

May 18, 2005

Agreed Statements between Ed Gerry and Richard L. Garwin,
together with individual statements by Gerry and Garwin,
presented at the "Scientific Adversary Procedure"
Dartmouth College, May 23, 1985
Arthur Kantrowitz, moderator

Garwin's Statement:

There has been no study within the government as to whether the U.S. should pursue the research toward the goal expressed in the President's speech-- to "replace deterrence by threat of retaliation" by means that are defensive; to "render nuclear weapons impotent and obsolete." (GARWIN)

Gerry's Statement:

The goal of the SDI program is to determine whether it is feasible to improve the security of the U.S. and its allies, while reducing the number and power of offensive nuclear weapons via a transition to defensive systems as the primary basis for continued deterrence of nuclear war. (GERRY)

Garwin's Goal:

The goal of continued avoidance of nuclear war is better achieved within the ABM treaty (which prohibits significant defense against strategic ballistic missiles) and does not require ever-increasing forces. It could be accomplished stably with 2000 warheads on each side if:

- both sides abandon the goal of destroying the strategic retaliatory force of the other side, and
- as is the purpose of the ABM Treaty, both sides abandon defense against the strategic retaliatory force of the other side.

Statement:

The question of countermeasure effectiveness will not be further debated here because Gerry feels that official secrecy precludes his participation. Further, Garwin states that countermeasures will defeat high performance systems while Gerry believes that solutions can be developed.

1. No system has been publicly presented which satisfies the twin requirements of the administration as presented by Paul Nitze 02/20/85-- to be survivable, and to be cost effective. (AGREED)
2. No viable defensive system can allow space mines to be placed within lethal range of space assets. (AGREED)
3. The utility if pop-up for boost phase intercept can be negated by fast-burn boosters. (AGREED)
4. If rail guns are to be used for ballistic missile defense, they must propel homing kill vehicles. (AGREED)

5. The energy efficiency considerations favor chemically propelled homing kill vehicles over rail guns up to an added velocity implied by the following equation: under assumptions of an electrical generation efficiency of 30%, rail gun efficiency of 30%, chemical rocket specific impulse of 300 seconds and stage-mass fraction of 90%. This velocity is approximately 16 km/sec. (See following table and calculations). (AGREED) (Appended May 2005)
6. Close-spaced decoys multiply greatly the number of HKVs needed for mid-course intercept unless they can be discriminated and designated. (AGREED)
7. Space-based kinetic energy weapons are fundamentally limited in effective range by their velocity and the time available for flyout to the target after launch. (AGREED but trivial)
8. In the context of an effective surveillance, acquisition, tracking, and designating system, HKVs would be effective in boost phase against the current class and deployment of Soviet ICBMs and SLBMs, and would have continuing effectiveness against re-entry vehicles in mid-course, and in defense of space-based assets, providing the space-based systems can survive, and Soviet countermeasures aren't effective. (Gerry believes that the system can survive and be effective against countermeasures, Garwin dissents).
9. In the continuing context of deterrence of nuclear war by threat of retaliation, technologies already exist to solve the problem of strategic force vulnerability sooner and at lower cost than via layered defense with space components. (AGREED)
10. Within the context of continuing deterrence of nuclear war by threat of retaliation, existing technology involving nuclear intercepts in space could be employed to handle a few rogue-nation ICBMs. A cooperative system could handle accidental launch of one or a few Soviet ICBMs. (AGREED)
11. Equation 13 of "How Many Orbiting Lasers for Boost Phase Intercept?" (Garwin) provides a good estimate of the number of laser battle stations of a given brightness and retarget time to counter a prescribed threat. The following table provides results of this calculation for various assumptions. (AGREED)
12. There is no known fundamental limit to laser power or brightness that can be achieved other than cost. (AGREED)
13. Countermeasures are a fundamental problem to the success of a high-performance strategic defense. (AGREED)
14. The SDI program is exploring possible solutions to all of the countermeasures issues which have been raised publicly and more. (AGREED)
15. So long as the Soviets can reliably deliver by any means (e.g., aircraft, cruise missiles, suitcase bombs) numbers of nuclear weapons causing catastrophic national damage, capability for nuclear retaliation against the Soviets will still be required for deterrence. (AGREED) Garwin's comment: The President's SDI-speech goal of eliminating offensive nuclear weapons will not then have been achieved.

16.

Propositions for Adversary Procedure

1/ Boosters have a very large infrared radiation which cannot be decoyed in a cost-effective way. (Gerry)

2/ A gradual reduction of the probability of war can lead to a finite hazard of nuclear war to eternity. E.g. if there is 1% probability of deterrence failing this year, 1% x a next year; 1% x a² the year after:

with a = 0.8
1% as of 0.08 as of 0.64 as of 0.51% ...
1% as of 0.18% as of 0.14% as of 0.11% ... (n.1985)

Sum (n = 1 to infinity) of Pn = Po/(1-a)
which becomes 5% to all time.

This is better than 10 years without reduction and a perfect system following. (Garwin)

Table appended May 2005, that is probably the table considered 05/23/85:

TABLE 1: For final velocity V_f achieved by rocket propulsion with exhaust velocity V_e = 3 km/s, the payload fraction is μ and the fraction of fuel total energy present in the payload kinetic energy is ε.

V _f	3	6	9	12	15	18	kms
α	1	2	3	4	5	6	
μ	37%	13.5%	5.0%	1.83%	0.67%	0.248%	
ε	59%	62%	47%	30%	17%	9.1%	

Table appended May 2005, that is probably the table considered 05/23/85:
See "Space Technology: Myth and Promise" by R.L. Garwin, published in the book Ways Out of the Arms Race, edited by J. Hassard, T. Kibble and P. Lewis. Proceedings of the Second International Scientists' Congress held at Imperial College of Science, Technology & Medicine, University of London, 2-4 December 1988. To be found at www.fas.org/RLG/.

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