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Theoretical Physics Note 90/72

024968

Notes on an American [redacted] P.N.E. excavation device

[redacted]

Summary

LRL data on the activities released from their [redacted] excavation device show it to use [redacted] after the first few [redacted]. The [redacted] fuel has [redacted] is of order ten. The design philosophy is very different from that of the [redacted].

also see C/H/4380 in K1828/001

October 1972

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[redacted]

[redacted]

~~SECRET~~ [redacted]

1. INTRODUCTION

Dr [redacted] drew my attention to [redacted] Rev 2, which lists some of the activities expected to be released to the environment* from an LLL [redacted] device for excavation P.N.E. In this paper I try to deduce something about the device. The main aim is to find whether there is anything grossly unexpected.

The device has been referred to, in [redacted], as the [redacted] explosive. However, it is likely that this name covers all LRL excavation devices, including their [redacted] version.

2. DATA USED

(a) Induced activities

We assume that the fraction released is the same as that for the fission products. Note that ratios such as [redacted] are in the present paper always ratios of atoms, as is our usual practice, and not of activities.

(b) Fission products

Table 2 of [redacted] Rev 2 gives [redacted] in fallout plus main cloud plus base surge. Here the "ton" of fp is [redacted]

From the arguments in [redacted] we believe that the LRL excavation devices have around, or a little less than, [redacted]. We assume this for their [redacted] device. This will be seen in what follows not to lead to any contradictions or impossibilities for the device. This [redacted] product release is plausible for a device fired at the depth which gives the biggest excavation.

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*Throughout this paper, "release" has this meaning.

However, it should be pointed out that the assumption has a widespread influence on our interpretation of the device. We use, for example, [redacted]: here the [redacted] creation [redacted] is known from the [redacted], whereas [redacted] comes as [redacted], i.e. [redacted] is proportional to what we assume for the total [redacted] Hence if any such quantity [redacted] leads to device peculiarity, we have to examine whether the [redacted] were perhaps significantly greater than [redacted] The [redacted] yield might perhaps be as low as [redacted], judging by evidence in [redacted], but is unlikely to be still lower.

(c) Residual [redacted]

[redacted].

[redacted] about their (hypothetical) [redacted] PNE device used [redacted] of their [redacted] total residual; see [redacted]. This [redacted] was said to be based on [redacted] experience.

[redacted], means a total residual of [redacted]. This is too big to be believable for the LRL [redacted] device.

Table 2 of [redacted] Rev 2 shows the division of [redacted] release between fallout, main cloud and base surge to be quite different from that for any other of the listed activities. Much less is in the fallout: only [redacted] other activities. This implies that unusually little of the [redacted] is left in the crater. Thus [redacted] must imply much more than [redacted].

[redacted]

US data on [redacted] show about [redacted] was released and so at optimum excavation depth more than [redacted] released.

It seems plausible that [redacted] was the fraction used by LRL in preparing [redacted] Rev 2 and hence that the [redacted] release means [redacted]. This is consistent with the earlier (1967) US statement that [redacted] an upper limit for the [redacted] release.

3. [redacted] OR OTHER PREVIOUS DEVICES AS A COMPONENT OF THE [redacted] DEVICE

One obvious possibility is that some earlier lower-yield excavation device was used as a component of the LRL [redacted] device. The only such possible components of which we have debris data are [redacted], with respective yields [redacted]. Their fission yields were [redacted] what we assume for the [redacted] devices.

Since [redacted] is reduced by hundreds in going from [redacted] to the [redacted] device, the extra components [redacted]. Hence it is only [redacted].

If we assume that the only [redacted] produced in the [redacted] device is that produced in a "[redacted]", the [redacted] of the former would be the same as for [redacted], namely [redacted]. But the [redacted] device has [redacted]. Hence a complete [redacted] is excluded as a component.

For [redacted] we have only [redacted] long-range data, which was three times too high at [redacted]. Still, it would predict for the [redacted] device [redacted]

It can be assumed that the [redacted] is [redacted]

unlikely to be a component of the [redacted] device, but if it were, [redacted] for the latter would be [redacted] merely from this [redacted] alone.

