Report To Congress:

Conceptual And Burden Sharing Issues Related To Space-Based Ballistic Missile Defense Interceptors

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March 1992

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Accession Number: 3429

Publication Date: Mar 01, 1992

Title: Report To Congress: Conceptual and Burden Sharing Issues Related to Space-Based Ballistic Missile Defense Interceptors

Corporate Author Or Publisher: Department of Defense, Washington, DC 20301

Comments on Document: Report in compliance with Missile Defense Act of 1991

Descriptors, Keywords: Refocus SDI GPALS Deployment Space Based Interceptor Brilliant Pebbles BP Ballistic Missile MDA Theater Missile Defense TMD THAAD CORPS SAM ERINT GBI BE Brilliant Eyes

Pages: 00033

Cataloged Date: Apr 06, 1992

Document Type: HC

Number of Copies In Library: 000001

Record ID: 23586

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I. Introduction

In compliance with the Missile Defense Act of 1991 (MDA), this report addresses "the conceptual and burden sharing issues associated with the option of deploying space-based interceptors (including Brilliant Pebbles) for the purpose of providing global defenses against ballistic missile attacks." These issues are best addressed in the context of the redirection of the SDI program, which reflects the recent dramatic changes in the international environment and emerging bipartisan support for developing and deploying effective defenses against limited ballistic missile strikes, whatever their source.

The positive changes in the U.S. relationship with the newly independent states of the former Soviet Union and the fundamental changes in Eastern Europe have markedly reduced the danger of a war in Europe that could escalate to the strategic nuclear level. Nevertheless, the threats posed by an accidental or unauthorized launch and by the proliferation of ballistic missiles have continued to increase.

In response to these trends, President Bush redirected the SDI in his 1991 State of the Union Address to pursue the limited deployment of a missile defense system. The goal of this defense is to protect U.S. forces deployed overseas, U.S. power projection forces, U.S. friends and allies, as well as the United States itself from accidental, unauthorized, and/or limited ballistic missile strikes. Because this concept stresses protection against ballistic missiles irrespective of their source, it is called Global Protection Against Limited Strikes (GPALS).

During the past year, the validity of that missile defense goal and the corresponding decision to redirect the SDI program has been underscored by Iraq's use of Scud missiles in the Gulf War and the continuing political uncertainties in the former Soviet Union.

The MDA represents a significant step toward meeting these goals—indeed it accelerated certain aspects of the President's plan. Nevertheless, one area of considerable controversy is Brilliant Pebbles (BP). After providing background elaboration on the President's approach and reviewing the MDA, this congressionally mandated report addresses the conceptual and burden sharing issues of BP in detail. The conclusion of this assessment is that BP is needed for high confidence, cost-effective U.S.

homeland and theater defenses. While BP's primary justification is to support U.S. national security requirements, the fact that it can help defend allies and friends means greater worldwide stability and therefore less likelihood that the U.S. would be drawn into a future conflict.

II. Background

A New Geostrategic Paradigm

The dramatic changes in Eastern Europe and the former Soviet Union, and events in the Persian Gulf have served to underscore the fact that the strategic environment the United States will confront in the 1990s will differ significantly from that which it faced in the early 1980s when the SDI Program was established. Because of these changes, which include the continued proliferation of ballistic missiles and weapons of mass destruction on a global scale, ballistic missile defense has become far more urgent and relevant to address these changes than could have been projected from the perspective of the early 1980s.

A fundamental assumption of U.S. military policy in the post-World War II era has been the need to prepare for global war with the Soviet Union, a war that was generally expected to begin with a short-warning attack into Western Europe. Furthermore, U.S. strategy to contain regional instability and conflicts derived directly from Moscow's expansionist strategy and our own efforts to counter that expansionism. In the realm of strategic systems, the growth in Soviet capabilities appeared to be relatively unconstrained by resource limitations.

In the past three years, historic changes in the strategic environment have transformed our primary security assumptions. The former Soviet empire has collapsed and been replaced by a commonwealth of independent states; Communist governments have collapsed in Eastern Europe and are being replaced by independent democratically elected governments; a unified Germany is a member of NATO; and the Warsaw Pact has formally been dissolved. The threat of a short-warning, conventional attack against Western Europe leading to global war is now less likely than at any time in the last 45 years.

While the conventional threat posed by the military forces of the former Soviet Union has declined and therefore the threat of global conventional conflict has receded, the potential for major regional threats to U.S. interests is growing. Although a new era holds the prospect for treating regional issues independent of the East-West context, we have witnessed the sobering truth that local sources of instability will continue to foster conflict. These conflicts, as the Gulf War has illustrated, can arise suddenly, unpredictably, and from unexpected quarters. The Gulf War presages the type of military conflict we are most likely to confront in this new era—major regional contingencies, often very far from home, against foes well armed with advanced conventional and unconventional weaponry. The proliferation of ballistic missiles and weapons of mass destruction increases the danger associated with these potential conflicts.

Today over 15 nations have ballistic missile capabilities. By the year 2000, perhaps 20 nations may have them and some of them will have weapons armed with chemical, nuclear, and possibly even biological warheads. A major implication for future regional conflicts that clearly emerges from the Gulf War is the military and political importance of possessing a capability to counter defensively the threatened or actual use of ballistic missiles and weapons of mass destruction.

This evolving political-military environment is fundamentally different from the bipolar geostrategic paradigm of the past 45 years. The basic framework of East-West relations has been altered by the political reorientation of Eastern Europe and demise of the Soviet Union; and regional instabilities, combined with the proliferation of advanced military technology, will pose a significant threat to the security interests of the United States and its friends and allies.

The New Emphasis On Defenses

Future Secretaries of Defense will need to be able to deploy defenses against ballistic missiles—whether against the kind of theater threat we face today, or the far more sophisticated threats we anticipate in the future. Defenses to protect the United States, and its overseas forces, friends and allies from limited ballistic missile strikes, would be an important component of the new U.S. military strategy, which focuses primarily on regional contingencies. U.S. defense planning and military forces must be prepared for a large number of potential contingencies that could occur in

various locations and with little warning, including limited ballistic missile strikes and the possibility of accidental and unauthorized ballistic missile launches.

While we are satisfied with the assurances we have received from Russia and the other three nuclear republics with regard to the maintenance of unified control over all the nuclear weapons of the former Soviet Union, the possibility of future political instability still creates concern about the potential for accidental and unauthorized strikes. Furthermore, the proliferation of ballistic missiles will multiply the possibilities for such a strike because of the increased chance that a missile launch could result from political instability within the acquiring countries or inadequate command and control safeguards. Countries with recently acquired missile arsenals may lack the technical safeguards and practical experience necessary to ensure that missiles cannot be launched without proper authorization, or as a result of mechanical malfunction or human error.

The purpose of strategic defense forces is to protect the United States against ballistic missile attack or coercion. A combined space- and surface-based defensive architecture would provide the highest confidence strategic defense for the American homeland against future limited missile threats and strikes, including accidental and unauthorized launches. Such a defensive capability could also contribute to the deterrence of intentional limited strikes by undermining their potential military or political value.

A combined defensive architecture also will uniquely support the other major elements of the new military strategy, particularly including forward deployment and crisis response. U.S. forward deployed and expeditionary forces will increasingly be operating within range of ballistic missile threats. U.S. missile defenses, in combination with those our allies and coalition partners might deploy, would protect us and them in maintaining a forward military presence in those areas threatened by ballistic missiles and would support our aim of continuing to play a leadership role in preserving global stability.

The ability to provide U.S. forces in the field with protection against ballistic missiles will support both the forward presence and crisis response capability of U.S. forces. In particular, active defense will be critical to provide protection, even on short notice, of ports and airfields for expeditionary forces and their reinforcement. In combination with active

defense, counterforce operations, C^3I and passive defense, the U.S. is provided with a capability to respond to the full range of military threats. In addition to providing protection, defenses could serve to defuse regional crises by contributing to the deterrence of ballistic missile attacks and offering a non-provocative, defensive response in the event of attacks. The Gulf War demonstrated the importance of having missile defenses as a non-escalatory means of crisis management in support of the new U.S. strategy; by providing Israel with a defensive response to Iraqi Scud attacks, defenses helped avoid an escalation of the conflict that could have destroyed the solidarity of the coalition.

In addition, the capability to defend cities and military targets against missile strikes would help ensure that neither the United States nor future coalition partners could be deterred by missile threats were it necessary to employ military power abroad to support U.S. national security objectives. The potential importance of such a defensive capability was highlighted by the Gulf War experience: had Saddam Hussein been capable of threatening missile strikes against civilian and military targets in the United States, Britain, and other coalition partners, it is likely that establishing and maintaining the coalition throughout Desert Shield and Desert Storm would have been more difficult. The high confidence, continuous, and global defensive coverage uniquely provided by space-based interceptors would be particularly important to mitigate such prospective coercive threats.

