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OK GRN DOT PL 10/31/

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INTEROFFICE MEMORANDUM

TO Bethe, Bradbury, Goransen, Mack, Magee, Manley
Peierls, Reines

FROM K. Fuchs

SUBJECT IBM RUN FOR BLAST WAVE IN AIR

CLASSIFICATION CANCELLED
PER DOC REVIEW JAN. 1973

The attached curve shows the peak pressure as function of distance, as obtained from the IBM-run. The overpressure is given in atmospheres, distance in meters and time in seconds. Zero time was taken as the time when the IBM-run started; this was 12 milli-sec after the start of the explosion.

Up to a radius R=80 meter an approximate analytical treatment was used, from which the initial conditions for the IBM-run were deduced. The run was intended to apply to an energy release of 10,000 tons of TNT and the shock pressure versus distance curve shown for R 80 applies for 10,000 tons. In this region effects of the finite weight of the gadget are important. The magnitude of this effect is shown by the two dotted curves, representing upper and lower limits for this effect as calculated for the Trinity gadget (scaled down to 10,000 tons).

At the start of the IBM-run, R=80 meter, overpressure = 76 atmospheres and the radiation front was at 260 meter. The radiation front was assumed stationary during the IBM-run. A check of the total energy in the initial conditions for the IBM-run (made unfortunately only after completion of the run) gave an energy of 12,900 tons. The discrepancy is presumably due to approximations made in the analytical treatment. A check of the total energy at a radius of 2,000 meters gave an energy of 13,100 tons. The discrepancy of 200 tons represents the error of the IBM calculation. Over most of the range the curve corresponds to an energy release of 13,000 tons, with the exception of small radii, which correspond to 10,000 tons.

The IBM-run extended to a distance of 6,300 meters. Beyond that radius an asymptotic relation was used, based essentially on acoustic theory, but including the effect of energy dissipation, as well as the effect of the shape of the pressure pulse.

jsh

K. FUCHS

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SUMMARY OF MECHANICAL EFFECTS

100 Ton Test and July 16th Nuclear Explosion

J. H. Manley

ABSTRACT

Measurements of blast pressure and earth motion for the 100 Ton Test and the July 16th Nuclear Explosion are summarized.

In order to have a summary of mechanical effects for easy reference, the data from various reports on both the 100 Ton Test and the July 16th Nuclear Explosion has been collected in Table I. These data are also shown graphically in Fig. 1.

The data have been selected in the sense that uncertain values have been omitted, and in some cases of apparently equal weight an average has been used in tabulation. Occasionally more than one value by a single method, appear at a given radius. These derive from equipment at different directions from the explosion. The difference in results for these cases is not great enough to suggest a significant asymmetry in the explosion. For complete details and description of the instrumentation, the original reports as indicated in Table I should be consulted.

The most extensive data on both explosions were obtained from the excess velocity measurement and from foil gauges. Neither method gives as precise information as desired; the velocity method involves an average between two distances, the foil method involves discrete pressure increments. However, by scaling the results of the 100 Ton Test (108 tons TNT equivalent neglecting any effects of wood boxes) one has:

Method	Nuclear Explosion, TNT equivalent in tons
Foil Gauges	9900 ± 1000
Excess velocity	10,000 ± 1000

Measurements of earth motion show that earth shock is unimportant as a damage producing agent in comparison to air blast. Different methods of scaling test results give values from 3000 to 15,000 tons TNT equivalent for the nuclear explosion.

TABLE I

AIR BLAST

July 16th Nuclear Explosion — 100 Ton Test

MECHANICAL IMPULSE GAUGE

	LA 355	LA 284
Radial Position:	1200 y	200 y
Peak Pressure	9.4 ± 15% psi	15 psi
Impulse	1.77 ± 6% psi-sec	0.426 psi-sec
Duration	0.65 ± 5% sec	0.130 sec

CONDENSER GAUGE

LA 366 — No record

Radial Position:	6000
Peak Pressure	0.58 ± 0.03 psi
Impulse	0.45 psi-sec

MICROBAROGRAPHS

LA 360 — Not used

Radial Position x 10^{-3} yds	Peak Pressure psi
10.0	0.47
13.4	0.31
15.5	0.13
48.3	0.03
50.0	0.11
60.5	0.04
63.3	0.03
78	0.008

PIEZO GAUGES

No record

LA 286

Radial Position yds	Peak Pressure psi	Impulse psi-sec
150	20.4	—
180	14.2	—
230	8.2	.470
230	9.0	.556
320	5.9	.346
740	1.6	.172
1500	0.73	.073
9200	0.13	.015

TABLE I (Page 2 - continued)

EXCESS VELOCITY

LA 352

Radial Position yds	Peak Pressure
448.7	45.2
593.2	25.3
593.3	27.2
838.4	14.0
838.4	12.2
1185.1	7.0
1184.9	7.1

LA 291 - records ambiguous

LA 286

Radial Position yds	Peak Pressure psi
164	16.2
204	10.2
204	11.0
272	6.3
498	2.2

PISTON GAUGES

LA 350

Radial Position yds	Peak Pressure psi
367	>60
500	24 - 26
567	<18
1000	2.6 - 6.7
1500	3.5 - 4.0
2000	> 2.8

Not Used

FOIL GAUGES

LA 354

Radial Position yds	Peak Pressure psi
800	6.18 - 7.35
814	6.18 - 7.35
1000	6.18 - 7.35
1190	5.09 - 6.18
1250	6.18 - 7.35
1250	5.09 - 6.18
1320	5.09 - 6.18
1360	6.18 - 7.35
1360	5.09 - 6.18
1400	3.96 - 5.09
1400	5.09 - 6.18
1445	5.09 - 6.18
1445	6.18 - 7.35
1490	3.96 - 5.09

cont. on Page 3

LA 288
Data revised in LA 354

Radial Position yds	Peak Pressure* psi
195	10.5 - 11.8
220	10.0 - 11.2
270	7.4 - 7.7
360	4.0 - 4.6
520	2.0 - 2.6

*Range given in lowest value of Table V column 6 to highest value Table V column 7. p. 10 of LA 354

TABLE I (Page 3 - continued)

LA 354 -

1490	5.09 - 6.18
1550	5.09 - 6.18
1550	6.18 - 7.35
1620	3.96 - 5.09
1710	3.96 - 5.09
1800	2.97 - 3.96
1800	3.96 - 5.09
1920	2.97 - 3.96
1920	3.96 - 5.09
2050	2.97 - 3.96
2250	2.10 - 2.97
2550	2.10 - 2.97
2675	2.10 - 2.97

CRUSHER GAUGES

LA 431 Not Used

Radial Position feet	Max. Pressure tons/sq. in.
327	1.10
328-1/4	1.34
320-1/4	1.26
322	1.36
208	4.95