

DE 91011252

*Inverse Ultravelocity Slings
for Boost-Phase Defense*

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

19980513 120

DTIC QUALITY INSPECTED 4

PLEASE RETURN TO:

BMD TECHNICAL INFORMATION CENTER
BALLISTIC MISSILE DEFENSE ORGANIZATION
7100 DEFENSE PENTAGON
WASHINGTON D.C. 20301-7100

Los Alamos

Los Alamos National Laboratory is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36.

U 3155

Prepared by Bo West, P Division

An Affirmative Action/Equal Opportunity Employer

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither The Regents of the University of California, the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by The Regents of the University of California, the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of The Regents of the University of California, the United States Government or any agency thereof.

*Inverse Ultravelocity Slings
for Boost-Phase Defense*

Gregory H. Canavan

Accession Number: 3155

Publication Date: Apr 01, 1991

Title: Inverse Ultravelocity Slings for Boost-Phase Defense

Personal Author: Canavan, G.H.

Corporate Author Or Publisher: Los Alamos National Laboratory, Los Alamos, NM 87545 Report Number: LA-12077-MS

Report Prepared for: U.S. Department of Energy, Washington, DC

Descriptors, Keywords: SDI Brilliant Pebble Boost Phase Interceptor Defense Submarine Theater Attack ICBM SSBN

Pages: 00006

Cataloged Date: Sep 25, 1991

Contract Number: W-7405-ENG-36

Document Type: HC

Number of Copies In Library: 000001

Original Source Number: DE91-011252

Record ID: 22616

Source of Document: DOE

CONTENTS

ABSTRACT	1
I. INTRODUCTION	1
II. ANALYSIS	2
III. SUMMARY AND CONCLUSIONS	4
REFERENCES	5

INVERSE ULTRAVELOCITY SLINGS FOR BOOST-PHASE DEFENSE

by

Gregory H. Canavan

ABSTRACT

Existing booster technology, brilliant pebble interceptors, survivable platforms, and developed warning, command, control, and communication could provide boost-phase defenses with the capability and flexibility required to significantly reduce the effectiveness of submarine and theater attacks.

I. INTRODUCTION

The paper that introduced "brilliant pebbles" as boost-phase defenses also discussed their use as ultravelocity slings. The slings would use conventional boosters to accelerate very small payloads to high enough velocities to reach intercontinental ballistic missiles (ICBMs) in their boost phase from launchers in the US.¹

For ICBMs, slings' performance would degrade in time if the ICBM boost and deployment times were reduced, because the velocities required would be prohibitive. For SLBMs that need not be the case. From the shore or from ships in the same bodies of water in which SSBNs were deployed, slings would have shorter ranges and could remain viable.

The same is true of theater defenses, where forward basing would overcome Earth curvature and allow a single site to cover all of Europe and much of Asia. That would overcome the large,

redundant inventories that are thought to penalize ground-based theater missile defenses.²

II. ANALYSIS

A useful point of reference is the exoatmospheric intercept system (ERIS) interceptor, which uses a booster weighing $M_B \approx$ a few tons to accelerate a $M_E \approx 300$ kg kill package to $V_E \approx 5$ km/s.³ A booster of roughly that size should be able to accelerate a $M_B \approx 30$ kg brilliant pebble to $V_E \approx V_E + c \cdot \ln(M_E/M_B) \approx 5$ km/s + $2.5 \cdot 5.8 \approx 19.5$.

Brilliant pebbles have an additional velocity increment of ≈ 6 km/s, so their kill packages could be accelerated to 20-25 km/s, 6-7 times the SLBM's average boost-phase velocity. With that velocity a sling could reach SLBMs by their booster burnout at $T \approx 300$ s from a distance of $\approx 6,000$ km away. No patrol areas have radii that large; ideally a single ship could cover an entire basin. There could, however, be delays in initiating and executing the intercept.

For booster of average acceleration a , the time to reach V is V/a , which reduces the sling's range by $V^2/2a$. For $V = 20$ km/s and $a = 20$ g, the acceleration time is ≈ 100 s, and the range reduction is about 1,000 km, which are significant, but tolerable. For lower velocities the penalties would be less. The time to detect launch and establish track with current sensors could be comparable to the acceleration time, but for many, low altitude sensors with overlapping coverage, e.g. brilliant pebble eyes, the time could be much shorter.

The longest delay could be that for the decision to release the sling. For phase 1 space based boost-phase interceptors that delay is estimated to be a few minutes; it could be reduced for later phases.^{4,5,6}

Taking these delays into account, the slings' range is approximately

$$R = V(T - T_d) - V^2/2a, \quad (1)$$

where T_d is the delay for release. Figure 1 shows range versus sling velocity for SLBM engagement times of $T = 200, 300,$ and 400

s and a current T_d of 120 s. For 400 s, which is typical of current SLBMs, the range roughly doubles from 2.5 to 5.5 Mm as V increases from 10 to 25 km/s. For 300 s the difference is under a factor of 2. For 200 s the range flattens out, because the fly out time, $T - T_d \approx 80$ s is so short that the sling spends little time at maximum velocity.