The Gulf War also illustrated the limitations involved in relying only on deterrence or offensive strikes to protect against ballistic missiles: Israeli cities were struck despite the credibility of the Israeli retaliatory threat; destroying Scuds offensively ultimately involved almost 2,500 air sorties and was only partially successful; and, while the air sorties did result in a change in the tempo and scale of Scud operations, the presense of active defenses could have provided immediate protection to Israel before the air campaign began and could have provided protection to U.S. forces killed in their barracks by Scud attacks at the end of the war.

The limited deployment of defenses will also support the new strategy's emphasis on force reconstitution. A capability to protect against limited strikes represents an appropriate level of defense within our strategic force structure, based on our current planning assumptions. If more ambitious missile defense capabilities are required in the future as a result of

changes in the international environment, the SDI Program will be developing the systems and technologies required to respond.

Finally, the limited deployment of defenses would also be an integral element in U.S. efforts to curtail ballistic missile proliferation. Defenses would undermine the military utility of such systems and should serve to dampen countries' incentives to acquire ballistic missiles. In addition, defensive protection offers an alternative means to respond to ballistic missile threats.

III. The President's Refocusing Of SDI

In his 1991 State of the Union Address, the President stated,

> "...Looking forward, I have directed that the SDI Program be refocused on providing protection from limited missile strikes, whatever their source. Let us pursue an SDI Program that can deal with any future threat to the United States, to our forces overseas, and to our friends and allies."

As a result, the program presented to Congress during 1991 was structured to develop options for deployment by the end of this decade of many of the same space- and ground-based elements of the previous SDI architecture—but in substantially reduced numbers. Rather than being sized to help deter a massive Soviet attack (now judged to be substantially less likely) involving thousands of ballistic missile weapons, the new SDI plan, involving half the ground-based interceptors and one-fourth the space-based interceptors previously planned in the Phase I Architecture, would protect the United States against limited attacks involving up to 200 ballistic missile warheads.

Consistent with the mandate in the FY 91 Defense Appropriations Act, the Administration also proposed an accelerated program to develop and deploy advanced Theater Missile Defense (TMD) systems (potentially based in-theater or transported there when needed, or based on ships). These systems, along with those being developed by our allies and friends, could be integrated into a global defense. This integrated defense would be significantly more effective than the Patriot defense demonstrated in the

Gulf War, as well as more efficient against theater missiles with ranges longer than the Scud.

The Administration calls this overall integrated plan for strategic and theater missile defenses Global Protection Against Limited Strikes, or GPALS. Global means protecting U.S. worldwide interests with theater defenses as well as defenses for the American homeland. Protection means the objective is high confidence of extremely low or no leakage. Limited means up to 200 attacking ballistic missile warheads in a variety of scenarios.

The scale of limited strikes depends on their source. For Third World threats we might expect one to a few tens of missiles launched simultaneously. For an accidental launch, we might be concerned with the launch of a single ICBM having 10 nuclear warheads or with the launch of a few such missiles. For an unauthorized launch, it might involve a regiment of ICBMs (e.g., 10 ICBMs with 10 warheads each) or of a full submarine of SLBMs (e.g., 20 SLBMs with 10 warheads each), launched within a short time. For advanced missiles, penetration aids could accompany the nuclear warheads. Missiles from some Third World countries might have primitive penetration aids, or none at all.

GPALS Description

The GPALS concept, which would protect against limited strikes, is less than half the size of the previous SDI Phase I architecture and would consist of surface- and space-based elements. Figure 1 depicts the integrated nature of the three segments of GPALS. The size of the respective pieces of the puzzle reflect the relative acquisition costs i.e., the ground-based segment for homeland defense will likely cost about 2.5 times that of either Brilliant Pebbles or the Theater Missile Defense Segment.

The defensive elements that comprise GPALS could be deployed sequentially as the technology is tested and proven, and need not await the deployment of the entire GPALS system. Nor would the deployment of a GPALS system be contingent on the technical maturity of follow-on systems. A GPALS defensive system would consist of the following:

- Space- and surface-based sensors capable of providing global, continuous surveillance and track, from launch to

intercept or impact, of ballistic missiles of all ranges. The use of space-based sensors would allow for a reduction in the size, cost, and number of the surface-based weapons and sensors, while increasing their performance. In combination, the sensors would provide information to U.S. forces and, potentially, to those of our allies as well.

- Interceptors, based both in space and on the surface, capable of providing high-confidence protection to areas under attack. Space-based interceptors could provide continuous, global interdiction capability against missiles with ranges in excess of approximately 500 km or about 300 miles. The surface-based interceptors, located in the United States, deployed with U.S. forces and, potentially, deployed by U.S. allies, would provide local point and area defenses.

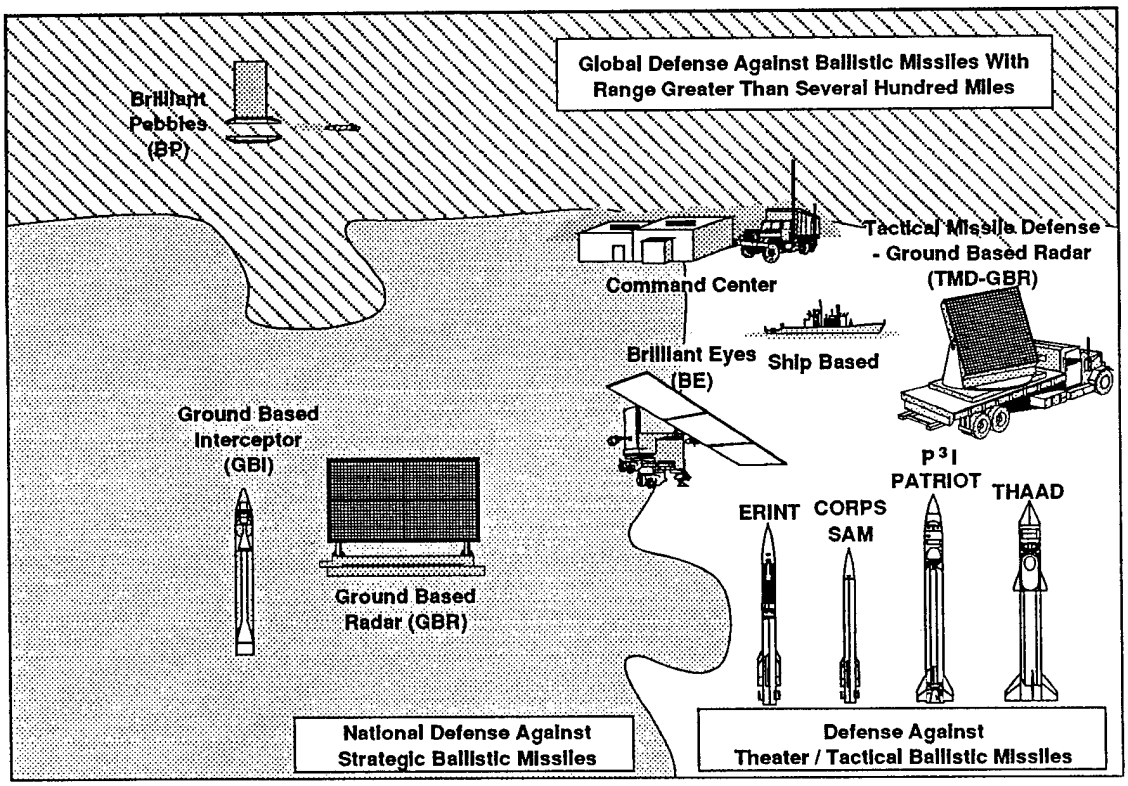

Figure 1. Global Protection Against Limited Strikes (GPALS)

A layered defense, including the combination of surface- and space-based interceptors and sensors, would provide the highest level of confidence inthe effectiveness of the defenses, and, over the full range of GPALS missions, would do so in the most cost-effective manner.

The use of multiple defense layers where each successive layer benefits from the action of previous layers, maximizes defense capabilities and reduces vulnerability to offensive countermeasures. Each separate layer, with its individual sensing, management, and intercept technologies, operates to increase the effectiveness of the total system and confidence in its performance.

Common to all the GPALS interceptors is the use of nonnuclear, hit-to-kill technology for destruction of all types of warheads—nuclear, chemical, biological, and conventional. The combination of space- and ground-based interceptors in independent layers of defense will ensure multiple opportunities to engage such threats and permit destruction of both missiles and warheads well away from the targets being defended.

Multiple early engagements, well away from the defended targets, are necessary to achieve high-confidence protection against even relatively small attacks. Because *deterrence* was the objective of the earlier Phase I SDI architecture, a significant degree of leakage was judged to be acceptable. The Phase I architecture would have enhanced deterrence of a massive Soviet attack involving several thousand ballistic missile warheads, even though over half of those warheads would have "leaked" through the defense in the event of a massive attack. Because *protection* against limited strikes is the objective of GPALS, however, the technical challenge is to achieve high confidence of very low or no leakage. Such high confidence protection requires multiple and early engagement opportunities.

