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Major General A. W. Betts, U.S.A.  
Director of Military Application  
U. S. Atomic Energy Commission  
Washington 25, D. C.

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Through: Technical Library, IADC

Dear General Betts:

This letter requests that the AEC ascertain with which agency in the DOD we may discuss specific technical areas of effects. As background for your understanding of this request, we will proceed to discuss our recent thoughts on the general topic of effects.

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In our joint letter of November 20, 1962, we described to you a possible plan of action whereby the AEC and the DOD might carry out a joint program of nuclear weapons effects measurements of maximum effectiveness within the general framework of the Gilpatrick-Seaborg agreement of November 5, 1962. Although there has been no formal response to this proposal, we are aware that considerations of various effects programs are actively under way in various agencies of the DOD and our informal contact with them has given us a good idea of the general effects areas which seem to be of the greatest interest and priority to the military. We are also aware that the problem of formalizing the responsibility for an overall effects program within a limited part of the DOD may be a difficult and time consuming task, and that the hopes expressed in our earlier letter of a technique of single and definitive contacts may be some time in realization.

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The three weapons laboratories, however, well recognize that time is passing, and that effective and efficient weapon test programs in the effects area require long planning and development times. This is especially true in the area of instrumentation development which for the more complex measurements should begin as promptly as possible. Accordingly, in anticipation of an eventual joint program

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with the DOD, representatives of the three laboratories have recently met to consider what steps may be taken at this time to get a joint AEC/DOD effects program under practical way. Their considerations were generally guided by the following assumptions:

A weapons effects test program should probably be considered in a time scale of the summer of 1964 with earlier times being both unlikely in a political sense and impractical in a technical sense. Tests are also considered which are technically impractical in 1964 but which require prompt initiation of technical work with the DOD in order to be accomplished in 1965.

The program should be a joint AEC/DOD endeavor in the sense that all tests should have the major objective of improving to the maximum extent the national position in this area. Thus specific test shots in the effects area should not be described or supported as "AEC" tests or "DOD" tests but rather as joint AEC/DOD effects tests involving a division of technical responsibilities as agreed upon for each specific shot or series. Furthermore, the decisions on who will carry out each technical program should be less influenced by whose "responsibility" the phenomenon may be (in the sense of the Gilgatic-Seaborg agreement) than by the ability of one agency or another to execute technically appropriate experiments. In other words, it should be more important that the right experiments get done in any given test than that one agency or another do them.

Finally, it was assumed that practical considerations would probably limit the total number of nuclear detonations whose primary purpose was weapon effects exploration. Accordingly, there has been an intentional effort to restrict our considerations to those areas of prime importance.

Within this general framework, the three laboratories concluded that there exist, at this time, at least three fairly well defined areas which can be described sufficiently well so that specific discussions could be undertaken with the DOD at once to work out the details of the eventual proposal to be made to the President and the practical details of what actual prior calculations and studies would be made (and by whom) and what eventual actual observations would be made (and by whom). We would like to make it very clear that we are in no way attempting to usurp any prerogatives of the DOD in this exercise; rather we have strong reason to believe that the DOD will find in the general proposals which follow a strong and encouraging parallelism with their own general ideas. Accordingly, while the descriptions which follow may seem specific, there is no intent to

imply a fixed position by the Laboratories, and the descriptions which are given are primarily for the purpose of initiating a tangible discussion and to provide more than a purely qualitative initial basis therefor.

The three areas in which we believe discussions could profitably start with the DOD immediately are described herewith:

Warhead-R/V Vulnerability (DOD interests in this area are typified by the "Slaighride" program. However, we have avoided the use of this term in the interest of initiating more general discussions.)

There is strong need for a program to measure the nuclear vulnerability of re-entering ICBM warhead/re-entry vehicle combinations, including effects of blast, fireball, neutrons, and gamma. A first experimental program should give main priority to evaluation of blast interactions. This would include:

- a. Evaluation of the environment created by the interaction of blast wave, vehicle, and vehicle bow shock.
- b. Study of the resulting aerodynamic behavior inside the blast sphere.
- c. Determination of the dynamic response of various warhead and R/V structures.

