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Third Report
of the
Defense Science Board Task Force
on

PENETRATION

15 September 1967

Office of the Director of Defense Research and Engineering
Washington, D. C. 20301

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3RD REPORT ON
PENETRATION
by the
Defense Science Board Task Force

15 SEPTEMBER 1967

OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D.C. 20301

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MEMBERSHIP

Defense Science Board Task Force
on
Penetration

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Dr. Charles W. Hoover	Bell Telephone Laboratories
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OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

15 September 1967

TO: THE SECRETARY OF DEFENSE

THROUGH: THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

The Defense Science Board herewith submits the Third Report of the DSB Task Force on Penetration. This report contains significant findings and recommendations directed toward improving the capability of our strategic bomber force to deliver their nuclear weapons on target. We invite your attention to these recommendations.

F. Seitz

Frederick Seitz
Chairman
Defense Science Board

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OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

29 August 1967

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Third Report

Please accept the third written report of the DSB Task Force on Penetration—on the subject of bombers. Until recently the Panel has devoted itself to missiles only, and I anticipate that we will have quite a few more meetings on the bomber problem before we have reached all our conclusions and recommendations. However, we have some preliminary thoughts, and in particular, the attached report contains a new concept proposed by the Panel for a low-altitude, long-range aircraft-delivered standoff missile. This concept has evoked considerable interest in the Air Force and I believe should be documented by the DSB

A. L. Latter
Chairman
Task Force on Penetration

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The Panel has been educating itself on the subject of bomber penetration (trying at the same time to keep track of ballistic missiles). We have heard briefings by Hdqs. USAF, Cornell Aeronautical Laboratories, and the Air Force Aeronautical Systems Division on pen-aids for the B-52, FB-111 and AMSA (Advanced Manned Strategic Aircraft). In this first report on bomber penetration, we would like to convey a few impressions and one novel suggestion.

By way of background, the current Air Force-preferred configuration for a new bomber is the AMSA—weighing 320,000 pounds; with a supersonic dash capability, and a subsonic range (without the dash)(with one refueling) of 6100 miles, including 2000 miles on the deck; and a payload of about 50,000 pounds. The payload is devoted principally to short range attack missiles (SRAMs) weighing about 2200 pounds each, with a range of 30 to 70 miles, depending upon the mode of delivery (on-the-deck or ballistic). The SRAMs permit the aircraft to stand off from the target, avoiding terminal defenses. Against sophisticated terminal defenses like SAM-D, the SRAMs may have to exhaust the defense supply of interceptors, possibly with the help of decoys. To avoid detection by SAM radars at ranges greater than the SRAM range, the penetration profile for the AMSA is planned to be at an altitude of 200 feet. To cope with area defenses such as F-12/AWACS, reliance is placed on ECM and possibly decoys simulating the AMSA. Consideration is also being given to the use of so-called lethal defense weapons, with which the bomber might destroy the AWACS or the F-12s or even air-to-air missiles launched by the F-12s. The lethal defense weapon and the SRAM could conceivably be combined into a single duel-purpose weapon.

The Panel has misgivings about the penetration capability of the AMSA as currently defined. The aircraft must fly a great distance over defended areas before delivering its warheads. Mobile SAMs or IR seekers could show up unexpectedly along the flight path. The effectiveness of ECM against an F-12/AWACS (which could operate well beyond the Soviet borders) is problematical: ECM may degrade interceptor vectoring accuracy somewhat but may not be able to prevent an F-12 from acquiring. The delivery accuracy of air-to-air missiles might also be degraded somewhat by ECM but probably not enough to do any good if the defense warhead is nuclear. Studies often assume that the defense will be non-nuclear, but in the Panel's opinion this assumption is unrealistic when applied to strategic bombers, especially in the time frame when AMSA would be operational.

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The Panel also notes that entirely new area defenses could appear in the 1975-85 time period. One obvious example, that seems not to be under consideration at all, is to augment the AWACS with a simple passive system of acoustic detectors. Low-flying aircraft make plenty of noise, so that even a coarse, inexpensive network of such detectors could keep more than adequate track of bombers to vector F-12s against them. Another possibility would be to eliminate the F-12s and use long-range (guided) SAMs (perhaps of the Tallinn type), directed against the bombers on the basis of information provided by the acoustic net. Accuracy achievable in this fashion would be quite adequate for SAMs with nuclear warheads. *

Based on such considerations, the Panel asked itself whether there exists a bomber configuration that would be much less vulnerable to possible enemy defenses, particularly area defenses. Is it possible to have a bomber that can release all of its warheads before encountering any of the defenses?