Early engagements permit the destruction of attacking missiles armed with weapons of mass destruction well away from the intended target. A capability for doing so is critical because, for example, if attacking high-yield nuclear weapons were detonated as a result of intercept at less than approximately 50 km altitude, major fire damage and destruction could result to cities beneath that detonation. A number of the GPALS elements could provide this capability. The capability to destroy weapons of mass destruction over the territory of the country launching the attack would be

optimal. The inclusion of space-based interceptors in a multilayered architecture would provide the key means of achieving such a defensive capability.

Theater Missile Defense

Given their integration in the GPALS concept, and to attain maximum military effectiveness and economic benefits in closely related technologies, the Department's TMD and SDI Programs have been integrated. Given our experience with theater ballistic missile threats in the Persian Gulf War, and the fact that these threats will become more sophisticated in the future, we are pursuing the development and deployment of advanced theater defenses by the mid-1990s as an urgent priority.

The Theater/Tactical elements of GPALS will be able to be deployed globally by the United States. These forward elements of our ballistic missile defense will be transportable and could be deployed with land or naval forces. Interceptors could be based in-theater continuously and moved to "hot spots" as needed. Friends or allies may also choose to deploy theater defenses that could be interoperable with those of the United States.

The goal is to provide layered defenses to achieve true area, as opposed to point, defense and high probability of success by employing improved (longer range) interceptors and sensors. Part of the program is evolutionary in that it begins with near-term improvements to Patriot. New active missile defense systems under development include the wide area, high altitude interceptor and sensor known as the Theater High Altitude Area Defense (THAAD) system; an autonomous missile called the Extended Range Interceptor (ERINT); CORPS SAM, a concept for complete replacement of the Hawk antiaircraft system with an antimissile, antiaircraft-capable system; and upgrades to the Navy's Aegis system. In addition, the U.S. is cooperating with Israel in developing the ARROW / ACES long-range theater defense interceptor.

The TMD program will develop options to allow a layered approach to theater defense. Ground-based and sea-based theater defense interceptor systems are necessary to protect against endoatmospheric ballistic missiles and to provide mid-course and terminal defense capability against missiles whose trajectories extend above the atmosphere. This layered approach will

ensure that overall system performance would be further enhanced because of the added early warning and target tracking information once space-based sensors (Brilliant Eyes) are coupled to the theater defense. Space-based sensors, able to provide high quality track information directly to the THAAD interceptor, for example, could increase several fold the defended radius of one battery. The use of space-based interceptors would complement the defense layering for TMD, providing the ability to engage missiles with ranges greater than 500 km early in their trajectories.

Ground-Based Tier for Homeland Defense (Limited Defense System)

A ground-based defense system for highly effective protection of the American homeland against limited strikes is being developed for deployment as part of GPALS before the end of the decade. The ground-based architecture consists of a command center and a combination of Brilliant Eyes (BE) satellites, terminal phase Ground-Based Radars (GBRs), and Ground-Based Interceptors (GBIs). An option also exists to add the Ground-Based Surveillance and Tracking System (GSTS) to the architecture. Such a limited defense system is consistent with the national defense system called for in The Missile Defense Act of 1991.

Up to seven ground-based interceptors sites, including sites in Alaska and Hawaii, could provide complete coverage of the United States against the variety of threats. The protection mission requires space-based tracking sensors such as Brilliant Eyes to support the ground-based interceptors and ground-based radars. With cueing from Brilliant Eyes, the ground-based interceptors could have independent engagement opportunities after an offensive missile has reached the apogee of its trajectory, as illustrated in Figure 2. Several interceptors could be "salvo launched" at each of these post-apogee independent engagement opportunities. Note that longer range missiles permit additional independent engagement opportunities.

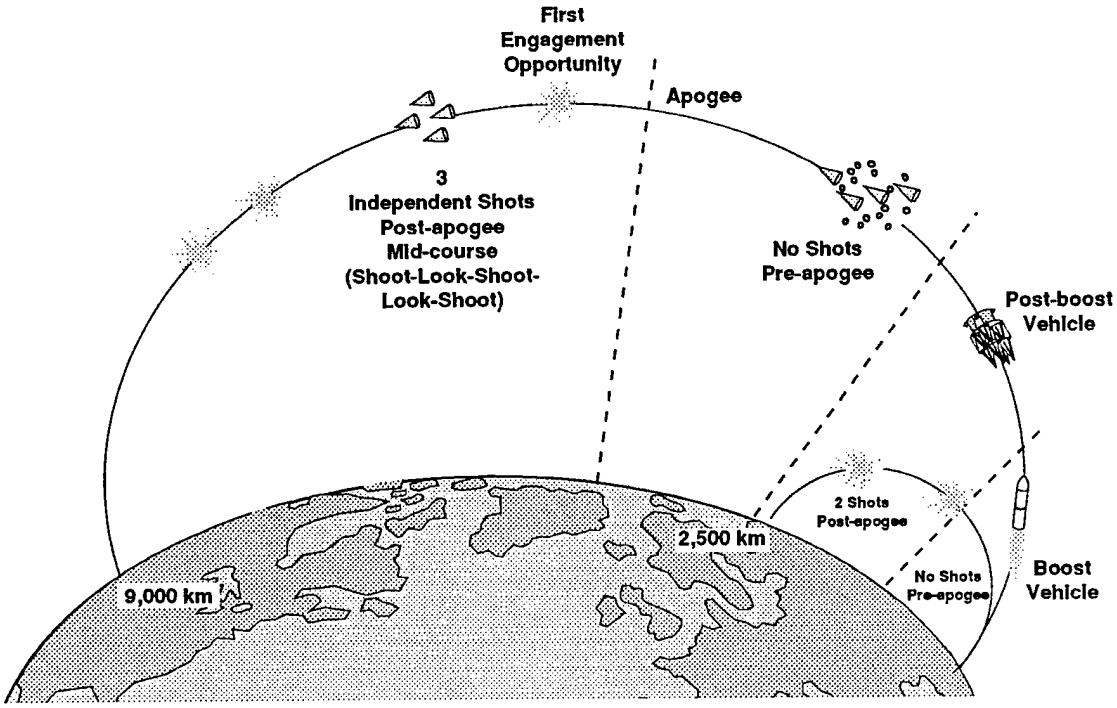

Figure 2. Independent Shot Opportunities For Ground Based Interceptors

Space-Based Interceptors

Brilliant Pebbles (BP) is a space-based, highly autonomous, proliferated, surveillance and kinetic hit-to-kill interceptor system. The BP concept consists of single interceptors and their associated "life jacket" carrier vehicles. The interceptor incorporates sensors, guidance control, battle management, and an axial propulsion stage. The interceptor will possess high-rate attitude control, on-board data processing, navigation, and divert propulsion capabilities. Each life jacket provides on-orbit power, low-rate attitude control, surveillance, communication, thermal control, and protection from the space environment and hostile countermeasures. Ground control systems will provide man-in-the-loop, positive control of the BP constellation.

The BP constellation planned for GPALS would include

approximately 1,000 interceptors, constituting the initial layer of a multilayered defense against both strategic and theater ballistic missiles. It would offer a defensive tier with warning, command and control, sensing, and intercept technologies that are independent of those dedicated to the surface-based layers.

BP would be continuously in position to provide global detection of an attack and a means to destroy both strategic and theater ballistic missiles. It could act autonomously to provide highly effective protection against a limited number of missiles, regardless of their source, that exceed 80 km altitude for more than about three minutes, as would be the case for missiles following minimum energy trajectories with ranges greater than approximately 500 km. Additionally, BP has shot opportunities against realistically depressed trajectory ballistic missiles with ranges greater than approximately 700-800 km. (See Figure 3.)

