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ABSTRACT

The total gamma and beta energy release rates following a fission burst are reported using ENDF/B-IV data in summation calculations. Results are given for fission at neutron spectrum energies of ^{235}U and ^{239}Pu between 10^{-1} and 7×10^5 s following bursts. Fallout decay power, obtained by subtractions of the gas contribution, is reported for the same interval.

I. INTRODUCTION

Estimates of fallout gamma decay power following a fission burst have generally included the gaseous contribution. This preliminary report contains new calculational results for a fission burst of ^{235}U and ^{239}Pu including a separation of the gaseous contribution. The beta decay power is included for completeness. Gases are assumed to be the unstable isotopes of Br, Kr, I, and Xe.

In addition to separating the gaseous decay power, these new calculations use the recent extensive ENDF/B-IV decay and yield data in improved codes. For this report a combination of the CINDER[1] and RIBD[2] codes was used in order to utilize the latest data compilation. Results should be valid at shorter times following fission than in previous calculations.

In contrast to an earlier Los Alamos Scientific Laboratory (LASL) study[3] that used 200 nuclides having half-lives $\geqslant$ 10 s and coupled at most to 1 precursor, the aggregate results reported here are based on 824 nuclides, some being coupled to 10 or more precursors and having half-lives varying from a few milliseconds to infinity. For this report, it was assumed that transmutation by neutron capture could be ignored, which is consistent with earlier LASL work. Therefore, the simple comparison of the number of nuclides should be made with the 712 nuclides in ENDF/B-IV.

Differences in the size of libraries can be misleading. Many nuclides in the new files are sufficiently short lived that they do not contribute to the decay power for fallout times exceeding a minute or so, and many nuclides have a low yield per fission. The new files are intended to be useful for a variety of applications; for burst studies of aggregate decay powers their main advantages would appear to be in extending the range of validity of calculations down to fallout times on the order of a second and in impoved fission product yields. The shorter times are of interest for other weapons and fission reactor applications. Data in ENDF/B-IV also offer the potential for gamma spectra calculations.

One aspect of the decay power associated with burst studies, as opposed to the buildup of decay power in long-term fission, is the effect of many nuclides which are shielded by an intermediate stable or long-lived nuclide. The decay power of these shielded nuclides results only from their direct fission yield, which is generally very low.

In long-term fission, the gases contribute about 30% of the total density of fission products. In a fission burst, the content (but not necessarily the decay power) of the *radioactive* products is lower, in part, because of the shielded gases and, in part, because only radioactive gases have been included in this report.

The calculations for the gaseous decay power included ~80 different nuclides plus their precursors. These were coupled in 61 linear chains having an average length of 4 nuclides. As already noted, the total decay power results from 712 nuclides.

Fallout decay power is assumed to be the total of all products minus the gaseous contributions. This is approximate for the following reasons noted by Bell:[4]

1. Some products have gaseous precursors and will therefore have a spatial fallout pattern different from the remaining non-volatile products.
2. Some fraction of the gaseous products having non-volatile precursors could be entrapped in the fallout of solids.

No study of these effects has been made, but further studies are likely warranted because of the findings noted in this report.

II. PREVIOUS LASL STUDIES OF DECAY POWER

As noted in the introduction, LASL report LA-3954[3] reports detailed calculations of decay power in terms of million electron volts per fission per second (MeV/fis/s) for ^{239}Pu fast fission and ^{235}U thermal fission. Table I lists the earlier results for the total β and γ decay power; this table includes values for intermediate fallout times supplied by Bell. Although times down to 10 s are tabulated, the earlier studies did not include nuclides having half-lives shorter than 10 s and, for times under ~100 s, values in Table I would therefore be expected to be low.

For times between approximately 1 and 100 h, Eq. (1) has been used to compute the gamma power $[H_\gamma(t)]$ in units of MeV/fis/s, and Eq. (1') was later recommended by Bell based on a fit to values in Ref. 3, as follows:

$$H_\gamma(t) \approx 0.951\ t^{-1.2} \quad \text{MeV/fis/s} \qquad (1)$$

$$H_\gamma(t) \approx 4.56\ t^{-1.31} \quad \text{MeV/fis/s} \qquad (1')$$

where t is in seconds and 3.6×10^3 s $\leq t \leq 3.6 \times 10^5$ s. Equation (1') is a much better fit to the values in Table I and differs from Eq. (1) by nearly a factor of 2 at 1 h. Equation (1') fits the ^{239}Pu values in Table I within 10% in the 1- to 100-h range. Equations (1) and (1') can be converted to units of MeV per kiloton by multiplying by 1.5×10^{23} fissions per kiloton.

