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Mr. Carlson and Mr. Mack
Mr. Penney

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The Heat of Combustion of Jumbo

Summary This memorandum points out that the heat of combustion of Jumbo has a 400 tons H. E. equivalent. The flame radius of the burning iron vapor is not likely to be less than 500 feet, provided the gadget explodes at an H.E. equivalent of 500 tons or more.

The energy needed to vaporize one gram of iron is between 300 and 400 calories. Taking the mass of jumbo to be 220 tons, and the heat of detonation of H.E. to be 1000 calories per gram, it is seen that Jumbo cannot be vaporized if the energy released by the gadget is less than about 100 tons H.E. equivalent. No doubt a much higher figure is necessary to ensure that all of the iron is vaporized; the exact value is, at the moment, unimportant, but a safe estimate would appear to be a 500 ton equivalent.

If Jumbo is completely vaporized there is a strong probability that the iron vapor will burn rapidly, and the energy thereby released will be right up in the front of the blast wave. The energy of combustion of one gram of solid iron at room temperature is about 1950 calories. Hence the H.E. equivalent of Jumbo is about 400 tons.

An air burst gadget, not enclosed in jumbo, will of course give a ball of fire, the maximum radius of which is not known, but can hardly exceed two or three hundred feet. A gadget exploded inside Jumbo, of H.E. energy equivalent 500 tons or more, will give a much larger ball of fire (flame). The exact dimensions are difficult to estimate, but probably the following comparison is correct to within 50%. A 1000 lb MC bomb case filled with aluminum dust (200 lb) exploded by 8 lb tetryl gave a flame 60 feet radius. The energy of burning of Jumbo is equal to that of burning 60 tons of aluminum. Scaling up the radius 60 ft by a factor $(60 \text{ tons} - 200 \text{ lb})^{1/3}$, we get as the radius of flame from Jumbo 500 ft. The duration of the flame will be about 10 seconds.

If the above estimates are approximately true, two conclusions may be reached.

- 1) Assuming the H.E. energy equivalent of the test gadget to be 100-500 tons, it will be difficult to estimate what fraction of the energy actually released came from the gadget and what fraction from burning Jumbo.
- 2) All phenomena associated with the ball of fire will be very different from what they would have been if jumbo were not used.

cc: Bainbridge Hirschfelder
 Bethe Oppenheimer
 Fussell Parsons

W. G. Penney

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 L. M. Redman
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