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AMERICAN SDI AND DEFENCE AGAINST BALLISTIC MISSILES IN EUROPE

BY

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AMERICAN SDI AND DEFENCE AGAINST BALLISTIC MISSILES IN EUROPE

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AMERICAN SDI AND DEFENCE AGAINST BALLISTIC MISSILES IN EUROPE

The SDI Research Program

1. The American Strategic Defence Initiative is a research program, intended to discover what is technically possible for defence against ballistic missiles. Unless and until the research has been completed, and followed by development and testing, it is unlikely that any decisions will be taken regarding deployment of operational systems. There may be a need for decisions prior to that regarding conduct of development or testing, especially if such would contravene the ABM Treaty, or regarding constraints on SDI research in connection with some future arms control agreement.

2. Although the activities now labelled as SDI were conceived in the United States, and are being paid for by the United States, they are affecting Allied relations in several ways. The United States invited its NATO allies and some other friendly nations to participate in the research program. The security of the NATO nations will be affected by the bilateral arms control negotiations being conducted by the US and the USSR in Geneva, and these are being linked by the Soviets to the American SDI. Many countries involved in multilateral arms control negotiations are concerned with activities such as nuclear testing, and with the prospects for arms control in space, and perceive that these may be affected by SDI or other developments related to ballistic missile defence.

3. Whichever nations do choose to participate in the SDI research program will improve their scientific and technological capabilities, quite possibly discovering applications outside of defence. While all of the NATO partners will likely be made aware of the major

findings of the SDI research program, the detailed technical knowledge necessary for design and production of equipment may be confined to those nations which have participated actively. Nations electing not to participate will lose an opportunity to advance their scientific capability, may lose some of their better scientists, and will probably lose the opportunity to participate in production of components if such occurs.

Differences between the Problems of Defence against Intercontinental and Theatre Range Ballistic Missiles

4. In order to reach the major strategic targets in North America, an ICBM launched in the USSR will have to be given a burnout velocity of about 4 nm/sec, and will take 30-35 minutes to follow a trajectory of 5000-6000 nm, climbing to about 700 nm above the earth at its apogee.

5. In contrast, a burned out velocity of about 2 1/2 nm/sec will allow an IRBM launched in the USSR to reach Western Europe in about 13 minutes, on a trajectory with a range of 1300 nm and an apogee at about 300 nm above the earth. The Soviet SS-20 can have considerably longer and higher trajectories, while those of the tactical missiles such as SS-22, SS-23, SS-21, Scaleboard, and SCUD are much shorter and lower. Submarine Launched Ballistic Missiles have ranges and apogee heights between those of ICBMs and theatre weapons.

6. These differences are illustrated on the two diagrams, in which the distances are given in kilometres rather than nautical miles. Figure I represents about one-quarter of the earth's circumference, about 10,000 km, representative of the distance between ICBM fields in the Western USSR and in the northern United States. The point at 0 km to the left of Figure I is the impact point on the earth, targetted by missiles travelling from right to left.

7. The boost and post-boost phases of the ICBM trajectory would be completed in the first 2000 km. The dashed straight line marked 'L.O.S.' represents the line of sight, tangent to the earth's surface at the target area, above which the missile should be directly visible. The ICBM would cross above this line of sight about ten minutes before impact.

8. The SS-20 IRBM is shown covering a distance of 5000 km, taking about 20 minutes, and with the boost and post-boost phases being completed in the first 1500 km. Because it follows a higher and slower trajectory than the ICBM, the SS-20 would be above the horizon as seen from the target area for more than ten minutes.

9. Also shown on Figure I is the SS-4 MRBM, covering a range of 2000 km, taking about 13 minutes, and above the horizon at the target for nearly all of the flight.

10. Figure II is drawn on a more expanded scale, incorporating only 2000 km, appropriate to the tactical and medium range missiles. SS-22 (Scaleboard) with a range of 900 km and time of flight of seven minutes, SS-23 (500 km and six minutes) and SCUD A(300 km and five minutes) are above the horizon for practically all of their trajectories. SS-23 and SCUD remain below an altitude of 100 km (indicated by the dotted contour), so that the atmosphere will have a considerable effect on the ballistics of flight as well as on performance of defensive systems.

