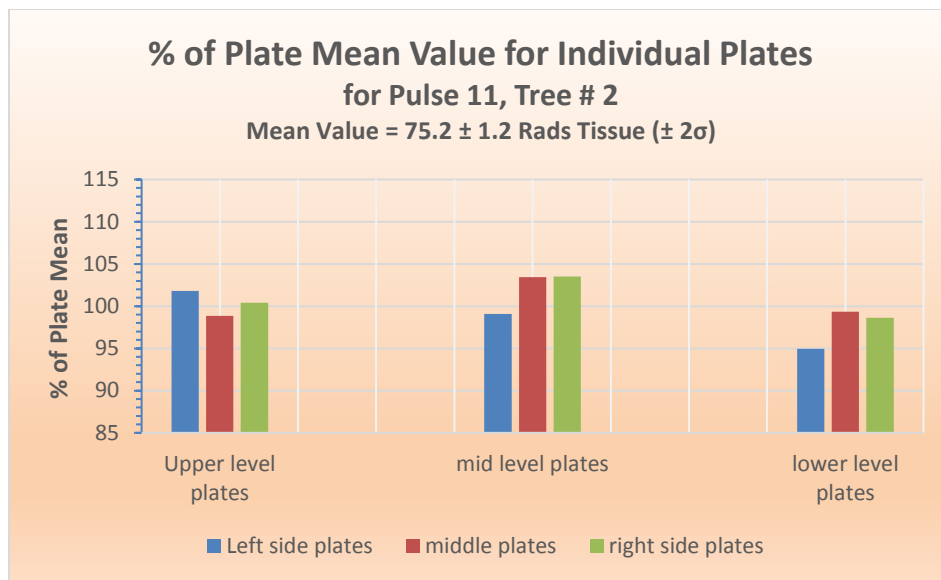


Fig. 17. Variation of gamma dose across the surface of the aluminum support plates holding the dosimeters at 2 meters from the Flattop reactor.

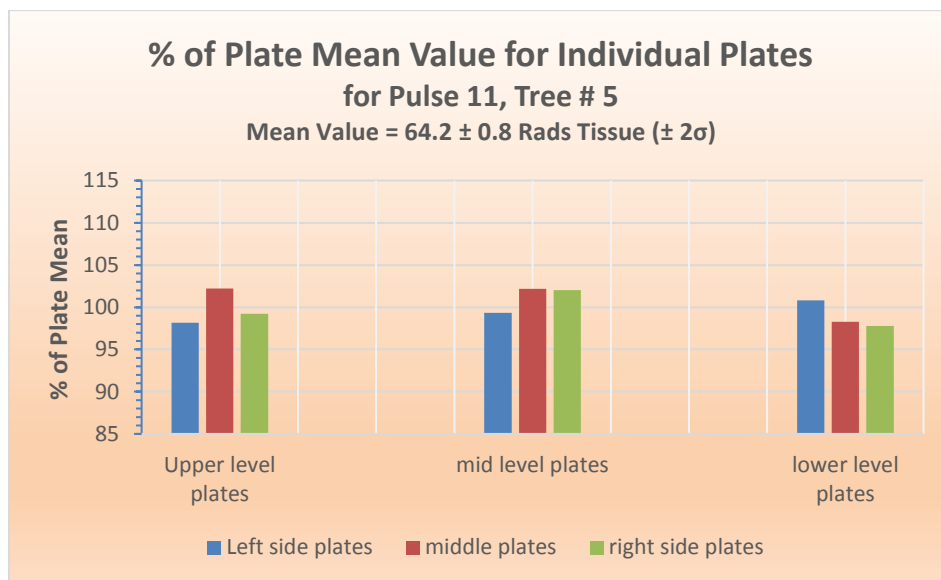


Fig. 18. Variation of gamma dose across the surface of the aluminum support plates holding the dosimeters at 3 meters from the Flattop reactor.

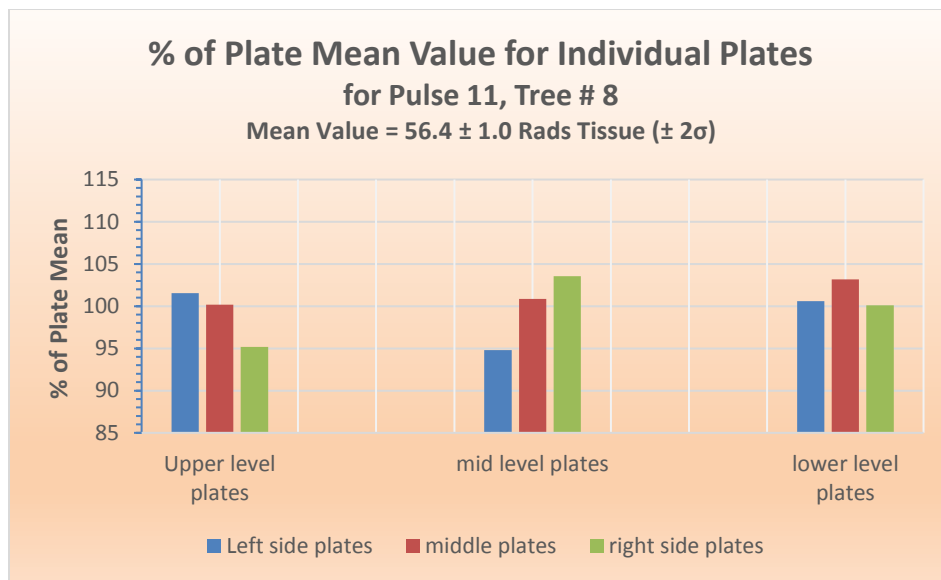


Fig. 19. Variation of gamma dose across the surface of the aluminum support plates holding the dosimeters at 4 meters from the Flattop reactor.

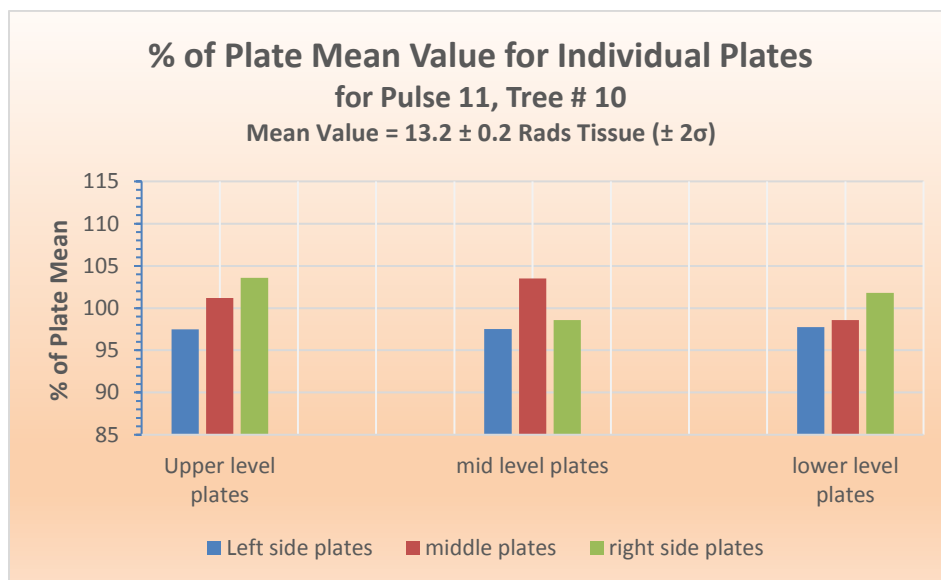


Fig. 20. Variation of gamma dose across the surface of the aluminum support plates holding the dosimeters at 8 meters from the Flattop reactor.

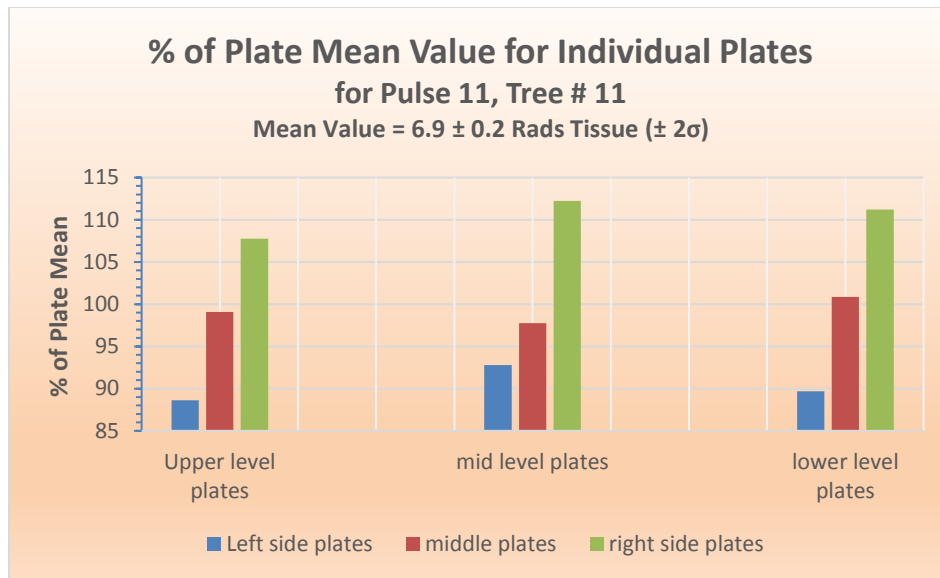


Fig. 21. Variation of gamma dose across the surface of the aluminum support plates holding the dosimeters at 8 meters from the Flattop reactor – Position 11.

As shown in Figure 21, position 11 variability was greatest for all of the irradiations, adding to the conclusion from the PNAD evaluations that this position has high variation and should not be used for intercomparisons.

Vertical and horizontal variations in the gamma doses are normally within $\pm 5\%$ for positions between 2 and 8 meters except for Position 11. The gamma doses do not show a trend or require correction for height at the 2-meter and beyond positions as illustrated below using the measured dose data for Pulse #13 (Figure 22). The results for height variability for all three pulses, Pulse 9, 11, and 13 showed similar patterns to that observed in Figure 22, regardless of position.

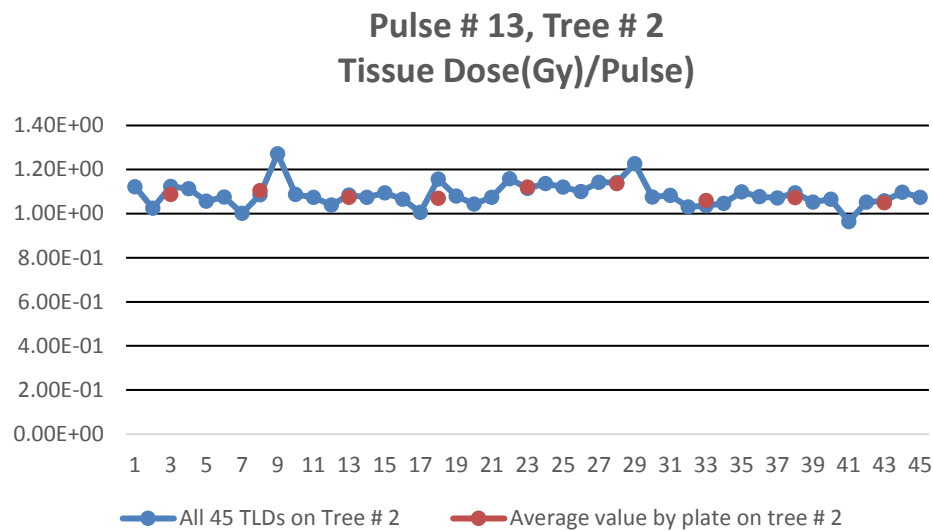


Fig. 22. Gamma dose at 2 meters from Flattop core for Pulse #13 using dosimeters positioned at multiple heights (plates).

The measured gamma tissue dose for the three Flattop irradiations as a function of distance are illustrated in Figure 23.

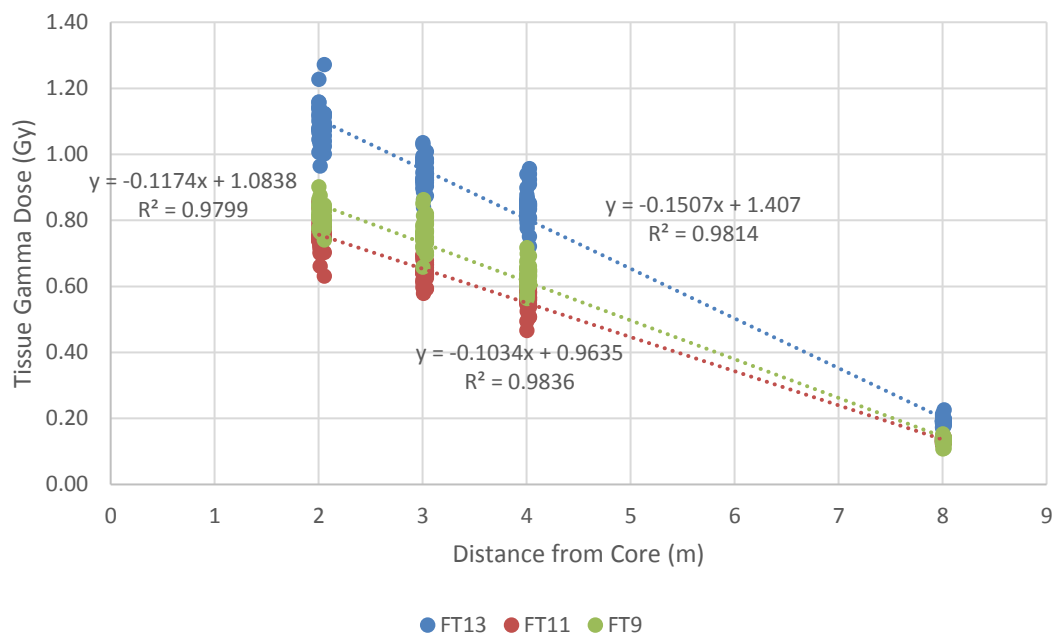


Fig. 23. Measured tissue gamma dose as a function of distance for three characterization measurements FT13, FT11, and FT9 using $\text{CaF}_2(\text{Mn})$ dosimeters.

The predictive equation as a function of distance and the total charge can be found in Figure 24. Statistical data associated with the prediction function are provided in Tables 3 and 4.

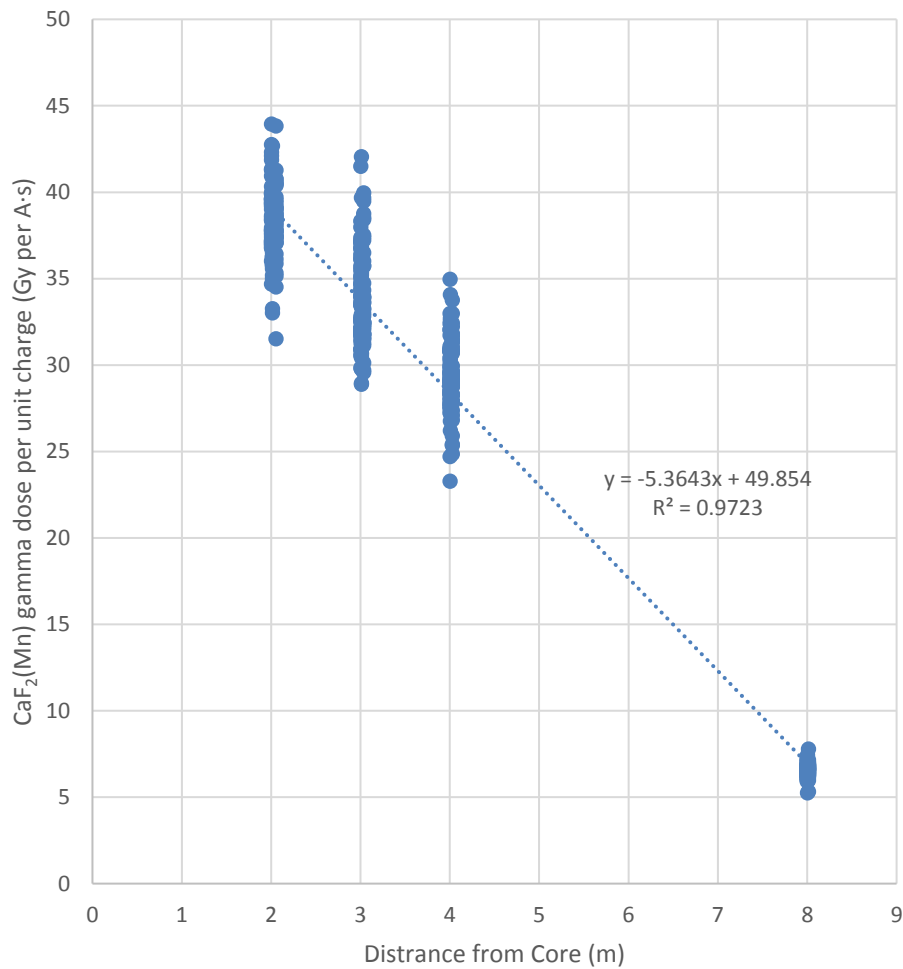


Fig. 24. Gamma tissue dose per unit charge as a function of distance using CaF₂(Mn) dosimeters.

Statistics for the regression of the CaF₂(Mn) regression are provided in Tables 4 and 5. This statistical data can be used to generate statistical errors for predicted gamma doses.

Table 4. Regression statistics for the prediction line in Figure 23.

<i>Regression Statistics</i>	
Multiple R	0.986
R Square	0.972
Adjusted R Square	0.972
Standard Error	2.062
Observations	540.000

Table 5. Variables and standard errors associated with the variables associated with the regression in Figure 23.

	<i>Coefficients</i>	<i>Standard Error</i>
Intercept	49.8540	0.1887
X Variable (m)	-5.3643	0.0391

LLNL PANASONIC 810 AND PERSONNEL ION CHAMBER GAMMA DOSES

Within each of the 129 deployed PNADs, LLNL includes Panasonic 810 dosimeters. The use of these dosimeters has been accredited by the DOE Laboratory Accreditation Program (DOELAP) and complies with ANSI N13.11 (2009) and DOE Standard DOE-STD-1095-2011. Like the PNAD neutron evaluations, the relative responses of these dosimeters were used to investigate if height corrections would be needed for gamma doses. No correction as a function of height was noted for any of the measured distances and heights from the core. Figure 25 demonstrated the typical effect of height on gamma dose.

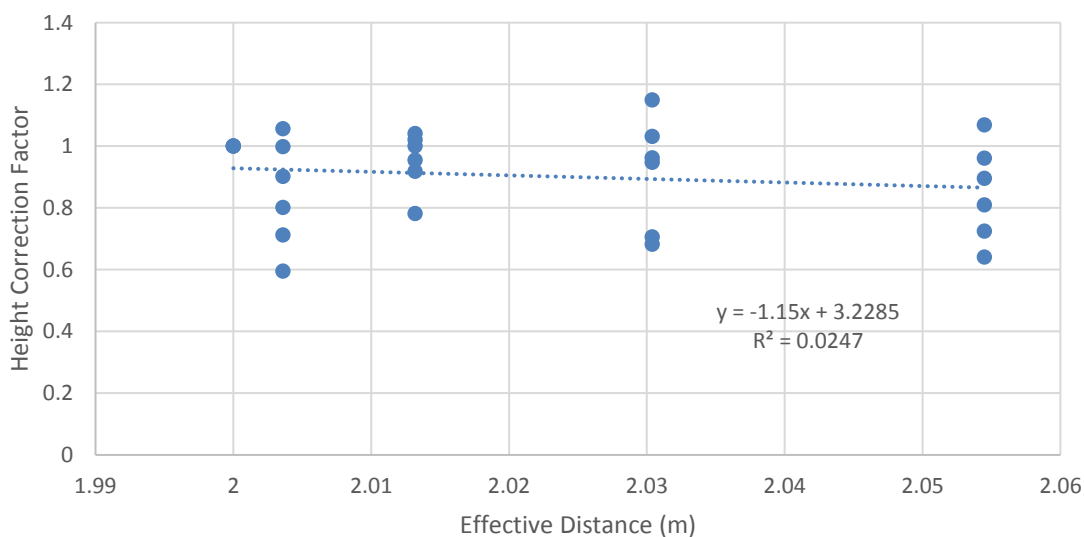


Fig. 25. Non-significant gamma dose height correction factor when positioned at the 2-meter radius from the core of the Flattop reactor.

In 2016, LLNL modified the algorithm for determining gamma dose from high exposure situations that had been previously encountered at the Godiva reactor. The modifications appear to have improved

performance and have improved consistency. Figure 26 compares the LLNL Panasonic dosimeter results to the SNL $\text{CaF}_2(\text{Mn})$ results. The LLNL 810 dosimeter gamma dose measurements tend to over-estimate gamma doses by approximately 44%. Additional evaluation and corrections may be needed before LLNL will be able to provide reasonably accurate gamma dose evaluations.

