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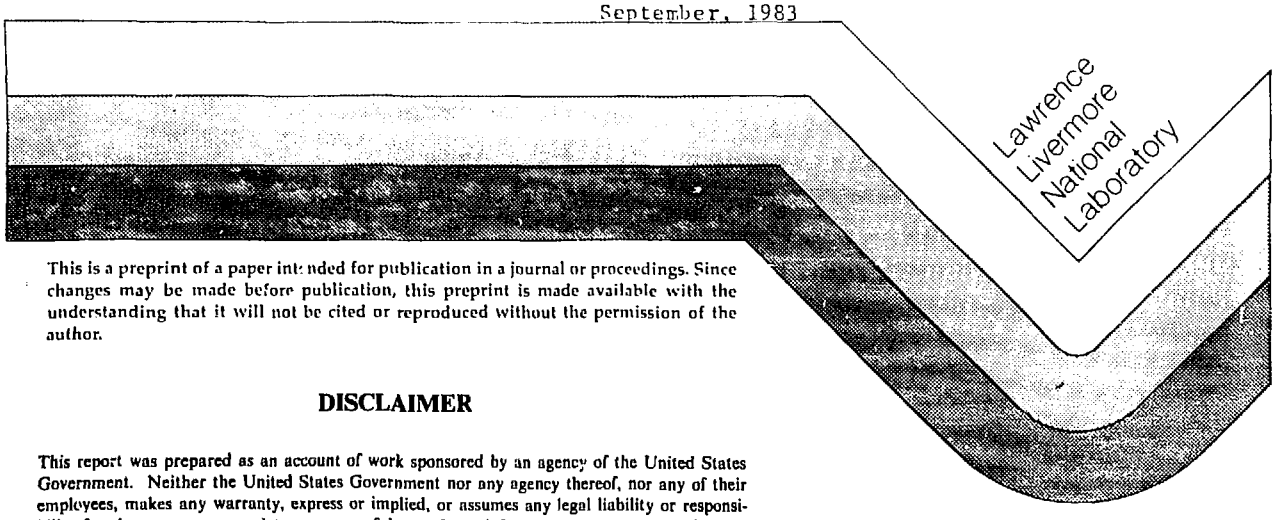

Neutron and Gamma-Ray Measurements on the LANL Little Boy Comet Assembly*

Dale E. Hankins

We measured the neutron and gamma-ray dose rates at various distances from the Little Boy Comet Assembly at Los Alamos National Laboratory (LANL), Los Alamos, New Mexico on April 28 and 29, 1983. The distances selected varied from 350 ft to 1860 ft from the assembly, with the latter point being located at the edge of the mesa overlooking Pajarito Canyon. We varied the power levels for the various runs but we have normalized all of them to a single power-level. We also made corrections for the variations in the power-level indicators of the assembly using data provided by LANL.[1]

We made the gamma-ray dose rate measurements with a RSS-111 Environmental Radiation monitor manufactured by Reuter-Stokes.[2] The spherical detector has a diameter of 25.4 cm and has an eight-liter sensitive volume. The wall of the detector is made of 304 stainless steel 3 mm thick and is filled with ultra-pure argon at a pressure of 2.5 MPa. The unit was operated on batteries for all our measurements.

The energy dependence of the instrument is shown in Fig. 1. No correction for the energy dependence was made to our results. To obtain the correct dose rate, the gamma-ray spectrum would have to be folded into the energy dependence curve. We do not have the gamma spectrum and therefore have not made the correction. The variation in the gamma spectra at our measurement distances are not expected to be large, and, therefore, the relative gamma dose rates are felt to be reasonably accurate. Our instrument was calibrated with ^{137}Cs and the data were taken from the chart recorder printout.

