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September 20, 1962
RS [redacted]236

G. C. DACEY - 5000

Re: Effect of Test Termination on US Weaponry

Ref: SDI TWX, Betts to Bradbury, Foster, and Schwartz, dtd 9/7/62, RS 3446/55857 (Livermore 1/1387)

Uncl Memo, Dacey to Draper, Fowler, and Biggs, dtd 9/12/62

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The following points are pertinent for your reply to the DMA question, "What would be lost to the United States if all nuclear testing were terminated by January 1, 1963":

1. A ban of all nuclear testing on January 1, 1963, if accompanied by reduced budgets for testing, as was encountered during the 1958-1961 period, would insure that the United States would be behind the USSR in nuclear weapon technology within three years if not sooner. There is no doubt whatever that the USSR is less than three years behind us and that they will be able to maintain vigorous development of their technology in weaponry during a test ban period.

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2. No detrimental effects would be produced by a complete nuclear test moratorium beginning January 1, 1963 if it were accompanied by an internal AEC policy statement that the AEC laboratories should plan and prepare a test series for spring of 1964 (or even spring 1965) which would consist of those tests required for maximum technical progress by the laboratories. This policy statement would of course have to be backed by appropriate funding for development of test devices, test plans, instrumentation, sites, etc.

This approach would of course require that the test series be carried out on its planned date. Otherwise the test capability, in particular the knowledgeable scientific manpower associated with the tests, would very rapidly disappear into scientific areas where progress can be made, such as space.

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3. If funding is provided for test planning, instrumentation, site preparation, etc., but no specific test data specified, then the US's capability will exist to carry out decreasingly reasonable test programs on short notice, for a period of maybe three years before complete deterioration.

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4. Related to but broader than weapon design technology is the vitally important consideration that the US learn what nuclear weapons will do in applications (both military and non-military) for which no data now exist. One major area of uncertainty is in the application of nuclear weapons to space warfare problems where there are indications that the USSR is very active. The space environment is where there is the most potential for modifying weapons outputs, and thereby increasing their military effectiveness, by careful consideration of weapon design features.

   The use of nuclear weapons in space will certainly lag seriously without the knowledge of direct debris interactions with materials, x-ray effects on satellites, electron trapping mechanisms in the earth's magnetic field, electromagnetic signals from space bursts, directed debris energy, propulsion efficiencies of bursts, etc.

   Further, there are reasonable arguments that outer space is the place where use of nuclear weapons is most logical in that all civilization is spared the after effects and only professional military groups and equipment will be involved. Thus the battle will be won by the group who makes the most sophisticated use of its nuclear weapons in space, and that will be the group which understands most about its outputs and effects on equipment in the space environment. We must work promptly toward an outer space test capability both for its application to weapon design tests, but more importantly for its application to finding out before the USSR what usefulness nuclear devices will have in space exploration and warfare.

These general comments are followed by a list of specific gaps in our knowledge that require further weapons tests. This list was primarily assembled by Byron Murphey. I concur in them all with some relatively insignificant comments.

My comment on Item 5 is that I doubt that the cost of a missile program has ever been reduced by giving it more bang in its payload. Thus I would tend to emphasize the importance of yield/weight improvements to the reduction of weapons vulnerability.

On Item 6 it seems important to also go outside the earth's magnetic field if for no other reason than to demonstrate that we can do reasonable tests there (if indeed we can) and to determine the physics of injection of debris into the magnetosphere.

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1. The vulnerability of the combination warhead and re-entry vehicle of an ICBM to anti-ICBM nuclear bursts needs to be established in detail in order to solve the weight compromise necessary to provide for decoys and/or multiple R/V's. The current assumption on CEP for the anti-ICBM is so small that no single ICBM R/V can survive. Thus, a very serious economic problem exists in the proper choice of multiple ICBM attack which must include decoys. The vulnerability distances must be well-known to space properly decoys and to choose properly the number of decoys or multiple R/V's required to assure explosion on target. The most critical problem is the R/V behavior under combination re-entry and shock loading. The next most critical problem is x-ray damage in case we discover higher intercept altitudes are important.

2. Although we are inclined to dismiss the very high yield problem as a wasteful method of nuclear attack, nonetheless, it can be shown that with a sufficiently high yield destructive thermal levels can be created high in the atmosphere. The exact yield required is highly dependent on the fluorescent efficiency of the upper atmosphere. Although some information was obtained on Star Fish Prime, more definite information is needed. The reason is that from a knowledge of the size of say a threatening very large satellite claimed to be a nuclear weapon, one could determine whether he had to destroy it promptly to avert the consequence of a nuclear attack challenge.

3. Similarly, high yield potential for destructive water wave production needs to be examined by an underwater test of a weapon no smaller than 1 mt.

4. The problem of what yield is required to destroy a large missile hardened launch site is not satisfactorily answered until we obtain good underground measurements for an actual surface burst. We think simulation of megaton yields by a low yield burst which is a carefully placed surface burst, will provide a much improved estimate when backed by theoretical calculations, laboratory experiments, HE experiments, and a few well chosen nuclear shots near the surface.

5. The gradual improvement in yield to weight ratio that is evident from Hardtack and Dominic is very important to the over-all cost of the missile program. Continued improvement should be sought not only in connection with the missile weight problem but also in connection with the vulnerability problem. Weight trade-offs will always be serious problems in relation to the total retaliatory force that is economically feasible.

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6. In connection with high altitude bursts it must be realized that the phenomenology changes rapidly with altitude because air density changes. For instance, to obtain data at density changes a factor of 100 apart, shots would be needed at roughly 32 km, 60 km, 90 km, 120 km, 220 km, and 500 km. About half of these will have been done at the completion of Dominic.

7. Whether it is desirable to show that one can do diagnostic tests behind the moon should be considered. Explosions in deep space could also provide proof tests for Vela Sierra and Vela Hotel systems.

8. Whatever potential Plowshare contains can only be realized by means of underground explosions designed to explore the application of nuclear explosives to peaceful purposes. Cratering experiments related to the possibility of a sea level canal between Atlantic and Pacific oceans seems to us important to that long range hope, as is the development of explosives that are clean from the radioactive fallout viewpoint.

9. Sophistication of Vela Uniform detection systems depends upon the occurrence of some underground explosions.

10. The yield/weight ratio for very small yields or small diameters is quite unsatisfactory from the user's point of view. Presumably advances can be made if the AEC continues to work on the problem.

Original Signed By
T. B. COOK

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TBC:abp

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