11. The trajectories of Figures I and II have been calculated for purely ballistic motion on the path producing the longest range for the launching velocity. In fact, the path will be slightly different during the boost phase, as the velocity is built up, and slightly different during the terminal phase, as velocity is reduced by air

resistance, and the time of flight will be slightly greater. The flight times on Figure II are rounded up for this reason. When the range is less than the maximum possible for a certain burnout velocity, a higher or a lower trajectory can be employed.

12. Terminal defence systems against ICBMs were developed over fifteen years ago. One has been in place around Moscow since 1969, and the US had one at the missile base near Grand Forks, N.D. for a brief period in the 1970s. It is probable that techniques developed since 1970, and improved through the SDI program, would allow a much better terminal defence to be installed in the 1990s, perhaps without the need for nuclear warheads. One defence unit of this type can only protect targets in a small area, so that separate installations would be required for each target group. So far the equipment has been on the ground, close to the targets, but it is conceivable that a future system would have some components airborne, projected into space, or orbiting in space.

13. Provided that warning can be given adequate to put the terminal defences into operation, it should be easier to intercept an IRBM than an ICBM. The warhead descends less rapidly, and at a steeper angle, unless the attacker has taken special steps (and expended extra energy) to alter the most energy-efficient trajectory. Terminal interception of tactical ballistic missiles, which approach more slowly, should be easier than for IRBMs. It can been seen from Figure II that a terminal defensive system located near '0' and able to detect a missile at a range of 1000 km, as long as it was above the horizontal line of sight, would have about three minutes to intercept an ICBM, five minutes for an SS-20, and seven minutes for an SS-4, and for an SS-22. The shorter range missiles like SS-23 and SCUD are slower still, and remain within the atmosphere for a large part of their trajectory. The problem begins to resemble that of engagement of high altitude aircraft, although the target is smaller, faster, and less vulnerable than an aircraft.

14. It seems probable that Western Europe could avail itself of terminal BMD more easily than could the USA. It is likely that nearly all of the necessary equipment would be on the ground, with the weapons near the targets, and warning radars as far forward as possible. If sensors in aircraft are necessary, a continuous patrol would have to be maintained, possibly combining the AWACS function with missile warning and tracking. Additional warning from satellites might also be available.

15. The structure of BMD thought to offer the best chance of providing effective protection of area targets against ICBMs would consist of several layers. A first layer would attempt to destroy the attacking missile in the boost phase, a second layer in the following 'post boost' phase, a third in the longer mid-course phase, while terminal defence would be the fourth layer. The terminal phase of an IRBM trajectory would last longer than for an ICBM, giving the defence a better chance, whereas the boost phase would be shorter (and terminate at a lower altitude), the post-boost phase shorter or non-existent, and the mid-course phase much shorter (perhaps five minutes instead of 20-25). If interception is to be accomplished during the boost or post-boost phase, the need for very rapid reaction makes it essential to have sensors and kill mechanisms in orbit, and makes a fast-acting weapon such as a Directed Energy Beam more likely to succeed than a rocket-propelled device. It is unlikely that the short time of flight and low trajectory of tactical missiles will permit any type of defence other than terminal.

16. As missile guidance is made more accurate, attacking weapons of intermediate and shorter range may become able to achieve a high probability of destroying small unhardened targets using conventional warheads. While NATO has provided hardened shelters for its GLCMs, Pershing IIs, and strike aircraft, the possibility arises that the missiles could be attacked individually after they have dispersed,

while airfield facilities, ports, depots, bridges, and many other key targets cannot be hardened. Thus, a case may arise for ballistic missile defence in Europe that would be needed during a conflict that had not escalated to the nuclear level.

17. Related to this problem is the question of whether BMD must depend on a nuclear kill mechanism. This would be a disadvantage for the defence of North America against ICBMs, for several reasons, one of which is the need to detonate the defensive warheads at altitudes high enough to minimize damage on the ground. The minimum altitude permissible would be higher for defence of soft than of hardened targets. A very important objection to the use of nuclear warheads is the effect on the electronic components of the defensive systems. Since warning times will be less, and since it may be necessary to defend against conventionally armed missiles, the disadvantages of nuclear kill mechanisms would be much greater for BMD of Europe than of North America.