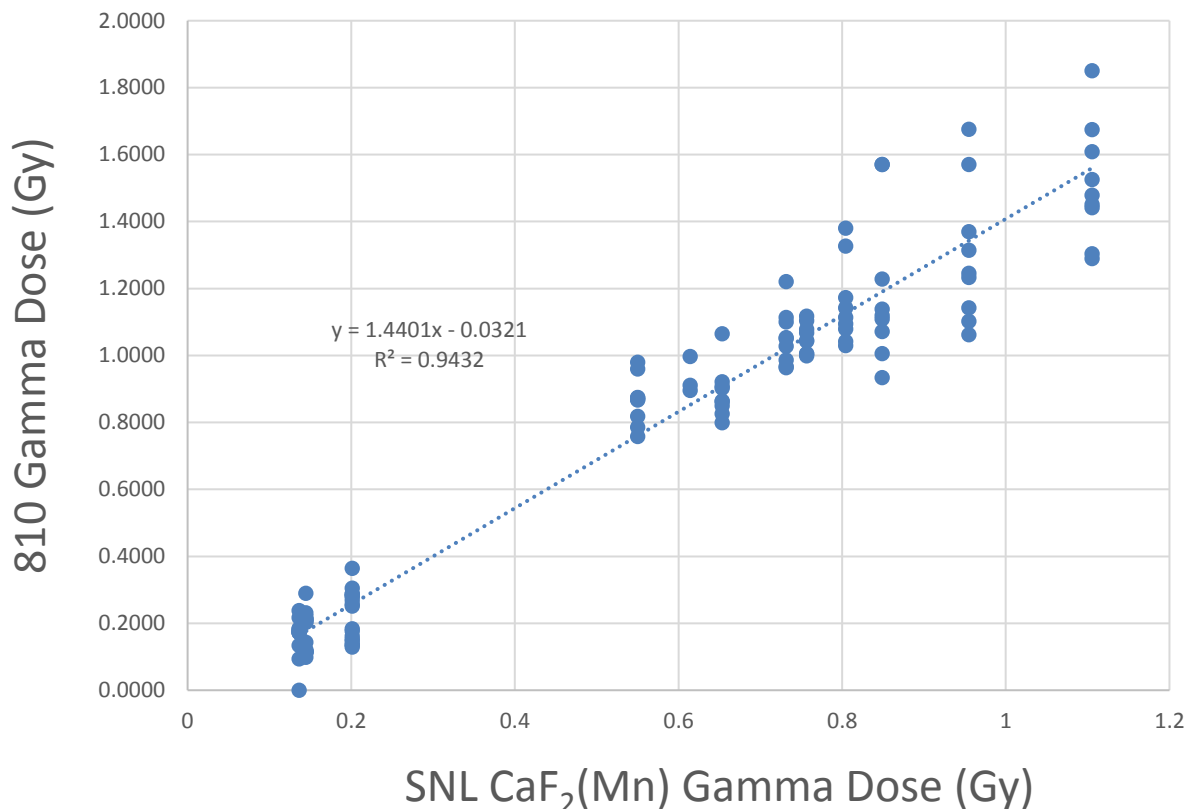


Fig. 26. Comparison of 810 and CaF_2 gamma dose for Flattop irradiations nos. 9, 11, and 13 - May 2017.

The response of the LLNL Panasonic dosimeters show a similar functional relationship to the $\text{CaF}_2(\text{Mn})$ dosimeters as a function of distance and integrated charge for the three exposure levels as demonstrated in Figures 27-28.

Figures 11, 12, 23 and 27 demonstrate that additional data is needed to establish a more reliable predictive function for fluence and dose as a function of total charge. The lack of measurements between 100 and 200 Coulombs limits the predictability of the fluence and dose. Future additional measurements would strengthen the prediction functions and allow for confident use of other currents and times of irradiations.

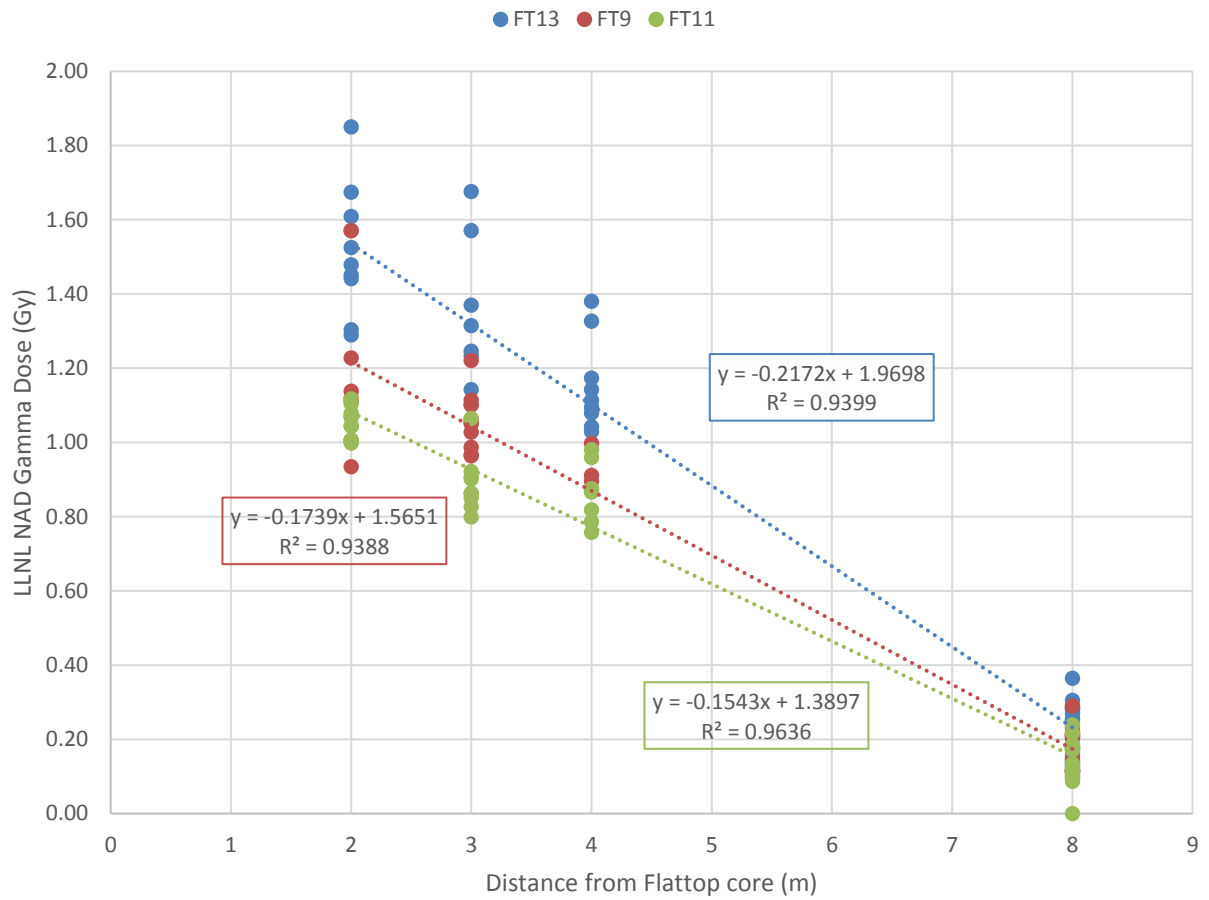


Fig. 27. LLNL 810 dosimeter measured gamma tissue dose as a function of distance for three characterization measurements FT13, FT11, and FT9.

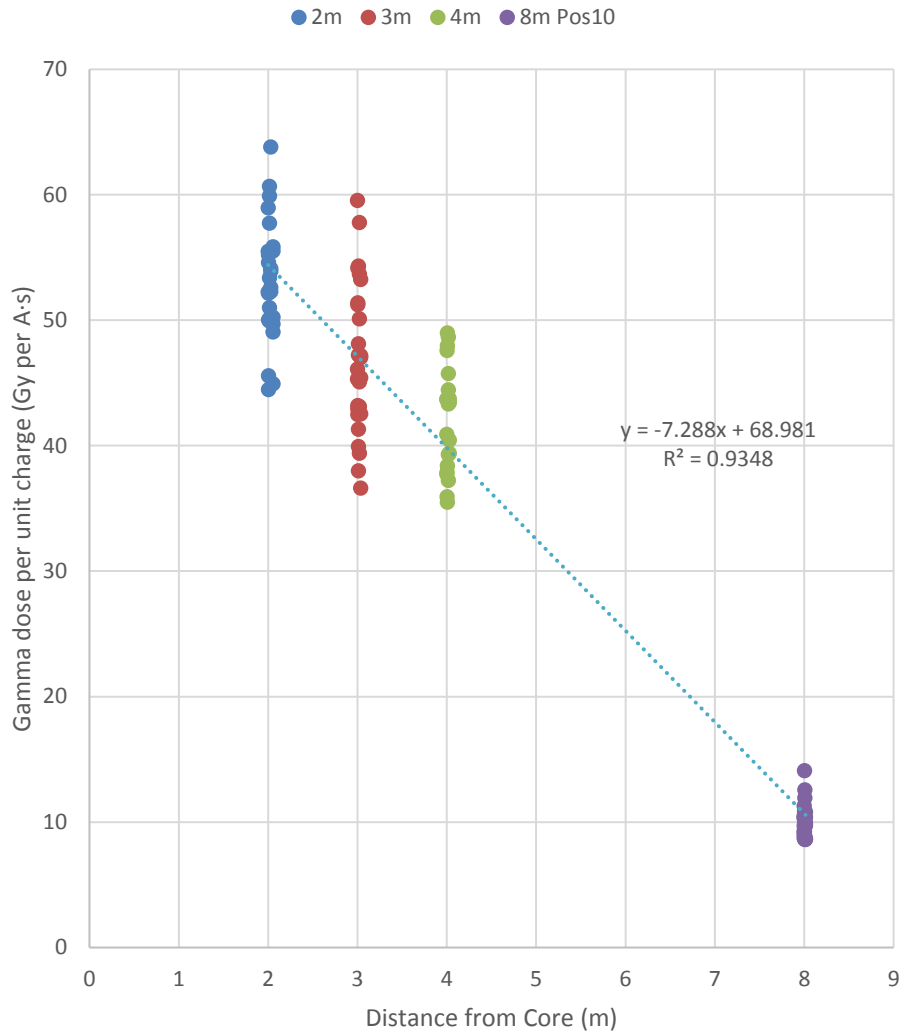


Fig. 28. Gamma tissue dose per unit charge as a function of distance using LLNL 810 dosimeters.

Personal Ion Chambers (PICs) were deployed for each irradiation (9, 1, and 13) at 2, 3, 4, and 8-meter locations. Appendix B provides the observed readings from the PICs. Figure 29 summarizes the PIC results per unit charge as a function of distance from the Flattop reactor, excluding Position 11.

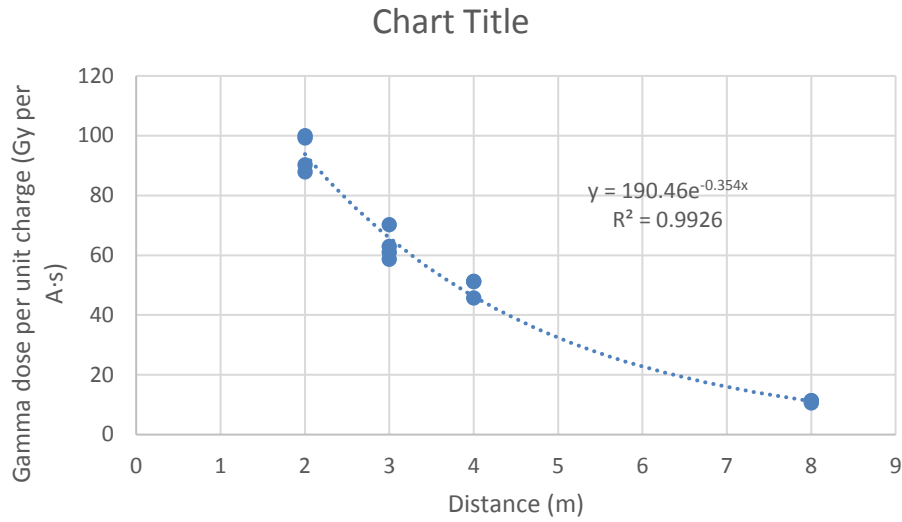


Fig. 29. Gamma tissue dose per unit charge as a function of distance using Personal Ion Chambers.

PIC readings provide predicted gamma dose results that were approximately 0% to 150% higher than $\text{CaF}_2(\text{Mn})$ predictions. A measurement of the PICs using gamma spectrometry demonstrated that the internal components of the PICs had become activated and the activation is likely to have influenced the readings. Additional evaluation on the use and reliability of PICs for the Flattop reactor is needed.

NEUTRON SPECTRAL MEASUREMENTS USING THE ROSPEC

LLNL deployed a ROSPEC™ spectrometer¹ during the week of 15-May-2017 to assist with the spectral evaluation of the Flattop reactor. The summary of irradiations where LLNL deployed the ROSPEC and results are provided in Table 6.

Table 6. Summary for LLNL ROSPEC measurements.

Date	17-May-2017	16-May-2017	17-May-2017	16-May-2017	17-May-2017	15-May-2017	18-May-2017
Run #	5	4	6	3	7	1	vi
LLNL ROSPEC ID	N9	N5	N10	N4	N13	N1	N15
Position	1	3	6	7	9	11	11
Distance	2m	2m	3m	4m	4m	8m	8m
FLATTOP Charge (A-s)	2.99E-07	2.72E-07	4.14E-07	1.77E-08	5.36E-07	2.21E-08	3.50E-06
Measurement time (s)	5,400	4,200	3,600	3,600	2,700	4,000	3,000
H*(10) in $\mu\text{Sv/h}$	637	573	723	23.3	801	4.363	163.6
Neutron fluence rate ($\text{n}/(\text{s}\cdot\text{cm}^2)$)	1,294	1,189	1,815	70.25	2,384	10.66	993

The LLNL ROSPEC exhibited higher than normal counts especially from counter #2. Background measurements before or after each measurement. The normalized background (relative to measurement time) was subtracted from each measurement and before unfolding the resulting spectrum. Table 5 provides a summary of the fluence and dose results.

Background corrected spectra for 2, 3, 4, and 8 meters are provided in Appendix A (Figures A1 – A7). Data values as a function of energy, fluence, and dose values data are also provided for each position in the Appendix A.

The neutron fluence per unit charge as a function of distance from the Flattop core is provided in Figure 28. There is strong correlation as a function of distance with an p-value of 0.000158. Tables 7 and 8 provide statistical data associated with the ROSPEC data correlation that can be used to generate statistical errors for predicted neutron fluences. The PNAD data demonstrated an incongruity with data at Position 11 (especially with respect to Position 10), however, the ROSPEC was located at a position between Positions 10 and 11 being slightly closer to Position 11 than Position 10. The PNAD observed incongruity may not have existed for the ROSPEC. Data from the second (AWE) ROSPEC used at these positions will help confirm or deny these results.

¹ ROSPEC (a Rotating Neutron Spectrometer) is a trademark of Bubble Technologies, 31278 Highway 17, Chalk River, K0J 1J0, Ontario, Canada.

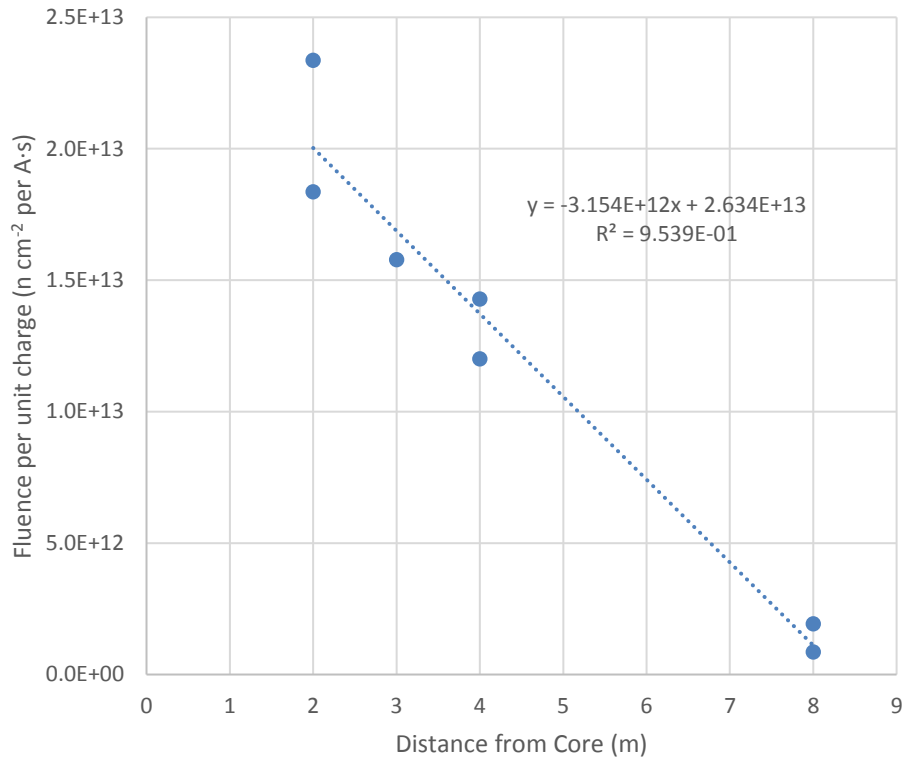


Figure 28. Neutron fluence per unit charge as a function of distance from the Flattop reactor core using the LLNL ROSPEC.

Table 7. Regression statistics for the prediction line in Figure 28.

<i>Regression Statistics</i>	
Multiple R	0.977
R Square	0.954
Adjusted R Square	0.945
Standard Error	1.954E+12
Observations	7

Table 8. Variables and standard errors associated with the variables associated with the regression in Figure 28.

	<i>Coefficients</i>	<i>Standard Error</i>
Intercept	2.634E+13	1.559E+12
X Variable (m)	-3.154E+12	3.101E+11

COMPARISON of LLNL PNAD and LLNL ROSPEC PREDICITON FUNCTIONS

The ROSPEC provides a very accurate neutron spectral measurement, but data must be collected at a low dose relative to the typical criticality accident. The predictions of the fluence and dose using ROSPEC data must scale several orders of magnitude higher than the levels used to make the spectral measurements. Figure 28 provides the functional relationship for scaling the ROSPEC results to higher levels of fluence at various distances from the FLATTOP reactor. In contrast, the LLNL PNADs are applicable to high dose situations typically encountered in criticality accidents, however the PNADs offer a limited spectral evaluation dividing the neutron spectrum in thermal, 1 eV to 1 MeV, 1 MeV to 3 MeV, and greater than 3 MeV. The predictive functions using the LLNL PNADs in relationship to distance from the Flattop reactor is provided in Figure 11. The predictions of fluence using each of these methods demonstrated a difference that ranged from -5% to 13% depending on the distance from the reactor. Table 9. Summarizes the fluence predictions using the functions in Figures 11 and 28 for the measured currents.