Values in Table I and these equations for the gamma radiation apply to the total MeV/fis/s including gases.

For comparison, the familiar Way-Wigner[5] approximation is given in Eq. (2)

$$H_\gamma(t) \approx 1.4\ t^{-1.2} \qquad (2)$$

where 1 s $\leq t \leq 10^5$ s.

The Way-Wigner equation actually applies to thermal fission of ^{235}U, but the difference between thermal and fast fission should be minor compared to the overall accuracy they expected (a factor of 2).

III. CALCULATED DECAY POWERS USING ENDF/B-IV DATA

For a ^{235}U and ^{239}Pu fast fission burst (neutron energies between 1 and 2 MeV) the beta and gamma decay powers have been calculated at 27 time intervals between 0.1 and 7×10^5 s (0.1 s to 8.1 days). This time period should exceed most intervals of interest. For the same time range, the decay powers from Br, Kr, I, and Xe classed as gasses have been calculated. All results use the new ENDF/B-IV library.

Results below about 1 s of cooling are likely to be low because of an increasing lack of knowledge of short-lived isomeric states which contribute shortly after fission. (However, the new calculations already show activities which exceed those in Ref. 3 by several hundred percent at 10 s.)

The following tables and figures are included in this report, Tables II and IV being of most interest.

Table I – Beta and gamma decay powers based on Ref. 3.

Table II – List the aggregate beta and gamma decay powers from all products, including gases from 0.1 to 10^7 s. These values can be compared to values in Table I, supplied by Bell,[4] which are based on the code and data described in Ref. 3. (See Table VI for a comparison.)

Table III – The decay powers from the ~80 isotopes of Br, Kr, I, and Xe are listed.

Table IV - The beta and gamma decay powers from the non-gaseous products are listed. This is assumed to be the best definition of fallout power in the absence of a more detailed analysis that would consider the effects already noted by Bell.

Table V - For the reader's convenience, the percentages of the total gamma power vs time due to gases are listed. The percentages of the total number of fission products (i.e., where total includes any stable nuclides) which are radioactive gases are also listed.

Table VI - For corresponding times, the percent deviations of the new calculations (Table II) over those based on Ref. 3 (Table I) are listed.

Table VII - Exponential fitting parameters for the total beta and gamma decay power.

Table VIII - Exponential fitting parameters for the non-gaseous decay power.

Figure 1 - The total ^{235}U and ^{239}Pu gamma power (Table II) are plotted.

Figure 2 - The power due to the non-gaseous products are plotted.

IV. EXPONENTIAL FITTING PARAMETERS

From Figs. 1 and 2, it is evident that the new results will not fit the form

$$H_\gamma(t) \simeq c_1 t^{-c_2} \tag{3}$$

over a large time, as has been used in the past. For comparison with Eqs. (1') and (2), the following least squares fits were made:

$$H_\gamma(t) \simeq 10.20\ t^{-1.375} \tag{4}$$

for $3 \times 10^3\ s \leq t \leq 2\quad 10^5$ s,

and

$$H_\gamma(t) \simeq 0.962\ t^{-1.143} \tag{5}$$

for $10 \leq t \leq 7 \times 10^3$ s.

In the region where the time domains of Eqs. (4) and (5) are common, these fits differ by 40 to 60%.

A piecewise least squares fitting to the form of Eq. (3) was obtained over five time domains, but a better overall fit was obtained using a sum of eight exponentials:

$$H(t) \simeq \sum_{i=1}^{8} A_i e^{-\lambda_i t} \tag{6}$$

where H(t) represents $H_\gamma(t)$ or $H_\beta(t)$.

The parameters A_i and λ_i are tabulated in Table VII for the total beta and gamma powers and in Table VIII for the non-gaseous powers. In all cases, the fit is better than 10% and is within ~1% at most cooling times.