18. A further disadvantage of a defence that depends on nuclear warheads is the possible delay in obtaining political authority to employ them. However, the very short times associated with defence against ballistic missiles, whether of intercontinental or theatre range, probably dictate that, if BMD is deployed on any significant scale, all peaceful planned launches of missiles will have to be announced ahead of time, with non-announced launchings being exposed to destruction.

19. The difficulties of BMD can be greatly increased if the attacker screens his real warheads in a cloud of decoys. Discrimination between warheads and decoys will be easier during the part of their trajectory spent within the atmosphere, so that it is likely to pose less of a problem for defences of Europe than of America.

20. Before any expensive systems were deployed, close consideration would need to be given to the vulnerability of the components, both to surprise attack and during a more protracted conflict. In this regard, space-based components are probably the most vulnerable.

21. A very important feature of the strategic posture of the North Atlantic Alliance is to retain a strong 'coupling' or 'linkage' between deterrence against attack on Europe and on North America. A fear generated by the SDI program is that an effective protective 'dome' over North America would leave Western Europe exposed to attack. An American response was that the purpose of SDI was to be able to construct the dome over the USSR, preventing delivery from that country of both ICBMs and IRBMs. Ground-based terminal defences would not produce either kind of huge dome, but would only protect targets in the immediate vicinity of the defensive installations. Space-based sensors might be able to serve defences in both continents.

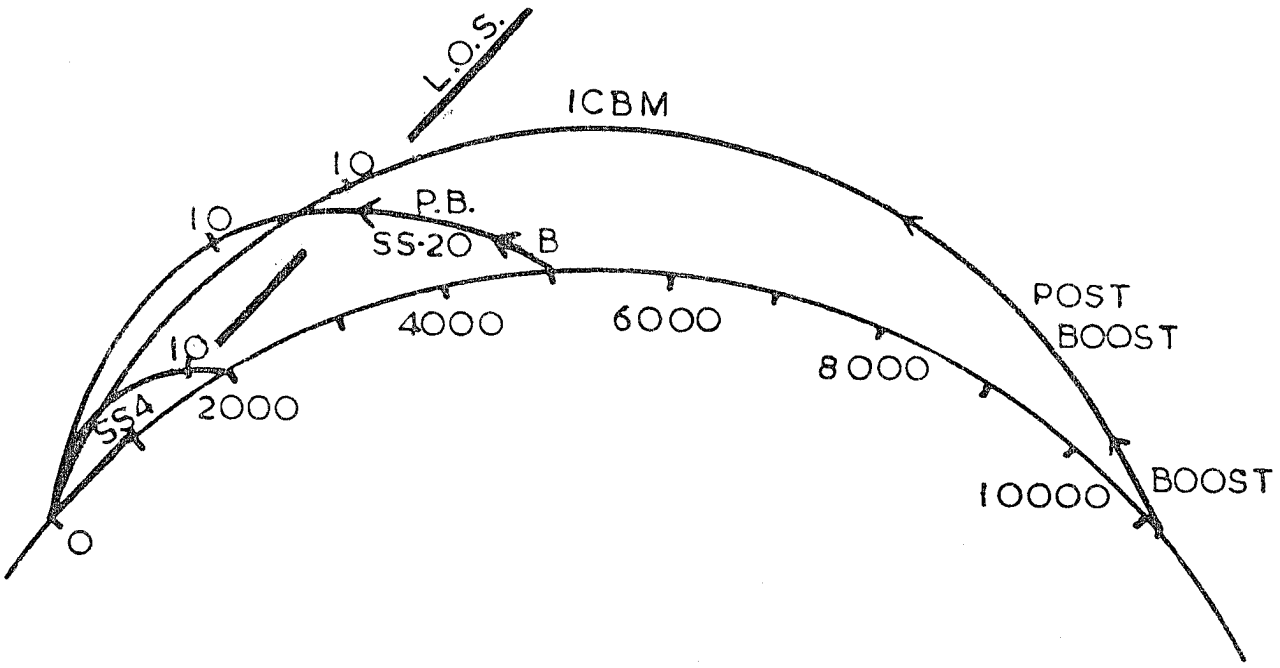
Conclusions

22. Looking towards the possibility of eventual deployment of defensive systems, it would seem likely that the interest of the NATO allies in Western Europe will be attracted towards terminal defences using non-nuclear kill mechanisms, and towards those types of devices for surveillance, acquisition, tracking, and fire control that can operate with a minimum of warning against ballistic missile trajectories much shorter and lower, and with much shorter burnout times than those of ICBMs.