<i>Predicted Fluence (n-cm²)</i>				
<i>Distance (m)</i>	Current (A-s)	LLNL ROSPEC	LLNL PNAD	% Difference
2	0.029	5.81E+11	6.55E+11	13%
	0.020	4.01E+11	4.52E+11	13%
	0.0205	4.11E+11	4.63E+11	13%
3	0.029	4.89E+11	5.01E+11	2%
	0.020	3.38E+11	3.46E+11	2%
	0.0205	3.46E+11	3.54E+11	2%
4	0.029	3.98E+11	3.78E+11	-5%
	0.020	2.74E+11	2.60E+11	-5%
	0.0205	2.81E+11	2.67E+11	-5%

APPENDIX A

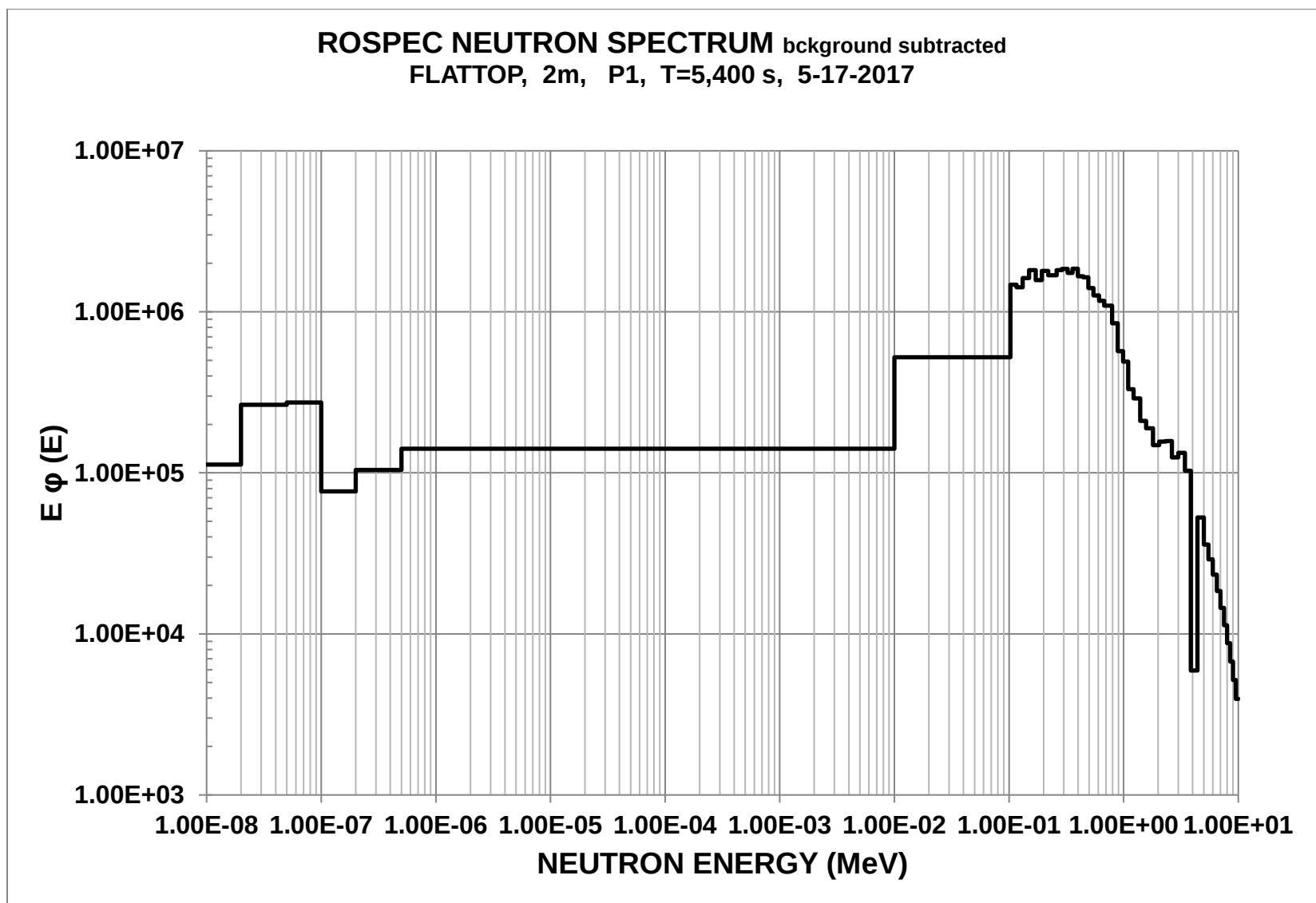


Fig. A1. Flattop spectrum at 2 meters, Position 1.

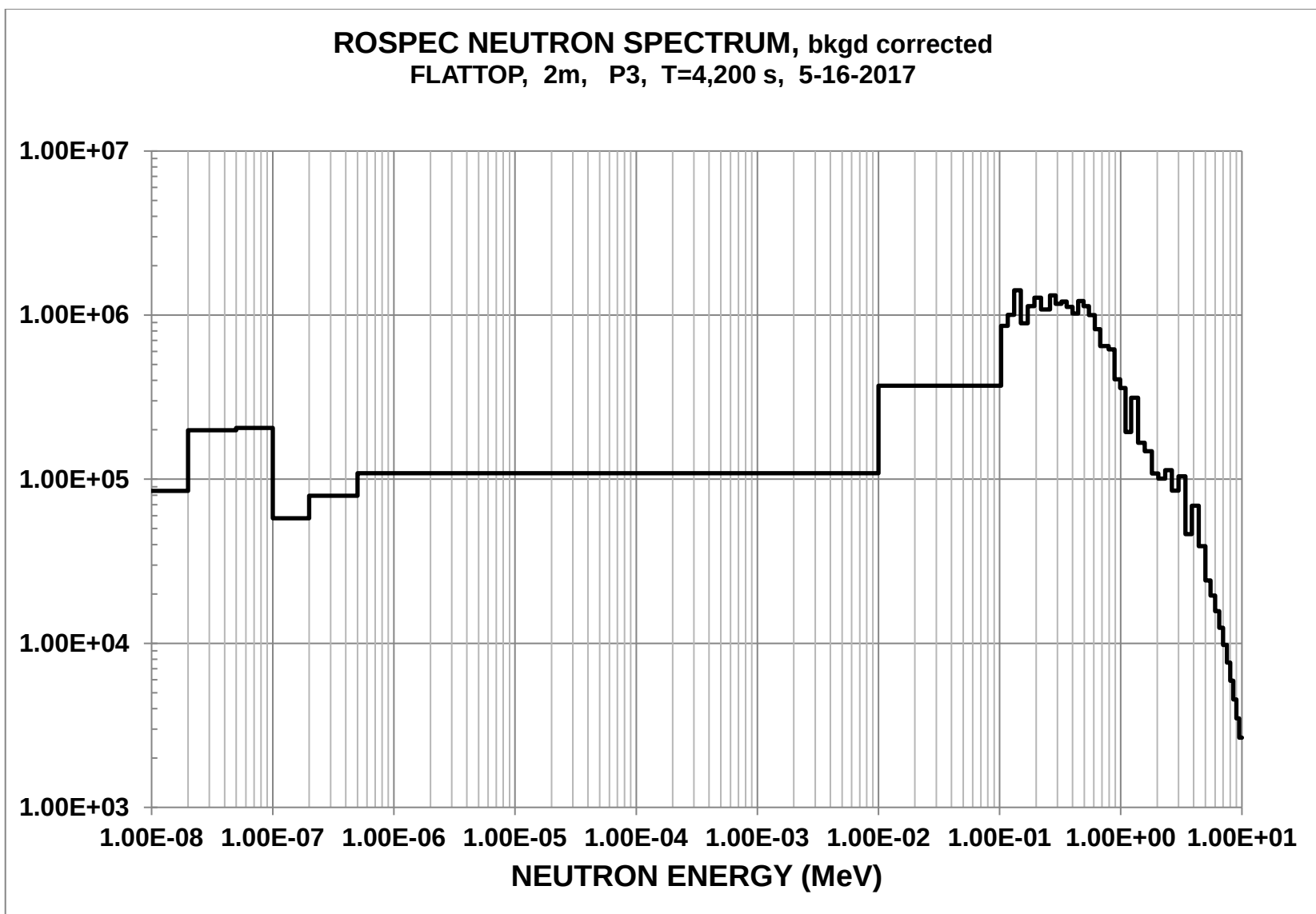
Table A1. Flattop spectral, fluence, and dose data at 2meters, Position 1 for 2.99×10^{-7} A.s.

E2 (MeV)	E1 (MeV)	FLUENCE/ GROUP	FLUENCE/ MeV	FLUENCE/ Lethargy	E avg. (MeV)
.1000E-08	.2000E-08	1.358E+03	1.358E+12	1.960E+03	.1500E-08
.2000E-08	.5000E-08	8.715E+03	2.905E+12	9.511E+03	.3500E-08
.5000E-08	.1000E-07	2.651E+04	5.301E+12	3.824E+04	.7500E-08
.1000E-07	.2000E-07	7.813E+04	7.813E+12	1.127E+05	.1500E-07
.2000E-07	.5000E-07	2.422E+05	8.074E+12	2.643E+05	.3500E-07
.5000E-07	.1000E-06	1.893E+05	3.786E+12	2.731E+05	.7500E-07
.1000E-06	.2000E-06	5.325E+04	5.325E+11	7.682E+04	.1500E-06
.2000E-06	.5000E-06	9.546E+04	3.182E+11	1.042E+05	.3500E-06
.5000E-06	.1000E-01	1.399E+06	1.399E+08	1.413E+05	.5000E-02
.1000E-01	.1027E+00	1.215E+06	1.311E+07	5.216E+05	.5635E-01
.1027E+00	.1166E+00	1.864E+05	1.345E+07	1.472E+06	.1096E+00
.1166E+00	.1317E+00	1.736E+05	1.148E+07	1.423E+06	.1241E+00
.1317E+00	.1493E+00	2.035E+05	1.153E+07	1.618E+06	.1405E+00
.1493E+00	.1707E+00	2.436E+05	1.137E+07	1.817E+06	.1600E+00
.1707E+00	.1934E+00	1.960E+05	8.642E+06	1.571E+06	.1821E+00
.1934E+00	.2199E+00	2.299E+05	8.687E+06	1.793E+06	.2066E+00
.2199E+00	.2606E+00	2.865E+05	7.029E+06	1.685E+06	.2402E+00
.2606E+00	.2906E+00	1.976E+05	6.588E+06	1.814E+06	.2756E+00
.2906E+00	.3244E+00	2.033E+05	6.023E+06	1.850E+06	.3075E+00
.3244E+00	.3581E+00	1.724E+05	5.107E+06	1.741E+06	.3413E+00
.3581E+00	.3994E+00	2.020E+05	4.898E+06	1.853E+06	.3787E+00
.3994E+00	.4444E+00	1.776E+05	3.946E+06	1.663E+06	.4219E+00
.4444E+00	.4931E+00	1.704E+05	3.495E+06	1.637E+06	.4688E+00
.4931E+00	.5456E+00	1.423E+05	2.711E+06	1.407E+06	.5194E+00
.5456E+00	.6094E+00	1.399E+05	2.195E+06	1.266E+06	.5775E+00
.6094E+00	.6769E+00	1.229E+05	1.821E+06	1.170E+06	.6431E+00
.6769E+00	.7946E+00	1.755E+05	1.490E+06	1.094E+06	.7358E+00
.7946E+00	.8870E+00	9.324E+04	1.009E+06	8.476E+05	.8408E+00
.8870E+00	.9871E+00	6.091E+04	6.085E+05	5.696E+05	.9371E+00
.9871E+00	.1095E+01	5.087E+04	4.719E+05	4.908E+05	.1041E+01
.1095E+01	.1218E+01	3.524E+04	2.861E+05	3.305E+05	.1157E+01
.1218E+01	.1391E+01	3.850E+04	2.227E+05	2.901E+05	.1305E+01
.1391E+01	.1573E+01	2.585E+04	1.420E+05	2.102E+05	.1482E+01
.1573E+01	.1807E+01	2.622E+04	1.120E+05	1.890E+05	.1690E+01
.1807E+01	.2041E+01	1.812E+04	7.743E+04	1.488E+05	.1924E+01
.2041E+01	.2327E+01	2.049E+04	7.164E+04	1.562E+05	.2184E+01
.2327E+01	.2639E+01	1.980E+04	6.345E+04	1.573E+05	.2483E+01
.2639E+01	.3003E+01	1.610E+04	4.422E+04	1.246E+05	.2821E+01
.3003E+01	.3419E+01	1.730E+04	4.158E+04	1.333E+05	.3211E+01
.3419E+01	.3861E+01	1.256E+04	2.842E+04	1.033E+05	.3640E+01
.3861E+01	.4407E+01	7.847E+02	1.437E+03	5.933E+03	.4134E+01
.4407E+01	.5000E+01	6.677E+03	1.126E+04	5.289E+04	.4703E+01
.5000E+01	.5500E+01	3.415E+03	6.830E+03	3.583E+04	.5250E+01
.5500E+01	.6000E+01	2.529E+03	5.058E+03	2.907E+04	.5750E+01
.6000E+01	.6500E+01	1.865E+03	3.729E+03	2.329E+04	.6250E+01
.6500E+01	.7000E+01	1.369E+03	2.737E+03	1.847E+04	.6750E+01
.7000E+01	.7500E+01	1.002E+03	2.003E+03	1.452E+04	.7250E+01
.7500E+01	.8000E+01	7.302E+02	1.460E+03	1.131E+04	.7750E+01
.8000E+01	.8500E+01	5.312E+02	1.062E+03	8.762E+03	.8250E+01
.8500E+01	.9000E+01	3.856E+02	7.712E+02	6.746E+03	.8750E+01
.9000E+01	.9500E+01	2.795E+02	5.590E+02	5.169E+03	.9250E+01
.9500E+01	.1000E+02	2.026E+02	4.052E+02	3.950E+03	.9750E+01

INTEGRATED FLUENCE = 6.9871E+06

FLUENCE RATE = 1.2939E+03

	INTEGRATED DOSE	DOSE RATE
KERMA	= 5.4658E-03 rads	3.6439E+00 mrads/hr
H	NCRP-38 = 7.3811E-02 rem	4.9208E+01 mrem/hr
H*(10)	ICRP-74 = 9.5547E-04 Sv	6.3698E+02 uSv/hr
Hp(10,0)	ICRP-74 = 9.8545E-04 Sv	6.5697E+02 uSv/hr



Fig, A2. Flattop spectrum at 2 meters, Position 3.

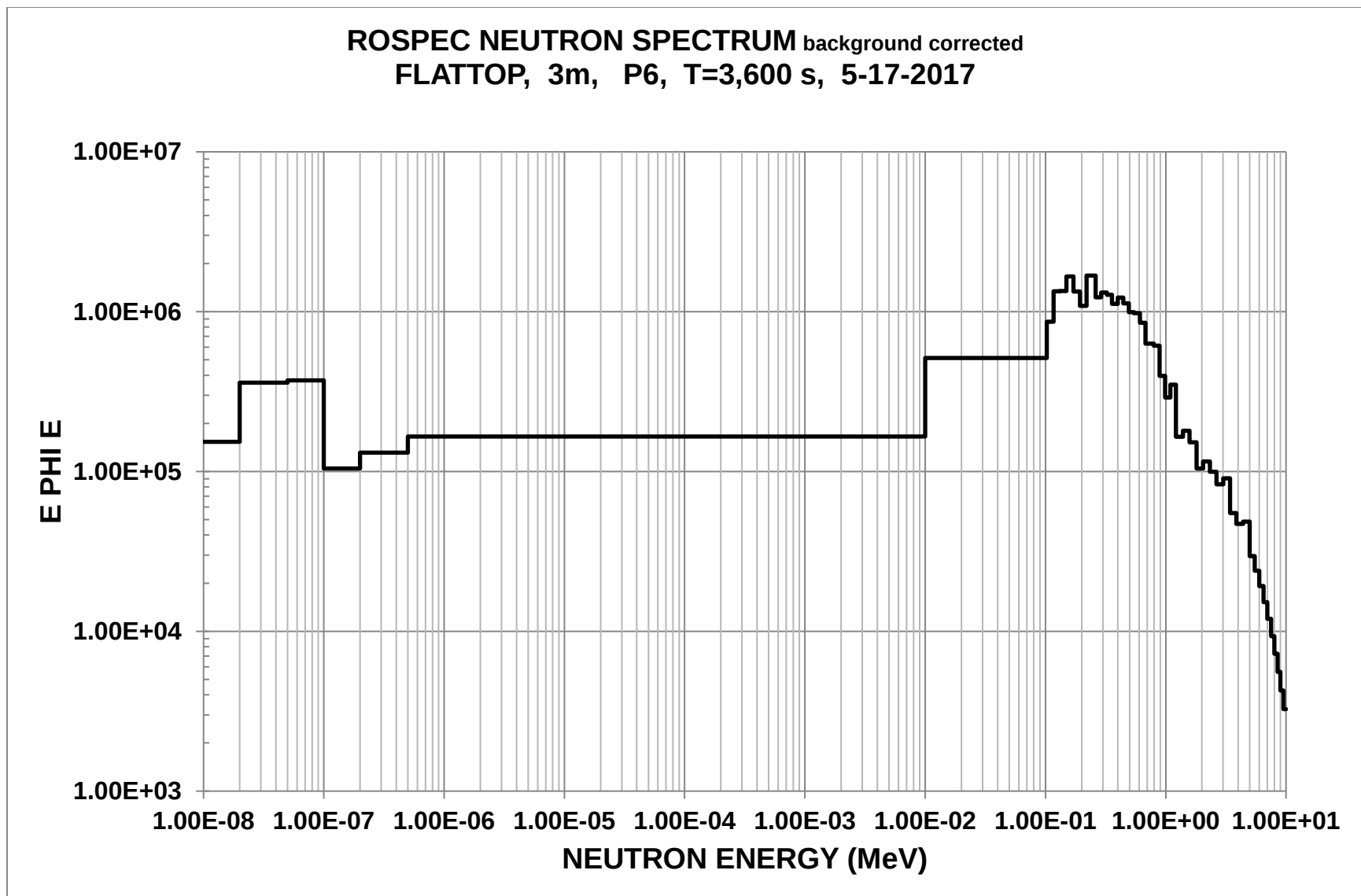
Table A2. Flattop spectral, fluence, and dose data at 2 meters, Position 3 for 2.72×10^{-7} A.s.

E2 (MeV)	E1 (MeV)	FLUENCE/ GROUP	FLUENCE/ MeV	FLUENCE/ Lethargy	E avg. (MeV)
.1000E-08	.2000E-08	1.022E+03	1.022E+12	1.474E+03	.1500E-08
.2000E-08	.5000E-08	6.557E+03	2.186E+12	7.156E+03	.3500E-08
.5000E-08	.1000E-07	1.994E+04	3.988E+12	2.877E+04	.7500E-08
.1000E-07	.2000E-07	5.879E+04	5.879E+12	8.481E+04	.1500E-07
.2000E-07	.5000E-07	1.822E+05	6.075E+12	1.989E+05	.3500E-07
.5000E-07	.1000E-06	1.424E+05	2.849E+12	2.055E+05	.7500E-07
.1000E-06	.2000E-06	4.007E+04	4.007E+11	5.780E+04	.1500E-06
.2000E-06	.5000E-06	7.264E+04	2.421E+11	7.927E+04	.3500E-06
.5000E-06	.1000E-01	1.077E+06	1.077E+08	1.087E+05	.5000E-02
.1000E-01	.1027E+00	8.644E+05	9.325E+06	3.711E+05	.5635E-01
.1027E+00	.1166E+00	1.089E+05	7.857E+06	8.601E+05	.1096E+00
.1166E+00	.1317E+00	1.224E+05	8.094E+06	1.003E+06	.1241E+00
.1317E+00	.1493E+00	1.782E+05	1.010E+07	1.417E+06	.1405E+00
.1493E+00	.1707E+00	1.198E+05	5.591E+06	8.934E+05	.1600E+00
.1707E+00	.1934E+00	1.416E+05	6.243E+06	1.135E+06	.1821E+00
.1934E+00	.2199E+00	1.640E+05	6.198E+06	1.279E+06	.2066E+00
.2199E+00	.2606E+00	1.843E+05	4.522E+06	1.084E+06	.2402E+00
.2606E+00	.2906E+00	1.437E+05	4.790E+06	1.319E+06	.2756E+00
.2906E+00	.3244E+00	1.286E+05	3.809E+06	1.170E+06	.3075E+00
.3244E+00	.3581E+00	1.198E+05	3.548E+06	1.210E+06	.3413E+00
.3581E+00	.3994E+00	1.224E+05	2.968E+06	1.123E+06	.3787E+00
.3994E+00	.4444E+00	1.090E+05	2.422E+06	1.021E+06	.4219E+00
.4444E+00	.4931E+00	1.269E+05	2.603E+06	1.219E+06	.4688E+00
.4931E+00	.5456E+00	1.149E+05	2.189E+06	1.136E+06	.5194E+00
.5456E+00	.6094E+00	1.107E+05	1.737E+06	1.002E+06	.5775E+00
.6094E+00	.6769E+00	8.633E+04	1.279E+06	8.218E+05	.6431E+00
.6769E+00	.7946E+00	1.040E+05	8.833E+05	6.485E+05	.7358E+00
.7946E+00	.8870E+00	6.814E+04	7.375E+05	6.195E+05	.8408E+00
.8870E+00	.9871E+00	4.337E+04	4.332E+05	4.056E+05	.9371E+00
.9871E+00	.1095E+01	3.728E+04	3.458E+05	3.597E+05	.1041E+01
.1095E+01	.1218E+01	2.071E+04	1.681E+05	1.942E+05	.1157E+01
.1218E+01	.1391E+01	4.159E+04	2.406E+05	3.134E+05	.1305E+01
.1391E+01	.1573E+01	2.049E+04	1.126E+05	1.667E+05	.1482E+01
.1573E+01	.1807E+01	2.056E+04	8.786E+04	1.482E+05	.1690E+01
.1807E+01	.2041E+01	1.320E+04	5.641E+04	1.084E+05	.1924E+01
.2041E+01	.2327E+01	1.324E+04	4.629E+04	1.010E+05	.2184E+01
.2327E+01	.2639E+01	1.428E+04	4.577E+04	1.135E+05	.2483E+01
.2639E+01	.3003E+01	1.103E+04	3.029E+04	8.533E+04	.2821E+01
.3003E+01	.3419E+01	1.352E+04	3.250E+04	1.042E+05	.3211E+01
.3419E+01	.3861E+01	5.627E+03	1.273E+04	4.628E+04	.3640E+01
.3861E+01	.4407E+01	9.112E+03	1.669E+04	6.889E+04	.4134E+01
.4407E+01	.5000E+01	4.942E+03	8.333E+03	3.914E+04	.4703E+01
.5000E+01	.5500E+01	2.300E+03	4.600E+03	2.413E+04	.5250E+01
.5500E+01	.6000E+01	1.703E+03	3.406E+03	1.957E+04	.5750E+01
.6000E+01	.6500E+01	1.256E+03	2.511E+03	1.569E+04	.6250E+01
.6500E+01	.7000E+01	9.217E+02	1.843E+03	1.244E+04	.6750E+01
.7000E+01	.7500E+01	6.745E+02	1.349E+03	9.777E+03	.7250E+01
.7500E+01	.8000E+01	4.918E+02	9.835E+02	7.620E+03	.7750E+01
.8000E+01	.8500E+01	3.577E+02	7.155E+02	5.901E+03	.8250E+01
.8500E+01	.9000E+01	2.597E+02	5.194E+02	4.543E+03	.8750E+01
.9000E+01	.9500E+01	1.882E+02	3.765E+02	3.481E+03	.9250E+01
.9500E+01	.1000E+02	1.365E+02	2.729E+02	2.660E+03	.9750E+01

INTEGRATED FLUENCE = 4.9956E+06

FLUENCE RATE = 1.1894E+03

	INTEGRATED DOSE	DOSE RATE
KERMA	= 3.8364E-03 rads	3.2883E+00 mrads/hr
H	NCRP-38 = 5.1912E-02 rem	4.4496E+01 mrem/hr
H*(10)	ICRP-74 = 6.6874E-04 Sv	5.7321E+02 uSv/hr
Hp(10,0)	ICRP-74 = 6.8974E-04 Sv	5.9120E+02 uSv/hr



Fig, A3. Flattop spectrum at 3 meters, Position 6.