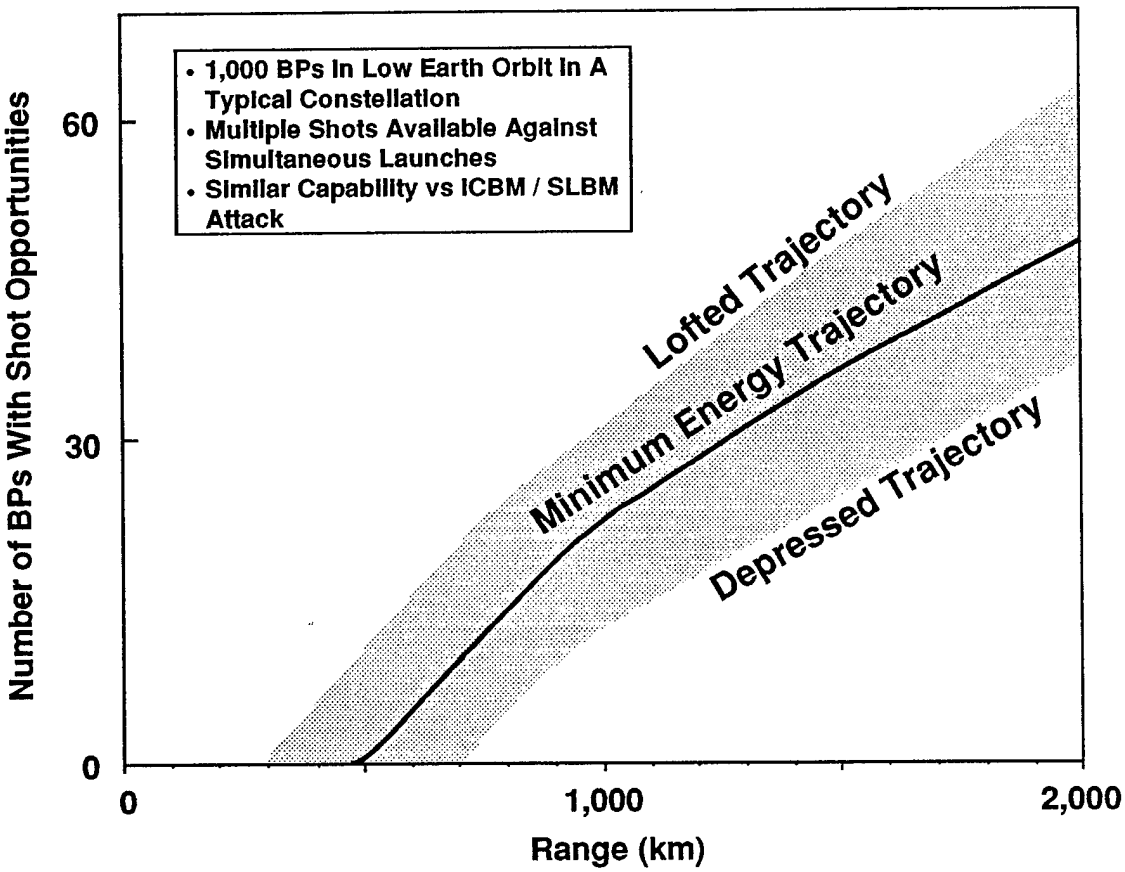

Figure 3. 1,000 Brilliant Pebbles Provide Intercept Opportunities Against Tactical Ballistic Missiles

As illustrated in Figure 4, protection could be provided for all but the most local areas against multiple launches of short-range ballistic missiles from a typical launch point in North Africa. Note the rapidly increasing number of capitals that could be placed at risk as missile range increases.

Figure 3 and the inset charts in Figure 4 illustrate the limitations of space-based interceptors against shorter-range targets. As the range of the threat missile decreases, the number of BPs available to take a shot at that missile also decreases. As figure 4 indicates, BP cannot engage short-range

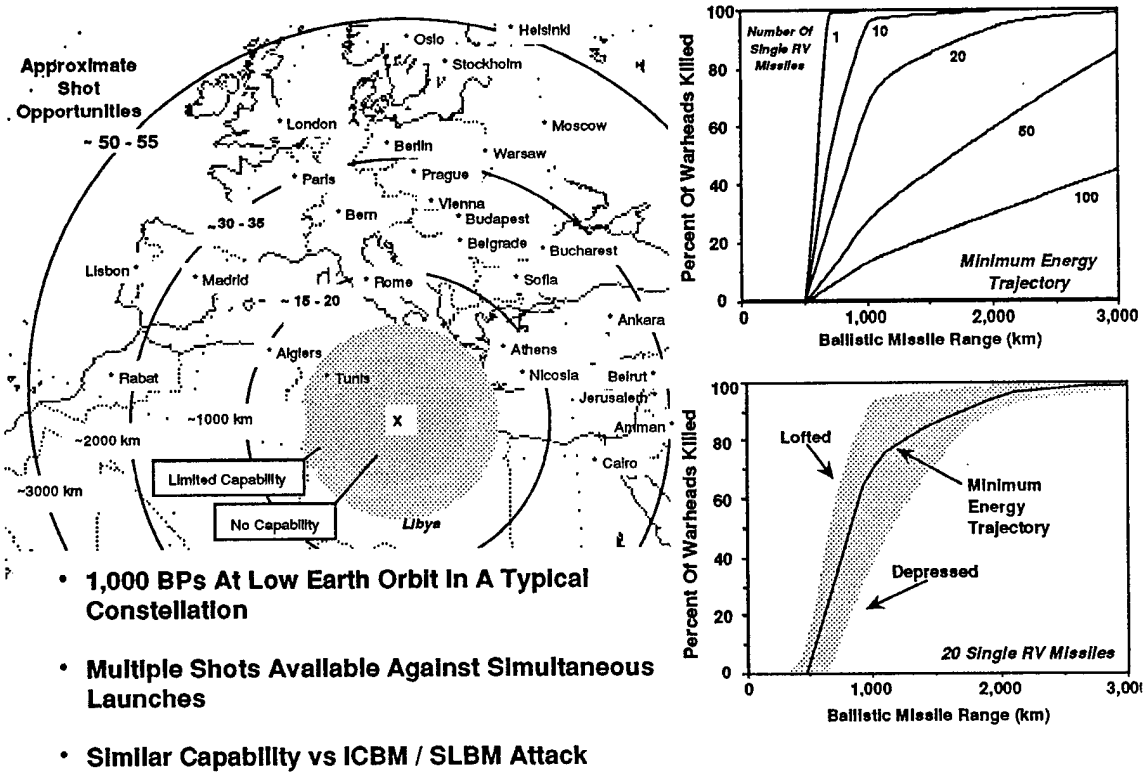

Figure 4. 1,000 Brilliant Pebbles Capability Against Hypothetical Attack From Libya

missiles that fly under about 500 km. Yet, the effectiveness of the 1,000 BP system rapidly increases as the range of threatening ballistic missiles grows. Figure 4 demonstrates this point: this BP constellation would be highly effective in protecting this entire region beyond about 1,000 kilometers against up to about 20 simultaneous launches of single warhead ballistic missiles with the capability of the CSS-2. (This trend of increasing

effectiveness with range continues such that a 1,000 BP constellation alone could provide protection against over 75 intercontinental, single RV, ballistic missiles.)

BP would be deployed in low earth orbit and operate in conjunction with the surface-based defensive tier. The combination of BPs and ground-based interceptors deployed in the United States, such as GBI, would provide the highest confidence protection of the United States against limited strategic missile threats. In some theaters, where the threat involves shorter range, mostly endoatmospheric missile threats that BP cannot engage, including short-range depressed trajectory systems, surface-based TMD such as THAAD, ERINT, and improved Patriot could complement BP to provide the highest confidence theater defense.

The surface-based defenses, both those located in the United States and those in the theater, would benefit from an independent assessment of threat characteristics, early cueing, and from the thinning of the threat by BP. The requirements for surface-based elements to detect threats at long-range and ensure highly effective coverage over broad areas can be significantly reduced by the presence of space-based defenses.

In addition, unlike surface-based defenses, BP could engage strategic MIRVed ballistic missiles before their multiple warheads and/or penetration aids are released. Consequently, a single BP could destroy numerous warheads and a BP constellation would provide the defense with high leverage against MIRVed missiles.

BP's capability for multiple shots per target would greatly increase the probability of intercept and ease the burden on surface-based interceptors, minimizing the number required to help perform national and theater defense.

BP could be available for deployment as early as the end of this decade, depending on the level at which the program is funded.

IV. The Missile Defense Act Of 1991

The passage of the Missile Defense Act (MDA) of 1991 (See Figure 5) represents a significant step toward a political consensus on fundamental

Goal

- Deploy An ABM System, Including One Or An Adequate Additional Number Of ABM Sites And Space-based Sensors, That Is Capable Of Providing A Highly Effective Defense Of The United States Against Limited Attacks Of Ballistic Missiles
- Maintain Strategic Stability
- Provide Highly Effective Theater Missile Defenses To Forward Deployed And Expeditionary Elements Of U.S. Armed Forces And To U.S. Friends And Allies

Theater Missile Defenses (TMD)

- Aggressively Pursue The Development Of Advanced Theater Missile Defense Systems With The Objective Of Down Selecting And Deploying Such Systems By The Mid-1990s
- Development Of Deployable And Rapidly Relocatable Advanced Theater Missile Defenses Capable Of Defending Forward-deployed And Expeditionary Elements Of The Armed Forces Of The United States
- Cooperation With Friendly And Allied Nations In the Development Of Theater Defenses Against Tactical Or Theater Ballistic Missiles

