Space Based Interceptor

Initially the Bush Administration articulated missile defense plans that included a significant commitment to a Space Based Interceptor [SBI] program. These plans provoked technical criticism and political controversy. The Administration apparently dropped these plans for space weapons, and the controversy faded. Critics of space based weapons were left with nothing to criticize. In reality, the Administration continued the Space-Based Interceptor program under a classified program, PE 0603891C Special Programs MDA, that first appeared in the 2005 budget request, around the time that overt funding for space based weapons was fading away. The program continues, without the political controversy that had attended the overtly funded program of previous years.

1. **The funding profile for PE 0603891C Special Programs MDA is generally consistent with the funding profile previously associated with the Space Based Interceptor** program**.**
2. **PE 0603891C Special** Programs **MDA appears as the Space Based Interceptor program is gradually fading away, or more precisely, fading to black.**
3. **No other significant missile defense initiative has faded from view.**
4. **Strong proponents of missile defense have long been very vocal advocates of space based kinetic energy weapons, dating back to Danny Graham and High Frontier, and yet there are no words of complaint from these quarters concerning the apparent abandoment of this iconic space weapon.**
5. **For several years the Space-Based Interceptor (SBI) was being developed in conjunction with the Kinetic Energy Interceptor (KEI), and ground or sea-based boost phase interceptor. The program aimed to develop a common kill vehicle to use in all three basing modes. More recently, the KEI program has focused on** development **of the booster, with the program planning to obtain a kill vehicle from another program. But no other program overtly funds a boost-phase kill vehicle, suggesting that such a kill vehicle is being funded by a covert program.**
6. **The Missile Defense Agency launched and continues to operate the NFIRE experimental spacecraft, which is intended to gather** data **in support of the development of a boost-phase kill vehicle, in the absence of an overt effort to develop such a kill vehicle.**

In a 2001 analysis, Gregory Canavan concluded that Space Based Interceptor (SBI) could have ranges that are adequate to address rogue ICBMs. Canavan concluded that the SBI KKV technology would appear to be common for space- and surface-based boost phase systems, and could have synergisms with improved midcourse intercept and discrimination systems. While advanced technology could be helpful in reducing costs, particularly for short range theater missiles, current technology appeared adequate for pressing rogue ICBM, accidental, and unauthorized launches. He found they were not overly sensitive to 30-60 s delay times, and that current technologies would support boost phase intercept with about 150 interceptors. Higher acceleration and velocity could reduce than number by about a factor of 3 at the cost of heavier and more expensive Kinetic Kill Vehicles (KKVs). Canavan concluded that 6g SBI would reduce optimal constellation costs by about 35%; 8g SBI would reduce them another 20%. Interceptor ranges fall rapidly with theater missile range. Constellations increase significantly for ranges under 3,000 km, even with advanced interceptor technology. For distributed launches, these estimates recover earlier strategic scalings, which demonstrate the improved absentee ratio for larger or multiple launch areas. Constellations increase with the number of missiles and the number of interceptors launched at each. Canavan economic estimates suggested that two SBI per missile with a modest midcourse underlay is appropriate. These optimistic assessments were typical of those consistently advanced by advocates since the early 1980s. Thus it was not surprising that Boost-phase defense -- disabling ballistic missiles while they are still under power -- received much attention as one possible element of the Bush Administration's National Missile Defense system.

But in July 2003 an independent study by the American Physical Society into the scientific and technical feasibility of boost-phase defense, concluded that intercepting missiles while their rockets are still burning would not be an effective approach for defending the U.S. against attacks. “ This study was conducted for the American Physical Society by a group that included recognized experts on missile defense. The group assessed the feasibility of boost-phase intercept in terms of fundamental science and engineering requirements,” said APS President Myriam Sarachik. A system of space-based interceptors, constrained by the short time window for intercept, would require a fleet of a thousand or more orbiting satellites just to intercept a single missile. Deploying such a fleet would require a five- to tenfold increase in the United States' annual space-launch capabilities. “Few of the components exist for deploying an effective boost-phase defense against liquid-propellant ICBMs and some essential components would take at least 10 years to develop,” said Study Group co-chair Daniel Kleppner. “According to U.S. intelligence estimates, North Korea and Iran could develop or acquire solid-propellant ICBMs within the next 10 to 15 years. Consequently, a boost-phase defense effective only against liquid-propellant ICBMs would risk being obsolete when deployed.”