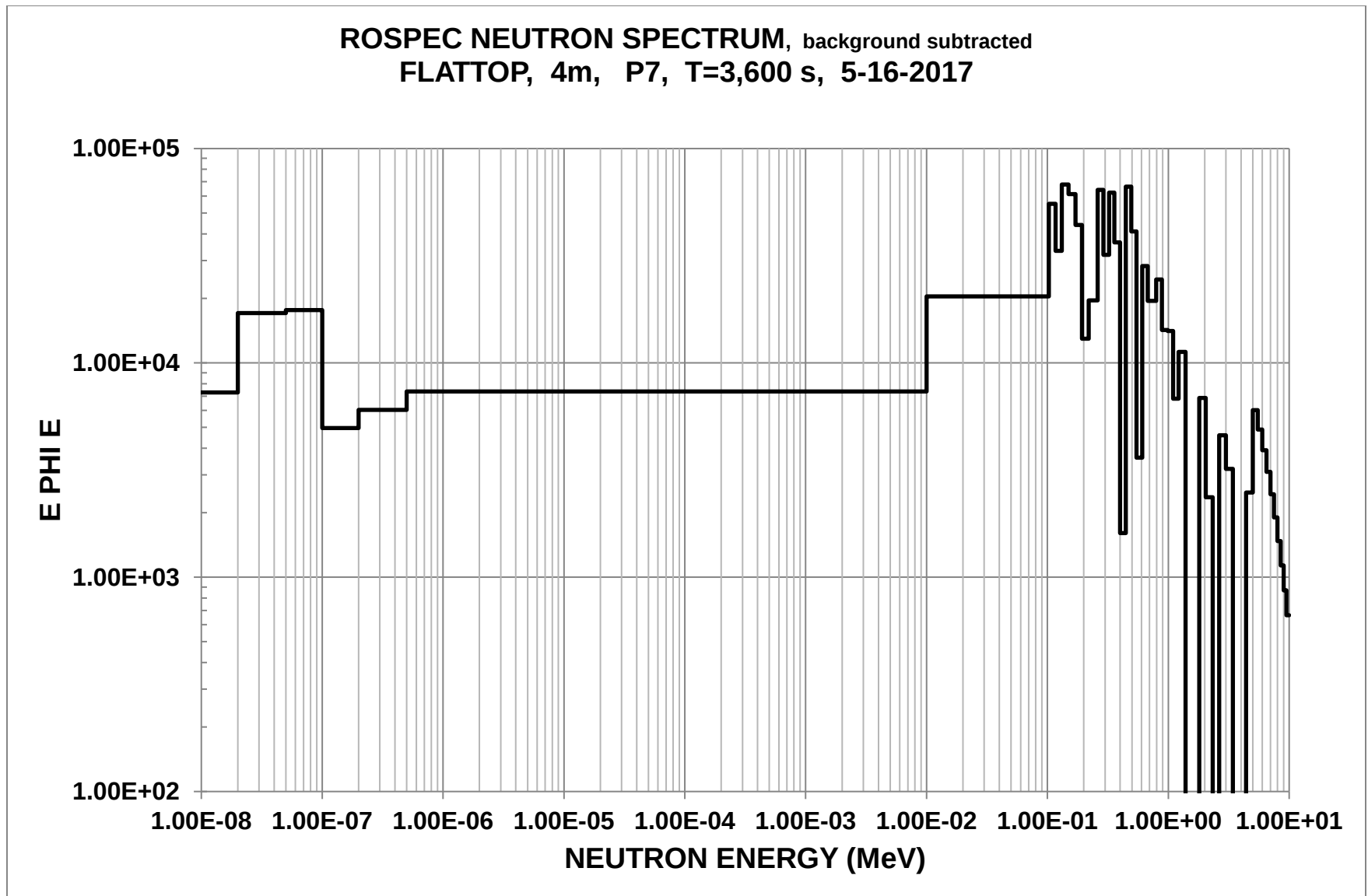
Table A3. Flattop spectral, fluence, and dose data at 3 meters, Position 6 for 4.14×10^{-7} A-s.

E2 (MeV)	E1 (MeV)	FLUENCE/ GROUP	FLUENCE/ MeV	FLUENCE/ Lethargy	E avg. (MeV)
.1000E-08	.2000E-08	1.847E+03	1.847E+12	2.664E+03	.1500E-08
.2000E-08	.5000E-08	1.185E+04	3.949E+12	1.293E+04	.3500E-08
.5000E-08	.1000E-07	3.603E+04	7.206E+12	5.198E+04	.7500E-08
.1000E-07	.2000E-07	1.062E+05	1.062E+13	1.532E+05	.1500E-07
.2000E-07	.5000E-07	3.293E+05	1.098E+13	3.593E+05	.3500E-07
.5000E-07	.1000E-06	2.574E+05	5.147E+12	3.713E+05	.7500E-07
.1000E-06	.2000E-06	7.239E+04	7.239E+11	1.044E+05	.1500E-06
.2000E-06	.5000E-06	1.204E+05	4.013E+11	1.314E+05	.3500E-06
.5000E-06	.1000E-01	1.637E+06	1.637E+08	1.653E+05	.5000E-02
.1000E-01	.1027E+00	1.196E+06	1.290E+07	5.135E+05	.5635E-01
.1027E+00	.1166E+00	1.095E+05	7.897E+06	8.645E+05	.1096E+00
.1166E+00	.1317E+00	1.633E+05	1.080E+07	1.339E+06	.1241E+00
.1317E+00	.1493E+00	1.695E+05	9.607E+06	1.348E+06	.1405E+00
.1493E+00	.1707E+00	2.227E+05	1.040E+07	1.661E+06	.1600E+00
.1707E+00	.1934E+00	1.665E+05	7.342E+06	1.335E+06	.1821E+00
.1934E+00	.2199E+00	1.394E+05	5.268E+06	1.087E+06	.2066E+00
.2199E+00	.2606E+00	2.859E+05	7.014E+06	1.681E+06	.2402E+00
.2606E+00	.2906E+00	1.340E+05	4.467E+06	1.230E+06	.2756E+00
.2906E+00	.3244E+00	1.448E+05	4.290E+06	1.318E+06	.3075E+00
.3244E+00	.3581E+00	1.264E+05	3.745E+06	1.277E+06	.3413E+00
.3581E+00	.3994E+00	1.220E+05	2.956E+06	1.119E+06	.3787E+00
.3994E+00	.4444E+00	1.306E+05	2.902E+06	1.223E+06	.4219E+00
.4444E+00	.4931E+00	1.172E+05	2.404E+06	1.126E+06	.4688E+00
.4931E+00	.5456E+00	1.005E+05	1.915E+06	9.937E+05	.5194E+00
.5456E+00	.6094E+00	1.083E+05	1.698E+06	9.798E+05	.5775E+00
.6094E+00	.6769E+00	8.963E+04	1.328E+06	8.532E+05	.6431E+00
.6769E+00	.7946E+00	1.013E+05	8.600E+05	6.314E+05	.7358E+00
.7946E+00	.8870E+00	6.747E+04	7.302E+05	6.134E+05	.8408E+00
.8870E+00	.9871E+00	4.245E+04	4.241E+05	3.970E+05	.9371E+00
.9871E+00	.1095E+01	3.011E+04	2.793E+05	2.905E+05	.1041E+01
.1095E+01	.1218E+01	3.719E+04	3.019E+05	3.488E+05	.1157E+01
.1218E+01	.1391E+01	2.186E+04	1.264E+05	1.647E+05	.1305E+01
.1391E+01	.1573E+01	2.209E+04	1.214E+05	1.797E+05	.1482E+01
.1573E+01	.1807E+01	2.111E+04	9.022E+04	1.522E+05	.1690E+01
.1807E+01	.2041E+01	1.272E+04	5.435E+04	1.044E+05	.1924E+01
.2041E+01	.2327E+01	1.518E+04	5.307E+04	1.157E+05	.2184E+01
.2327E+01	.2639E+01	1.251E+04	4.011E+04	9.945E+04	.2483E+01
.2639E+01	.3003E+01	1.073E+04	2.947E+04	8.301E+04	.2821E+01
.3003E+01	.3419E+01	1.175E+04	2.826E+04	9.060E+04	.3211E+01
.3419E+01	.3861E+01	6.679E+03	1.511E+04	5.493E+04	.3640E+01
.3861E+01	.4407E+01	6.217E+03	1.139E+04	4.700E+04	.4134E+01
.4407E+01	.5000E+01	6.134E+03	1.034E+04	4.859E+04	.4703E+01
.5000E+01	.5500E+01	2.816E+03	5.632E+03	2.955E+04	.5250E+01
.5500E+01	.6000E+01	2.086E+03	4.171E+03	2.397E+04	.5750E+01
.6000E+01	.6500E+01	1.538E+03	3.075E+03	1.921E+04	.6250E+01
.6500E+01	.7000E+01	1.129E+03	2.257E+03	1.523E+04	.6750E+01
.7000E+01	.7500E+01	8.259E+02	1.652E+03	1.197E+04	.7250E+01
.7500E+01	.8000E+01	6.022E+02	1.204E+03	9.330E+03	.7750E+01
.8000E+01	.8500E+01	4.381E+02	8.761E+02	7.226E+03	.8250E+01
.8500E+01	.9000E+01	3.180E+02	6.360E+02	5.563E+03	.8750E+01
.9000E+01	.9500E+01	2.305E+02	4.610E+02	4.263E+03	.9250E+01
.9500E+01	.1000E+02	1.671E+02	3.342E+02	3.258E+03	.9750E+01

INTEGRATED FLUENCE = 6.5342E+06

FLUENCE RATE = 1.8151E+03

	INTEGRATED DOSE	DOSE RATE
KERMA	= 4.1586E-03 rads	4.1586E+00 mrads/hr
H	NCRP-38 = 5.5995E-02 rem	5.5995E+01 mrem/hr
H*(10)	ICRP-74 = 7.2323E-04 Sv	7.2323E+02 uSv/hr
Hp(10,0)	ICRP-74 = 7.4664E-04 Sv	7.4664E+02 uSv/hr



Fig, A4. Flattop spectrum at 4 meters, Position 7.

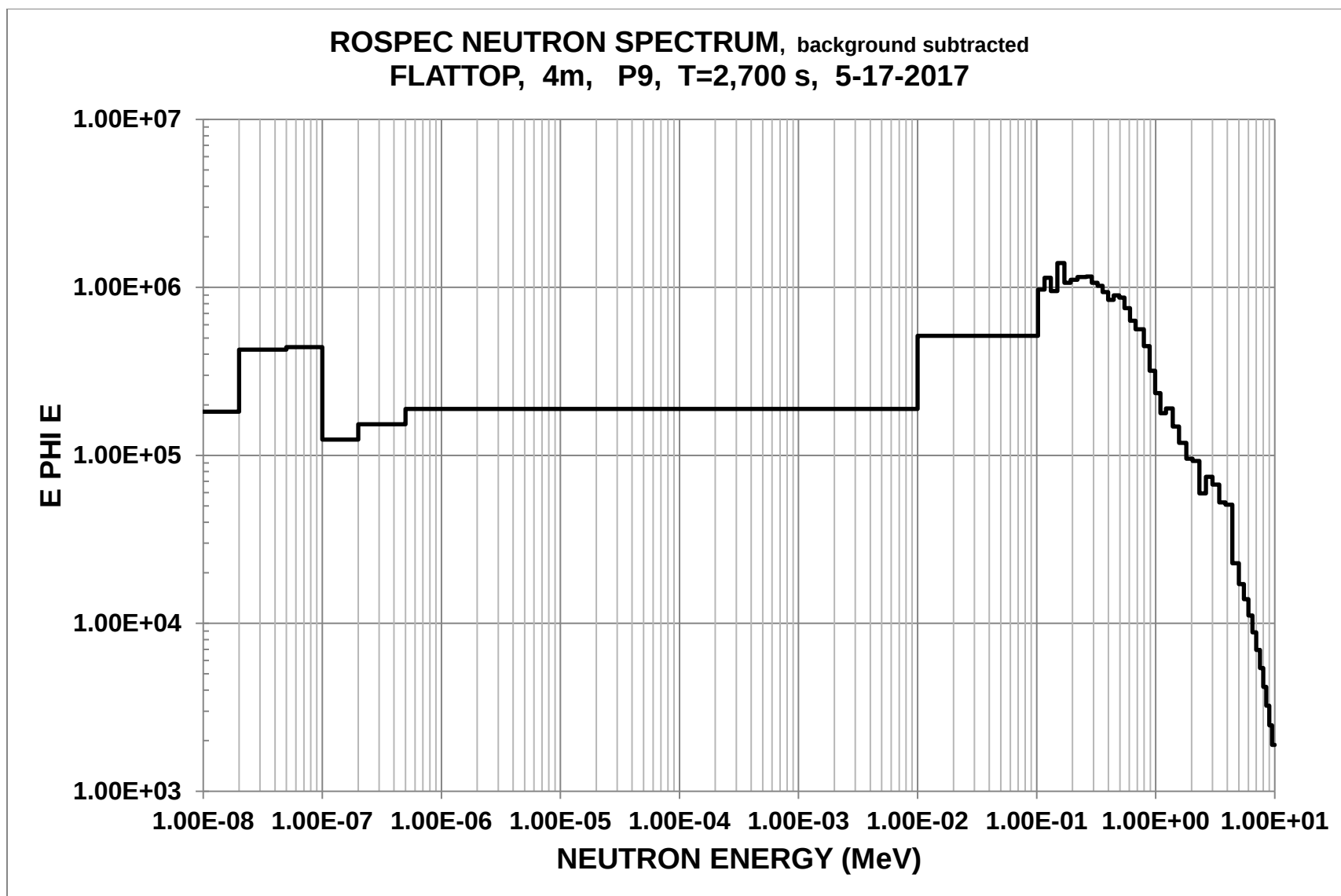
Table A4. Flattop spectral, fluence, and dose data at 4 meters, Position 7 for 1.77×10^{-8} A.s.

E2 (MeV)	E1 (MeV)	FLUENCE/ GROUP	FLUENCE/ MeV	FLUENCE/ Lethargy	E avg. (MeV)
.1000E-08	.2000E-08	8.769E+01	8.769E+10	1.265E+02	.1500E-08
.2000E-08	.5000E-08	5.626E+02	1.875E+11	6.140E+02	.3500E-08
.5000E-08	.1000E-07	1.711E+03	3.422E+11	2.469E+03	.7500E-08
.1000E-07	.2000E-07	5.044E+03	5.044E+11	7.277E+03	.1500E-07
.2000E-07	.5000E-07	1.564E+04	5.212E+11	1.707E+04	.3500E-07
.5000E-07	.1000E-06	1.222E+04	2.445E+11	1.763E+04	.7500E-07
.1000E-06	.2000E-06	3.438E+03	3.438E+10	4.960E+03	.1500E-06
.2000E-06	.5000E-06	5.537E+03	1.846E+10	6.043E+03	.3500E-06
.5000E-06	.1000E-01	7.291E+04	7.291E+06	7.362E+03	.5000E-02
.1000E-01	.1027E+00	4.764E+04	5.140E+05	2.046E+04	.5635E-01
.1027E+00	.1166E+00	6.992E+03	5.045E+05	5.523E+04	.1096E+00
.1166E+00	.1317E+00	4.061E+03	2.686E+05	3.329E+04	.1241E+00
.1317E+00	.1493E+00	8.546E+03	4.845E+05	6.798E+04	.1405E+00
.1493E+00	.1707E+00	8.208E+03	3.832E+05	6.123E+04	.1600E+00
.1707E+00	.1934E+00	5.489E+03	2.420E+05	4.400E+04	.1821E+00
.1934E+00	.2199E+00	1.663E+03	6.286E+04	1.297E+04	.2066E+00
.2199E+00	.2606E+00	3.324E+03	8.157E+04	1.955E+04	.2402E+00
.2606E+00	.2906E+00	6.995E+03	2.332E+05	6.420E+04	.2756E+00
.2906E+00	.3244E+00	3.509E+03	1.040E+05	3.194E+04	.3075E+00
.3244E+00	.3581E+00	6.160E+03	1.825E+05	6.223E+04	.3413E+00
.3581E+00	.3994E+00	3.980E+03	9.650E+04	3.651E+04	.3787E+00
.3994E+00	.4444E+00	1.716E+02	3.814E+03	1.607E+03	.4219E+00
.4444E+00	.4931E+00	6.912E+03	1.418E+05	6.640E+04	.4688E+00
.4931E+00	.5456E+00	4.157E+03	7.917E+04	4.109E+04	.5194E+00
.5456E+00	.6094E+00	3.994E+02	6.265E+03	3.614E+03	.5775E+00
.6094E+00	.6769E+00	2.976E+03	4.408E+04	2.832E+04	.6431E+00
.6769E+00	.7946E+00	3.126E+03	2.654E+04	1.949E+04	.7358E+00
.7946E+00	.8870E+00	2.695E+03	2.917E+04	2.450E+04	.8408E+00
.8870E+00	.9871E+00	1.521E+03	1.519E+04	1.422E+04	.9371E+00
.9871E+00	.1095E+01	1.461E+03	1.355E+04	1.410E+04	.1041E+01
.1095E+01	.1218E+01	7.261E+02	5.894E+03	6.810E+03	.1157E+01
.1218E+01	.1391E+01	1.492E+03	8.630E+03	1.124E+04	.1305E+01
.1391E+01	.1573E+01	-1.110E+02	-6.096E+02	-9.023E+02	.1482E+01
.1573E+01	.1807E+01	-2.771E+02	-1.184E+03	-1.998E+03	.1690E+01
.1807E+01	.2041E+01	8.351E+02	3.569E+03	6.858E+03	.1924E+01
.2041E+01	.2327E+01	3.098E+02	1.083E+03	2.363E+03	.2184E+01
.2327E+01	.2639E+01	-1.661E+02	-5.325E+02	-1.320E+03	.2483E+01
.2639E+01	.3003E+01	5.939E+02	1.631E+03	4.596E+03	.2821E+01
.3003E+01	.3419E+01	4.157E+02	9.992E+02	3.204E+03	.3211E+01
.3419E+01	.3861E+01	-2.167E+02	-4.903E+02	-1.783E+03	.3640E+01
.3861E+01	.4407E+01	-2.126E+02	-3.895E+02	-1.608E+03	.4134E+01
.4407E+01	.5000E+01	3.139E+02	5.293E+02	2.486E+03	.4703E+01
.5000E+01	.5500E+01	5.740E+02	1.148E+03	6.022E+03	.5250E+01
.5500E+01	.6000E+01	4.251E+02	8.502E+02	4.885E+03	.5750E+01
.6000E+01	.6500E+01	3.134E+02	6.268E+02	3.915E+03	.6250E+01
.6500E+01	.7000E+01	2.300E+02	4.600E+02	3.104E+03	.6750E+01
.7000E+01	.7500E+01	1.683E+02	3.367E+02	2.440E+03	.7250E+01
.7500E+01	.8000E+01	1.227E+02	2.455E+02	1.902E+03	.7750E+01
.8000E+01	.8500E+01	8.928E+01	1.786E+02	1.473E+03	.8250E+01
.8500E+01	.9000E+01	6.481E+01	1.296E+02	1.134E+03	.8750E+01
.9000E+01	.9500E+01	4.698E+01	9.395E+01	8.689E+02	.9250E+01
.9500E+01	.1000E+02	3.406E+01	6.811E+01	6.639E+02	.9750E+01

INTEGRATED FLUENCE = 2.5291E+05

FLUENCE RATE = 7.0253E+01

	INTEGRATED DOSE	DOSE RATE
KERMA	= 1.3708E-04 rads	1.3708E-01 mrads/hr
H	NCRP-38 = 1.8277E-03 rem	1.8277E+00 mrem/hr
H*(10)	ICRP-74 = 2.3300E-05 Sv	2.3300E+01 uSv/hr
Hp(10,0)	ICRP-74 = 2.4029E-05 Sv	2.4029E+01 uSv/hr



Fig, A5. Flattop spectrum at 4 meters, Position 9.