V. DISCUSSION

Between 100 and 10^7 s, the new total gamma power rates for ^{239}Pu deviate from those based on Ref. 3 from a high of ~52% to a low of ~ -6%. Below 100 s, the deviation increased to ~555% at 10 s (the smallest time for which Ref. 3 results were supplied). Values for ^{235}U are similar (see Table VI).

Comparisons of the total γ powers for ^{235}U with the Way-Wigner expression [Eq. (2)] over its range of validity (1 - 10^5 s) show the following: the new calculations indicate a larger total energy release; the new values are 80% lower at 1 s and, by 50 s, the new values are ~3.5% higher; there is a monotonic increase over the Way-Wigner expression peaking at ~ + 97.5% at 5×10^3 s; thereafter the difference decreases monotonically to < 0.1% at 5×10^4 s and -3.6% at 10^5 s. Way and Wigner originally estimated their statistical approach was accurate within a factor of two, and this is essentially the range of difference we find using ENDF/B-IV data.

Values for the gas contribution were surprisingly large for fallout times between ~1 and 194 h (see Table V). Thirty to fifty percent of the power in this time interval is due to the gases. This result was examined in detail, assuming ENDF/B-IV nuclide data to be correct. At times on the order of one day, essentially all of the gas power is due to ^{131}I, ^{132}I, ^{133}I, ^{133}Xe, and ^{133m}Xe, with ^{132}I being dominant. Independent calculations for these were subsequently made using two codes and a desk calculation. The dominant ^{132}I, which has a half-life of ~2.3 h, has a large gamma release per fission but a small direct yield. However, it is in transient equilibrium with ^{132}Te which has a large cumulative yield and a half-life of ~78 h. This accounts for the qualitative behavior. The other nuclides have moderately long half-lives and are in isobaric chains which have large cumulative yields.

The large values we find below 100 s compared to those in Ref. 1 (Table VI) are not surprising. All nuclides having a fission yield and half-lives down to the millisecond range are included in the new calculations.

The differences of ^{239}Pu and ^{235}U powers are also of interest. The log-log plots of Figs. 1 and 2 are deceptive. At 1, 10, 100, 1 000, 10 000, and 100 000 s, the total ^{235}U gamma decay powers exceed the ^{239}Pu values by 50, 33, 22, 9, 18, and 1.4%, respectively. For the non-gaseous products, the corresponding values are 42, 21, 11, 6, 14, and 11%.

In summary, the new calculations for the total decay powers deviate from previous predictions by factors of two or more, depending on the time after fission, and the gaseous component constitutes up to 50% of the total at ~50 h after fission.

ACKONWLEDGMENTS

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3. M. E. Battat, D. J. Dudziak, and H. R. Hicks, "Fission Product Energy Release and Inventory from ^{239}Pu Fast Fission," Los Alamos Scientific Laboratory report LA-3954 (October 1968).

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TABLE.1

TOTAL DECAY POWER (MEV/FISS-S) FOLLOWING A FISSION BURST OF PU239 FAST AND U235 THERMAL FISSION BASED ON REF 3 (LA-3954 1968)[a]

TIME SEC	PU239 (FAST FISSION) BETA	PU239 (FAST FISSION) GAMMA	U235 (THERMAL FISSION) BETA	U235 (THERMAL FISSION) GAMMA
10	1.35-2	6.09-3	2.15-2	7.36-3
15	1.13-2	5.68-3	1.68-2	6.91-3
20	9.96-3	5.50-3	1.41-2	6.87-3
30	8.34-3	5.21-3	1.11-2	6.83-3
50	6.54-3	4.65-3	8.24-3	6.40-3
70	5.44-3	4.14-3	6.65-3	5.81-3
100	4.32-3	3.49-3	5.13-3	4.93-3
150	3.13-3	2.69-3	3.59-3	3.76-3
200	2.39-3	2.14-3	2.66-3	2.94-3
300	1.56-3	1.46-3	1.67-3	1.94-3
500	8.78-4	8.59-4	9.04-4	1.06-3
700	6.11-4	6.06-4	6.16-4	6.92-4
1000	4.22-4	4.25-4	4.20-4	4.47-4
1500	2.77-4	2.88-4	2.75-4	2.86-4
2000	2.01-4	2.16-4	2.01-4	2.12-4
3000	1.22-4	1.38-4	1.25-4	1.37-4
5000	5.96-5	7.36-5	6.46-5	7.62-5
7000	3.67-5	4.67-5	4.19-5	5.06-5
10000	2.21-5	2.77-5	2.68-5	3.16-5
15000	1.28-5	1.46-5	1.63-5	1.74-5
20000	8.78-6	9.31-6	1.15-5	1.11-5
30000	5.30-6	5.38-6	6.93-6	6.24-6
50000	2.81-6	2.99-6	3.51-6	3.31-6
70000	1.77-6	2.02-6	2.11-6	2.19-6
100000	1.06-6	1.30-6	1.19-6	1.39-6
150000	5.78-7	7.75-7	6.19-7	8.17-7
200000	3.73-7	5.42-7	3.86-7	5.64-7
300000	2.04-7	3.39-7	2.06-7	3.51-7
500000	1.04-7	2.00-7	1.09-7	2.14-7
700000	7.09-8	1.43-7	7.74-8	1.58-7