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The neutron instrument we used was the pulsed neutron remmeter developed by Thorngate, et al.[3] The instrument was designed for use with pulsed sources, but was selected for this study because it has a high sensitivity. The detector is a lithium glass scintillator 3.2 mm thick, 25.4 mm in diameter, and contains 6.6% lithium enriched to 94% ^{6}Li. The crystal is surrounded by a 28.3 cm diameter sphere. The energy dependence of the remmeter is similar to that of other remmeters (9" sphere, Andersson-Braun, Sudsvik).[4] These remmeters over-respond to intermediate energy neutrons so the results presented here are higher than the actual dose rates. We have not attempted to correct for the over-response since we do not know precisely how much the instrument over-responds. Since the spectral changes at the distances we used are small, the relative dose-rate readings should be fairly accurate.

Our results are given in Table 1. In some cases, more than one measurement at different power levels was made. These data have been plotted in Fig. 2. The shape and slope of the curves for the gamma rays and the neutrons are different, but both show a drop that is much more rapid than the inverse-square relationship predicts. The decrease in the neutron dose rate from the SHEBA Critical Assembly was found to follow the inverse square out to 225 ft, which was the largest distance measured.[5] For the Little Boy Comet Assembly, there is a departure from the inverse square, occurring between 350 and 650 ft. Beyond 650 ft, the results follow a straight line (see Fig. 2), but have a much greater slope.

The measurements at 1840 and 1860 ft were made in the evening with the temperature at ~58°F, relative humidity 12 to 15°, and barometric pressure, 23.04 inches. The other measurements were made on the following days, but we did not record the weather conditions. All measurements were at a height of one meter above the ground.

Table 1. Dose Rates from the Little Boy Critical Assembly.

Location	Distance (ft)	Distance (m)	Indicated Reactor Power	Measured Dose Rate Neutron (mrem/h)	Measured Dose Rate Gamma (μR/h)	Normalized* Dose Rates Neutron (mrem/h)	Normalized* Dose Rates Gamma (mR/h)
along road	350	107	0.257×10^{-8}	0.315	25	10.8	0.55
			0.9×10^{-8}	0.970	48	9.8	0.39
along road	650	198	0.9×10^{-7}	2.17	100	2.4	0.10
at gate	960	293	0.9×10^{-7}	0.457	36	0.49	0.029
corner near control room	1190	363	0.25×10^{-6}	0.542	45	0.22	0.014
near guard station	1340	408	0.25×10^{-6}	0.354	32	0.14	0.009
road junction	1840	560	0.5×10^{-5}	1.35	120	0.026	0.0022
			0.9×10^{-5}	2.63	peg	0.029	----
			0.9×10^{-6}	0.291	32	0.031	0.0025
top of mesa	1860	567	0.25×10^{-6}	0.076	20	0.025	0.0027
back-ground				0.012	9.5 (11.0 on mesa)		

*Normalized to 0.1×10^{-6} AMP and corrected for variations in the linear current indication for each range.

References

1. R. E. Malenfant and H. M. Forehand, Jr., "Power Calibration of the Little Boy Comet Assembly for the Period 4/83 - 7/83," Los Alamos National Laboratory, Los Alamos, NM, Memo Q2-83-3871A/83.

2. RSS-111 Area Monitor System, Operational Manual, Reuter-Stokes, Cleveland, Ohio.

3. J. E. Thorngate, G. F. Hunt and D. W. Rueppel, Rem Meter for Pulsed Sources of Neutrons, Lawrence Livermore National Laboratory, Livermore, CA UCID-18792 (1980).

4. D. E. Hankins, "Energy-Dependence Measurements of Remmeters and Albedo Neutron Dosimeters at Neutron Energies of Thermal and Between 2 keV and 5.67 MeV," in: Proceedings of the International Radiation Protection Association, 4th International Congress, Paris, France, pp. 553-556 (1977).

5. D. E. Hankins, R. V. Griffith, J. H. Thorngate and D. W. Rueppel, "Neutron and Gamma-Ray Measurements at the LANL SHEBA Critical Assembly," in: Hazards Control Department Annual Technology Review 1982, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-50007-82 (1983).