23. It may turn out that nearly all of the equipment needed for BMD in Western Europe would be ground-based, possibly supplemented by sensors in aircraft maintaining continuous patrol, and possibly commencing with improvements to systems originally designed for

defence against aircraft. A multilayered defence for North America would require space-based sensors and a greater variety of anti-missile weapons.

24. Thus, the participation of the Western Europeans in SDI is likely to concentrate on sensors and weapons that operate inside the atmosphere, while the United States will extend its efforts to space, to rapid-acting long range kill mechanisms, and to extraordinarily complicated problems of data processing and computing.

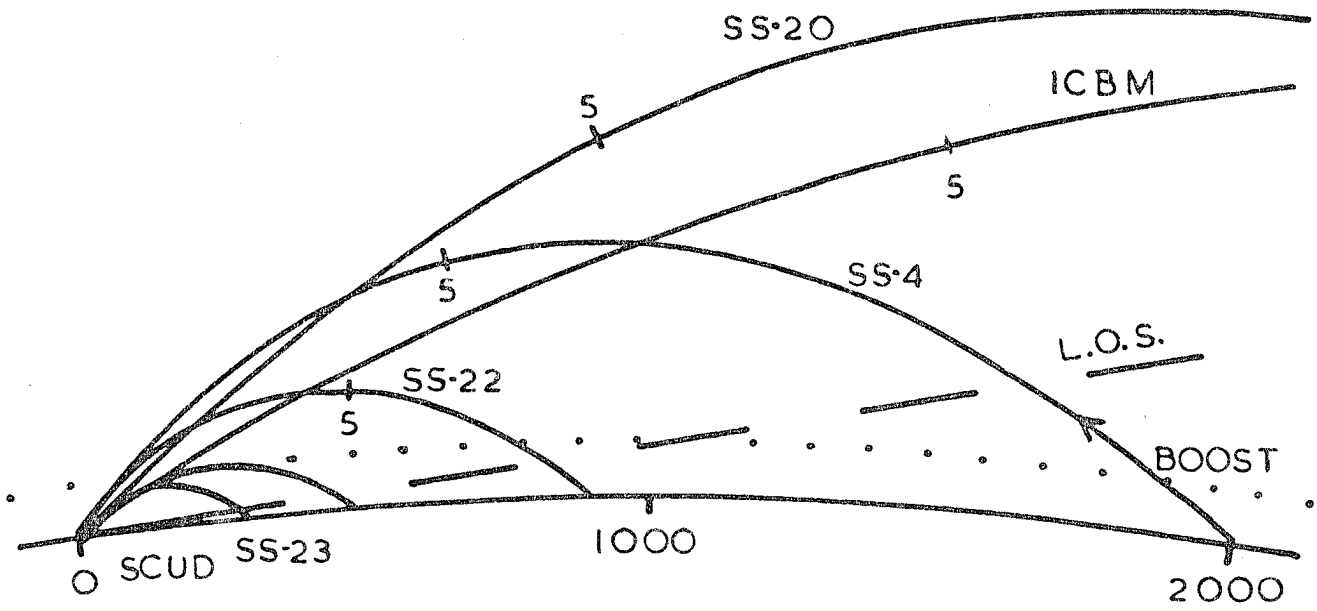


Ranges in km

Times in Minutes

MISSILE	RANGE	FLIGHT TIME	Vo
ICBM	11,000 km	35 Min	7 km/sec
SS-20	5,000	20	5.5
SS-4	1,950	13	3.6

FIGURE I



Ranges in km

Times in Minutes

MISSILE	RANGE	FLIGHT TIME	Vo
ICBM	11,100 km	35 Min	7 km/sec
SS-20	5,000	20	5.5
SS-4	1,950	13	3.8
SS-22 (SCALE BOARD)	900	7	2.5
SS-23	500	6	2.0
SCUD A	300	5	1.5
SS-21	100	3	1.2

FIGURE II

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