What we can deduce is that:

(a) [redacted] is not a component of the [redacted] device;

(b) [redacted] is used near t[redacted] in the [redacted] device [redacted] up to one to a few ktons; thereafter, [redacted].

4. [redacted] AND [redacted] MASSES

We assume [redacted]. Then [redacted] shows that [redacted] per [redacted] means fuel efficiency [redacted]. Hence the [redacted] mass was of order [redacted]. For definiteness, we use [redacted].

We assume a [redacted]. Then we can use the [redacted] relation [redacted] for [redacted] as a function of [redacted], obtaining the [redacted] as a function of [redacted] then gives boundary crossings out of the [redacted] in the top two groups and so an estimate of [redacted] as in section [redacted]. This [redacted] neglects the stronger creation in [redacted] and so should be an underestimate. From evidence in [redacted], the [redacted] calculated in this way has to be multiplied by [redacted]. Table 1 shows the results. As the expected value of [redacted] from [redacted] Rev 2

Table 1

[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

Rev 2 is [redacted] it appears that, in round numbers, [redacted] is of order [redacted] and [redacted]

the [redacted] mass is of order a couple of [redacted].

We note that [redacted] mass is quite plausible, at order [redacted]. It is interesting that the [redacted] mass is the same as in the [redacted] whereas their [redacted] masses are quite different [redacted].

The value of [redacted] is plausible, order [redacted]: compare [redacted]

[redacted] ... (1)

where [redacted] is a factor about [redacted]; for all this see [redacted] Hence for the LRL [redacted] device [redacted] should be about [redacted] This could be wrong [redacted], [redacted] depends on the [redacted] across the [redacted] components, and this could well differ from that for the [redacted] of [redacted]. If anything, [redacted] would rise and so [redacted] would fall.

[redacted] Rev 2 gives [redacted]. Now US doctrine is that [redacted] so there is [redacted]

Another activity quoted is [redacted], which [redacted] points out comes from [redacted]. [redacted] he would expect [redacted] with a decrease on going to lower neutron energies. Thus the [redacted] is plausible.

5. [redacted] DEBRIS

The spectrum reaching the [redacted] is measured by [redacted], which for [redacted] against [redacted] and

[redacted]

much the same for [redacted]. Thus the [redacted] Rev 2 value of [redacted] shows that the [redacted] is being used on [redacted].

A better measure of spectrum is [redacted], which is [redacted] for [redacted] this PNE device. This ratio measures fast flux/slow flux and shows that the [redacted] in the [redacted] device is in a much harder flux than the [redacted]. The obvious meaning is that [redacted] is being used [redacted].

If we assume a [redacted] of the [redacted] get out of [redacted] above the [redacted] threshold of [redacted] then [redacted] must be about [redacted]. This agrees quite well with the [redacted]. Assuming this ratio for the LRL [redacted] device, the [redacted] generated within the [redacted] components correspond to about a [redacted]. This agrees quite well with (b) of section 3.

6. OTHER DATA

The only other activities quoted in [redacted] Rev 2 are [redacted], both of which appear to be generated in rock and depend too much on shielding and rock composition to be any guide to the design of the device.

[redacted] has shown that if these products are given their most likely sources, namely

[redacted]

then the [redacted] ratio of cross-sections and the source concentrations in the earth's upper crust lead to an activity ratio [redacted] of [redacted].

[redacted]

7. COMPARISON WITH [redacted] P.N.E. [redacted]

Data for [redacted] and [redacted] hypothetical [redacted] excavation device are given in [redacted]. They make an interesting comparison with the LRL device; see Table 2. Note the big difference in design philosophy. The [redacted] is bigger than they used in the [redacted] weapon tests i.e. [redacted] is not just a simple modification of a [redacted] weapon.