The engagement time is made up of the SLBM booster burn and bus deployment times. The former is currently ≈ 300 s; fast burn booster technology is harder to employ for SLBMs, so the burn time could remain at 200-300 s. Bus deployment times are currently ≥ 300 s. For current serial deployments the number of RVs released increases roughly linearly from 0 at T to all of them at $T + T_d$, so on the average the value of a bus phase intercept is only about half. The 400 s engagement time assumes roughly half of the intercepts of current 300 s buses.⁷

In time buses could get faster, but if their boosters could only get down to 150-200 s, even parallel deployment, which involves a significant penalty in the number of RVs carried, would leave the engagement time at 300 s. Thus, Fig. 1 indicates that ranges of 2-5 Mm should be possible with developed sensors and control.

Figure 2 shows the sensitivity to decision times from 0 to 150 s. The velocity plotted is that needed to reach a SLBM at range 2 Mm. The bottom curve is for a current $T = 400$ s. At $T_d = 0$, i.e. automatic launch, $V \approx 5$ km/s; even for $T_d = 100$ s, $V \approx 7$ km/s, which could be reached with current kill packages. The top curve is for $T = 300$ s. At $T_d = 0$, $V \approx 7$ km/s; for $T_d = 100$ s, $V \approx 12$ km/s, which is well within the capabilities estimated above. Comparing the two curves suggests that slings should be relatively insensitive to delays of a few minutes.

These comments are predicated on the survival of the sling launch platform. Although they would only have to survive for the first few hundred seconds, they would presumably be attacked before launch if their purpose was known, since they would be in open water. One approach would be to spread the slings over a number of smaller vessels or SSNs, which would reduce the mass

and improve performance. An alternative would be to conceal the slings on nonmilitary flag ships in transit. Their modest masses could make that attractive and noninterfering.

III. SUMMARY AND CONCLUSIONS

Simple estimates indicate that a combination of existing booster technology, brilliant pebble interceptors, survivable ocean platforms, and developed warning, command, control, and communication could provide boost-phase defenses with the capability and flexibility required to significantly reduce the effectiveness of SSBN launchers. This report adds little technically to the original note; it mainly points out that the current interest in theater defenses could justify further study.

REFERENCES

1. L. Wood, "Brilliant Pebbles and Ultravelocity Slings: A Robust, Treaty-Compliant Accidental Launch Protection System," Lawrence Livermore National Laboratory report UCRL (draft), 28 May 1988.
2. G. Canavan, "Defensive Technologies for Europe," S. Lakoff and R. Willoughby, Eds. Strategic Defense and the Western Alliance (Lexington: Boston, 1987).
3. T. Postol, "Implications of Accidental Launch Protection Systems for US Security," Statement before the House Armed Services Committee Panel on SDI, 20 April 1988; New Scientist, 21 April 1988.
4. A. Carter, "The Command and Control of Nuclear War," Scientific American, 252(1), pp. 32-39, January 1985.
5. J. Gardner, E. Gerry, R. Jastrow, W. Nierenberg, and F. Seitz, Missile Defense in the 1990s (Marshall Inst., Washington, DC, 1987).
6. F. Ikle and A. Wohlstetter, Discriminate Deterrence, Report of the Commission on Integrated Long-Term Strategy (Washington DC, US Government Printing Office, January 1988).
7. G. Canavan, "Directed Energy Architectures," Los Alamos National Laboratory report LA-11285-MS, March 1988; Proceedings "SDI: the First Five Years", Institute for Foreign Policy Analysis, Washington, DC, 13-16 March 1988.