What we have in mind of course is the analogue for bombers of the missile MIRV concept. Just before the bomber reaches the perimeter of the Soviet area defenses, the warheads would be launched, independently targeted and, as in the case of multiple warheads for missiles, spaced so as to avoid multiple kills. By the time the defenses come into play there would no longer be a single valuable target. All the warheads would confront the defenses as individual targets.

The concept we are proposing is of course reminiscent of Skybolt. Skybolt, however, is not very attractive because the number of warheads that can be delivered this way is quite limited. ** In addition, the same defenses that are effective against ICBMs and SLBMs would be effective against Skybolt, whereas we would prefer to force the enemy to a basically different type of defense.

An alternative to Skybolt might be a long-range on-the-deck cruise missile, for instance a longer range version of Hound Dog or a ramjet like the low-altitude supersonic vehicle (LASV) currently being tested by the Air Force. However, both of these vehicles are supersonic,

*For the present purpose our discussion of this type of defense is meant to justify our concern for AMSA penetration. Actually, this defense is of interest in its own right and should be studied as a possible augmentation for our own F-12/AWACS program.

**Skybolt might be MIRVable.

which means that to achieve a great standoff range—upwards of 1000 miles—the gross weight would considerably exceed ten thousand pounds. With such a large gross weight, as in the case of Skybolt, the number of independent warheads per bomber would be too small to be of interest.

The essence of the Panel's idea is to abandon the supersonic requirement—to have a large number of warheads rather than great speed. As far as we can tell, the defense cost to negate an on-the-deck cruise missile is a rather insensitive function of the missile speed. What we propose therefore is something between Mach 0.5 and Mach 0.85. With this speed the remarkable possibility exists of making a long-range cruise missile with a gross weight between one and two thousand pounds.

More specifically, we have considered a fanjet missile weighing about fifteen hundred pounds; with one to two hundred pounds devoted to warhead; a fuel weight of five or six hundred pounds; propulsion, a couple hundred pounds; structure, 350 pounds; and guidance and control, 150 to 200 pounds. There would be some form of terminal guidance such as TERCOM. The missile would fly close to the ground with the aid of terrain-following equipment. Wings would be foldable for easy packaging. The overall missile length would be less than 15 feet. The range of the missile, with the above characteristics, we think might be as much as 2000 miles.

The vehicle we are describing is a hasty Panel design* and should be regarded as tentative until it has been carefully checked out. The parameters chosen are arbitrary. The range of 2000 miles may be unnecessarily great. This point needs careful study. In fact, that is the main purpose of this report: to recommend that the Panel's concept of having a large number of subsonic standoff cruise missiles be thoroughly studied.

The Panel has not yet given much thought to the design of the aircraft that would be most suitable to carry these standoff missiles. Perhaps something like the C-5A would be best; a big airplane tends to minimize the cost of delivered payload. On the other hand, it is very important to design the aircraft so that it can be scrambled quickly on warning and so that it can make use of a great number of makeshift bases—in order to maximize survivability.** It could turn out that the AMSA itself is a reasonably satisfactory aircraft for the purpose—especially a larger subsonic version presently under consideration.

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*The Panel is indebeted to Jim Drake and Joe Wadsworth (Consultants), also to W. H. Krase (RAND), for a quick look at feasibility.

**The C-5A may be satisfactory from this point of view.

Actually, the Panel would like to avoid bringing the AMSA/SRAM configuration into sharp opposition to the long-range standoff-missile version we are proposing. Rather, what we have in mind is an aircraft that can do whatever it is felt the AMSA should do—for instance, penetrate with a lot of SRAMs—but in addition could also carry the long-range standoff missiles and not be forced to penetrate defenses. In short, we are proposing a more versatile bomber system. At this stage it seems plausible that the versatility could be achieved without greatly compromising the proposed AMSA design, since all that is required is compatibility with the on-the-deck cruise missiles. That should be straightforward since the cruise missiles and the SRAMs are roughly the same size and weight.

