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10 February 1959

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The President's Science Advisory Committee



REPORT, Panel on AICBM

Meeting of 17 December 1958

The Panel met on 17 December 1958. Panel members present were:

- E. M. Purcell, Acting Chairman
- L. V. Berkner
- W. E. Bradley
- W. K. M. Panofsky

Also present during part or all of the discussions were:

- D. Z. Beckler
- D. E. Dustin
- W. R. Hutchins
- J. R. Mares
- B. McMillan
- H. Scoville
- H. R. Skifter

During the course of the meeting the Panel heard a description of work at Columbia University on techniques for radar detection and tracking of missiles and satellites. This was presented by Dean Dunning, and Professors O'Neill and Bernstein of Columbia. The Panel also heard a description of the present ARPA program of research relating to AICBM, given by W. R. Hutchins.

The main topics of discussion were:

A. The likelihood that the Soviets will use lightweight warheads in order either to carry several warheads per missile or to carry relatively heavy decoys.

B. The threat of Soviet missiles to the U.S. retaliatory force, and the relation of:

- (i) dispersal and hardening,
- (ii) early warning and quick reaction, and
- (iii) active defenses,

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MR 79-118 #3  
By DJH Date 8/13/79

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C. Other possible values of active defenses, and the urgency that appears to attach to the Nike-Zeus program.

D. The dangers to the Nike-Zeus system from the effects of high altitude nuclear bursts.

The Panel's views on these matters are summarized below.

A. Decoys and clustered warheads.

1. If nuclear testing is discontinued, it is highly unlikely that the Soviets will be able to use a tactic that depends upon lightweight warheads

2. On the other hand, if nuclear testing continues, there is no reason now to foresee, for the Soviets, any less sophistication in warhead designs in 1964-1965 than we foresee for ourselves.

3. Lightweight warheads are probably seriously more vulnerable to nuclear destruction by the interceptor than are heavier ones.

4. Soviet stocks of nuclear materials probably would not seriously limit his use of lightweight or clustered warheads, until the number of such reached many thousand.

5. Intelligence cannot rule out the possibility that the Soviets will use heavy re-entry bodies (e.g. - over 5,000 lbs.).

6. It is likely that decoys which adequately simulate live warheads, against discrimination both by radar and by atmospheric drag, need not weigh more than 1/10 as much as the warhead being simulated.

7. There is now no reason to believe that, in 1965, each Soviet ICBM will not present several, and perhaps very many, threatening objects to confuse and saturate U.S. defenses. Whether more than one of these objects is a live warhead may depend not only upon technical factors, but upon choices made by the Soviets for tactical reasons.

8. An effective technique for measuring the actual mass of an incoming object -- in addition to its weight/drag ratio -- would seriously limit the decoying tactics available to the Soviets. In principle, a determination of mass could result from a simultaneous measurement of velocity, deceleration, and of the energy dissipated by heat radiation from the incoming object. Although there seems little promise that a



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practicable method can be developed to do this, the value of a successful method urges a search for possibilities.

B. Protecting the retaliatory force.

1. The Nike-Zeus system cannot be a factor in protecting the retaliatory force before 1964 or 1965.

2. In general the tactics of dispersal, hardening, concealment through mobility, and quick reaction upon early warning, all seem more certainly effective, and more inexpensively effective, than active defenses, for protecting the retaliatory force. Furthermore, these tactics are available, and can be implemented to an effective degree relatively soon.

3. The Panel believes that these "passive" tactics should be considered as the basic anti-missile defenses for both the aircraft and the missiles of the U.S. retaliatory force. We urge in the strongest terms that they be exploited more fully, and more rapidly than present plans call for.

C. Other values of active defenses.

1. Active defenses appear to be the only means of achieving much protection for cities against attack by missiles. Without challenging the overriding importance of protection for the retaliatory force, the Panel notes two circumstances in which protection for cities has value:

(i) The condition in which the Soviets have a superiority in missiles great enough that they can direct up to a few hundred, but not as many as a thousand missiles, at cities, in addition to those directed at our retaliatory forces. In this case, active defenses would not contribute to preventing attack but could none the less save many lives.

(ii) The condition in which the U.S. is able to complete an attack while most of the Soviet force is still grounded. In this case, the U.S. must be able to withstand retaliation by those Soviet missiles which, inevitably, will escape the most carefully planned counterforce operation. Again, active defenses could save many lives.

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2. Another condition in which active defenses have value is that in which offensive forces are limited by agreement. In this case, it is possible to consider building even an active defense system which cannot be overwhelmed within the limits of agreed forces.

3. None of the circumstances just listed can be ruled out as possibilities for the future. The Panel urges therefore that the research and development for the Nike-Zeus system be continued. It must be emphasized however, that this research and development program is not an alternative to immediate and effective exploitation of passive tactics for defending the retaliatory forces.

4. One of the measures for passively defending the retaliatory force -- hardening -- progressively reduces in effectiveness as the aiming accuracy of the attacking ICBM is improved. Therefore, in the long run, active defenses become more effective relative to hardening, although not in an absolute sense. Furthermore, an active defense system which is itself hard enough to ignore near misses could add an effective increment of defense to a concentrated target (e.g. - a missile base) which is already hardened. The present Nike-Zeus system is not hard enough to be useful in this way.

D. High altitude effects.

It appears now that the effects of nuclear bursts at high altitude -- in particular, bursts of the Nike-Zeus warhead itself -- will not completely cripple the presently planned Zeus radars. There is no assurance, however, that one to several nearby bursts will not seriously hamper the performance of the acquisition radar. The effect will be to increase the difficulty of identifying incoming objects as threatening or not, and to degrade the accuracy of data for acquisition. The Panel feels very strongly that the Zeus system will not be assuredly protected against these effects of its own weapons until it is equipped with an acquisition radar operating at a frequency somewhat higher than 2,000 mc/s.

B. McMillan  
Technical Assistant

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