In July 2004 the Congressional Budget Office evaluated alternatives for Boost-Phase Missile Defense. One set of cases looked at the capability -- in terms of the performance of the BPI system and the quantity of equipment purchased -- to counter liquid-fuel ICBMs launched at the United States from anywhere in North Korea or Iran. The costs of the illustrative BPI systems range from $16 billion to $37 billion (in 2004 dollars) for the surface-based systems in Options 1 through 3 and from $27 billion to $78 billion for the space-based systems in Options 4 and 5. One significant reason that the space-based systems would be more expensive, on the whole, is that those options envision deploying a greater number of interceptors than in the surface-based systems and include costs for launching those interceptors into orbit. The increased difficulty of countering solid-fuel ICBMs has different implications for each of CBO's options. For space based systems, total costs would more than double -- to ranges of about $163 billion to $224 billion for Option 4 and $57 billion to $80 billion for Option 5.

Space-Based Interceptor (SBI) Annual Budget Activity

Under the 2002 budget proposal of June 2001, 0603883C Boost Defense Segment included Project 4040 Space-Based Boost. This effort was specifically aimed at advancing the state of the art for space-based BPI applications. Appropriate experimentation and test & evaluation activities will be conducted to support informed assessment and decision-making regarding candidate space based intercept capabilities to include space-based lasers and advanced space-based boost kinetic energy concepts. The Space-Based Kinetic Energy Experiment (SBX) was a risk reduction effort to demonstrate a KE BPI concept that can potentially provide a global-limited missile defense capability against emerging world threats. A decision regarding commitment to future development of a Space-based interceptor (SBI) capability hinges upon success in engaging a ballistic missile in the boost phase of flight. The objective for this experiment was to conduct a test in which a kinetic kill vehicle (KKV) engaged a thrusting target against a below the horizon background. Success will provide “Proof of Concept/Feasibility” that a KKV can operate in the boost phase regime.

Under the 2003 budget proposal of February 2002, 0603883C Boost Defense Segment included Project 4040 Space-Based Boost. This effort was focused on development of space-based kinetic energy (KE) applications for intercepting targets in the boost phase. Appropriate experimentation and test & evaluation activities would be conducted to support informed assessment and decision-making regarding candidate space based boost kinetic energy intercept capabilities. These candidate capabilities would be supported by risk reduction activities, advanced sensor data integration and fusion, BM/C2, and advanced Kill Vehicle (KV) components and integration. In parallel, this project would be supported by modeling and simulation validated by experimentation and phenomenology data collection. The completion of concept assessment in early FY 2003 would facilitate the rapid initiation of component development and fabrication for risk reduction and critical experiments.

The Missile Defense Agency (MDA) wanted to add kinetic energy intercept (KI) capabilities to the Ballistic Missile Defense System (BMDS) Test Bed. The first step was to develop and demonstrate a KI capability against ballistic missiles in the boost flight phase. This technology could also eventually be used to intercept missiles in midcourse and terminal flight phases.

The MDA anticipated using two test beds to demonstrate KI capabilities, a terrestrial test bed, with both land- and sea-based platforms, and a space test bed. Test launches would initially be conducted from a mobile deployable ground-based platform. Although a ground-based platform would be developed first, a critical system objective is to develop a sea-based KI capability in the BMDS Test Bed as soon as practical. The MDA plans to demonstrate the capabilities of a space test bed in parallel to demonstrating the ground-based platform. The space test bed would provide an alternative to the terrestrial test bed and vice versa.

MDA would select a contractor for development and test of a terrestrial-based KE BPI, and then start work for a space-based KE BPI testbed. The contractor selected for the terrestrial-based program would be precluded from competing for the space-based effort. The plan for the Space Based Interceptor Testbed was being defined, aiming for a capability starting in 2004. The FY '03 budget included $30 million in new funding to explore the design of space-based kill vehicles.

MDA issued a draft request for proposals for the KE BPI concept design phase on 07 January 2002, with a formal RFP expected by Feb. 4. MDA expected to award up to three firm-fixed price eight-month contracts worth a total of $10 million in April. At the end of that concept development time frame, MDA expected to select one contractor to proceed with development and testing of the new interceptor. In April 2003 MDA awarded $10 million contracts to Lockheed Martin and Northrop Grumman teams for the first phase of the ground-based KE BPI program. Initially, the KE BPI program aimed to develop and test a robust kinetic energy kill capability against ballistic missiles in the boost/ascent phase with some capability against ballistic missiles in other flight phases. Lockheed Martin and Boeing agreed to partner for the KE BPI program and Raytheon joined the Northrop Grumman team.

Under the 2004 budget proposal of February 2003, funding for the Kinetic Energy Boost transitioned into the Ballistic Missile Defense System (BMDS) Interceptor Program Projects 0913 and 0013, but there is no separate line item for space based activities. In parallel with the Block 2008 Interceptor program, MDA would develop a Space Based Test Bed for incremental testing of space-based interceptor capabilities. The first satellites were to be available for this testing in Block 2008 with additional functionality provided in successive Blocks. Initial on-orbit tests will commence in Block 2008 with three to five satellites. The Test Bed capability will be expanded in two-year Blocks.