The tests must include a variety of conditions, such as both axial and lateral intercepts. The major objective would be to provide verification or guidance of theory that could be applied to various design programs for hardened warhead/vehicle systems.

Test vehicles should have the features such as shape and hardness, of advanced systems; and they should probe the more severe conditions that advanced systems will be able to withstand. Nuclear tests involving exposure of such vehicles can take place in 1965 if experiment design effort is begun immediately. Prior to this experiment and in 1964 we believe a near surface atmospheric test is needed to provide initial confirmation of blast and neutron hardened vehicle design concepts and to provide preliminary checkout of instrumentation for the hardened warhead-R/V test in 1965.

Electromagnetic Pulse Phenomenology (or Vulnerability) (DOD interests in this area are typified by the Minuteman site hardening program and the "Rufus" program. The latter, however, does not appear likely for a 1964 test series.)

The 1964 electromagnetic pulse vulnerability tests will serve to establish the influence of certain detonation parameters:

- a. Clean/dirty devices -- to establish effect of type of radiation flux and spectrum.
- b. Yield dependence -- to evaluate presence and magnitude of close-in low frequency inductive energy at higher yields not important at kiloton levels.
- c. Symmetric/asymmetric devices -- to evaluate the relative contribution of strong device asymmetry to environmental asymmetry effects.
- d. Height-of-burst effects -- evaluate extended charge transfer mechanisms with the conducting plane and their influence of the asymmetric models.

A strong preference for such tests over a very highly conducting medium has arisen from theoretical considerations such that an ocean salt-water environment appears to be singularly appropriate. The parametric tests would require several bursts (five is a minimum) in a yield range from a few kiloton to a few megaton; the extent to which such tests could be integrated with the weapon development test program is problematical at present, but certainly is worthy of considerably more study than has been given.

Instrumentation development problems require a low yield atmospheric shot for evaluation of radiation sensitivity of exposed close-in sensors and for their calibration inside the so-called conducting zone.

There continues to be unresolvable, large uncertainties in electromagnetic phenomena with respect to high yield detonations over "poor" conductivity media (ground). The close-in coupling of electromagnetic energy and the response of large hardened underground military systems both require a high yield ground surface burst for their solution. Examples of potentially vulnerable military systems and components must be exposed.

Close-in instrumentation will be required to obtain data for improving confidence in theoretical predictions. This test will probably be beyond 1964 but again experiment planning between appropriate DOD and AEC groups should begin promptly.

#### Anti-ICBM Problems

The nation is heavily involved in the discussion and planning of systems for defense against missile attack and the corollary problem of penetrating possible enemy defense systems. In this connection serious questions are raised concerning, for example, missile kill mechanisms, and nuclear burst effects on the ever-present radar systems. From the Dominic tests there is a body of experimental data which is now being analyzed by both DOD and AEC groups. Whether this analysis can be completed in time to feed effectively into the design of AICBM tests in 1964 is uncertain. However, even without this analysis one can nominate likely candidates for such tests in 1964. There will need to be a lot of discussion between DOD and AEC to find a mutually agreed-upon program, but we think that the following are tests of high interest:

#### a. Environmental test of SPHINX warhead

The SPHINX warhead will probably be developed in underground tests, but it would seem desirable to conduct a final test in the natural environment, that is, somewhere between 7 and 25 km altitude. In such a test one would want to measure radar transmission, get thorough photographic coverage, and measure neutron output and blast.