[a]VALUES SUPPLIED BY GEORGE BELL AND BASED ON NUCLIDE DATA AND CODE DESCRIBED IN REF (1). ONLY VALUES UP TO 7.0E+5 SEC ARE TABULATED HERE. THE TABULATION BY BELL EXTENDED TO 2.0E+9 SEC.

TABLE II

TOTAL DECAY POWER (MEV/FISS-S) FOLLOWING A
U235 AND PU239 FISSION BURST
(ENDF/B-IV DATA)[a]

(FAST FISSION, 1- 2 MEV)

TIME SEC	PU239 BETA	PU239 GAMMA	U235 BETA	U235 GAMMA
0	5.088-1	3.883-1	9.495-1	7.235-1
0.1	4.526-1	3.453-1	8.245-1	6.245-1
0.2	4.085-1	3.109-1	7.265-1	5.470-1
0.5	3.180-1	2.411-1	5.345-1	3.978-1
1	2.388-1	1.805-1	3.793-1	2.793-1
2	1.671-1	1.260-1	2.519-1	1.841-1
5	9.145-2	6.900-2	1.301-1	9.480-2
10	5.315-2	4.136-2	7.255-2	5.500-2
20	2.864-2	2.408-2	3.657-2	3.107-2
30	1.913-2	1.686-2	2.315-2	2.132-2
50	1.175-2	1.068-2	1.339-2	1.325-2
80	7.375-3	6.715-3	8.030-3	8.235-3
100	5.820-3	5.290-3	6.245-3	6.450-3
200	2.607-3	2.273-3	2.752-3	2.809-3
300	1.603-3	1.384-3	1.692-3	1.699-3
500	9.070-4	8.050-4	9.400-4	9.500-4
800	5.585-4	5.430-4	5.655-4	6.035-4
1000	4.429-4	4.560-4	4.473-4	4.971-4
2000	2.006-4	2.536-4	2.082-4	2.738-4
3000	1.157-4	1.674-4	1.243-4	1.827-4
5000	5.430-5	8.900-5	6.165-5	1.007-4
8000	2.701-5	4.556-5	3.292-5	5.370-5
10000	1.977-5	3.260-5	2.485-5	3.861-5
20000	8.225-6	1.003-5	1.095-5	1.229-5
50000	2.811-6	2.991-6	3.567-6	3.245-6
100000	1.068-6	1.330-6	1.207-6	1.349-6
200000	3.797-7	5.790-7	3.874-7	5.565-7
700000	7.625-8	1.580-7	7.860-8	1.507-7

[a] ENDF/B-IV DATA MAY NOT BE ADEQUATE FOR CALCULATIONS BELOW A ONE-SECOND COOLING TIME.