Test Bed development will consist of technology development and Test Bed integration programs. KE Boost Test Bed [this term only appears in the FY2004 budget] development and testing continued in FY 2004. MDA will conduct real-time fire control / C2BMC exercises and simulated engagements using space launch and ballistic missile targets of opportunity. In addition, ground-based and air-based sensors will collect boost/ascent phase data on these targets of opportunity to support the Block 2008 capability development.

MDA's longer-term goal is to develop low-cost enhanced BMDS multi-use interceptors that have the capability to defend against threat missiles in the boost, midcourse and exo-atmospheric terminal phases of flight. Therefore, MDA consolidated next generation interceptor (booster plus kill vehicle (KV)) development efforts into one BMDS interceptor program. This BMDS Interceptor will counter the evolving threat through the spiral development of the Block 2008 Interceptor with enhanced KV capability. Technology advances are likely to include higher divert capability, greater seeker sensitivity, advanced discrimination capability, and lower-weight KVs.

Under the 2004 budget proposal of February 2003, in Block 2010 MDA would develop and test an advanced Space Based Test Bed in support of a Block 2010 capability. It will augment and/or replace the Block 2008 Space Based Test Bed and retire most, if not all, major risks in space-based, kinetic energy ballistic missile defense. MDA will develop and test an advanced Space Based Test Bed in support of a Block 2010 capability. It will augment and/or replace the Block 2008 Space Based Test Bed and retire most, if not all, major risks in space based, kinetic energy ballistic missile defense. Building on the Block 2008 Space Based Test Bed, the Block 2010 Space Based Test Bed will develop an additional three to five satellites with advanced, lightweight lifejackets and interceptors. A technology development effort focused on the miniaturization of space based components will support the Block 2010 Test Bed testing by developing advanced, high performance kill vehicles and axial propulsion. We will also address key issues such as lifejacket/interceptor miniaturization, inter-satellite communications, interceptor guidance, and constellation management and control during this phase. The Block 2008 Test Bed integrator will be responsible for developing Block 2010 Space Based Test Bed. The prime contractor will integrate advanced interceptor and lifejacket technologies into the existing Block 2008 Test Bed.

For the FY 2005 budget submitted February 2004. For Block 12, the KEI acquisition strategy includes the development of a space-based interceptor test bed. The Defense Science Board (DSB) has examined past space-based interceptor efforts including the Brilliant Pebbles and Space Based Interceptor programs and identified a number of technical challenges remaining unresolved. Therefore, we are taking a slow and deliberate approach to better understand and resolve some of these challenges. In FY 2004 MDA would initiate an analytical effort with the MDNT to identify the benefits of incorporating space-based interceptors into a layered ballistic missile defense system.

The MDNT will continue this effort by outlining a concept of operations (CONOPS), forming a framework for future war-games at the Joint National Integration Center. MDA would also build on the foundation laid by the land based Block 2010 program along with NFIRE. Beginning in FY 2005 and continuing through FY 2009, the space program will begin a ground based risk reduction effort. MDA would initiate development of miniaturized, lightweight interceptor components, with the initial emphasis on developing a liquid axial stage. Based on the results of these risk reduction efforts, the Director, Missile Defense Agency, will make a decision in 2008 to begin the transition to develop satellites to conduct on orbit experiments. These experiments will exercise the functionality of a space-based BMDS. By 2012, the space-based test bed was planned to have a thin constellation of 3 to 6 spacecraft on orbit.

Under the FY2006 budget submitted February 2005, the BMDS Interceptor program element 0603886C funds the BMDS Interceptor Block 12/14 Test Bed as well as the Space Test Bed. In the kill vehicle area MDA would focus on seeker and propulsion development. For the seeker, MDA would develop and test a 2-color all-reflective prototype seeker (comprised of a 2-color focal plane array, new signal processor, and all reflective optics) to demonstrate the ability of the interceptor to acquire and track, transition from plume to hardbody, discriminate the lethal object, and select a hardbody aimpoint on boost, ascent and midcourse targets. The Space Test Bed project would begin in FY08. MDA's objective in adding a space-based interceptor layer to the BMDS is to transition the mobile terrestrial intercept capabilities to space in order to overcome the basing and geographic access limitations of our land, sea, and airborne defenses. MDA would build upon our terrestrial multi-use interceptor, BMDS sensor and BMDS C2BMC capabilities to achieve a cost-effective space-based layer. A limited constellation of space-based interceptors (50-100 satellites) offers thin boost/ascent defense against intercontinental ballistic missiles. The same size constellation provides multi-shot mid course defense against medium to intercontinental range ballistic missiles. Beginning in FY08, MDA would initiate a Space Test Bed competitive concept design phase of approximately one year. The development and test phase would start in FY09 with key milestones including multiple space-based intercept tests in Block 12/14 and a constellation production decision in Block 14. MDA anticipated the Development and Test phase to run through FY15 in order to enter a production phase for a small space layer in FY16.