#### b. Clean-dirty difference for radar effects

The differences between ionization produced by clean and dirty bombs is an important question, bearing on the design of both defensive warheads (self-blackout) and warheads for precursor bursts (to aid penetration). Thus, there is interest in the clean-dirty difference in smaller yields at lower altitudes and larger yields at higher altitudes. By the latter, we mean yields in the megaton range at altitudes above 100 km. In the higher altitudes interest is also strong in the ionization produced by an asymmetric device of calculable directionality.

c. Magnetic containment

We think there may be merit to the idea of using magnetic containment of bomb debris to produce an area of intense radar blackout. If the magnetic bubble is not too unstable, the debris may be confined to a small enough bundle of magnetic field lines to achieve such a high intensity blackout. To test this idea a yield of about 10 kt at between 1000 and 2000 km altitude would probably suffice. The calculability of such a burst is sufficiently uncertain that an experimental test will be required if this type blackout is ever to be possibly used by the DOD.

We would therefore like to make the following specific and definite request: Would the AEC be willing to ascertain for us with which agency in the DOD we may discuss each of these specific areas. We recognize at this time that we may be instructed to deal with different agencies in each case and this is not unsatisfactory. We believe these three areas of no less interest to the DOD (and, of course, they may well have others) than they are to us, and we would like to initiate discussions with whatever agency would be responsible for the planning on the DOD side of the eventual test if approved. In other words, we are well aware that no one at this time can authorize or promise any test, but if there were to be a test (or tests) in one or another of the above areas, can it not be ascertained now from the DOD to whom they would give current planning and ultimate execution authority? On our side, we would then assign individuals from the Laboratories to represent the AEC so that the ultimate test, receiving planning inputs from both agencies and with early definition of who will measure what, can be finally presented to higher authority with the combined backing of the AEC and the DOD and maximize in every way possible all the information which can be obtained.

We would like to make three additional points which relate to the general problem of defining a 1964 atmospheric test series. These are:

1. The above lists do not, of course, include those shots which will be proposed by Los Alamos or Livermore in the course of normal weapon development. These shots would, of course, be supported primarily by the AEC since they are primarily for the purposes of the AEC's own program. However, since the Gilpatrick-Seaborg agreement makes the AEC responsible for the general knowledge of weapon outputs, we would expect to have a program of effects measurements of this nature on many of such shots. Thus, there is an interaction between shots for developmental purposes and the effects program which should

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not be ignored. New devices whose primary character is to be provide new types (or new distributions) of weapon outputs clearly would have extensive measurements of this sort along with the normal observations of yield by various methods.

2. The three AEC Laboratories are strongly of the opinion that a true space shot at 10<sup>6</sup> km or greater should receive serious consideration at the present time. It is clear that such a test requires several years' preparation time, and therefore we propose to plan what seems to be the best experiment feasible. The primary objectives of such an experiment would be to make a practical test of the feasibility of testing in "space" and to provide an objective test of Vela Hotel and Vela Sierra detection techniques. While undoubtedly everyone will look for "effects" associated with such an experiment, it is unlikely that such of a case can be made a priori, that this should be a joint AEC/DOD effects shot. Accordingly, we believe that this experiment should probably be similar to those of (1) above and be listed with those for which the AEC regards itself as primarily responsible. However, guidance is urgently required as to whether current planning for this experiment should be restricted within the AEC or whether the DOD (and if so, whom) should be involved in the vehicular planning.
3. We are aware of other DOD effects or systems interests which are almost entirely, if not entirely within the area of pure DOD responsibility. The listing above should in no way be construed as lack of enthusiasm for such shots but rather our own opinion that greatest need for effects information lies in the areas which we have described above, and that, if we had to make a choice within a limited number of permitted detonations, the three exploratory areas noted above seem to us to be the most important. Presumably this is equivalent to a procedure whereby weapon development shots are primarily supported by AEC, some "effects" shots should have strong joint AEC/DOD support, and other shots must, probably, be primarily supported by the DOD although the AEC may well find it of interest and importance to make or to suggest that certain effects measurements be made on them.

We hope we may receive your response to our specific query about with whom we should discuss these matters in the DOD as soon as possible, since many of these programs are of such technical and constructional complexity that, to have them ready by the summer of 1964 will require almost immediate procurement and construction initiation.

Very truly yours,

[REDACTED]

A. W. Betts

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(Signature page)

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