Thought should be given to defenses that might be especially effective against the low-speed cruise missiles. The Panel, for example, is worried by the possibility of widespread deployment of (cheap non-nuclear) Chaparral-type defenses. (Of course such defenses are even more worrisome for a penetrating aircraft.) We note, however, that a Chaparral cannot produce a weapon kill rapidly enough to prevent salvage fuzing. The warhead would destroy all Chaparral launchers in that vicinity. A large number of standoff missiles, salvage-fuzed, could be launched in train along the same flight path, and if attacked, could clear out a corridor for subsequent missiles.

Before concluding this report, it should be made clear that in suggesting a new bomber configuration, the Panel does not mean to imply that they believe that a new bomber (an AMSA or whatever) is needed. Whether a new bomber is or is not needed is a complex (not entirely technical) question, which the Panel (after discussion with members of ODDR&E) has decided to avoid as much as possible. Rather the Panel proposes to consider the question: assuming that there is to be a new bomber, how should it be configured so as to contribute most to our Assured Destruction (as well as Damage Limiting) Capability?

Actually, the concept we are proposing—multiple independently-targeted low-altitude missile*—is just as applicable to aircraft that we already have (the B-52 and FB-111) as it is to the AMSA. The Panel is anxious to see the concept exploited for all strategic aircraft.

In studying the concept, initial effort should be directed toward establishing technical feasibility. The concept has obvious merit if a

*MILAM (pronounced mi lam).

lightweight, long-range packageable missile can be made. We suggest that preliminary design studies be undertaken as soon as possible by appropriate propulsion and small-airframe contractors. Consideration should be given to the use of high-density hydro-carbon fuels such as Shelldyne. Radar cross-section reduction should be examined. Properly designed, a tiny vehicle like the MILAM should be a very difficult target for the AWACS to acquire. IR suppression, which should be easy for such a low-thrust engine, should be investigated to counter Chaparral-type defenses. After technical feasibility has been demonstrated, parametric trade-offs—based on the contractor designs—can help determine the best choice of range, payload, speed, packaging, etc.

One last comment should be made concerning other possible uses for the long-range on-the-deck cruise missile. In an era of advanced defenses—if that should come about—missiles of this type might be very useful for tactical purposes. The range could be shortened and sizeable HE warheads substituted for some of the fuel. The missiles need not be launched from aircraft. They might be launched from the surface, for example. The possibility of making such dual purpose missiles should be studied.

APPENDIX

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D C 20301

18 February 1967

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Defense Science Board Tasks

I would like the board to undertake an evaluation of our present and advanced developments for ballistic missile penetration and to recommend alternate courses of action where appropriate. A statement of the purpose of the Task Force follows:

> The Soviet are developing a ballistic missile defense which may already be in a state of partial deployment. To be sure that our strategic-missile force remains effective against this evolving threat, measures must be taken to ensure adequate penetration. Of all the measures that have been proposed for improving ballistic missile penetration capability, the only one that appears to increase effectiveness independently of the details of the defense system is multiple warheads, already incorporated in the POLARIS A-3 and planned for MINUTEMAN and POSEIDON. The task force will consider the question whether this measure by itself is an adequate response—if not with the present POLARIS and MINUTEMAN systems, then possibly with larger-payload missiles like POSEIDON or a new ICBM for which the cost per unit weight of payload is considerably reduced.
>
> It is anticipated, however, that multiple warheads alone may not be a correct single approach and that some of the other proposed measures should also be employed. To make these other measures effective, however, we may have to wait until late in the defense deployment stage for the necessary intelligence information concerning the characteristics of the defense. In this situation it is essential to have a quick reaction capability for deploying the appropriate penetration aids—and for continual modification of these penetration aids as the defense posture undergoes further changes. To achieve such a quick reaction capability, it is necessary to select out of the vast array of penetration-aid possibilities, a number of specific ones that seem most likely to be effective against a plausible evolution of the threat, and to emphasize R&D of these penetration aids to bring

them to a state closer to operational readiness. The task force will address the question of which penetration aids are the most promising, and to what degree of readiness they should be brought.

I envision that this Task Force will remain in existence to be able to provide continued direction as both the threat estimation and our technology capability changes. Preliminary recommendations should be available by 1 June 1966.

Mr. Daniel J. Fink has been named cognizant Deputy for this task and will provide staff support as required.

/s/

John S. Foster, Jr.