The FY2006 budget, submitted February 2005, marks the advent of the new PE 0603891C Special Programs MDA, for which no further information other than annual funding levels is provided. The budget requested $349,522,000 for 2006, rising to $1,097,252,000 for Fy 2009, and a total of $5,015,120,000 over the 2006 to 2011 timeframe.

In 2006 the Agency transitioned the Space Test Bed Program (Project R216) from the BMDS Interceptors PE (0603886C) to the Ballistic Missile Defense System Space Program (Project 0517, PE 0603895C), with initial funding in FY 2008.

The Ballistic Missile Defense System Space Program will integrate a variety of MDA existing and future space efforts to assess the technical risk and viability of developing the BMDS space layer capability. The Space Test Bed will begin to exploit the natural advantages of space systems and integrate them into the BMDS. These advantages include a 24/7 global presence to defend against asymmetric threats, provide access to geographically denied areas, an ability to close a global fire control loop for the BMDS and to complement existing terrestrial capabilities.

The Space Test Bed is an essential element of the BMDS acquisition plan. A Space Layer will complement the forward-based, boost and midcourse capabilities of the BMDS, mitigating limitations imposed by geography and basing availability. A Space Layer helps protect the United States and Allies against asymmetric threats designed to exploit coverage and engagement gaps in our terrestrial defenses. We plan to explore the addition of a space-based defensive layer to complement the evolutionary BMDS. MDA believed that a mix of terrestrial and space-basing offers the most effective global defense against ballistic missiles.

The current effort under program element 0603895C BMD System Space Program is limited to the Space Test Bed. Potentially, under the management of the Space Applications Center of Excellence, this Ballistic Missile Defense Space System program element will integrate multiple space-dependent tests, demonstrations, integration efforts and experiments that provide capability improvements, reduce developmental cycle times and/or improve integrated BMDS performance. Known programs/projects include the Space Test Bed, the Near Field Infrared Experiment (NFIRE), and the Missile Defense Space Experimentation Center (MDSEC).

In FY06, the NFIRE program was transferred from the Kinetic Energy Interceptor program element (PE 0603886C) to the Advanced Technology program element (PE 0603175C). In FY07, MDA requested the NFIRE program and all associated funding be moved into program element 0603895C BMD System Space Program.

In FY07, the MDSEC began development under the STSS program element (PE 0603893C) and in FY08 is expected to be merged into this program element along with associated funding from PE 0603893C. The MDSEC is a collaborative experimentation environment for all BMDS elements that rely on, experiment with, or seek to improve the BMDS capability by utilizing space-based, systems-derived data. Programs currently interacting within the MDSEC activity are: STSS, NFIRE, External Sensors Laboratory (ESL), Project HERCULES, Microsatellites, CONUS Kinetic Energy Interceptor (CKEI), C2BMC and others.

The National Defense Authorization Act for Fiscal Year 2007 [Oct. 17, 2006] provided *SEC. 222. LIMITATION ON USE OF FUNDS FOR SPACE-BASED INTERCEPTOR.*

(a) LIMITATION.—No funds appropriated or otherwise made available to the Department of Defense may be obligated or expended for the testing or deployment of a space-based interceptor until 90 days after the date on which a report described in subsection (c) is submitted.

(b) SPACE-BASED INTERCEPTOR DEFINED.—For purposes of this section, the term ''space-based interceptor'' means a kinetic or directed energy weapon that is stationed on a satellite or orbiting platform and that is intended to destroy another satellite in orbit or a ballistic missile launched from earth.

(c) REPORT.—A report described in this subsection is a report prepared by the Director of the Missile Defense Agency and submitted to the congressional defense committees containing the following:

(1) A description of the essential components of a proposed space-based interceptor system, including a description of how the system proposed would enhance or complement other missile defense systems.

(2) An estimate of the acquisition and life-cycle cost of the system described under paragraph (1), including lift cost and periodic replacement cost due to depreciation and attrition.

(3) An analysis of the vulnerability of such a system to counter-measures, including direct ascent and co-orbital interceptors, and an analysis of the functionality of such a system in the aftermath of a nuclear detonation in space.

(4) A projection of the foreign policy and national security implications of a space-based interceptor program, including the probable response of United States adversaries and United States allies.