Initial Deployment

- Develop For Deployment By The Earliest Date Allowed By The Availability Of Appropriate Technology Or By FY 96 A Cost Effective, Operationally Effective, And ABM Treaty-Compliant ABM System At A Single Site As The Initial Step Toward Deployment Of The ABM System Described In The First Goal Listed Above.
  - 100 Ground-based Interceptors (The Design Of Which Will Be Determined By Competition And Down Selection)
  - Fixed, Ground-based, ABM Battle Management Radars
  - Optimum Utilization Of Space Sensors Including Sensors Capable Of Cueing Ground-based ABM Interceptors And Providing Initial Targeting Vectors

Limited Defense System (NMD)

- Development Of Systems, Components And Architectures For A Deployable ABM System Capable Of Providing A Highly Effective Defense Of The U. S. Against Limited Strikes, But Below A Threshold That Would Bring Into Question Strategic Stability
  - Includes Activities Necessary To Develop And Test Systems, Components, And Architectures Capable Of Deployment By FY 96 As Part Of An ABM Treaty Compliant Initial Site Defense System
  - For Purposes Of Planning, Evaluation, Design, And Effectiveness Studies, Such Programs, Projects, And Activities May Take Into Consideration Both The Current Limitations Of The ABM Treaty And Modest Changes To Its Numerical Limitations And Its Limitations On The Use Of Space-based Sensors

Spaced-based Interceptors (GMD)

- Conduct Research On Space-based Kinetic-kill Interceptors And Associated Sensors That Could Provide An Overlay To Ground-based ABM Interceptors
- Robust Funding For Research And Development, For Follow-on Technologies, Including Brilliant Pebbles, Is Required
- Deployment Of Brilliant Pebbles Is Not Included In The Initial Plan For The Limited Defense System Architecture
- Report On Conceptual And Burden Sharing Issues Associated With The Option Of Deploying Space-based Interceptors (Including Brilliant Pebbles) For The Purpose Of Providing Global Defenses Against Ballistic Missile Attacks

ABM Treaty Negotiations

- Congress Recognizes The President's Call For "Immediate" Concrete Steps To Permit The Deployment Of Defenses Against Limited Ballistic Missile Strikes And The Soviets Undertaking To Consider Such Proposals From The United States On Nonnuclear ABM Systems
- Congress Urges The President To Pursue Immediate Discussions With The Soviets On The Feasibility And Mutual Interests Of Amendments To The ABM Treaty To Permit
  - Additional Ground Sites And Interceptors
  - Increased Use Of Space Sensors For Direct Battle Management
  - Clarification Of Development And Testing
  - Flexibility For Advanced ABM Technology
  - Clarification Between TMD And ABM Defenses

Review Of Deployment Options

- Interim Report Due MAY 94 On Progress Of Negotiations
- Assess Progress And Consider Options To The U.S. As Now Exist Under The ABM Treaty

Deployment Plan

- Within 180 Days, Submit Deployment Plan For TMD Systems And The ABM System Established By The Goals Of The 1991 Missile Defense Act

NMD = National Missile Defense GMD = Global Misssile Defense TMD = Theater Missile Defense

Figure 5. The Missile Defense Act Of 1991

missile defense goals. The national goal identified in the MDA is to:

> (1) deploy an antiballistic missile system, including one or an adequate additional number of antiballistic missile sites and space-based sensors, that is capable of providing a highly effective defense of the United States against limited attacks of ballistic missiles;
>
> (2) maintain strategic stability; and
>
> (3) provide highly effective Theater Missile Defenses (TMD) to forward deployed and expeditionary elements of the Armed Forces of the United States and to friends and allies of the United States.

The MDA states that the limited deployment of defenses should be "designed to protect the United States against limited ballistic missile threats, including accidental or unauthorized launches or Third World attacks." The Administration concurs with Congress concerning the need for a defensive capability to protect against these threats; indeed, they constitute the primary rationale for the Administration's missile defense program presented to Congress in 1991.

The Administration also shares the MDA goal of deploying defenses, consistent with stability, capable of providing highly effective defense against limited ballistic missile strikes, whatever their source, for the United States, U.S. forward-deployed and expeditionary forces, friends and allies. The MDA calls for highly effective TMD by the mid-1990s, for example, repeating the Congressional endorsement of TMD in the FY 91 Appropriations Act.

In support of the goal for national missile defense, the MDA identifies, as an initial step, the deployment of a single missile defense site by the earliest date allowed by technology availability or by FY 96. This Congressional mandate accelerates by three to four years the initial deployment envisioned in the Administration's FY 92 budget request.

Although the MDA mandated that space-based interceptors such as Brilliant Pebbles (BP) not be included in the initial plan for deploying the limited defense system, it established a separate Space-Based Interceptor program element, including Brilliant Pebbles, which has as its primary objective, "the conduct of research on space-based interceptors to provide

an overlay for ground-based interceptors." Furthermore, the MDA explicitly stated a requirement for "robust funding for research and development of such promising follow-on antiballistic missile technologies." This will permit the Administration to continue to develop options for deployment of BP by the end of this decade.

The Administration had already taken actions which are consistent with the MDA goal of initiating discussions with the former Soviet Union to relax ABM Treaty restrictions and permit the limited deployment of missile defenses. In his September 1991 Arms Control Initiative, President Bush called "on the Soviet leadership to join us in taking immediate, concrete steps to permit the limited deployment of nonnuclear defenses to protect against limited ballistic missile strikes—whatever their source." On 5 October 1991, then-President Gorbachev replied: "We are ready to discuss the U.S. proposal on nonnuclear ABM systems." In addition to this high-level diplomatic exchange, briefings on GPALS by a U.S. delegation to Soviet and Republic representatives took place in Moscow during the first week of October 1991. The presentation was positively received, perhaps reflecting a new era in U.S. relations with the Republics of the former Soviet Union and the new Commonwealth of Independent States. These discussions were continued with representatives of the Soviet center and the republics in Washington in late November.

In January 1992, Russian President Boris Yeltsin proposed that the U.S. and Russia cooperate on developing and operating a joint global defense system. High-level discussions have been undertaken to explore this initiative.

V. Space-Based Interceptors: Conceptual Issues

Multilayered Defense Is Necessary For Protection

The importance of a multilayered space- and ground-based defense is generally well appreciated for strategic defense architectures designed to

defend the United States against massive ballistic missile attacks, especially in countering reactive offensive countermeasures.[1]

Less well understood is the importance of layered defenses, including space-based interceptors, in the context of efforts to establish highly effective nonnuclear defenses against limited ballistic missile strikes -- as called for in the MDA.

The GPALS protection mission for civilian and military assets establishes a goal for high confidence of very low or no warhead leakage -- an ambitious goal, but one which we should strive for. Assured interception of attacking warheads depends on two factors: First, warheads must be successfully detected and tracked for defensive weapons to be directed against them (i.e., if you can't find it, you can't shoot at it). Second, the interceptor must be designed to destroy every target engaged with a high probability of kill.

Most traditional analyses have assumed perfection in detecting and tracking target missiles and reentry vehicles. The truth, however, is that detection and tracking is not perfect. Consequently, imperfect detection and tracking makes it difficult for a single, ground-based, tier to successfully accomplish the protection mission, which requires high confidence of very low or no leakage. This is because ground-based interceptors just cannot locate -- and thus engage -- enough of the attacking warheads to assure protection. Compounding this problem is the fact that ground-based interceptors cannot engage missiles and warheads during the early stages of flight. These points make a compelling case for a space-based tier that can engage attacking missiles during the boost, post-boost, and mid-course phases of flight.

Figures 2 and 6 illustrate the above case. As was shown in figure 2 (page 12), ground-based interceptors, even with early warning and cueing from space-based sensors, cannot provide any shot opportunities until late in the mid-course phase of a trajectory, after over half the attacking missile's flight is over. In contrast, as shown in figure 6, space-based

[1] For example, offensive countermeasures to reduce the effectiveness of mid-course and terminal defenses (such as highly MIRVed ballistic missiles) generally would make boost-phase defenses more effective. Conversely, measures to counter boost-phase defenses (such as fast burn boosters) generally would make mid-course and terminal defenses more effective. In short, multilayered defenses, including space- and surface-based interceptors, would make the task of designing effective countermeasures most difficult.

interceptors could provide multiple shot opportunities, beginning in the early boost phase of an attacking long-range ballistic missile's flight trajectory and extending through the entire mid-course phase until the reentry vehicle returns too deeply into the earth's atmosphere -- e.g., below about 80 km altitude. (Specially designed interceptors could accommodate the atmospheric heating that would accompany reentry down to 40-60 km altitude). For example, a typical 1,000 BP constellation would provide against a 9,000 km range threat up to 5 BPs with a boost phase shot opportunity; 30-35 BPs with a post-boost vehicle shot; and 125-135 BPs with three shots (shoot-look-shoot-look-shoot) in mid-course. Accordingly each ballistic missile trajectory is exposed to at least five independent shots in addition to the three shots provided by GBI (Figure 2, page 12).