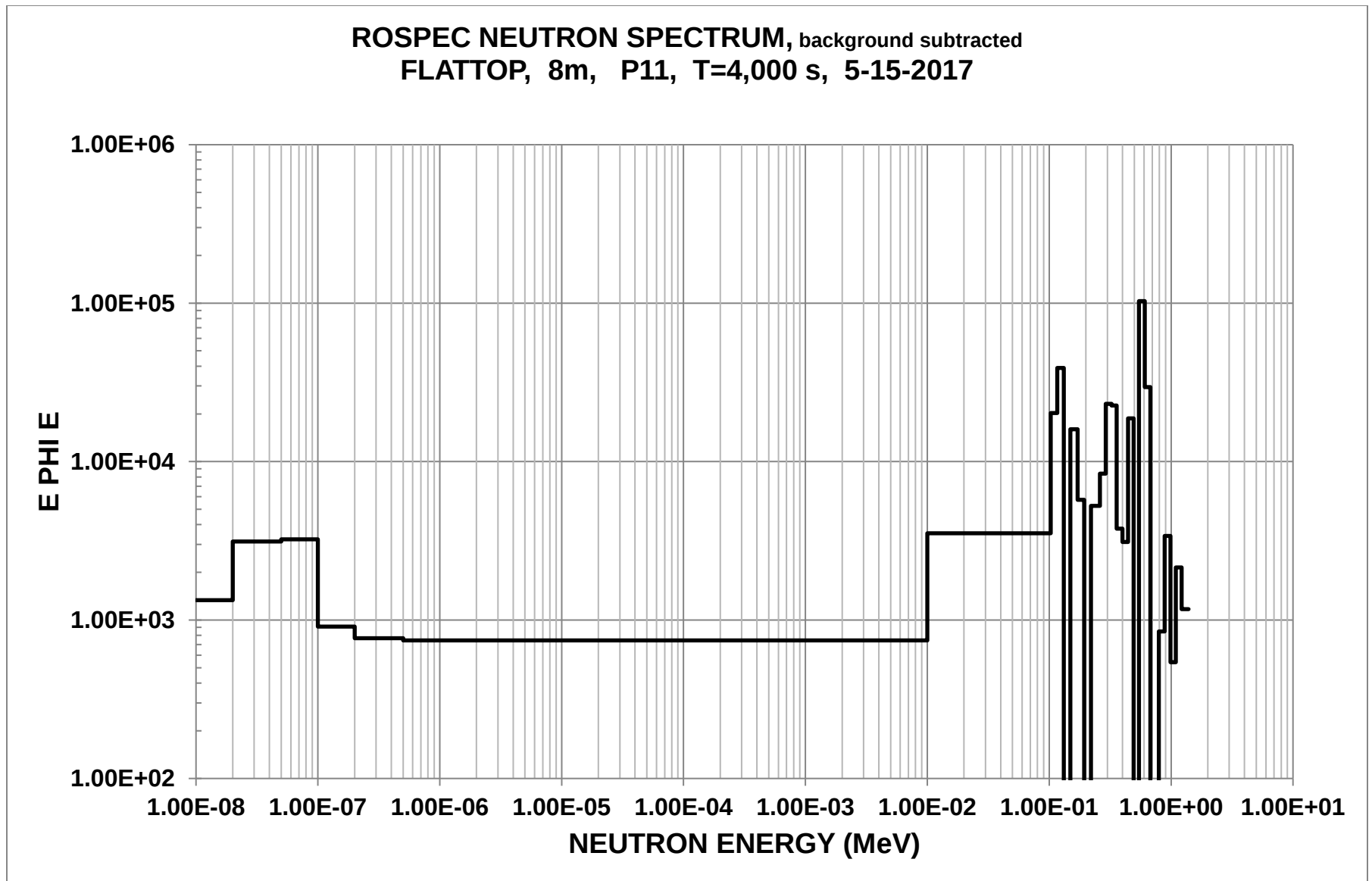
Table A5. Flattop spectral, fluence, and dose data at 4 meters, Position 9 for 5.36×10^{-7} A.s.

E2 (MeV)	E1 (MeV)	FLUENCE/ GROUP	FLUENCE/ MeV	FLUENCE/ Lethargy	E avg. (MeV)
.1000E-08	.2000E-08	2.192E+03	2.192E+12	3.163E+03	.1500E-08
.2000E-08	.5000E-08	1.407E+04	4.689E+12	1.535E+04	.3500E-08
.5000E-08	.1000E-07	4.278E+04	8.556E+12	6.172E+04	.7500E-08
.1000E-07	.2000E-07	1.261E+05	1.261E+13	1.819E+05	.1500E-07
.2000E-07	.5000E-07	3.909E+05	1.303E+13	4.267E+05	.3500E-07
.5000E-07	.1000E-06	3.056E+05	6.111E+12	4.408E+05	.7500E-07
.1000E-06	.2000E-06	8.595E+04	8.595E+11	1.240E+05	.1500E-06
.2000E-06	.5000E-06	1.403E+05	4.677E+11	1.531E+05	.3500E-06
.5000E-06	.1000E-01	1.873E+06	1.873E+08	1.891E+05	.5000E-02
.1000E-01	.1027E+00	1.201E+06	1.296E+07	5.156E+05	.5635E-01
.1027E+00	.1166E+00	1.227E+05	8.854E+06	9.693E+05	.1096E+00
.1166E+00	.1317E+00	1.391E+05	9.201E+06	1.141E+06	.1241E+00
.1317E+00	.1493E+00	1.197E+05	6.785E+06	9.519E+05	.1405E+00
.1493E+00	.1707E+00	1.871E+05	8.737E+06	1.396E+06	.1600E+00
.1707E+00	.1934E+00	1.330E+05	5.864E+06	1.066E+06	.1821E+00
.1934E+00	.2199E+00	1.421E+05	5.372E+06	1.109E+06	.2066E+00
.2199E+00	.2606E+00	1.960E+05	4.808E+06	1.152E+06	.2402E+00
.2606E+00	.2906E+00	1.265E+05	4.218E+06	1.161E+06	.2756E+00
.2906E+00	.3244E+00	1.169E+05	3.464E+06	1.064E+06	.3075E+00
.3244E+00	.3581E+00	1.012E+05	2.998E+06	1.022E+06	.3413E+00
.3581E+00	.3994E+00	1.022E+05	2.477E+06	9.371E+05	.3787E+00
.3994E+00	.4444E+00	8.988E+04	1.997E+06	8.418E+05	.4219E+00
.4444E+00	.4931E+00	9.341E+04	1.916E+06	8.973E+05	.4688E+00
.4931E+00	.5456E+00	8.787E+04	1.674E+06	8.686E+05	.5194E+00
.5456E+00	.6094E+00	8.325E+04	1.306E+06	7.533E+05	.5775E+00
.6094E+00	.6769E+00	6.652E+04	9.855E+05	6.332E+05	.6431E+00
.6769E+00	.7946E+00	9.035E+04	7.672E+05	5.633E+05	.7358E+00
.7946E+00	.8870E+00	4.922E+04	5.327E+05	4.475E+05	.8408E+00
.8870E+00	.9871E+00	3.408E+04	3.404E+05	3.187E+05	.9371E+00
.9871E+00	.1095E+01	2.430E+04	2.254E+05	2.345E+05	.1041E+01
.1095E+01	.1218E+01	1.898E+04	1.540E+05	1.780E+05	.1157E+01
.1218E+01	.1391E+01	2.529E+04	1.463E+05	1.906E+05	.1305E+01
.1391E+01	.1573E+01	1.824E+04	1.002E+05	1.483E+05	.1482E+01
.1573E+01	.1807E+01	1.647E+04	7.037E+04	1.187E+05	.1690E+01
.1807E+01	.2041E+01	1.164E+04	4.974E+04	9.558E+04	.1924E+01
.2041E+01	.2327E+01	1.214E+04	4.244E+04	9.255E+04	.2184E+01
.2327E+01	.2639E+01	7.462E+03	2.392E+04	5.930E+04	.2483E+01
.2639E+01	.3003E+01	9.634E+03	2.647E+04	7.456E+04	.2821E+01
.3003E+01	.3419E+01	8.701E+03	2.091E+04	6.706E+04	.3211E+01
.3419E+01	.3861E+01	6.387E+03	1.445E+04	5.254E+04	.3640E+01
.3861E+01	.4407E+01	6.736E+03	1.234E+04	5.092E+04	.4134E+01
.4407E+01	.5000E+01	2.877E+03	4.851E+03	2.279E+04	.4703E+01
.5000E+01	.5500E+01	1.633E+03	3.267E+03	1.714E+04	.5250E+01
.5500E+01	.6000E+01	1.210E+03	2.420E+03	1.390E+04	.5750E+01
.6000E+01	.6500E+01	8.919E+02	1.784E+03	1.114E+04	.6250E+01
.6500E+01	.7000E+01	6.546E+02	1.309E+03	8.833E+03	.6750E+01
.7000E+01	.7500E+01	4.791E+02	9.582E+02	6.944E+03	.7250E+01
.7500E+01	.8000E+01	3.493E+02	6.986E+02	5.412E+03	.7750E+01
.8000E+01	.8500E+01	2.541E+02	5.082E+02	4.191E+03	.8250E+01
.8500E+01	.9000E+01	1.845E+02	3.689E+02	3.227E+03	.8750E+01
.9000E+01	.9500E+01	1.337E+02	2.674E+02	2.473E+03	.9250E+01
.9500E+01	.1000E+02	9.692E+01	1.938E+02	1.890E+03	.9750E+01

INTEGRATED FLUENCE = 6.4378E+06

FLUENCE RATE = 2.3844E+03

	INTEGRATED DOSE	DOSE RATE
KERMA	= 3.4428E-03 rads	4.5905E+00 mrads/hr
H	NCRP-38 = 4.6672E-02 rem	6.2229E+01 mrems/hr
H*(10)	ICRP-74 = 6.0048E-04 Sv	8.0064E+02 uSv/hr
Hp(10,0)	ICRP-74 = 6.2016E-04 Sv	8.2688E+02 uSv/hr



Fig, A6. Flattop spectrum at 8 meters, Position 11.

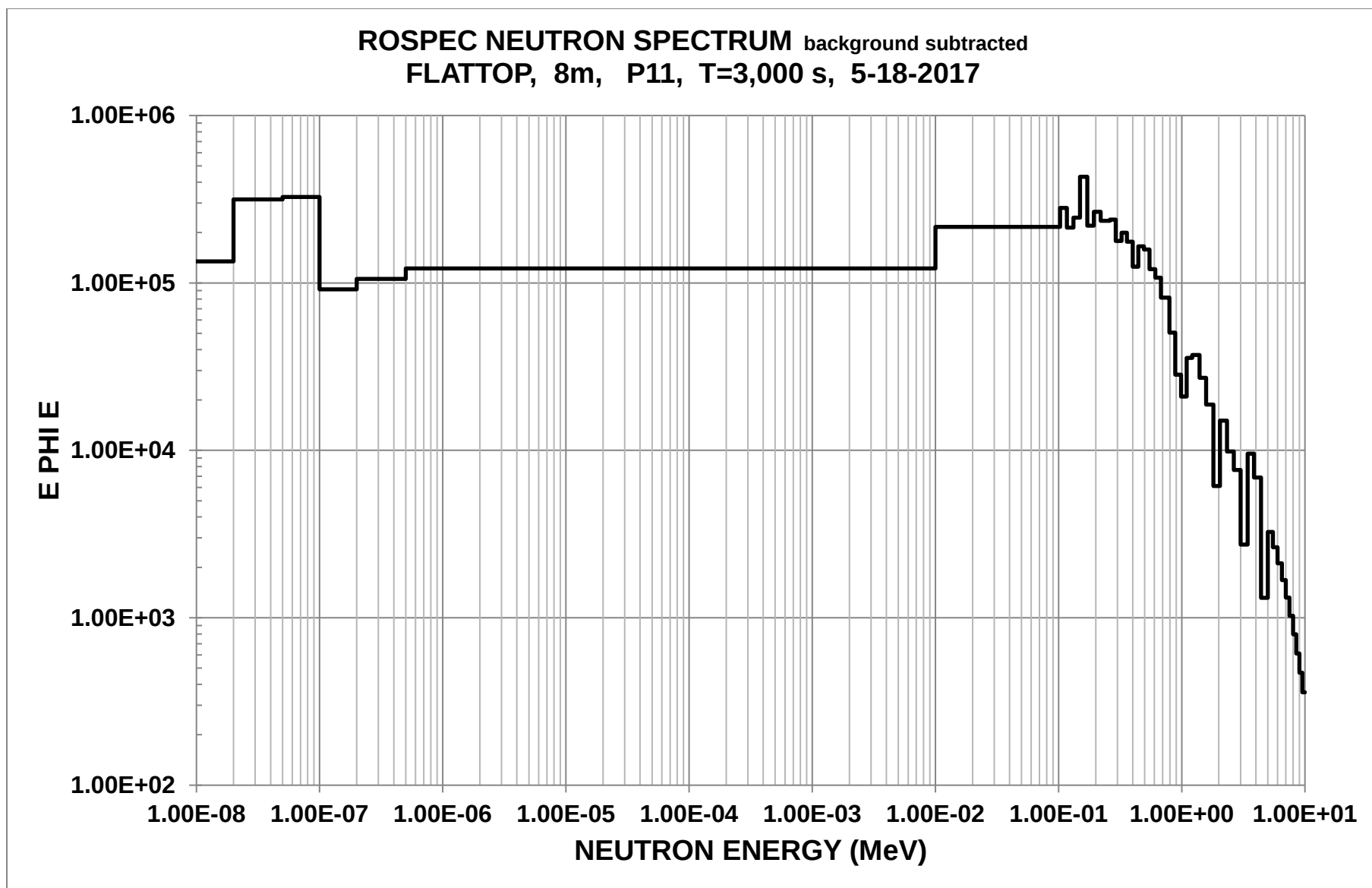
Table A6. Flattop spectral, fluence, and dose data at 8 meters, Position 11 for 2.21×10^{-8} A.s.

E2 (MeV)	E1 (MeV)	FLUENCE/ GROUP	FLUENCE/ MeV	FLUENCE/ Lethargy	E avg. (MeV)
.1000E-08	.2000E-08	1.607E+01	1.607E+10	2.318E+01	.1500E-08
.2000E-08	.5000E-08	1.031E+02	3.436E+10	1.125E+02	.3500E-08
.5000E-08	.1000E-07	3.135E+02	6.271E+10	4.523E+02	.7500E-08
.1000E-07	.2000E-07	9.243E+02	9.243E+10	1.333E+03	.1500E-07
.2000E-07	.5000E-07	2.865E+03	9.551E+10	3.127E+03	.3500E-07
.5000E-07	.1000E-06	2.240E+03	4.479E+10	3.231E+03	.7500E-07
.1000E-06	.2000E-06	6.299E+02	6.299E+09	9.088E+02	.1500E-06
.2000E-06	.5000E-06	7.026E+02	2.342E+09	7.668E+02	.3500E-06
.5000E-06	.1000E-01	7.362E+03	7.363E+05	7.434E+02	.5000E-02
.1000E-01	.1027E+00	8.205E+03	8.852E+04	3.523E+03	.5635E-01
.1027E+00	.1166E+00	2.562E+03	1.849E+05	2.024E+04	.1096E+00
.1166E+00	.1317E+00	4.748E+03	3.140E+05	3.893E+04	.1241E+00
.1317E+00	.1493E+00	-2.946E+03	-1.670E+05	-2.343E+04	.1405E+00
.1493E+00	.1707E+00	2.146E+03	1.002E+05	1.601E+04	.1600E+00
.1707E+00	.1934E+00	7.151E+02	3.153E+04	5.733E+03	.1821E+00
.1934E+00	.2199E+00	-2.433E+02	-9.197E+03	-1.898E+03	.2066E+00
.2199E+00	.2606E+00	8.931E+02	2.191E+04	5.252E+03	.2402E+00
.2606E+00	.2906E+00	9.150E+02	3.050E+04	8.398E+03	.2756E+00
.2906E+00	.3244E+00	2.542E+03	7.532E+04	2.314E+04	.3075E+00
.3244E+00	.3581E+00	2.233E+03	6.617E+04	2.256E+04	.3413E+00
.3581E+00	.3994E+00	4.116E+02	9.979E+03	3.776E+03	.3787E+00
.3994E+00	.4444E+00	3.316E+02	7.369E+03	3.106E+03	.4219E+00
.4444E+00	.4931E+00	1.952E+03	4.005E+04	1.876E+04	.4688E+00
.4931E+00	.5456E+00	-1.201E+04	-2.288E+05	-1.187E+05	.5194E+00
.5456E+00	.6094E+00	1.138E+04	1.785E+05	1.030E+05	.5775E+00
.6094E+00	.6769E+00	3.097E+03	4.588E+04	2.948E+04	.6431E+00
.6769E+00	.7946E+00	-3.512E+02	-2.982E+03	-2.190E+03	.7358E+00
.7946E+00	.8870E+00	9.320E+01	1.009E+03	8.473E+02	.8408E+00
.8870E+00	.9871E+00	3.629E+02	3.625E+03	3.394E+03	.9371E+00
.9871E+00	.1095E+01	5.620E+01	5.214E+02	5.423E+02	.1041E+01
.1095E+01	.1218E+01	2.286E+02	1.855E+03	2.144E+03	.1157E+01
.1218E+01	.1391E+01	1.554E+02	8.987E+02	1.171E+03	.1305E+01
.1391E+01	.1573E+01	0.000E+00	0.000E+00	0.000E+00	.1482E+01
.1573E+01	.1807E+01	0.000E+00	0.000E+00	0.000E+00	.1690E+01
.1807E+01	.2041E+01	0.000E+00	0.000E+00	0.000E+00	.1924E+01
.2041E+01	.2327E+01	0.000E+00	0.000E+00	0.000E+00	.2184E+01
.2327E+01	.2639E+01	0.000E+00	0.000E+00	0.000E+00	.2483E+01
.2639E+01	.3003E+01	0.000E+00	0.000E+00	0.000E+00	.2821E+01
.3003E+01	.3419E+01	0.000E+00	0.000E+00	0.000E+00	.3211E+01
.3419E+01	.3861E+01	0.000E+00	0.000E+00	0.000E+00	.3640E+01
.3861E+01	.4407E+01	0.000E+00	0.000E+00	0.000E+00	.4134E+01
.4407E+01	.5000E+01	0.000E+00	0.000E+00	0.000E+00	.4703E+01
.5000E+01	.5500E+01	0.000E+00	0.000E+00	0.000E+00	.5250E+01
.5500E+01	.6000E+01	0.000E+00	0.000E+00	0.000E+00	.5750E+01
.6000E+01	.6500E+01	0.000E+00	0.000E+00	0.000E+00	.6250E+01
.6500E+01	.7000E+01	0.000E+00	0.000E+00	0.000E+00	.6750E+01
.7000E+01	.7500E+01	0.000E+00	0.000E+00	0.000E+00	.7250E+01
.7500E+01	.8000E+01	0.000E+00	0.000E+00	0.000E+00	.7750E+01
.8000E+01	.8500E+01	0.000E+00	0.000E+00	0.000E+00	.8250E+01
.8500E+01	.9000E+01	0.000E+00	0.000E+00	0.000E+00	.8750E+01
.9000E+01	.9500E+01	0.000E+00	0.000E+00	0.000E+00	.9250E+01
.9500E+01	.1000E+02	0.000E+00	0.000E+00	0.000E+00	.9750E+01

INTEGRATED FLUENCE = 4.2633E+04

FLUENCE RATE = 1.0658E+01

	INTEGRATED DOSE	DOSE RATE
KERMA	= 2.6682E-05 rads	2.4013E-02 mrads/hr
H	NCRP-38 = 3.6701E-04 rem	3.3031E-01 mrem/hr
H*(10)	ICRP-74 = 4.8401E-06 Sv	4.3561E+00 uSv/hr
Hp(10,0)	ICRP-74 = 4.9343E-06 Sv	4.4409E+00 uSv/hr



Fig, A7. Flattop spectrum at 8 meters, Position 11.

Table A7. Flattop spectral, fluence, and dose data at 8 meters, Position 11 for 3.50×10^{-6} A.s.