Fig. 1 Range vs velocity

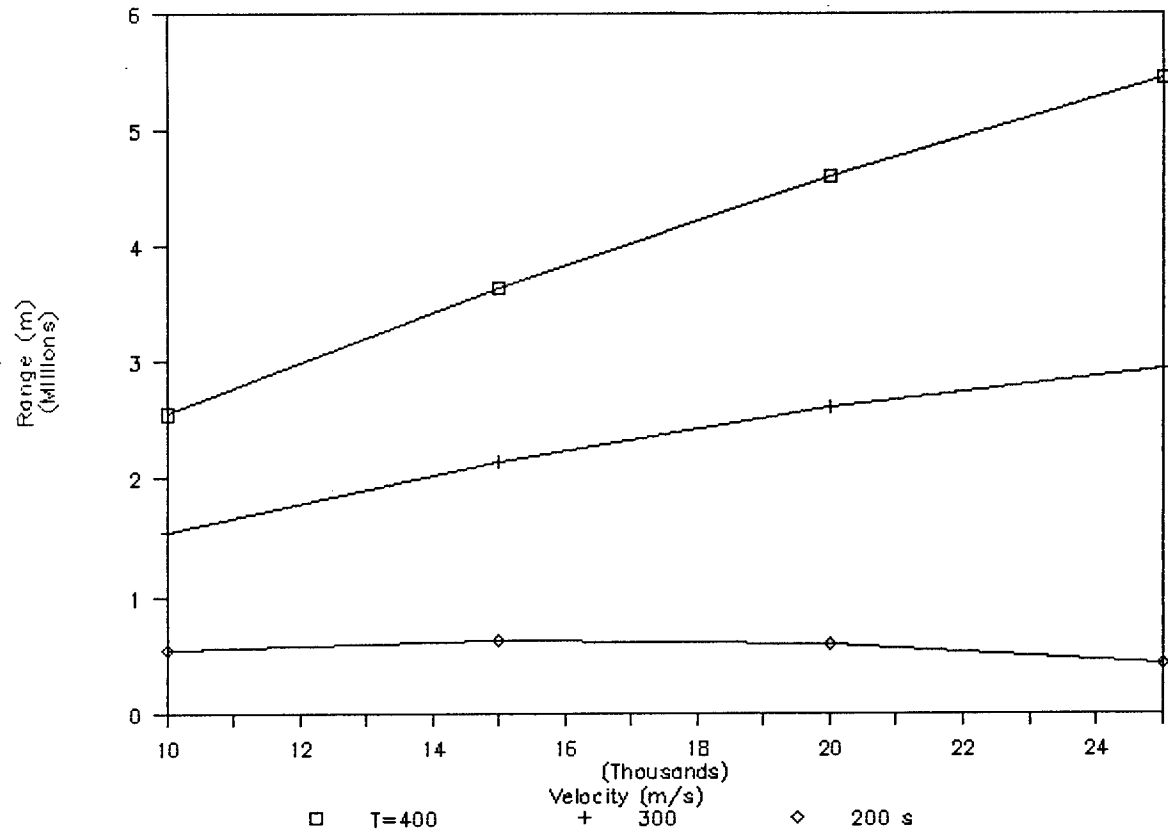
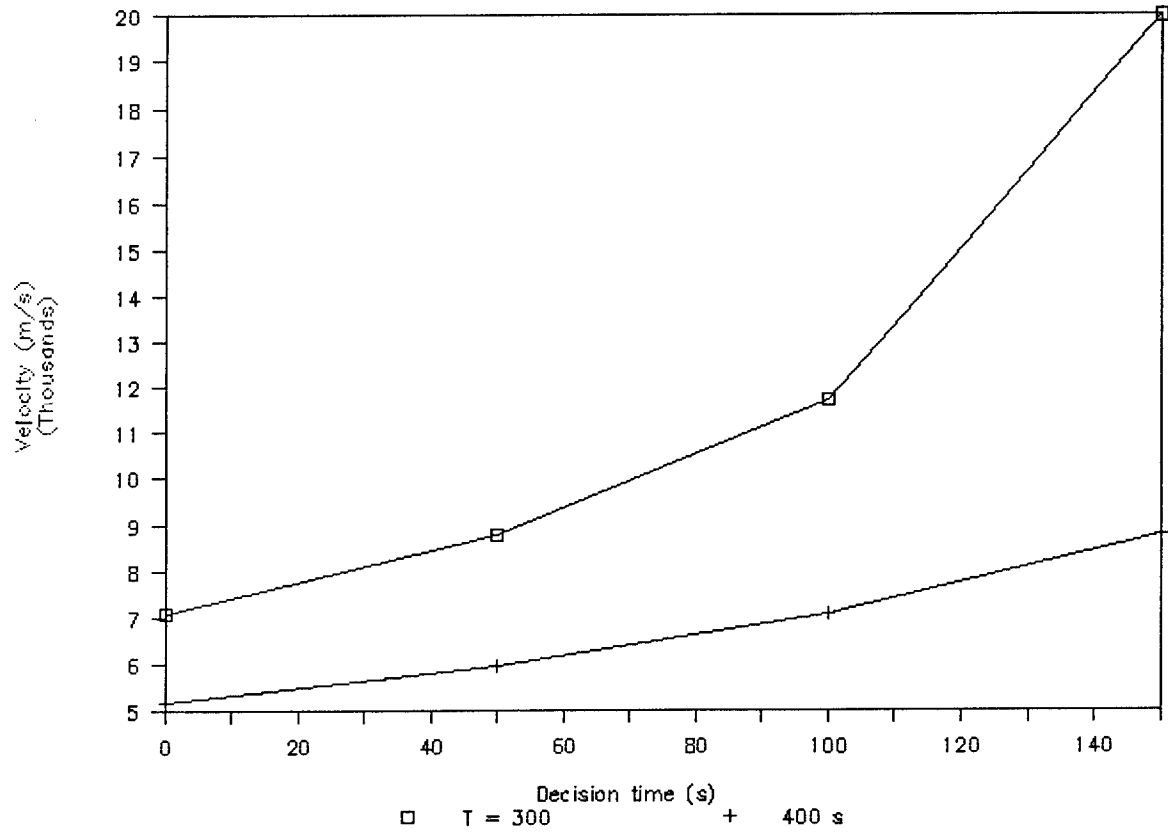


Fig.2 Velocity vs decision time



This report has been reproduced directly from the best available copy.

It is available to DOE and DOE contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831. Prices are available from (615) 576-8401, FTS 626-8401.

It is available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.