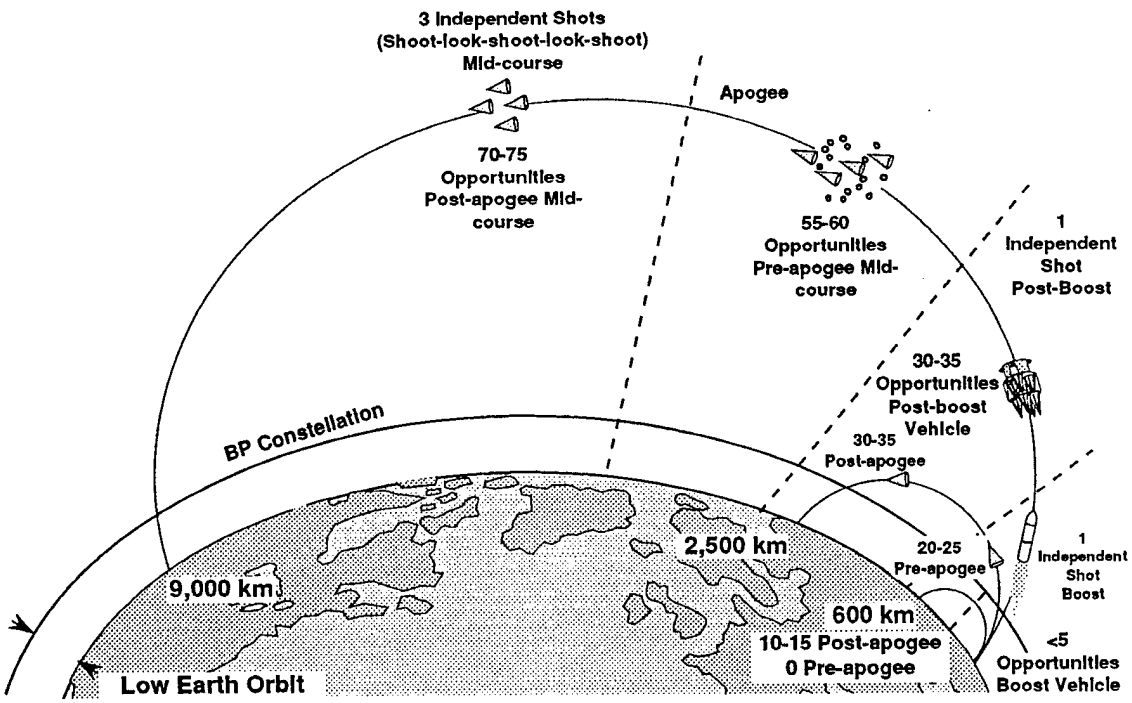

Figure 6. 1,000 Brilliant Pebbles Have Shot Opportunities In Many Flight Phases

In addition, the large number of mid-course opportunities depicted in Figure 6 means that shots can be selected from a wide spectrum of closing velocities and viewing geometries to maximize probability of kill. This contrasts with GBI where the location of fixed sites dictates the shot geometries.

The desirability of intercepting warheads early and well away from the intended target was one of the lessons of the Gulf War. One of the limitations associated with Patriot during Operation Desert Storm involved debris from Scuds destroyed in the atmosphere landing on target areas and causing civilian casualties and property damage. The modified Scud missiles launched by Iraq against Israel and Saudi Arabia would have been accessible from space and could have been intercepted far from their targets by Brilliant Pebbles. Since intercepts would have taken place above the atmosphere, debris from destroyed missiles would have been dispersed over a wider area and mostly burned up during reentry, thereby rendering any remaining debris considerably less harmful by the time of impact. Longer range missiles involved in proliferation that could threaten many capitals in Europe and the Far East, such as the CSS-2—built and sold by the Chinese—would be even more vulnerable to BP engagement.

A balanced deployment of space- and surface-based defenses would provide the highest confidence protection against the entire range of ballistic missile threats, particularly if reactive or responsive threat scenarios are included. The combination of space- and ground-based defenses would also minimize the number of deployment sites for ground-based interceptors and the total number of interceptors (space- and ground-based) needed for protecting the United States. For example, an inventory of approximately 2,000 space- and surface-based interceptors would permit a highly effective defense. Substantially more than 2,000 interceptors would be required to achieve the same effectiveness if space-based interceptors were precluded. Furthermore, a combined space- and ground-based defense is expected to be less expensive than a ground-based-only defense of comparable effectiveness in protecting the United States against the more stressing scenarios involving submarine-launched ballistic missiles.

Contrary to common belief, the technology is of comparable maturity for space- and ground-based interceptor systems. Indeed, the challenge to

make space-based interceptors lighter, more autonomous, and less expensive has driven the kinetic energy technology development activities over the past nine years. The architectures for ground-based interceptor systems are now exploiting these same developments.

Continuous, Global Coverage Is Critical

Continuous, global, defensive coverage also is critical to highly effective defense of U.S. forward-based and expeditionary forces because the location and timing of regional crises and conflicts cannot reliably be predicted and may occur with little or no warning. BP could help protect U.S. forces that must deploy abroad rapidly in response to a fast-paced regional crisis. In such a contingency, where an adversary might attempt to oppose the initial buildup of U.S. and allied forces with ballistic missile strikes against ports, airfields, and early arriving troops, space-based interceptors could offer protection before surface-based interceptors were emplaced, helping to maintain stability during a period of escalation and mobilization.

Because space-based interceptors offer continuous, global coverage, they could defend multiple theaters simultaneously. This capability will become increasingly important because the proliferation of medium-range missiles will extend missile threats beyond any single theater, including to areas where ground-based defenses might not be deployed. In the event of a crisis in the Middle East, for example, BP could provide protection to vulnerable U.S. and allied targets located in adjacent theaters, including cities, staging points, or forces necessary for operations in the primary theater. See Figure 4 (page 14).

Surface-based TMD systems are necessary to defend against shorter range ballistic missiles (i.e., less than 500 km), but can protect a comparatively much smaller geographic area involving such threats than can BP. Therefore, to be effective in a regional crisis, TMD must either be forward based or transported to the theater. To provide the same degree of immediate, global coverage possible with space-based interceptors against longer range ballistic missiles, surface-based interceptors would have to be predeployed virtually worldwide at significant cost.

As illustrated by Figure 7, including space-based interceptors in the defense architecture would cost the United States far less than deploying

sufficiently extensive surface-based TMD systems to provide comprehensive, continuous protection for U.S. forward-based and expeditionary forces. It would reduce the overall requirement for surface-based interceptors and their associated level of necessary manpower and logistic support. In this regard it should be recalled that during Operation Desert Shield/Desert Storm more than 450 C-141 equivalent air sorties were required to transport ground-based defenses into the theater.