TABLE III

DECAY POWER (MEV/FISS-S) FROM FISSION PRODUCT GASES FOLLOWING A U235 AND PU239 FISSION BURST[a] (ENDF/B-IV DATA)

TIME SEC	PU239 BETA	PU239 GAMMA	U235 BETA	U235 GAMMA
0	2.742-2	3.246-2	8.878-2	7.786-2
0.1	2.617-2	3.025-2	8.191-2	7.129-2
0.2	2.508-2	2.839-2	7.633-2	6.597-2
0.5	2.248-2	2.426-2	6.456-2	5.485-2
1	1.943-2	2.006-2	5.311-2	4.433-2
2	1.546-2	1.540-2	4.038-2	3.323-2
5	9.742-3	9.316-3	2.374-2	1.947-2
10	6.460-3	6.036-3	1.462-2	1.225-2
20	4.140-3	3.831-3	8.430-3	7.416-3
30	3.126-3	2.865-3	5.917-3	5.401-3
50	2.089-3	1.862-3	3.588-3	3.410-3
80	1.348-3	1.150-3	2.147-3	2.057-3
100	1.062-3	8.818-4	1.647-3	1.565-3
200	4.470-4	3.340-4	6.582-4	5.866-4
300	2.572-4	1.815-4	3.692-4	3.168-4
500	1.244-4	9.298-5	1.724-4	1.521-4
800	5.783-5	5.927-5	7.797-5	8.478-5
1000	3.893-5	5.028-5	5.219-5	6.750-5
2000	1.430-5	3.427-5	1.968-5	4.228-5
3000	1.026-5	2.833-5	1.417-5	3.489-5
5000	7.162-6	2.190-5	9.765-6	2.723-5
8000	4.861-6	1.552-5	6.509-6	1.958-5
10000	3.817-6	1.224-5	5.049-6	1.553-5
20000	1.430-6	4.257-6	1.696-6	5.284-6
50000	6.203-7	1.426-6	5.903-7	1.429-6
100000	3.192-7	6.508-7	2.948-7	6.004-7
200000	1.165-7	2.847-7	1.075-7	2.589-7
700000	2.085-8	6.536-8	1.863-8	5.808-8

[a] THE GASES INCLUDE ALL UNSTABLE NUCLIDES OF BR, KR, I AND XE. ALSO SEE FOOTNOTE TABLE II.

TABLE IV

TOTAL DECAY POWER (MEV/FISS-S) FROM NON-GASEOUS FISSION PRODUCTS (ENDF/B-IV DATA)[a]

TIME SEC	PU239 BETA	PU239 GAMMA	U235 BETA	U235 GAMMA
0	4.914-1	3.558-1	8.607-1	6.456-1
0.1	4.264-1	3.151-1	7.426-1	5.532-1
0.2	3.834-1	2.825-1	6.502-1	4.810-1
0.5	2.955-1	2.163-1	4.694-1	3.430-1
1	2.194-1	1.604-1	3.147-1	2.350-1
2	1.516-1	1.106-1	2.115-1	1.509-1
5	8.171-2	5.360-2	1.064-1	7.533-2
10	4.669-2	3.532-2	5.793-2	4.275-2
20	2.450-2	2.025-2	2.814-2	2.365-2
30	1.60[illegible]-2	1.400-2	1.723-2	1.592-2
50	9.661-3	8.818-3	9.797-3	9.480-3
60	6.027-3	5.565-3	5.883-3	6.178-3
100	4.758-3	4.408-3	4.598-3	4.885-3
200	2.160-3	1.939-3	2.094-3	2.222-3
300	1.346-3	1.203-3	1.323-3	1.382-3
500	7.926-4	7.120-4	7.676-4	7.979-4
800	5.007-4	4.837-4	4.875-4	5.187-4
1000	4.049-4	4.057-4	3.951-4	4.296-4
2000	1.863-4	2.193-4	1.885-4	2.315-4
3000	1.054-4	1.391-4	1.101-4	1.478-4
5000	4.714-5	6.710-5	5.198-5	7.347-5
8000	2.215-5	3.004-5	2.641-5	3.412-5
10000	1.595-5	2.036-5	1.980-5	2.328-5
20000	6.795-6	5.773-6	9.254-6	7.006-6
50000	2.191-6	1.565-6	2.977-6	1.816-6
100000	7.486-7	6.792-7	9.122-7	7.486-7
200000	2.632-7	2.943-7	2.799-7	2.976-7
700000	5.540-8	9.264-8	5.997-8	9.262-8

[a] SEE FOOTNOTE TABLE II.