[redacted] has pointed out that the results of this paper

Table 2

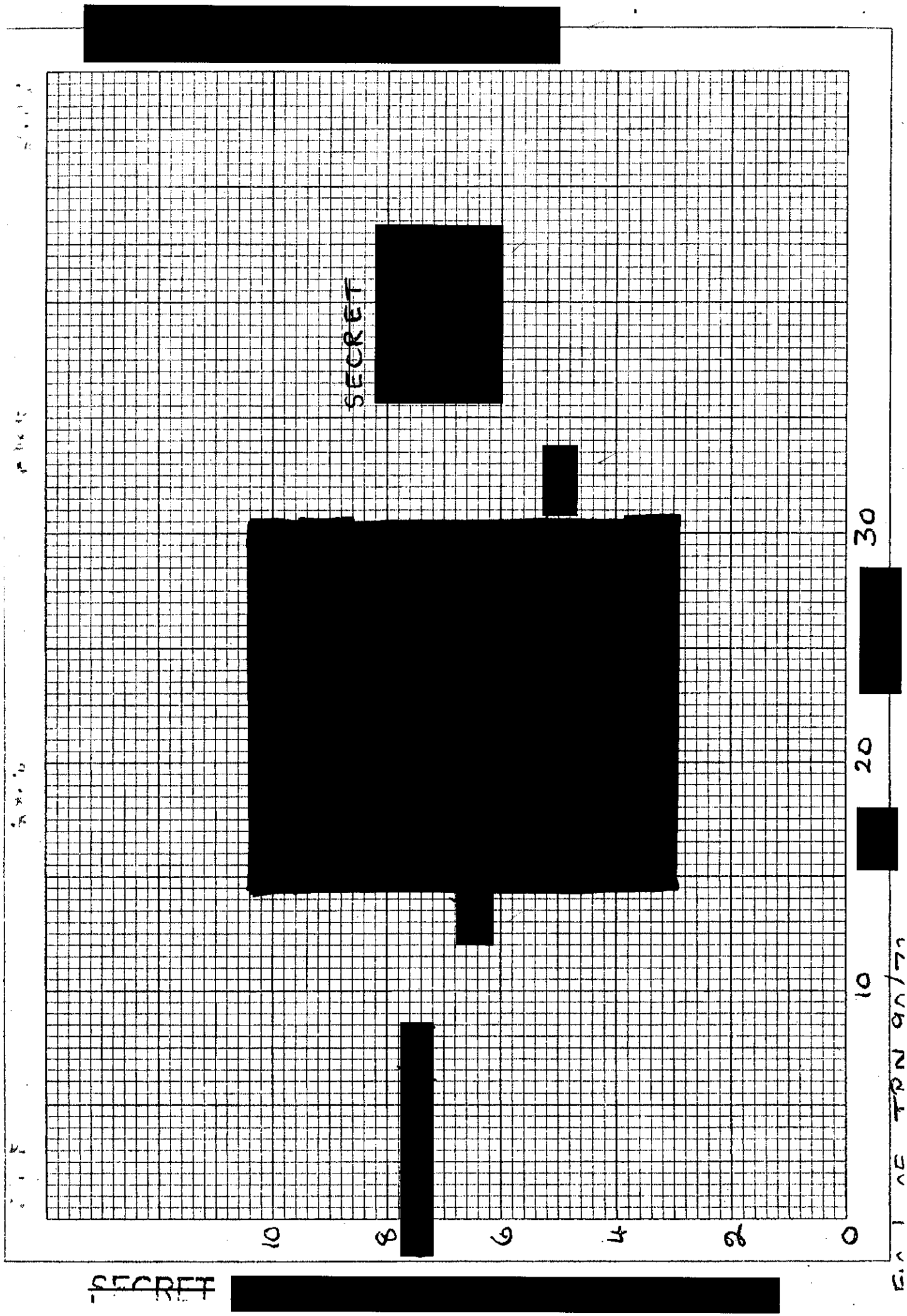
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
Device yield, ktons	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

are consistent with the [redacted] deduction (p.16, also 17 to 19) that the modification of [redacted].

We note that [redacted] was used in [redacted] the year before [redacted] joined LRL. One can suspect that the reversion [redacted] at the end of the sixties was a result of a [redacted] campaign inside LRL. [redacted]

8. INTERDEPENDENCE OF [redacted]

Calculations were made of the [redacted] with twice the [redacted] efficiency. The results, in Fig 1, refer to constant total yield. Using less [redacted] and putting up the [redacted] to give the same [redacted] yield, we get less [redacted] Using e.g. Fig 1 of [redacted] we can see that the implosion system will also be [redacted] Thus, [redacted], it needs [redacted] to cut down [redacted]" at given yield, but for a given implosion system we can at least choose how we want to divide activity between [redacted].



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