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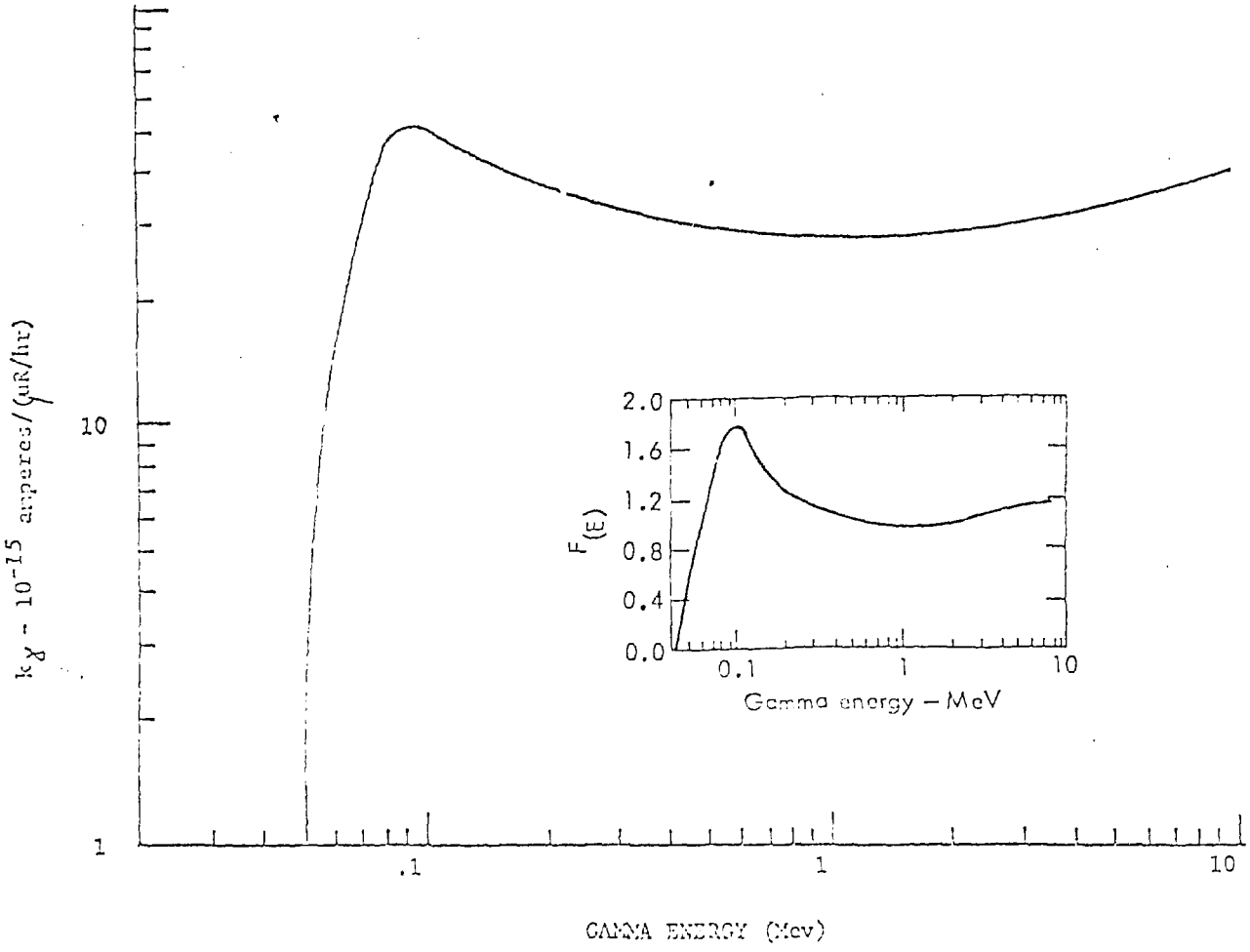

Figure 1. Spectral sensitivity for the RSS-111 environmental radiation monitor.