TABLE V

PERCENT OF TOTAL GAMMA POWER (MEV/FISS-S) AND FISSION PRODUCT CONTENT WHICH ARE RADIOACTIVE GASES[a] (ENDF/B-IV DATA)

	PU239 PERCENT		U235 PERCENT	
TIME SEC	DENSITY	MEV/FISS	DENSITY	MEV/FISS
0	17.5	8.4	23.2	10.8
0.1	17.5	8.8	23.2	11.4
0.2	17.4	9.1	23.1	12.1
0.5	17.3	10.1	22.9	13.8
1	17.2	11.1	22.7	15.9
2	17.0	11.9	22.4	18.0
5	16.6	13.5	21.8	20.5
10	16.2	14.6	21.2	22.3
20	16.3	16.2	20.7	24.3
30	15.9	17.0	20.0	25.3
50	15.2	17.4	18.9	25.7
80	14.3	17.1	17.6	25.0
100	13.8	16.7	16.9	24.3
200	12.4	14.7	14.8	20.9
300	11.7	13.1	13.8	18.7
500	11.2	11.6	12.9	16.0
800	10.9	10.9	12.4	14.0
1000	10.9	11.0	12.3	13.6
2000	11.2	13.5	12.3	15.4
3000	11.4	17.2	12.3	19.1
5000	11.4	24.6	12.1	27.0
8000	11.1	34.1	11.3	36.5
10000	10.8	37.5	10.8	40.2
20000	9.8	42.4	9.2	43.0
50000	8.6	47.7	7.6	44.0
100000	7.2	48.9	6.3	44.5
200000	6.0	49.2	5.1	46.5
700000	3.8	41.4	3.1	38.6

[a]THE PERCENT CONTENT IS A PERCENT OF ALL FISSION PRODUCTS, INCLUDING STABLE NUCLIDES, WHICH ARE RADIOACTIVE GASES. SEE FOOTNOTE TABLE II.

TABLE VI

PERCENT DEVIATION FROM VALUES IN LA-3954 (REF 3)[a]
OF TOTAL DECAY POWER (MEV/FISS-S) USING
ENDF/B-IV DATA

TIME SEC	PU239 BETA	PU239 GAMMA	U235 BETA	U235 GAMMA
10	293.7	579.1	237.4	647.3
20	187.5	337.8	159.4	352.2
30	129.4	223.6	108.6	212.2
50	79.7	129.7	62.5	107.0
100	34.7	51.6	21.7	30.8
200	9.1	6.2	3.5	-4.5
300	2.8	-5.2	1.3	-12.5
500	3.3	-6.3	4.0	-10.5
1000	5.0	7.3	6.5	11.2
2000	-.2	17.4	3.5	29.2
3000	-5.2	21.3	-0.6	36.3
5000	-8.8	20.9	-4.6	32.2
10000	-10.5	17.7	-7.3	22.2
20000	-6.3	7.7	-4.8	10.7
50000	-.04	-.03	1.6	-2.0
100000	-.8	2.3	1.4	-2.9
200000	1.8	6.8	0.4	-1.3
700000	7.5	10.5	1.5	-4.6

[a] LA-3954 VALUES ARE BASED ON FAST FISSION FOR PU239 AND THERMAL FISSION FOR U235. THE NEW CALCULATIONS USE ONLY FAST FISSION YIELDS.

TABLE VII

LEAST SQUARES FITTING PARAMETERS FOR EQ. (6)
(TOTAL POWER)

	BETA A	BETA λ	GAMMA A	GAMMA λ
^{239}Pu				
	3.1842-1	1.0690+0	2.3499-1	1.1929+0
	1.2341-1	1.3627-1	9.7231-2	1.7186-1
	2.4256-2	2.2425-2	2.5057-2	2.7456-2
	3.9742-3	4.7439-3	5.4257-3	6.7125-3
	7.0065-5	1.6937-4	1.5347-4	1.7692-4
	7.2616-4	7.9503-4	6.6933-4	7.5890-4
	8.7176-6	2.6653-5	7.5661-6	2.4335-5
	6.1330-7	2.9785-6	8.4034-7	2.3876-6
^{235}U				
	6.2765-1	1.2662+0	4.6870-1	1.4448+0
	2.0001-1	1.5446-1	1.5869-1	1.9771-1
	3.5648-2	2.7996-2	3.5579-2	2.9901-2
	5.4312-3	5.5177-3	6.8571-3	6.4170-3
	7.8117-4	8.3998-4	7.2906-4	7.7724-4
	8.1787-5	1.6757-4	1.6862-4	1.6696-4
	1.2777-5	2.8583-5	8.8824-6	2.5292-5
	6.2601-7	2.9645-6	8.0905-7	2.4009-6