E2 (MeV)	E1 (MeV)	FLUENCE/ GROUP	FLUENCE/ MeV	FLUENCE/ Lethargy	E avg. (MeV)
.1000E-08	.2000E-08	1.620E+03	1.620E+12	2.337E+03	.1500E-08
.2000E-08	.5000E-08	1.039E+04	3.464E+12	1.134E+04	.3500E-08
.5000E-08	.1000E-07	3.161E+04	6.322E+12	4.560E+04	.7500E-08
.1000E-07	.2000E-07	9.318E+04	9.318E+12	1.344E+05	.1500E-07
.2000E-07	.5000E-07	2.889E+05	9.628E+12	3.152E+05	.3500E-07
.5000E-07	.1000E-06	2.258E+05	4.516E+12	3.257E+05	.7500E-07
.1000E-06	.2000E-06	6.350E+04	6.350E+11	9.162E+04	.1500E-06
.2000E-06	.5000E-06	9.686E+04	3.229E+11	1.057E+05	.3500E-06
.5000E-06	.1000E-01	1.208E+06	1.208E+08	1.220E+05	.5000E-02
.1000E-01	.1027E+00	5.036E+05	5.434E+06	2.162E+05	.5635E-01
.1027E+00	.1166E+00	3.556E+04	2.565E+06	2.808E+05	.1096E+00
.1166E+00	.1317E+00	2.608E+04	1.725E+06	2.138E+05	.1241E+00
.1317E+00	.1493E+00	3.086E+04	1.750E+06	2.455E+05	.1405E+00
.1493E+00	.1707E+00	5.774E+04	2.695E+06	4.307E+05	.1600E+00
.1707E+00	.1934E+00	2.742E+04	1.209E+06	2.198E+05	.1821E+00
.1934E+00	.2199E+00	3.407E+04	1.288E+06	2.657E+05	.2066E+00
.2199E+00	.2606E+00	3.992E+04	9.795E+05	2.348E+05	.2402E+00
.2606E+00	.2906E+00	2.602E+04	8.673E+05	2.388E+05	.2756E+00
.2906E+00	.3244E+00	1.956E+04	5.795E+05	1.780E+05	.3075E+00
.3244E+00	.3581E+00	1.972E+04	5.843E+05	1.992E+05	.3413E+00
.3581E+00	.3994E+00	1.921E+04	4.657E+05	1.762E+05	.3787E+00
.3994E+00	.4444E+00	1.332E+04	2.960E+05	1.247E+05	.4219E+00
.4444E+00	.4931E+00	1.724E+04	3.536E+05	1.656E+05	.4688E+00
.4931E+00	.5456E+00	1.604E+04	3.055E+05	1.585E+05	.5194E+00
.5456E+00	.6094E+00	1.337E+04	2.097E+05	1.210E+05	.5775E+00
.6094E+00	.6769E+00	1.130E+04	1.675E+05	1.076E+05	.6431E+00
.6769E+00	.7946E+00	1.312E+04	1.114E+05	8.178E+04	.7358E+00
.7946E+00	.8870E+00	5.557E+03	6.015E+04	5.052E+04	.8408E+00
.8870E+00	.9871E+00	3.032E+03	3.029E+04	2.836E+04	.9371E+00
.9871E+00	.1095E+01	2.173E+03	2.015E+04	2.096E+04	.1041E+01
.1095E+01	.1218E+01	3.798E+03	3.083E+04	3.562E+04	.1157E+01
.1218E+01	.1391E+01	4.924E+03	2.849E+04	3.711E+04	.1305E+01
.1391E+01	.1573E+01	3.339E+03	1.835E+04	2.716E+04	.1482E+01
.1573E+01	.1807E+01	2.607E+03	1.114E+04	1.880E+04	.1690E+01
.1807E+01	.2041E+01	7.467E+02	3.191E+03	6.132E+03	.1924E+01
.2041E+01	.2327E+01	1.972E+03	6.896E+03	1.504E+04	.2184E+01
.2327E+01	.2639E+01	1.237E+03	3.965E+03	9.833E+03	.2483E+01
.2639E+01	.3003E+01	9.859E+02	2.709E+03	7.630E+03	.2821E+01
.3003E+01	.3419E+01	3.550E+02	8.534E+02	2.736E+03	.3211E+01
.3419E+01	.3861E+01	1.161E+03	2.626E+03	9.547E+03	.3640E+01
.3861E+01	.4407E+01	9.097E+02	1.666E+03	6.878E+03	.4134E+01
.4407E+01	.5000E+01	1.662E+02	2.803E+02	1.317E+03	.4703E+01
.5000E+01	.5500E+01	3.102E+02	6.203E+02	3.254E+03	.5250E+01
.5500E+01	.6000E+01	2.297E+02	4.594E+02	2.640E+03	.5750E+01
.6000E+01	.6500E+01	1.694E+02	3.387E+02	2.116E+03	.6250E+01
.6500E+01	.7000E+01	1.243E+02	2.486E+02	1.677E+03	.6750E+01
.7000E+01	.7500E+01	9.097E+01	1.819E+02	1.319E+03	.7250E+01
.7500E+01	.8000E+01	6.632E+01	1.326E+02	1.028E+03	.7750E+01
.8000E+01	.8500E+01	4.825E+01	9.649E+01	7.958E+02	.8250E+01
.8500E+01	.9000E+01	3.502E+01	7.005E+01	6.127E+02	.8750E+01
.9000E+01	.9500E+01	2.539E+01	5.077E+01	4.695E+02	.9250E+01
.9500E+01	.1000E+02	1.840E+01	3.681E+01	3.588E+02	.9750E+01
INTEGRATED FLUENCE = 2.9779E+06			FLUENCE RATE = 9.9262E+02		
INTEGRATED DOSE			DOSE RATE		
KERMA	= 7.5732E-04 rads		9.0878E-01 mrads/hr		
H	NCRP-38 = 1.0878E-02 rem		1.3053E+01 mrem/hr		
H*(10)	ICRP-74 = 1.3631E-04 Sv		1.6357E+02 uSv/hr		
Hp(10,0)	ICRP-74 = 1.4140E-04 Sv		1.6968E+02 uSv/hr		

APPENDIX B

PNAD and CaF₂(Mn) DATA

Table B1. LLNL PNAD neutron fluence results as a function of effective distance from the reactor core for IER 252 Flattop irradiation #13 (see Fig 5).

<i>Effective Distance (m)</i>	<i>Approximate Neutron Energy Range</i>			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
2.054	7.03E+09	3.21E+10	6.68E+11	4.65E+10
2.030	7.22E+09	3.09E+10	5.85E+11	4.62E+10
2.013	7.63E+09	3.78E+10	6.04E+11	4.18E+10
2.004	7.81E+09	3.52E+10	5.9E+11	4.36E+10
2.000	7.86E+09	3.26E+10	5.41E+11	4.67E+10
2.004	7.63E+09	3.06E+10	4.87E+11	4.77E+10
2.013	7.57E+09	3.63E+10	4.55E+11	5.1E+10
2.030	6.7E+09	3.46E+10	5.23E+11	4.22E+10
2.054	4.74E+09	2.07E+10	4.64E+11	4.79E+10
3.037	3.73E+09	1.81E+10	3.9E+11	4.43E+10
3.020	3.36E+09	1.65E+10	3.48E+11	4.72E+10
3.009	3.71E+09	1.88E+10	3.87E+11	4.78E+10
3.002	3.7E+09	1.79E+10	4.25E+11	4.64E+10
3.000	3.62E+09	1.67E+10	4.32E+11	4.49E+10
3.002	3.83E+09	1.46E+10	3.85E+11	4.81E+10
3.009	3.67E+09	1.72E+10	4.14E+11	4.53E+10
3.020	3.31E+09	1.85E+10	3.3E+11	4.76E+10
3.037	3.5E+09	1.54E+10	3.2E+11	4.88E+10
4.028	1.73E+09	9.34E+09	3.4E+11	4.24E+10
4.015	1.62E+09	1.01E+10	3.05E+11	4.26E+10
4.007	2.22E+09	1.15E+10	2.91E+11	4.68E+10
4.002	1.92E+09	1.35E+10	3.58E+11	4.2E+10
4.000	2.31E+09	1.12E+10	3.12E+11	4.28E+10
4.002	2.16E+09	1.05E+10	2.98E+11	4.45E+10
4.007	1.99E+09	1.08E+10	2.79E+11	4.02E+10
4.015	1.57E+09	1.24E+10	2.91E+11	3.97E+10
4.028	1.9E+09	1.11E+10	2.77E+11	4.32E+10
8.014	3.8E+08	3.14E+09	4.94E+10	8.32E+09
8.008	4.98E+08	2.72E+09	4.88E+10	9.6E+09
8.003	5.24E+08	5.21E+09	6.12E+10	9.4E+09
8.001	3.48E+08	2.38E+09	7.01E+10	9.27E+09
8.000	6.27E+08	2.5E+09	6.53E+10	9.01E+09
8.001	3.92E+08	4.14E+09	7.39E+10	1.02E+10
8.003	3.85E+08	3.34E+09	6.88E+10	9.42E+09
8.008	5.82E+08	5E+09	3.43E+10	9.19E+09
8.014	4.68E+08	3.54E+09	5.95E+10	9.51E+09

Table B2. LLNL PNAD neutron tissue kerma results as a function of effective distance from the reactor core for IER 252 Flattop irradiation #13 (see Fig 6).

<i>Effective Distance (m)</i>	<i>Approximate Neutron Energy Range</i>			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
2.054	0.373	1.06	5.41	0.0325
2.030	0.383	1.02	4.74	0.0323
2.013	0.404	1.25	4.9	0.0293
2.004	0.414	1.16	4.78	0.0305
2.000	0.417	1.08	4.38	0.0327
2.004	0.404	1.01	3.95	0.0334
2.013	0.401	1.2	3.68	0.0357
2.030	0.355	1.14	4.24	0.0295
2.054	0.251	0.682	3.76	0.0335
3.037	0.198	0.598	3.16	0.031
3.020	0.178	0.546	2.82	0.0331
3.009	0.197	0.62	3.13	0.0335
3.002	0.196	0.592	3.45	0.0325
3.000	0.192	0.552	3.5	0.0315
3.002	0.203	0.48	3.12	0.0337
3.009	0.195	0.569	3.35	0.0317
3.020	0.175	0.611	2.68	0.0333
3.037	0.185	0.509	2.59	0.0342
4.028	0.0916	0.308	2.76	0.0297
4.015	0.0858	0.332	2.47	0.0298
4.007	0.118	0.378	2.36	0.0328
4.002	0.102	0.445	2.9	0.0294
4.000	0.122	0.368	2.52	0.03
4.002	0.115	0.348	2.41	0.0312
4.007	0.105	0.356	2.26	0.0281
4.015	0.0832	0.41	2.36	0.0278
4.028	0.101	0.368	2.24	0.0303
8.014	0.0201	0.104	0.4	0.00582
8.008	0.0264	0.0898	0.395	0.00672
8.003	0.0278	0.172	0.496	0.00658
8.001	0.0185	0.0786	0.568	0.00649
8.000	0.0332	0.0825	0.529	0.00631
8.001	0.0208	0.137	0.598	0.00717
8.003	0.0204	0.11	0.557	0.00659
8.008	0.0309	0.165	0.278	0.00643
8.014	0.0248	0.117	0.482	0.00666

Table B3. LLNL PNAD neutron fluence results as a function of effective distance from the reactor core for IER 252
Flatop irradiation #11 (see Fig 7).

<i>Effective Distance (m)</i>	<i>Approximate Neutron Energy Range</i>			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
2.054	5.09E+09	2.26E+10	3.38E+11	3.26E+10
2.030	5.04E+09	2.52E+10	3.41E+11	3.01E+10
2.013	4.94E+09	2.50E+10	3.47E+11	3.35E+10
2.004	5.12E+09	2.38E+10	4.16E+11	3.71E+10
2.000	5.47E+09	2.68E+10	4.03E+11	3.27E+10
2.004	5.20E+09	2.42E+10	3.24E+11	3.33E+10
2.013	5.25E+09	2.64E+10	2.93E+11	2.92E+10
2.030	5.20E+09	2.28E+10	3.94E+11	3.12E+10
2.054	3.34E+09	1.35E+10	3.24E+11	3.25E+10
3.037	2.72E+09	1.19E+10	3.36E+11	3.09E+10
3.020	2.54E+09	1.37E+10	2.45E+11	3.26E+10
3.009	2.57E+09	1.14E+10	8.26E+11	3.03E+10
3.002	2.53E+09	1.21E+10	2.06E+11	3.21E+10
3.000	2.66E+09	1.15E+10	3.29E+11	3.15E+10
3.002	2.62E+09	1.41E+10	2.11E+11	3.02E+10
3.009	2.94E+09	2.00E+10	3.38E+11	3.12E+10
3.020	2.24E+09	1.17E+10	2.37E+11	3.32E+10
3.037	2.66E+09	1.09E+10	2.06E+11	3.29E+10
4.028	1.40E+09	7.85E+09	2.53E+11	2.84E+10
4.015	1.34E+09	5.92E+09	2.15E+11	3.05E+10
4.007	1.55E+09	7.55E+09	2.42E+11	2.67E+10
4.002	1.39E+09	4.85E+09	2.47E+11	2.86E+10
4.000	1.43E+09	7.24E+09	1.82E+11	3.06E+10
4.002	1.75E+09	6.83E+09	2.59E+11	3.06E+10
4.007	1.75E+09	6.37E+09	2.25E+11	2.86E+10
4.015	1.31E+09	6.89E+09	1.84E+11	3.10E+10
4.028	1.45E+09	4.86E+09	1.77E+11	2.91E+10
8.014	3.35E+08	1.59E+09	6.37E+10	6.77E+09
8.008	3.78E+08	2.79E+09	6.12E+10	7.20E+09
8.003	2.33E+08	2.36E+09	6.48E+10	6.96E+09
8.001	3.79E+08	1.66E+09	7.24E+10	6.66E+09
8.000	3.83E+08	1.10E+09	5.31E+10	6.48E+09
8.001	2.50E+08	3.24E+09	4.96E+10	6.88E+09
8.003	2.05E+08	3.35E+09	6.02E+10	7.26E+09
8.008	2.66E+08	1.31E+09	6.41E+10	6.54E+09
8.014	3.42E+08	4.50E+08	4.08E+10	7.52E+09

Table B4. LLNL PNAD neutron tissue kerma results as a function of effective distance from the reactor core for IER
252 Flattop irradiation #11 (see Fig. 8)

<i>Effective Distance (m)</i>	<i>Approximate Neutron Energy Range</i>			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
2.054	0.27	0.746	2.73	0.0228
2.030	0.267	0.832	2.76	0.0211
2.013	0.262	0.826	2.81	0.0234
2.004	0.271	0.786	3.37	0.026
2.000	0.29	0.885	3.26	0.0229
2.004	0.276	0.798	2.62	0.0233
2.013	0.278	0.872	2.37	0.0205
2.030	0.276	0.752	3.2	0.0218
3.037	0.144	0.394	2.72	0.0216
3.020	0.134	0.453	1.99	0.0228
3.009	0.136	0.376	6.69	0.0212
3.002	0.134	0.399	1.67	0.0225
3.000	0.141	0.379	2.66	0.022
3.002	0.139	0.465	1.71	0.0211
3.009	0.156	0.66	2.74	0.0219
3.020	0.119	0.386	1.92	0.0233
3.037	0.141	0.361	1.67	0.023
4.028	0.0742	0.259	2.05	0.0199
4.015	0.0712	0.195	1.74	0.0213
4.007	0.0822	0.249	1.96	0.0187
4.002	0.0738	0.16	2	0.02
4.000	0.0756	0.239	1.48	0.0214
4.002	0.0927	0.225	2.1	0.0214
4.007	0.0928	0.21	1.82	0.02
4.015	0.0695	0.227	1.49	0.0217
4.028	0.0769	0.16	1.43	0.0204
8.014	0.0177	0.0526	0.516	0.00474
8.008	0.0201	0.0922	0.496	0.00504
8.003	0.0123	0.078	0.525	0.00487
8.001	0.0201	0.0549	0.586	0.00467
8.000	0.0203	0.0362	0.43	0.00454
8.001	0.0133	0.107	0.402	0.00482
8.003	0.0109	0.111	0.488	0.00508
8.008	0.0141	0.0432	0.519	0.00458
8.014	0.0181	0.0148	0.331	0.00526

Table B5. LLNL PNAD neutron fluence results as a function of effective distance from the reactor core for IER 252 Flattop irradiation #9 (see Fig. 9).

<i>Effective Distance (m)</i>	<i>Approximate Neutron Energy Range</i>			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
2.054	5.74E+09	2.80E+10	3.97E+11	3.47E+10
2.030	5.75E+09	2.70E+10	4.42E+11	3.45E+10
2.013	5.79E+09	2.55E+10	3.85E+11	3.36E+10
2.004	6.23E+09	2.93E+10	4.21E+11	3.64E+10
2.000	6.04E+09	3.11E+10	4.71E+11	3.64E+10
2.004	6.14E+09	3.07E+10	4.77E+11	3.72E+10
2.013	5.97E+09	2.70E+10	4.21E+11	3.52E+10
2.030	5.15E+09	2.74E+10	4.87E+11	3.56E+10
2.054	5.01E+09	2.26E+10	4.15E+11	3.64E+10
3.037	2.70E+09	1.51E+10	3.23E+11	3.46E+10
3.020	2.47E+09	1.49E+10	3.29E+11	4.00E+10
3.009	2.43E+09	1.31E+10	3.31E+11	3.75E+10
3.002	2.44E+09	1.17E+10	3.17E+11	3.71E+10
3.000	2.41E+09	1.26E+10	3.59E+11	3.81E+10
3.002	2.91E+09	1.06E+10	3.35E+11	3.78E+10
3.009	2.62E+09	1.11E+10	3.22E+11	3.79E+10
3.020	2.53E+09	1.19E+10	3.34E+11	4.02E+10
3.037	2.34E+09	1.08E+10	3.12E+11	3.69E+10
4.015	1.60E+09	5.13E+09	2.05E+11	3.29E+10
4.000	1.55E+09	9.41E+09	2.28E+11	3.12E+10
4.015	1.55E+09	6.90E+09	2.56E+11	3.46E+10
8.014	3.30E+08	2.34E+09	3.27E+10	6.11E+09
8.008	4.26E+08	1.99E+09	4.51E+10	6.51E+09
8.003	3.33E+08	2.48E+09	3.59E+10	6.03E+09
8.001	4.10E+08	2.23E+09	5.55E+10	7.63E+09
8.000	2.68E+08	2.37E+09	5.43E+10	6.49E+09
8.001	2.86E+08	2.51E+09	6.19E+10	6.78E+09
8.003	3.45E+08	2.03E+09	5.08E+10	6.52E+09
8.008	3.88E+08	2.13E+09	4.85E+10	6.58E+09
8.014	3.40E+08	1.48E+09	NM	7.15E+09

NM = not measurable

Table B6. LLNL PNAD neutron tissue kerma results as a function of effective distance from the reactor core for IER 252 Flattop irradiation #9 (see Fig. 10).

<i>Effective Distance (m)</i>	<i>Approximate Neutron Energy Range</i>			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
2.054	0.304	0.925	3.22	0.0243
2.030	0.304	0.891	3.58	0.0242
2.013	0.307	0.842	3.12	0.0235
2.004	0.33	0.968	3.41	0.0255
2.000	0.32	1.03	3.82	0.0255
2.004	0.325	1.01	3.87	0.0261
2.013	0.316	0.892	3.41	0.0246
2.030	0.273	0.903	3.95	0.025
2.054	0.265	0.745	3.36	0.0254
3.037	0.143	0.497	2.62	0.0242
3.020	0.131	0.493	2.66	0.028
3.009	0.129	0.433	2.68	0.0263
3.002	0.129	0.387	2.57	0.026
3.000	0.128	0.417	2.91	0.0267
3.002	0.154	0.35	2.71	0.0265
3.009	0.139	0.366	2.61	0.0265
3.020	0.134	0.391	2.7	0.0282
3.037	0.124	0.357	2.53	0.0258
4.015	0.085	0.169	1.66	0.023
4.000	0.082	0.31	1.85	0.0218
4.015	0.0823	0.228	2.07	0.0243
8.014	0.0175	0.0773	0.265	0.00428
8.008	0.0226	0.0658	0.365	0.00455
8.003	0.0177	0.0819	0.291	0.00422
8.001	0.0217	0.0735	0.45	0.00534
8.000	0.0142	0.0783	0.44	0.00454
8.001	0.0152	0.0829	0.502	0.00475
8.003	0.0183	0.067	0.411	0.00456
8.008	0.0206	0.0702	0.393	0.0046
8.014	0.018	0.0488	NM	0.005

NM = not measurable

Table B7. Neutron fluence per unit charge as a function of distance from the Flattop reactor core using PNADs (see Fig. 11).