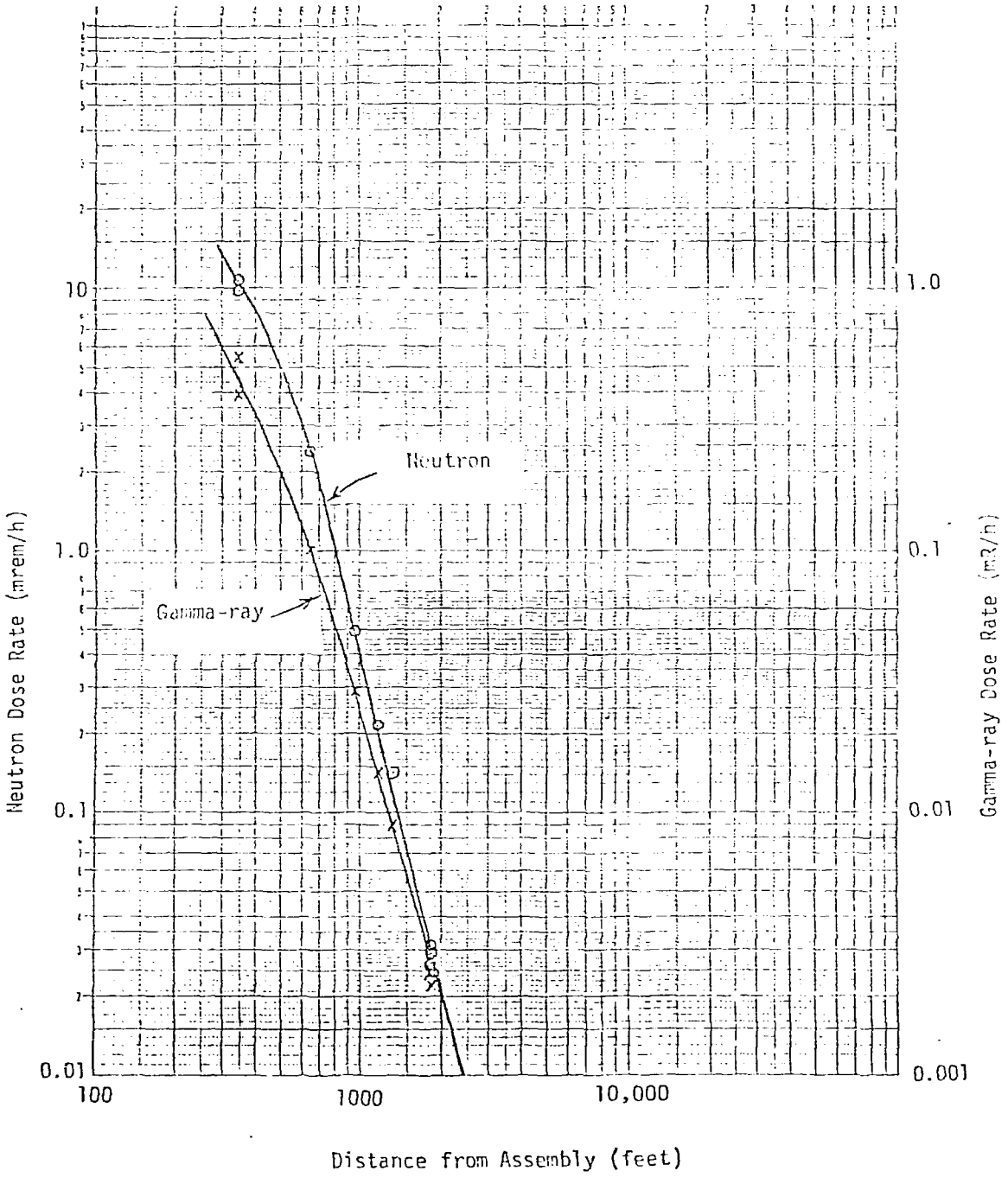

Figure 2. Neutron and gamma ray dose rates as a function of distance from the Little Boy Comet Assembly. All readings have been normalized to linear current range of 0.1×10^{-6}.