TABLE VIII

LEAST SQUARES FITTING PARAMETERS FOR EQ. (6)
(NON-GASEOUS POWER)

	BETA A	BETA λ	GAMMA A	GAMMA λ
^{239}Pu				
	3.0626-1	1.0921+0	2.4491-1	9.1773-1
	1.1349-1	1.3729-1	5.8438-2	1.0447-1
	2.0485-2	2.3256-2	1.4866-2	1.8620-2
	3.3359-3	4.9263-3	2.4263-3	4.6348-3
	6.7642-4	7.6407-4	5.5191-4	6.3025-4
	5.2878-5	1.6796-4	8.9469-5	1.7153-4
	7.9363-6	2.9368-5	4.0044-6	2.4245-5
	4.3460-7	2.9428-6	3.9923-7	2.0869-6
^{235}U				
	5.8482-1	1.4187+0	4.3829-1	1.3861+0
	1.7907-1	1.6595-1	1.2068-1	1.7917-1
	2.8945-2	3.1047-2	2.4996-2	2.9660-2
	4.4382-3	5.9879-3	5.0137-3	6.1109-3
	7.0652-4	8.0322-4	6.3809-4	6.8195-4
	6.0488-5	1.7128-4	1.0308-4	1.6867-4
	1.2184-5	3.0707-5	4.9098-6	2.4445-5
	4.5313-7	2.8894-6	3.9461-7	2.0706-6