<i>Effective Distance (m)</i>	<i>Approximate Neutron Energy Range</i>			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
2.054	2.42E+11	1.11E+12	2.30E+13	1.60E+12
2.030	2.49E+11	1.06E+12	2.02E+13	1.59E+12
2.013	2.63E+11	1.30E+12	2.08E+13	1.44E+12
2.004	2.69E+11	1.21E+12	2.03E+13	1.50E+12
2.000	2.71E+11	1.12E+12	1.87E+13	1.61E+12
2.004	2.63E+11	1.06E+12	1.68E+13	1.65E+12
2.013	2.61E+11	1.25E+12	1.57E+13	1.76E+12
2.030	2.31E+11	1.19E+12	1.80E+13	1.46E+12
2.054	1.63E+11	7.12E+11	1.60E+13	1.65E+12
3.037	1.29E+11	6.25E+11	1.35E+13	1.53E+12
3.020	1.16E+11	5.71E+11	1.20E+13	1.63E+12
3.009	1.28E+11	6.48E+11	1.33E+13	1.65E+12
3.002	1.28E+11	6.18E+11	1.47E+13	1.60E+12
3.000	1.25E+11	5.77E+11	1.49E+13	1.55E+12
3.002	1.32E+11	5.02E+11	1.33E+13	1.66E+12
3.009	1.27E+11	5.94E+11	1.43E+13	1.56E+12
3.020	1.14E+11	6.38E+11	1.14E+13	1.64E+12
3.037	1.21E+11	5.31E+11	1.10E+13	1.68E+12
4.028	5.96E+10	3.22E+11	1.17E+13	1.46E+12
4.015	5.58E+10	3.47E+11	1.05E+13	1.47E+12
4.007	7.66E+10	3.95E+11	1.00E+13	1.61E+12
4.002	6.60E+10	4.65E+11	1.24E+13	1.45E+12
4.000	7.96E+10	3.85E+11	1.07E+13	1.48E+12
4.002	7.46E+10	3.63E+11	1.03E+13	1.54E+12
4.007	6.85E+10	3.72E+11	9.62E+12	1.39E+12
4.015	5.41E+10	4.28E+11	1.00E+13	1.37E+12
4.028	6.57E+10	3.84E+11	9.54E+12	1.49E+12
8.014	1.31E+10	1.08E+11	1.70E+12	2.87E+11
8.008	1.72E+10	9.38E+10	1.68E+12	3.31E+11
8.003	1.81E+10	1.80E+11	2.11E+12	3.24E+11
8.001	1.20E+10	8.21E+10	2.42E+12	3.20E+11
8.000	2.16E+10	8.62E+10	2.25E+12	3.11E+11
8.001	1.35E+10	1.43E+11	2.55E+12	3.53E+11
8.003	1.33E+10	1.15E+11	2.37E+12	3.25E+11
8.008	2.01E+10	1.72E+11	1.18E+12	3.17E+11
8.014	1.61E+10	1.22E+11	2.05E+12	3.28E+11
8.014	1.30E+10	9.79E+09	6.37E+11	1.51E+11
8.008	2.70E+09	1.05E+10	3.97E+11	1.75E+11

Table B7. continued*Effective Distance (m)*

Approximate Neutron Energy Range

	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
8.003	4.81E+09	2.96E+10	8.45E+11	1.71E+11
8.001	8.64E+08	6.49E+10	1.87E+11	1.47E+11
8.000	1.65E+09	3.70E+10	8.36E+11	1.79E+11
8.001	2.01E+09	4.96E+10	1.11E+12	1.71E+11
8.003	2.24E+09	6.08E+11	8.22E+11	1.70E+11
8.008	7.99E+08	1.61E+10	1.13E+12	1.68E+11
8.014	4.33E+09	8.28E+09	5.52E+11	1.92E+11
2.054	2.54E+11	1.13E+12	1.69E+13	1.63E+12
2.030	2.52E+11	1.26E+12	1.71E+13	1.51E+12
2.013	2.47E+11	1.25E+12	1.74E+13	1.67E+12
2.004	2.56E+11	1.19E+12	2.08E+13	1.85E+12
2.000	2.73E+11	1.34E+12	2.01E+13	1.63E+12
2.004	2.60E+11	1.21E+12	1.62E+13	1.67E+12
2.013	2.63E+11	1.32E+12	1.46E+13	1.46E+12
2.030	2.60E+11	1.14E+12	1.97E+13	1.56E+12
2.054	1.67E+11	6.77E+11	1.62E+13	1.63E+12
3.037	1.36E+11	5.96E+11	1.68E+13	1.54E+12
3.020	1.27E+11	6.86E+11	1.23E+13	1.63E+12
3.009	1.29E+11	5.70E+11	4.13E+13	1.52E+12
3.002	1.26E+11	6.05E+11	1.03E+13	1.60E+12
3.000	1.33E+11	5.74E+11	1.64E+13	1.57E+12
3.002	1.31E+11	7.05E+11	1.05E+13	1.51E+12
3.009	1.47E+11	9.99E+11	1.69E+13	1.56E+12
3.020	1.12E+11	5.85E+11	1.19E+13	1.66E+12
3.037	1.33E+11	5.47E+11	1.03E+13	1.65E+12
4.028	7.00E+10	3.92E+11	1.26E+13	1.42E+12
4.015	6.72E+10	2.96E+11	1.07E+13	1.52E+12
4.007	7.75E+10	3.77E+11	1.21E+13	1.33E+12
4.002	6.96E+10	2.42E+11	1.24E+13	1.43E+12
4.000	7.13E+10	3.62E+11	9.11E+12	1.53E+12
4.002	8.74E+10	3.41E+11	1.30E+13	1.53E+12
4.007	8.76E+10	3.19E+11	1.13E+13	1.43E+12
4.015	6.55E+10	3.45E+11	9.22E+12	1.55E+12
4.028	7.26E+10	2.43E+11	8.84E+12	1.46E+12
8.014	1.67E+10	7.97E+10	3.18E+12	3.39E+11
8.008	1.89E+10	1.40E+11	3.06E+12	3.60E+11
8.003	1.16E+10	1.18E+11	3.24E+12	3.48E+11
8.001	1.90E+10	8.32E+10	3.62E+12	3.33E+11
8.000	1.92E+10	5.48E+10	2.66E+12	3.24E+11
8.001	1.25E+10	1.62E+11	2.48E+12	3.44E+11

Table B7. continued*Effective Distance (m)*

	Approximate Neutron Energy Range			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
8.003	1.03E+10	1.68E+11	3.01E+12	3.63E+11
8.008	1.33E+10	6.55E+10	3.21E+12	3.27E+11
8.014	1.71E+10	2.25E+10	2.04E+12	3.76E+11
8.014	0.00E+00	0.00E+00	3.50E+11	1.62E+11
8.008	6.36E+09	3.52E+10	1.05E+12	1.56E+11
8.003	0.00E+00	3.83E+10	3.10E+13	1.92E+11
8.001	8.58E+09	3.50E+10	3.14E+11	1.93E+11
8.000	2.12E+09	4.17E+10	1.38E+13	1.80E+11
8.001	7.90E+09	3.28E+10	5.70E+11	1.79E+11
8.003	0.00E+00	2.48E+10	1.37E+12	1.58E+11
8.008	0.00E+00	4.77E+09	7.72E+11	1.93E+11
8.014	0.00E+00	2.16E+10	1.51E+12	1.67E+11
2.054	2.80E+11	1.37E+12	1.94E+13	1.69E+12
2.030	2.80E+11	1.32E+12	2.15E+13	1.68E+12
2.013	2.82E+11	1.24E+12	1.88E+13	1.64E+12
2.004	3.04E+11	1.43E+12	2.05E+13	1.77E+12
2.000	2.95E+11	1.52E+12	2.30E+13	1.77E+12
2.004	3.00E+11	1.50E+12	2.33E+13	1.82E+12
2.013	2.91E+11	1.32E+12	2.05E+13	1.72E+12
2.030	2.51E+11	1.34E+12	2.38E+13	1.74E+12
2.054	2.44E+11	1.10E+12	2.02E+13	1.77E+12
3.037	1.32E+11	7.35E+11	1.58E+13	1.69E+12
3.020	1.21E+11	7.29E+11	1.60E+13	1.95E+12
3.009	1.19E+11	6.40E+11	1.61E+13	1.83E+12
3.002	1.19E+11	5.72E+11	1.55E+13	1.81E+12
3.000	1.18E+11	6.16E+11	1.75E+13	1.86E+12
3.002	1.42E+11	5.17E+11	1.63E+13	1.84E+12
3.009	1.28E+11	5.41E+11	1.57E+13	1.85E+12
3.020	1.23E+11	5.78E+11	1.63E+13	1.96E+12
3.037	1.14E+11	5.27E+11	1.52E+13	1.80E+12
4.015	7.82E+10	2.50E+11	1.00E+13	1.60E+12
4.000	7.55E+10	4.59E+11	1.11E+13	1.52E+12
4.015	7.58E+10	3.36E+11	1.25E+13	1.69E+12
8.014	1.61E+10	1.14E+11	1.59E+12	2.98E+11
8.008	2.08E+10	9.73E+10	2.20E+12	3.17E+11
8.003	1.62E+10	1.21E+11	1.75E+12	2.94E+11
8.001	2.00E+10	1.09E+11	2.71E+12	3.72E+11
8.000	1.30E+10	1.16E+11	2.65E+12	3.17E+11
8.001	1.39E+10	1.23E+11	3.02E+12	3.31E+11
8.003	1.68E+10	9.91E+10	2.48E+12	3.18E+11
8.008	1.89E+10	1.04E+11	2.36E+12	3.21E+11

Table B7. continued

<i>Effective Distance (m)</i>	Approximate Neutron Energy Range			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
8.014	1.66E+10	7.22E+10	0.00E+00	3.49E+11
8.014	0.00E+00	4.86E+10	4.19E+11	1.70E+11
8.008	0.00E+00	3.51E+10	6.94E+11	1.91E+11
8.003	0.00E+00	2.46E+10	3.26E+11	1.68E+11
8.001	0.00E+00	1.65E+10	6.10E+11	2.03E+11
8.000	0.00E+00	6.71E+09	8.87E+11	1.77E+11
8.001	1.51E+09	3.22E+10	1.31E+12	1.89E+11
8.003	9.53E+09	7.86E+10	1.06E+12	1.97E+11
8.008	2.34E+08	2.41E+09	3.90E+11	1.68E+11
8.014	2.00E+09	7.30E+10	2.57E+12	2.08E+11

Table B8. Tissue kerma per unit charge as a function of distance from the Flattop reactor core using PNADs (see Fig. 12).

<i>Effective Distance (m)</i>	<i>Approximate Neutron Energy Range</i>			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
2.054	12.86	36.55	186.55	1.12
2.030	13.21	35.17	163.45	1.11
2.013	13.93	43.10	168.97	1.01
2.004	14.28	40.00	164.83	1.05
2.000	14.38	37.24	151.03	1.13
2.004	13.93	34.83	136.21	1.15
2.013	13.83	41.38	126.90	1.23
2.030	12.24	39.31	146.21	1.02
3.037	6.83	20.62	108.97	1.07
3.020	6.14	18.83	97.24	1.14
3.009	6.79	21.38	107.93	1.16
3.002	6.76	20.41	118.97	1.12
3.000	6.62	19.03	120.69	1.09
3.002	7.00	16.55	107.59	1.16
3.009	6.72	19.62	115.52	1.09
3.020	6.03	21.07	92.41	1.15
3.037	6.38	17.55	89.31	1.18
4.028	3.16	10.62	95.17	1.02
4.015	2.96	11.45	85.17	1.03
4.007	4.07	13.03	81.38	1.13
4.002	3.52	15.34	100.00	1.01
4.000	4.21	12.69	86.90	1.03
4.002	3.97	12.00	83.10	1.08
4.007	3.62	12.28	77.93	0.97
4.015	2.87	14.14	81.38	0.96
4.028	3.48	12.69	77.24	1.04
8.014	0.69	3.59	13.79	0.20
8.008	0.91	3.10	13.62	0.23
8.003	0.96	5.93	17.10	0.23
8.001	0.64	2.71	19.59	0.22
8.000	1.14	2.84	18.24	0.22
8.001	0.72	4.72	20.62	0.25
8.003	0.70	3.79	19.21	0.23
8.008	1.07	5.69	9.59	0.22
8.014	0.86	4.03	16.62	0.23
8.014	0.69	0.32	5.17	0.11
8.008	0.14	0.34	3.22	0.12
8.003	0.25	0.98	6.83	0.12

Table B8. continued*Effective Distance (m)*

Approximate Neutron Energy Range

	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
8.001	0.05	2.14	1.52	0.10
8.000	0.09	1.22	6.76	0.13
8.001	0.11	1.64	9.00	0.12
8.003	0.12	20.07	6.66	0.12
8.008	0.04	0.53	9.14	0.12
8.014	0.23	0.27	4.48	0.13
8.000	1.01	3.89	NM	NM
2.054	13.50	37.30	136.50	1.14
2.030	13.35	41.60	138.00	1.06
2.013	13.10	41.30	140.50	1.17
2.004	13.55	39.30	168.50	1.30
2.000	14.50	44.25	163.00	1.15
2.004	13.80	39.90	131.00	1.17
2.013	13.90	43.60	118.50	1.03
2.030	13.80	37.60	160.00	1.09
3.037	7.20	19.70	136.00	1.08
3.020	6.70	22.65	99.50	1.14
3.002	6.70	19.95	83.50	1.13
3.000	7.05	18.95	133.00	1.10
3.002	6.95	23.25	85.50	1.06
3.009	7.80	33.00	137.00	1.10
3.020	5.95	19.30	96.00	1.17
3.037	7.05	18.05	83.50	1.15
4.028	3.71	12.95	102.50	1.00
4.015	3.56	9.75	87.00	1.07
4.007	4.11	12.45	98.00	0.94
4.002	3.69	8.00	100.00	1.00
4.000	3.78	11.95	74.00	1.07
4.002	4.64	11.25	105.00	1.07
4.007	4.64	10.50	91.00	1.00
4.015	3.48	11.35	74.50	1.09
4.028	3.85	8.00	71.50	1.02
8.014	0.89	2.63	25.80	0.24
8.008	1.01	4.61	24.80	0.25
8.003	0.62	3.90	26.25	0.24
8.001	1.01	2.75	29.30	0.23
8.000	1.02	1.81	21.50	0.23
8.001	0.67	5.35	20.10	0.24
8.003	0.55	5.55	24.40	0.25
8.008	0.71	2.16	25.95	0.23
8.014	0.91	0.74	16.55	0.26

Table B8. continued*Effective Distance (m)*

	Approximate Neutron Energy Range			
	> 3 MeV	1 - 3 MeV	1 eV - 1 MeV	Thermal
8.008	0.34	1.16	8.50	0.11
8.001	0.46	1.16	2.55	0.14
8.000	0.11	1.38	112.00	0.13
8.001	0.42	1.09	4.62	0.13
2.054	14.83	45.12	157.07	1.19
2.030	14.83	43.46	174.63	1.18
2.013	14.98	41.07	152.20	1.15
2.004	16.10	47.22	166.34	1.24
2.000	15.61	50.24	186.34	1.24
2.004	15.85	49.27	188.78	1.27
2.013	15.41	43.51	166.34	1.20
2.030	13.32	44.05	192.68	1.22
2.054	12.93	36.34	163.90	1.24
3.037	6.98	24.24	127.80	1.18
3.020	6.39	24.05	129.76	1.37
3.009	6.29	21.12	130.73	1.28
3.002	6.29	18.88	125.37	1.27
3.000	6.24	20.34	141.95	1.30
3.002	7.51	17.07	132.20	1.29
3.009	6.78	17.85	127.32	1.29
3.020	6.54	19.07	131.71	1.38
3.037	6.05	17.41	123.41	1.26
4.015	4.15	8.24	80.98	1.12
4.000	4.00	15.12	90.24	1.06
4.015	4.01	11.12	100.98	1.19
8.014	0.85	3.77	12.93	0.21
8.008	1.10	3.21	17.80	0.22
8.003	0.86	4.00	14.20	0.21
8.001	1.06	3.59	21.95	0.26
8.000	0.69	3.82	21.46	0.22
8.001	0.74	4.04	24.49	0.23
8.003	0.89	3.27	20.05	0.22
8.008	1.00	3.42	19.17	0.22
8.001	0.08	1.06	10.63	0.13
8.003	0.51	2.60	8.59	0.14
8.008	0.01	0.08	3.16	0.12
8.014	0.11	2.41	20.83	0.15

Table B9. Measured tissue gamma dose as a function of distance for three characterization measurements FT13, FT11, and FT9 using CaF₂(Mn) dosimeters (see Fig. 23).

<i>Effective Distance (m)</i>	<i>Gamma Tissue Dose (Gy)</i>		
	Pulse 9	Pulse 11	Pulse 13
2.054483	8.03E-01	7.82E-01	1.12E+00
2.054483	8.31E-01	7.03E-01	1.02E+00
2.054483	7.74E-01	7.52E-01	1.12E+00
2.054483	7.87E-01	7.94E-01	1.11E+00
2.054483	7.96E-01	7.46E-01	1.06E+00
2.054483	8.11E-01	7.56E-01	1.08E+00
2.054483	8.01E-01	6.30E-01	1.00E+00
2.054483	8.35E-01	7.58E-01	1.09E+00
2.054483	8.46E-01	7.64E-01	1.27E+00
2.054483	8.32E-01	8.09E-01	1.09E+00
2.054483	7.41E-01	7.48E-01	1.07E+00
2.054483	8.36E-01	7.71E-01	1.04E+00
2.054483	8.08E-01	7.62E-01	1.08E+00
2.054483	8.28E-01	7.68E-01	1.07E+00
2.054483	7.90E-01	7.80E-01	1.09E+00
2.003597	8.09E-01	7.67E-01	1.07E+00
2.003597	8.12E-01	8.55E-01	1.01E+00
2.003597	8.27E-01	7.43E-01	1.16E+00
2.003597	7.74E-01	7.48E-01	1.08E+00
2.003597	8.47E-01	7.80E-01	1.04E+00
2.003597	9.01E-01	7.40E-01	1.07E+00
2.003597	8.63E-01	7.92E-01	1.16E+00
2.003597	8.19E-01	7.51E-01	1.11E+00
2.003597	8.39E-01	8.37E-01	1.14E+00
2.003597	8.07E-01	7.71E-01	1.12E+00
2.003597	8.05E-01	7.43E-01	1.10E+00
2.003597	8.12E-01	7.55E-01	1.14E+00
2.003597	7.76E-01	7.38E-01	1.14E+00
2.003597	8.12E-01	7.36E-01	1.23E+00
2.003597	8.46E-01	7.53E-01	1.07E+00
2.013182	7.69E-01	7.74E-01	1.08E+00
2.013182	8.75E-01	7.24E-01	1.03E+00
2.013182	7.77E-01	7.54E-01	1.04E+00
2.013182	8.01E-01	7.57E-01	1.05E+00
2.013182	8.20E-01	7.00E-01	1.10E+00
2.013182	8.06E-01	7.67E-01	1.08E+00
2.013182	8.11E-01	7.26E-01	1.07E+00
2.013182	8.15E-01	8.18E-01	1.09E+00

Table B9. continued*Effective Distance (m)*

Gamma Tissue Dose (Gy)

	Pulse 9	Pulse 11	Pulse 13
2.013182	8.37E-01	7.22E-01	1.05E+00
2.013182	8.06E-01	7.03E-01	1.06E+00
2.013182	7.84E-01	7.35E-01	9.64E-01
2.013182	8.13E-01	7.15E-01	1.05E+00
2.013182	8.03E-01	7.16E-01	1.06E+00
2.013182	8.23E-01	6.60E-01	1.10E+00
2.013182	7.63E-01	7.45E-01	1.07E+00
3.036593	7.04E-01	6.46E-01	9.21E-01
3.036593	7.69E-01	6.43E-01	9.42E-01
3.036593	7.48E-01	6.65E-01	9.42E-01
3.036593	7.38E-01	5.94E-01	9.85E-01
3.036593	7.33E-01	6.37E-01	9.03E-01
3.036593	8.09E-01	6.32E-01	9.39E-01
3.036593	7.66E-01	6.64E-01	9.22E-01
3.036593	7.88E-01	6.72E-01	9.14E-01
3.036593	7.90E-01	6.35E-01	9.29E-01
3.036593	6.95E-01	6.78E-01	9.36E-01
3.036593	8.19E-01	6.30E-01	8.73E-01
3.036593	7.63E-01	6.48E-01	1.01E+00
3.036593	7.32E-01	5.91E-01	9.76E-01
3.036593	8.13E-01	6.57E-01	9.41E-01
3.036593	7.94E-01	6.25E-01	9.57E-01
3.002399	7.42E-01	6.18E-01	9.19E-01
3.002399	7.40E-01	6.93E-01	9.71E-01
3.002399	6.58E-01	6.80E-01	9.11E-01
3.002399	7.66E-01	6.88E-01	1.03E+00
3.002399	7.54E-01	5.97E-01	9.28E-01
3.002399	7.86E-01	6.95E-01	9.45E-01
3.002399	7.20E-01	6.41E-01	9.24E-01
3.002399	7.53E-01	6.50E-01	9.20E-01
3.002399	7.63E-01	6.39E-01	9.76E-01
3.002399	7.18E-01	6.56E-01	9.87E-01
3.002399	7.46E-01	6.11E-01	8.96E-01
3.002399	7.61E-01	6.42E-01	9.71E-01
3.002399	8.51E-01	6.53E-01	9.94E-01
3.002399	7.79E-01	6.41E-01	9.84E-01
3.002399	7.60E-01	6.42E-01	1.03E+00
3.008804	7.14E-01	6.08E-01	9.09E-01
3.008804	7.32E-01	6.13E-01	9.76E-01
3.008804	7.85E-01	6.59E-01	8.96E-01
3.008804	8.62E-01	6.34E-01	9.04E-01