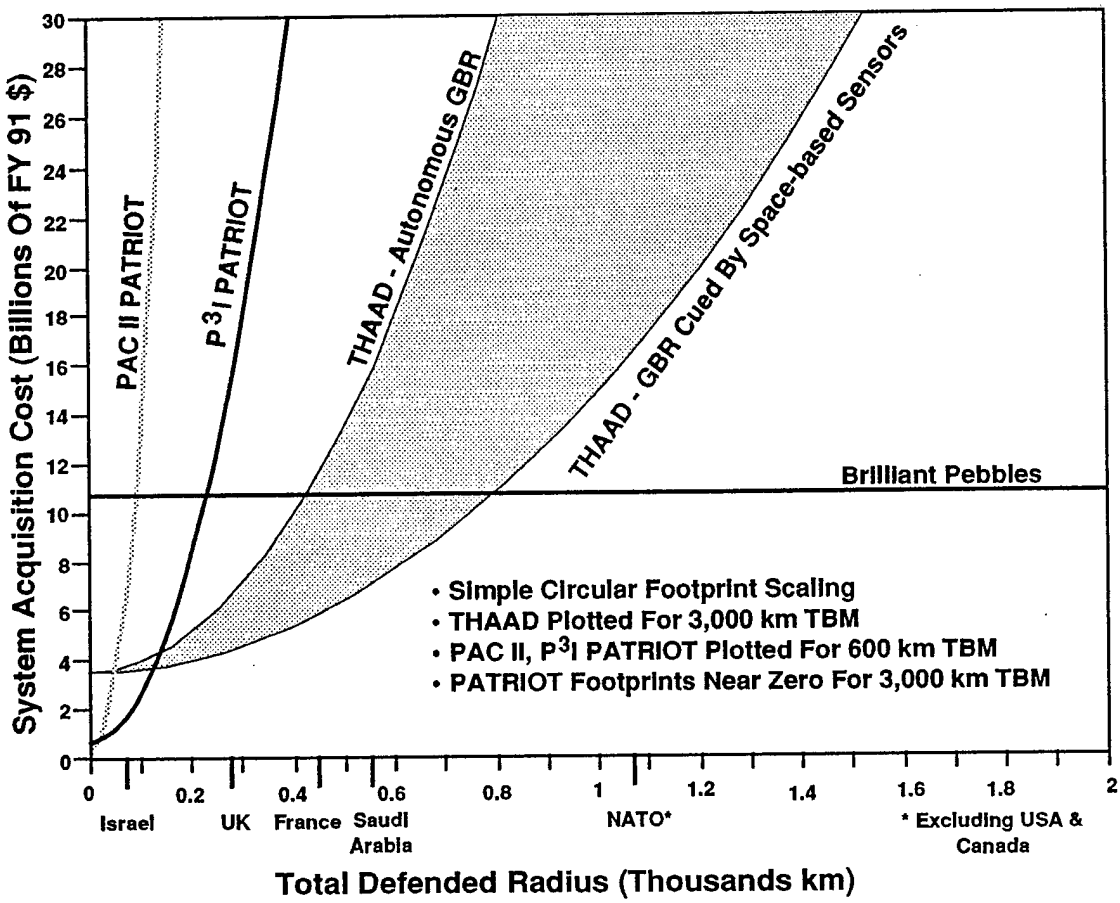

Figure 7. Space-Based Interceptors Significantly Reduce Large Area Coverage Cost

The deployment of space-based interceptors also would alleviate the need to maintain continuously alert out-of-region forward-based TMD systems, thereby significantly reducing costs for many scenarios pertinent to the future multipolar world. Instead, ground-based TMD systems in high-threat areas would be augmented by the worldwide coverage of BP. Space-basing would also ease the overseas basing issues prospectively associated with deploying large numbers of surface-based interceptors globally.

With respect to allied defense, BP deployment could provide an initial defense tier complementing the allies' own ground-based defenses, resulting in effective protection against the entire range of threats. U.S. deployment of BP could ease the burden of allied costs for TMD, thereby increasing the incentives for allied investment in their own ground-based defenses. These allied TMD systems could, in turn, provide additional coverage for U.S. forward deployed and expeditionary forces, especially against short- range missile attack.

World's Policeman?

The potential for continuous, global coverage has led some to be concerned that BP would place the United States in the role of "world's policeman." That capability, however, would not equate to a global commitment to intervene in regional conflicts any more than does the long-standing U.S. capability for global power projection, and would create no greater U.S. responsibility to intervene in a crisis or conflict than exists with our strategic nuclear deterrent today.

Just as the U.S. capability for global power projection increases the options available to U.S. leaders in the event of regional crises, so too would the global defense coverage provided by space-based interceptors. We witnessed during Desert Storm the role defenses can play in controlling escalatory pressures and providing U.S. commanders with the flexibility to prosecute conflict on our own terms. In future crises involving ballistic missile threats, BP could provide U.S. leaders with defensive options critical to successful crisis management. Like other military capabilities, BP employment would depend on the specific circumstances and on U.S. interests and commitments, and would be selective and controlled. Such an option could serve to reduce pressures for escalation by providing an alternative to more provocative actions such as preemption or retaliatory offensive strikes. BP could be key to managing a fast-paced regional crisis, providing U.S. leaders with important military options that do not exist today.

Space-Based Interceptors Support U.S. Arms Control Objectives

The United States is continuing to pursue a more stable strategic balance at lower levels of forces. The Strategic Arms Reduction Talks

(START) Treaty is a major accomplishment and will provide the framework for further reductions. But we have already gone and will continue to go further. In the wake of the failed Soviet coup, President Bush announced a series of unilateral steps to reduce further U.S. nuclear arsenals and challenged the Soviets to respond in kind and to join with the United States in dramatic actions, including banning MIRVed ICBMs and taking immediate, concrete actions to facilitate the limited deployment of ballistic missile defenses. Then-President Gorbachev responded favorably to most of what President Bush proposed. Moreover, opportunities for even greater progress were created by the subsequent dissolution of the Soviet Union.

Indeed, with the end of the Soviet Union and the communist ideology that served as a driving factor in strategic competition, traditional concerns about strategic and arms race stability are alleviated. Indeed, the United States can deploy ballistic missile defenses in a manner that does not threaten stability, particularly if we proceed in the context of an agreement that permits the limited deployment of ballistic missile defenses.

Brilliant Pebbles reinforce other arms control objectives in two ways. First, they permit using far fewer total interceptors to protect against limited attack than would be required if deployments were limited to the ground-based systems, as discussed in Section III. Second, they are extremely effective against heavily MIRVed ballistic missiles; so, even a small constellation would provide an incentive to reduce MIRVs consistent with U.S. arms control proposals -- and would serve as an effective counter to breakout scenarios once agreements to deMIRV ICBMs have been implemented.

Brilliant Pebbles are Consistent with Arms Control Efforts to Reduce Proliferation

Basing defensive interceptors in space would strengthen U.S. efforts to curtail ballistic missile proliferation. The proliferation trend is toward increasing ballistic missile range, and some developing countries already possess or are pursuing missiles with ranges greater than about 500 km. BP would render all such systems potentially ineffective, regardless of their location, or increase their cost by requiring developing countries to develop countermeasures. Given the limited infrastructure and economic resources of many of these countries, it is highly unlikely that they will be able to

effectively counter U.S. space-based interceptors. Consequently, deploying BP will challenge the military and terrorist value of all but short-range missiles. This should serve to dampen developing countries' incentives to acquire longer range missiles, just as ground-based TMD should do for shorter-range missiles.

Summary: BP Contributes To U.S. Security

Combined space- and ground-based defenses, then, would contribute critically to a capability for highly effective defense of the United States, its forward-based and expeditionary forces, friends and allies. As part of a layered defensive system, the space-based tier would: minimize the total number of defense interceptors necessary for highly effective protection; contribute significantly to the effectiveness of surface-based defenses; and provide constant coverage for those areas where surface defenses are not located. BP should also contribute to U.S. arms control goals and help reduce the incentives underlying ballistic missile proliferation. These characteristics of space-basing would make an enormous contribution to protecting the United States, our overseas forces, friends and allies against limited missile strikes.

VI. Allied And Burden Sharing Issues

The United States has long consulted with its allies and friends regarding SDI research, development, testing and deployment plans. This consultative process is receiving new impetus due to the President's SDI redirection and the MDA, which manifest growing emphasis on providing protection for the United States, our forward-deployed and expeditionary forces, and U.S. friends and allies.

Allied interest in missile defense appears higher than in the past, principally because of the experience of the Gulf War and the proliferation of ballistic missiles. A number of U.S. allies are engaged in assessments of the growing ballistic missile threat, its implication for their own security, and their resulting requirement for defenses. Many have expressed increasing interest in TMD, owing to their perception of the proximity of potential threats to their territory. They, too, have a major security interest in countering the threat posed by proliferation and in a capability to defend

against accidental and unauthorized launches.

The new NATO Strategic Concept recognizes missile defense as one part of a multifaceted strategy to confront the proliferation challenge. The November 1991 Rome Summit document states: "In light of the potential risks it poses, the proliferation of ballistic missiles and weapons of mass destruction should be given special consideration. Solution of this problem will require complementary approaches including, for example, export control and missile defenses." The United States is discussing GPALS with its allies and assessing possible interest and avenues for allied cooperation and contributions.

Allied Participation In SDI Research

A number of U.S. allies have already made noteworthy contributions in certain areas of basic research applicable to missile defense, and allied participation in SDI research predates the refocusing of the program toward GPALS. In fact, there has been a considerable level of allied participation in SDI related research since early in the program. To date, SDI joint efforts with several allies have led to over 300 contracts, valued at $800 million, including allied investments in SDI since 1986 of over $100 million. Shortly after the initiation of the SDI program the United States negotiated Memoranda of Understanding (MOUs) regarding SDI research with the United Kingdom, Germany, Israel, Italy, and Japan. All foreign participation in SDI contracting is subject to Congressionally-mandated restrictions regarding free and open competition.

Allied contributions to developing relevant technologies have been significant. The United Kingdom (U.K.) has been working on the Knowledge-Based System (KBS) Data Fusion Demonstrator, neutral particle beam (NPB) technology, and artificial intelligence experiments. The Netherlands Organization for Applied Scientific Research has undertaken pioneering research in electromagnetic launcher technologies. The German company Messerschmidt-Bölkow-Blohm (MBB) used its Shuttle Pallet Satellite (SPAS) and specifically designed instruments for the Infrared Background Signature Survey (IBSS) to image rocket plumes and collect other phenomenology. SDIO and the French Ministry of Defense have agreed to exchanges of data on Free Electron Laser (FEL) research. And a number of allies have collaborated with the United States on Theater

Missile Defense Architecture Studies (TMDAS). In each of these cases, the allied participant has made a unique contribution in a specialized area of expertise and in some cases they have invested their own resources in these projects.

Brilliant Pebbles technology collaboration with Allies is occurring in several areas on an industry-to-industry basis. In addition, the United Kingdom Ministry of Defence, through its SDI Participation Office and MOD research establishments, undertook an independent assessment of the initial Lawrence Livermore Brilliant Pebbles concept and helped to identify critical technical areas requiring special attention. With the selection of U.S. contractors for BP demonstration and validation, the U.K. is proceeding to update its independent assessment by analyzing the concepts being developed by Martin Marietta and TRW.