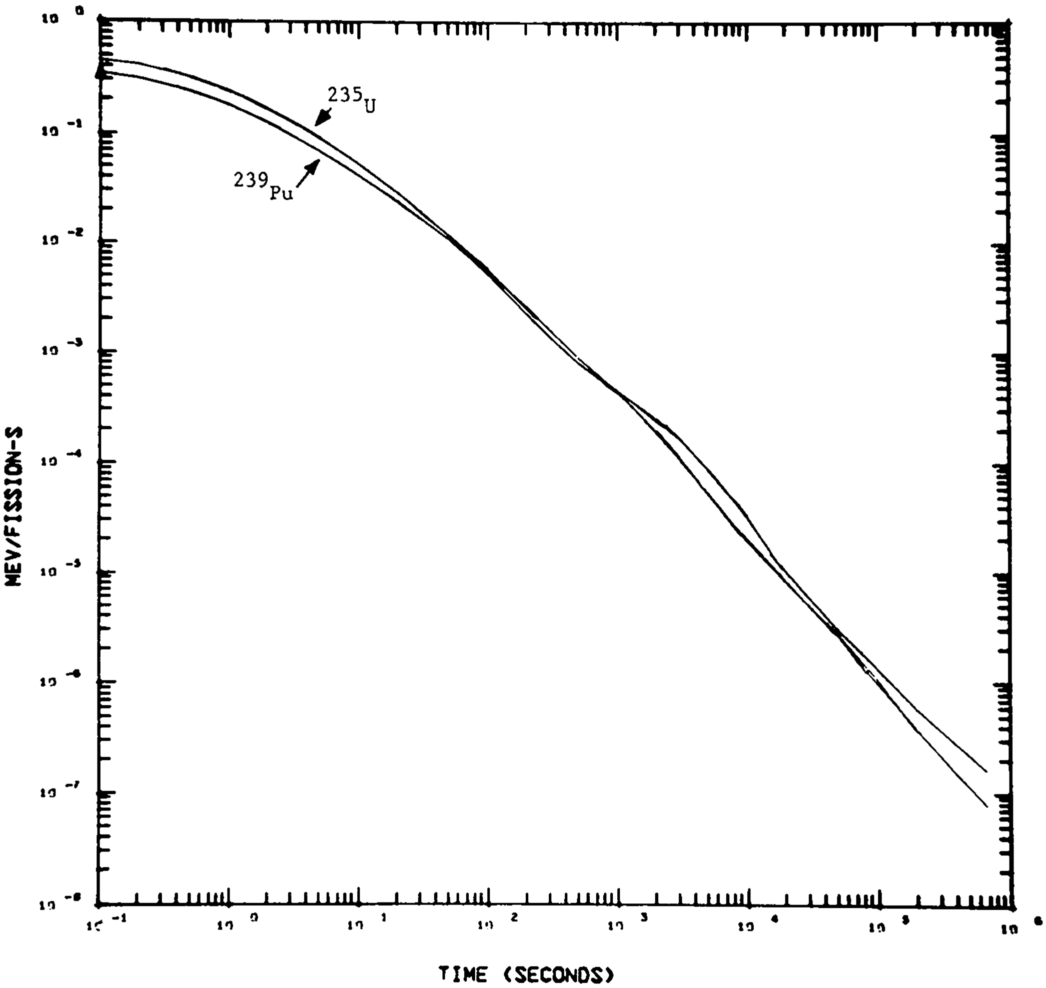

Fig. 1. Total gamma power (MeV/fis/s) for a ^{235}U and ^{239}Pu fission burst.

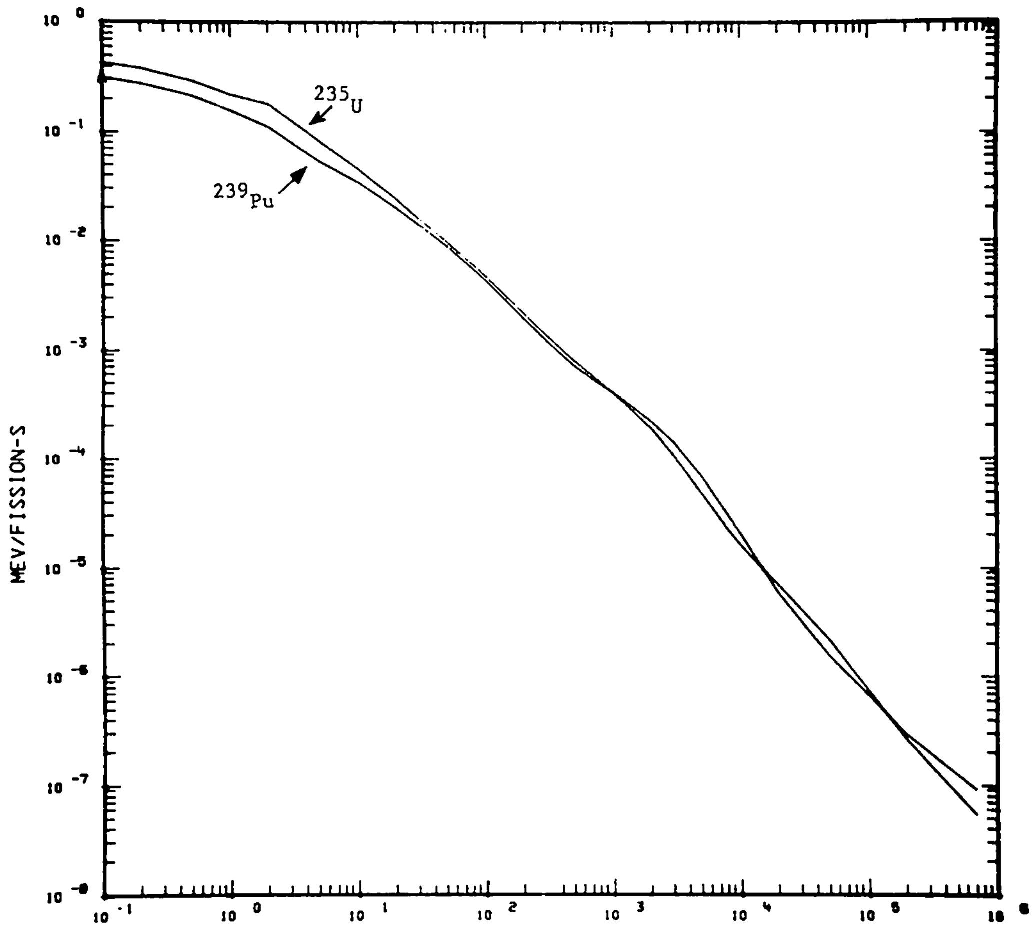

Fig. 2. ^{235}U and ^{239}Pu gamma power (MeV/fis-s) from non-gaseous fission products in fission burst.

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