Table B9. continued*Effective Distance (m)*

	Gamma Tissue Dose (Gy)		
	Pulse 9	Pulse 11	Pulse 13
3.008804	7.10E-01	6.25E-01	8.98E-01
3.008804	7.34E-01	6.40E-01	8.39E-01
3.008804	7.15E-01	6.39E-01	9.67E-01
3.008804	7.26E-01	6.45E-01	9.77E-01
3.008804	7.34E-01	6.53E-01	8.86E-01
3.008804	7.47E-01	5.78E-01	9.39E-01
3.008804	7.55E-01	6.53E-01	9.69E-01
3.008804	8.13E-01	7.04E-01	8.96E-01
3.008804	7.62E-01	6.13E-01	8.63E-01
3.008804	7.09E-01	6.20E-01	9.89E-01
3.008804	7.24E-01	6.46E-01	9.05E-01
4.027518	6.14E-01	5.67E-01	8.46E-01
4.027518	6.44E-01	5.42E-01	9.23E-01
4.027518	6.50E-01	5.08E-01	9.56E-01
4.027518	6.30E-01	5.59E-01	9.40E-01
4.027518	6.37E-01	5.07E-01	9.09E-01
4.027518	6.50E-01	5.58E-01	8.08E-01
4.027518	6.43E-01	5.65E-01	8.35E-01
4.027518	6.04E-01	5.83E-01	8.05E-01
4.027518	6.33E-01	5.36E-01	8.48E-01
4.027518	6.29E-01	5.80E-01	7.21E-01
4.027518	6.44E-01	5.75E-01	8.43E-01
4.027518	6.61E-01	5.82E-01	8.42E-01
4.027518	6.07E-01	5.93E-01	7.51E-01
4.027518	6.92E-01	5.65E-01	8.33E-01
4.027518	6.50E-01	5.47E-01	8.52E-01
4.0018	6.01E-01	6.17E-01	8.46E-01
4.0018	7.17E-01	5.81E-01	8.39E-01
4.0018	6.31E-01	5.52E-01	8.42E-01
4.0018	6.23E-01	5.68E-01	8.06E-01
4.0018	6.30E-01	6.00E-01	8.56E-01
4.0018	6.32E-01	5.70E-01	8.77E-01
4.0018	6.33E-01	5.85E-01	8.57E-01
4.0018	5.69E-01	5.45E-01	8.21E-01
4.0018	6.13E-01	5.52E-01	8.37E-01
4.0018	6.33E-01	5.92E-01	8.98E-01
4.0018	6.57E-01	4.94E-01	8.04E-01
4.0018	6.50E-01	5.60E-01	8.63E-01
4.0018	6.76E-01	4.65E-01	8.55E-01
4.0018	6.57E-01	5.82E-01	8.42E-01
4.0018	6.37E-01	5.70E-01	9.39E-01

Table B9. continued*Effective Distance (m)*

Gamma Tissue Dose (Gy)

	Pulse 9	Pulse 11	Pulse 13
4.006607	6.35E-01	5.51E-01	8.14E-01
4.006607	5.80E-01	5.65E-01	7.76E-01
4.006607	5.63E-01	5.70E-01	8.38E-01
4.006607	6.07E-01	5.61E-01	8.68E-01
4.006607	6.31E-01	5.74E-01	7.96E-01
4.006607	6.24E-01	6.02E-01	8.64E-01
4.006607	6.25E-01	5.67E-01	8.31E-01
4.006607	5.74E-01	5.63E-01	8.59E-01
4.006607	5.98E-01	5.61E-01	8.19E-01
4.006607	6.70E-01	6.15E-01	7.89E-01
4.006607	6.55E-01	6.51E-01	8.38E-01
4.006607	5.96E-01	5.49E-01	8.28E-01
4.006607	5.90E-01	5.66E-01	8.20E-01
4.006607	6.98E-01	5.46E-01	8.23E-01
4.006607	6.30E-01	5.24E-01	8.51E-01
8.013794	1.35E-01	1.36E-01	1.94E-01
8.013794	1.38E-01	1.37E-01	2.00E-01
8.013794	1.38E-01	1.36E-01	1.89E-01
8.013794	1.36E-01	1.33E-01	2.26E-01
8.013794	1.40E-01	1.43E-01	1.99E-01
8.013794	1.42E-01	1.40E-01	1.88E-01
8.013794	1.35E-01	1.32E-01	1.89E-01
8.013794	1.30E-01	1.32E-01	1.77E-01
8.013794	1.38E-01	1.33E-01	1.87E-01
8.013794	1.40E-01	1.32E-01	1.90E-01
8.013794	1.22E-01	1.28E-01	1.93E-01
8.013794	1.43E-01	1.25E-01	1.81E-01
8.013794	1.28E-01	1.28E-01	1.95E-01
8.013794	1.09E-01	1.34E-01	1.85E-01
8.013794	1.30E-01	1.29E-01	1.82E-01
8.0009	1.34E-01	1.25E-01	1.98E-01
8.0009	1.42E-01	1.32E-01	1.90E-01
8.0009	1.34E-01	1.29E-01	1.85E-01
8.0009	1.28E-01	1.36E-01	2.12E-01
8.0009	1.25E-01	1.29E-01	1.91E-01
8.0009	1.40E-01	1.43E-01	1.71E-01
8.0009	1.41E-01	1.33E-01	2.06E-01
8.0009	1.38E-01	1.35E-01	1.93E-01
8.0009	1.42E-01	1.39E-01	1.85E-01
8.0009	1.33E-01	1.34E-01	1.93E-01
8.0009	1.27E-01	1.29E-01	1.91E-01

Table B9. continued*Effective Distance (m)*

8.0009

8.0009

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8.003306

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8.003306

Gamma Tissue Dose (Gy)

Pulse 9

Pulse 11

Pulse 13

1.30E-01

1.28E-01

1.88E-01

1.39E-01

1.22E-01

1.73E-01

1.37E-01

1.42E-01

1.92E-01

1.30E-01

1.23E-01

1.91E-01

1.28E-01

1.42E-01

1.96E-01

1.28E-01

1.32E-01

1.91E-01

1.52E-01

1.35E-01

1.91E-01

1.23E-01

1.30E-01

1.84E-01

1.35E-01

1.34E-01

1.88E-01

1.34E-01

1.33E-01

1.90E-01

1.35E-01

1.33E-01

1.86E-01

1.34E-01

1.34E-01

1.86E-01

1.48E-01

1.21E-01

1.87E-01

1.43E-01

1.29E-01

1.82E-01

1.28E-01

1.31E-01

1.85E-01

1.22E-01

1.27E-01

1.83E-01

1.08E-01

1.28E-01

1.77E-01

1.26E-01

1.26E-01

1.84E-01

1.47E-01

1.33E-01

1.83E-01

Table B10. Gamma tissue dose per unit charge as a function of distance using CaF₂(Mn) dosimeters (see Fig. 24).

<i>Effective Distance (m)</i>	<i>Gamma Tissue Dose (Gy)</i>		
	Pulse 9	Pulse 11	Pulse 13
2.054483	3.92E+01	3.91E+01	3.87E+01
2.054483	4.05E+01	3.51E+01	3.53E+01
2.054483	3.78E+01	3.76E+01	3.87E+01
2.054483	3.84E+01	3.97E+01	3.84E+01
2.054483	3.88E+01	3.73E+01	3.64E+01
2.054483	3.95E+01	3.78E+01	3.71E+01
2.054483	3.91E+01	3.15E+01	3.45E+01
2.054483	4.07E+01	3.79E+01	3.74E+01
2.054483	4.13E+01	3.82E+01	4.38E+01
2.054483	4.06E+01	4.05E+01	3.75E+01
2.054483	3.61E+01	3.74E+01	3.71E+01
2.054483	4.08E+01	3.86E+01	3.59E+01
2.054483	3.94E+01	3.81E+01	3.74E+01
2.054483	4.04E+01	3.84E+01	3.70E+01
2.054483	3.85E+01	3.90E+01	3.77E+01
2.003597	3.95E+01	3.84E+01	3.68E+01
2.003597	3.96E+01	4.27E+01	3.47E+01
2.003597	4.03E+01	3.72E+01	3.99E+01
2.003597	3.78E+01	3.74E+01	3.72E+01
2.003597	4.13E+01	3.90E+01	3.60E+01
2.003597	4.39E+01	3.70E+01	3.70E+01
2.003597	4.21E+01	3.96E+01	3.99E+01
2.003597	3.99E+01	3.75E+01	3.84E+01
2.003597	4.09E+01	4.19E+01	3.92E+01
2.003597	3.93E+01	3.86E+01	3.86E+01
2.003597	3.93E+01	3.72E+01	3.79E+01
2.003597	3.96E+01	3.78E+01	3.94E+01
2.003597	3.78E+01	3.69E+01	3.93E+01
2.003597	3.96E+01	3.68E+01	4.23E+01
2.003597	4.13E+01	3.76E+01	3.71E+01
2.013182	3.75E+01	3.87E+01	3.73E+01
2.013182	4.27E+01	3.62E+01	3.56E+01
2.013182	3.79E+01	3.77E+01	3.57E+01
2.013182	3.91E+01	3.79E+01	3.61E+01
2.013182	4.00E+01	3.50E+01	3.79E+01
2.013182	3.93E+01	3.83E+01	3.71E+01
2.013182	3.95E+01	3.63E+01	3.70E+01
2.013182	3.98E+01	4.09E+01	3.77E+01

Table B10. continued*Effective Distance (m)*

Gamma Tissue Dose (Gy)

	Pulse 9	Pulse 11	Pulse 13
2.013182	4.08E+01	3.61E+01	3.63E+01
2.013182	3.93E+01	3.52E+01	3.67E+01
2.013182	3.82E+01	3.67E+01	3.33E+01
2.013182	3.97E+01	3.57E+01	3.63E+01
2.013182	3.92E+01	3.58E+01	3.65E+01
2.013182	4.01E+01	3.30E+01	3.78E+01
2.013182	3.72E+01	3.72E+01	3.70E+01
3.036593	3.43E+01	3.23E+01	3.18E+01
3.036593	3.75E+01	3.22E+01	3.25E+01
3.036593	3.65E+01	3.33E+01	3.25E+01
3.036593	3.60E+01	2.97E+01	3.40E+01
3.036593	3.57E+01	3.18E+01	3.11E+01
3.036593	3.95E+01	3.16E+01	3.24E+01
3.036593	3.74E+01	3.32E+01	3.18E+01
3.036593	3.84E+01	3.36E+01	3.15E+01
3.036593	3.85E+01	3.18E+01	3.20E+01
3.036593	3.39E+01	3.39E+01	3.23E+01
3.036593	4.00E+01	3.15E+01	3.01E+01
3.036593	3.72E+01	3.24E+01	3.47E+01
3.036593	3.57E+01	2.96E+01	3.37E+01
3.036593	3.97E+01	3.28E+01	3.25E+01
3.036593	3.87E+01	3.13E+01	3.30E+01
3.002399	3.62E+01	3.09E+01	3.17E+01
3.002399	3.61E+01	3.47E+01	3.35E+01
3.002399	3.21E+01	3.40E+01	3.14E+01
3.002399	3.74E+01	3.44E+01	3.55E+01
3.002399	3.68E+01	2.98E+01	3.20E+01
3.002399	3.83E+01	3.47E+01	3.26E+01
3.002399	3.51E+01	3.20E+01	3.19E+01
3.002399	3.67E+01	3.25E+01	3.17E+01
3.002399	3.72E+01	3.19E+01	3.36E+01
3.002399	3.50E+01	3.28E+01	3.40E+01
3.002399	3.64E+01	3.05E+01	3.09E+01
3.002399	3.71E+01	3.21E+01	3.35E+01
3.002399	4.15E+01	3.27E+01	3.43E+01
3.002399	3.80E+01	3.20E+01	3.39E+01
3.002399	3.71E+01	3.21E+01	3.57E+01
3.008804	3.48E+01	3.04E+01	3.14E+01
3.008804	3.57E+01	3.07E+01	3.36E+01
3.008804	3.83E+01	3.29E+01	3.09E+01
3.008804	4.20E+01	3.17E+01	3.12E+01

Table B10. continued*Effective Distance (m)*

	Gamma Tissue Dose (Gy)		
	Pulse 9	Pulse 11	Pulse 13
3.008804	3.46E+01	3.12E+01	3.10E+01
3.008804	3.58E+01	3.20E+01	2.89E+01
3.008804	3.49E+01	3.20E+01	3.33E+01
3.008804	3.54E+01	3.23E+01	3.37E+01
3.008804	3.58E+01	3.26E+01	3.05E+01
3.008804	3.64E+01	2.89E+01	3.24E+01
3.008804	3.68E+01	3.26E+01	3.34E+01
3.008804	3.97E+01	3.52E+01	3.09E+01
3.008804	3.72E+01	3.07E+01	2.97E+01
3.008804	3.46E+01	3.10E+01	3.41E+01
3.008804	3.53E+01	3.23E+01	3.12E+01
4.027518	2.99E+01	2.83E+01	2.92E+01
4.027518	3.14E+01	2.71E+01	3.18E+01
4.027518	3.17E+01	2.54E+01	3.30E+01
4.027518	3.07E+01	2.79E+01	3.24E+01
4.027518	3.11E+01	2.53E+01	3.13E+01
4.027518	3.17E+01	2.79E+01	2.79E+01
4.027518	3.14E+01	2.83E+01	2.88E+01
4.027518	2.95E+01	2.92E+01	2.78E+01
4.027518	3.09E+01	2.68E+01	2.93E+01
4.027518	3.07E+01	2.90E+01	2.48E+01
4.027518	3.14E+01	2.88E+01	2.91E+01
4.027518	3.22E+01	2.91E+01	2.90E+01
4.027518	2.96E+01	2.96E+01	2.59E+01
4.027518	3.38E+01	2.82E+01	2.87E+01
4.027518	3.17E+01	2.74E+01	2.94E+01
4.0018	2.93E+01	3.09E+01	2.92E+01
4.0018	3.50E+01	2.91E+01	2.89E+01
4.0018	3.08E+01	2.76E+01	2.90E+01
4.0018	3.04E+01	2.84E+01	2.78E+01
4.0018	3.07E+01	3.00E+01	2.95E+01
4.0018	3.08E+01	2.85E+01	3.02E+01
4.0018	3.09E+01	2.92E+01	2.96E+01
4.0018	2.78E+01	2.72E+01	2.83E+01
4.0018	2.99E+01	2.76E+01	2.89E+01
4.0018	3.09E+01	2.96E+01	3.10E+01
4.0018	3.21E+01	2.47E+01	2.77E+01
4.0018	3.17E+01	2.80E+01	2.98E+01
4.0018	3.30E+01	2.33E+01	2.95E+01
4.0018	3.21E+01	2.91E+01	2.90E+01
4.0018	3.11E+01	2.85E+01	3.24E+01

Table B10. continued*Effective Distance (m)*

Gamma Tissue Dose (Gy)

	Pulse 9	Pulse 11	Pulse 13
4.006607	3.10E+01	2.75E+01	2.81E+01
4.006607	2.83E+01	2.82E+01	2.67E+01
4.006607	2.75E+01	2.85E+01	2.89E+01
4.006607	2.96E+01	2.80E+01	2.99E+01
4.006607	3.08E+01	2.87E+01	2.74E+01
4.006607	3.04E+01	3.01E+01	2.98E+01
4.006607	3.05E+01	2.83E+01	2.86E+01
4.006607	2.80E+01	2.82E+01	2.96E+01
4.006607	2.92E+01	2.80E+01	2.83E+01
4.006607	3.27E+01	3.08E+01	2.72E+01
4.006607	3.19E+01	3.25E+01	2.89E+01
4.006607	2.91E+01	2.74E+01	2.86E+01
4.006607	2.88E+01	2.83E+01	2.83E+01
4.006607	3.41E+01	2.73E+01	2.84E+01
4.006607	3.07E+01	2.62E+01	2.93E+01
8.013794	6.57E+00	6.79E+00	6.68E+00
8.013794	6.74E+00	6.86E+00	6.88E+00
8.013794	6.72E+00	6.78E+00	6.53E+00
8.013794	6.62E+00	6.64E+00	7.78E+00
8.013794	6.81E+00	7.16E+00	6.85E+00
8.013794	6.90E+00	7.01E+00	6.47E+00
8.013794	6.59E+00	6.59E+00	6.52E+00
8.013794	6.35E+00	6.58E+00	6.11E+00
8.013794	6.71E+00	6.63E+00	6.46E+00
8.013794	6.85E+00	6.62E+00	6.57E+00
8.013794	5.96E+00	6.38E+00	6.65E+00
8.013794	6.98E+00	6.24E+00	6.23E+00
8.013794	6.25E+00	6.41E+00	6.73E+00
8.013794	5.31E+00	6.72E+00	6.39E+00
8.013794	6.34E+00	6.45E+00	6.29E+00
8.0009	6.52E+00	6.25E+00	6.82E+00
8.0009	6.92E+00	6.58E+00	6.55E+00
8.0009	6.53E+00	6.46E+00	6.37E+00
8.0009	6.24E+00	6.82E+00	7.33E+00
8.0009	6.08E+00	6.45E+00	6.59E+00
8.0009	6.85E+00	7.17E+00	5.90E+00
8.0009	6.89E+00	6.64E+00	7.12E+00
8.0009	6.71E+00	6.73E+00	6.65E+00
8.0009	6.90E+00	6.94E+00	6.39E+00
8.0009	6.48E+00	6.72E+00	6.65E+00
8.0009	6.21E+00	6.46E+00	6.59E+00

Table B10. continued*Effective Distance (m)**8.0009**8.0009**8.0009**8.0009**8.003306**8.003306**8.003306**8.003306**8.003306**8.003306**8.003306**8.003306**8.003306**8.003306**8.003306**8.003306**8.003306**8.003306**8.003306*

Gamma Tissue Dose (Gy)

Pulse 9

Pulse 11

Pulse 13

6.33E+00

6.41E+00

6.49E+00

6.76E+00

6.11E+00

5.97E+00

6.67E+00

7.09E+00

6.60E+00

6.35E+00

6.14E+00

6.59E+00

6.22E+00

7.10E+00

6.74E+00

6.23E+00

6.59E+00

6.58E+00

7.43E+00

6.73E+00

6.58E+00

6.00E+00

6.51E+00

6.36E+00

6.60E+00

6.70E+00

6.47E+00

6.54E+00

6.67E+00

6.56E+00

6.59E+00

6.67E+00

6.40E+00

6.54E+00

6.70E+00

6.40E+00

7.22E+00

6.07E+00

6.46E+00

6.96E+00

6.47E+00

6.28E+00

6.23E+00

6.57E+00

6.37E+00

5.97E+00

6.34E+00

6.31E+00

5.24E+00

6.40E+00

6.12E+00

6.16E+00

6.32E+00

6.34E+00

7.15E+00

6.67E+00

6.33E+00

Table B11. Personal Ion Chamber gamma dose measurements of the Flattop reactor.

Pulse ID	Current (A-s)	PIC Set ID	Distance (m)	Gamma Dose (rad)				Comment
				0-600R PIC	0-200R PIC	0-100R PIC	0-20R PIC	
9	0.0205	LLNL6	2	222	185	OS	OS	Top Right of Plate
		LLNL12	2	195	175	OS	OS	Bottom Right of Plate
		LLNL7	3	150	138	OS	OS	Top Right of Plate
		LLNL11	3	120	130	OS	OS	Bottom Right of Plate
		LLNL8	4	110	100	OS	OS	Top Right of Plate
		LLNL9	8 (Pos 10)	20	25	25	OS	Top Right of Plate
		LLNL10	8 (Pos 11)	TL	10	8	8.6	Top Right of Plate
11	0.02	LLNL1	2	200	200	OS	OS	Top Right of Plate
		LLNL2	3	120	132	OS	OS	Top Right of Plate
		LLNL3	4	100	105	OS	OS	Top Right of Plate
		LLNL4	8 (Pos 10)	20	23	25	20	Top Right of Plate
		LLNL5	8 (Pos 11)	TL	8	9	8	Top Right of Plate
13	0.029	SNL1	2	255	OS	OS	OS	Lower Right Top Plate
		SNL2	3	170	170	OS	OS	Lower Right Top Plate
		SNL3	4	125	140	OS	OS	Lower Right Top Plate
		SNL4	8 (Pos 10)	25	32	35	OS	Lower Right Top Plate
		SNL5	8 (Pos 11)	10	16	15	13	Lower Right Top Plate

OS = Off Scale

TL = Too Low of dose to read with this range.