Israel is actively engaged in the Arrow/ACES interceptor development program, based on a cost-sharing agreement with the United States. The program is demonstrating a number of key engineering developments and operational functions of potential use for the United States. Germany is heavily involved with the United States in the Patriot Growth program, while France, Italy, and Spain are cooperating in the Eurosam Future Surface-to-Air Family (FSAF), an independent system with TMD capability. These defensive systems developed (or codeveloped) and deployed by our allies and partners would provide additional protection both to U.S. forces stationed in the region and to U.S. expeditionary forces dispatched in time of crisis. Furthermore, a number of allies have purchased Patriot systems from the United States and more have expressed interest since the Gulf War.

Additional Opportunity For Allied Participation

With the reorientation of the SDI program toward GPALS, the United States believes that increased opportunities exist for allied cooperation. In particular, the United States seeks to work with its allies to continue mutual security relationships, including cooperation regarding ballistic missile defenses, for confronting the instabilities of the evolving post-Cold War multipolar world. For example, Administration officials briefed NATO defense ministers and other officials on GPALS on a number of occasions in 1991, and have held direct consultations with MOU signatory countries and others. These discussions have focused on describing our GPALS concept,

the threats it addresses, and the role we see for defenses in the context of the emerging security environment. Further discussions will be held with some countries concerning the implications of defense deployment for allied technology programs, operational planning, and security concerns.

Allies have been encouraged to analyze their own need for defenses and to consider participation in GPALS, particularly in TMD systems. Cooperation would be a logical means of utilizing the technology developed under SDI to meet common security needs. There are several general avenues for cooperation:

- Participation in SDIO's basic research and development programs that have application to GPALS. This could mean participation in technology research and development, or in GPALS-related experiments.

- Government-to-government cooperation specifically in TMD-related aspects of GPALS, which may be of particular interest to allies.

- Independent acquisition of a TMD system, either purchased from another country, such as the United States, or indigenously developed, which could be interoperable with other elements of a GPALS system.

The more limited scope and objectives of the GPALS program and the more open attitude of senior leaders of the former Soviet Union and the newly independent states toward ballistic missile defense may alleviate many of the reservations previously expressed by allies with respect to the deployment of missile defense.

The war in the Persian Gulf demonstrated the value of defenses by protecting the populations of Saudi Arabia and Israel and in helping to deny Iraq the escalatory response its missile strikes were intended to provoke. As illustrated in Figure 4 (page 14), U.S. deployment of space-based defenses would demonstrate U.S. support for its allies by providing a unique military capability, particularly in light of reductions in U.S. forward- deployed nuclear and conventional forces. It could also give the United States and its allies valuable time to respond to a crisis or regenerate forces, contributing to the effectiveness of the new U.S. alliance- and coalition-oriented defense strategy.

U.S.-allied cooperation on GPALS could facilitate autonomous allied TMD systems. If allies deploy autonomous missile defense systems, it is anticipated that those systems could be interoperable with elements of the U.S. defense, thus increasing their effectiveness. For example, they could potentially make use of data derived from U.S. space-based sensors and thereby improve their effectiveness and range. BP could provide the initial defensive layer that would thin an attack, easing the burden on allied TMD. Allied TMD could, in turn, contribute to the protection of U.S. overseas forces and reduce the U.S. TMD burden.

The limited deployment of defenses, including BP, would respond to both U.S. and allied security interests in this period of "diverse and multi-directional risks," as characterized in the NATO Strategic Concept. A well defined and coordinated system architecture will be important to assure the interoperability of those indigenous system elements necessary to enable effective allied defenses to deal with future contingencies similar to the Gulf War.

While the support from formal alliance partners will remain a fundamental element in U.S. military strategy, the United States must be increasingly prepared to fight as part of an ad hoc coalition if it becomes involved in a conflict where formal security relationships are nonexistent or immature (as was demonstrated in the Gulf War). The optimal approach for both formal alliance and ad hoc coalitions in an era of declining budgets and an increased regional focus is to exploit comparative advantage and role specialization.

Burden Sharing And Role Specialization

Under the new U.S. defense strategy—responding to a rapidly changing strategic environment—burden sharing could be approached more in terms of role specialization than cost-sharing. Specialization as a means of burden sharing has played a key role in past U.S.-allied security cooperation. For example, the U.S. central strategic deterrent has, for decades, contributed directly to the security for the United States. And, under "extended deterrence," U.S. strategic systems have also contributed to allied security and to a more stable international order. Most recently, the Gulf War demonstrated that a key U.S. comparative advantage is missile defense. Similarly, GPALS, including BP, would directly support U.S.

security interests worldwide, and could contribute to allied defenses and help stabilize the post-Cold War international order.

With regard to role specialization, U.S. deployment of space-based interceptors as an initial defense tier could complement allied ground-based defenses as well as surface-based U.S. TMD systems, providing more effective protection for U.S. forces, allies and friends. While the space-based tier could offer protection for U.S. allies and friends, its primary justification, as discussed earlier, is to provide high-confidence protection for the United States and U.S. forward-deployed and expeditionary forces. Thus, while cost-sharing would be desirable, U.S. interests would be served by unilaterally proceeding with appropriate space- and ground-based defenses.

The post-Cold War multipolar world—where regional conflicts represent the main potential instability rather than the threat from a monolithic Soviet Union and its client states—may well further encourage allied interest in the utility of a global defense system including space-based interceptors. In any case, the present schedule does not call for a deployment decision for space-based interceptors until the end of this decade. Consequently, considerable time is available to consider and articulate their utility and roles while developing and testing Brilliant Pebbles, as called for in the MDA.

VII. Summary And Conclusion

In his 1991 State of the Union Address, President Bush directed that the SDI program be refocused to provide the capability to defend the United States against limited ballistic missile strikes, whatever their source, and provide protection for U.S. forces overseas, allies and friends. With the passage of the MDA, a major step has been made toward a consensus between the Administration and the Congress on U.S. missile defense goals. The national goal identified in the MDA is to deploy missile defense systems, consistent with stability and capable of providing a highly effective defense of the United States against limited ballistic missile attack, and highly effective TMD for U.S. forward-deployed and expeditionary forces, friends and allies.

In response to dramatic changes in the international security environment, the United States has established a new defense strategy. Ballistic missile defense will provide critical support for that new strategy and BP would contribute significantly to U. S. strategic and theater defense requirements. In addition, as forward-deployed nuclear and conventional forces are reduced under the new strategy, the deployment of defenses capable of extending protection to our allies becomes an increasingly important indicator of our military strength and a tangible indicator that we remain committed to the security of our friends and allies.

The conclusion of this assessment is that BP is needed for high-confidence, cost-effective U.S. homeland and theater defenses. BP could also help defend our allies and friends, but its primary justification is to support U.S. national security requirements. Moreover, to the extent that BP contributes to the management of regional crises and conflicts by reducing incentives for preemptive ballistic missile strikes, this benefits the United States by reducing the potential risks of being drawn into an armed conflict.

Space-based interceptors would offer unique characteristics critical to the new U.S. strategy and U.S. ballistic missile defense objectives. BP, for example, would provide continuous, global defense coverage, contributing significantly to the effectiveness of surface-based interceptors and reducing the total number of space- and surface-based interceptors required to perform the missions of national and theater defense. Space-based interceptors also can engage offensive missiles early in their trajectories, reducing concern about the potential for fallout and the dispersion of chemical or biological agents over target areas.

The combination of space and surface-based defensive layers would provide the highest level of confidence for defending against limited ballistic missile attacks—for protection of the U.S. homeland and theater defense. A multilayered, combined deployment also would support U.S. arms control objectives, including nonproliferation. Furthermore, costs for a combined defense would likely be less than for a defense of comparable capability limited to surface-based interceptors.

A number of U.S. allies have already made noteworthy contributions in certain areas of basic research applicable to ballistic missile defense. Direct discussions have been held with allies about the GPALS program and

they have been encouraged to participate. There is, in fact, growing allied interest in GPALS, as witnessed by NATO Secretary General Manfred Woener's recent call for active cooperation on GPALS by our European allies.

It is important to work with our allies and friends to assure interoperability between elements of the GPALS system and potential TMD systems of our allies and friends. A space-based defensive tier could contribute to the effectiveness of TMD, including allied TMD systems. It is anticipated that allied TMD, interoperable with U.S. space-based defenses, could increase the effectiveness of allied defenses and the protection they could provide to U.S. overseas forces, reducing the U.S. TMD burden.

In the future, burden sharing in support of comprehensive defenses against limited ballistic missile strikes may be conceived more in terms of role specialization than cost sharing. Such an approach would befit a strategy now focusing on regional conflict and U.S. participation in ad hoc coalitions as well as formal alliances.