Order Code RL31111

Missile Defense: The Current Debate

Updated February 25, 2002

Coordinated by Steven A. Hildreth and Amy F. Woolf
Specialists in National Defense
Foreign Affairs, Defense, and Trade Division

Missile Defense: The Current Debate

Summary

The United States has pursued missile defenses since the dawn of the missile age shortly after World War II. The development and deployment of missile defenses has not only been elusive, but has proven to be one of the most divisive issues of the past generation.

The Bush Administration has substantially altered the debate over missile defenses. The Administration requested significant funding increases for missile defense programs (about 61 percent above that approved by Congress for FY2001), eliminated the distinction between national and theater missile defense, restructured the missile defense program to focus more directly on developing deployment options for a "layered" capability to intercept missiles aimed at U.S. territory across the whole spectrum of their flight path, adopted a new, untried development and acquisition strategy, and announced U.S. withdrawal from the 1972 Anti-ballistic Missile Treaty.

The Administration argued these steps were necessary in response to growing concerns over the spread of weapons of mass destruction and their means of delivery, especially on the part of a handful of potentially hostile states and terrorists. In addition, they asserted that U.S. deterrence theory has outlived its usefulness, and that it could not be relied upon to dissuade unstable leaders in rogue states.

Critics take issue with assertions that the threat is increasing, citing evidence that the number of nations seeking or possessing nuclear weapons has actually declined over the past twenty years. Moreover, they argue that the technology for effective missile defense remains immature, that deployment is provocative to allies, friends, and adversaries, and it is a budget-buster that reduces the availability of funds to modernize and operate U.S. conventional military forces. They argue especially that major powers will view U.S. missile defense as an attempt at strategic domination and that some, such as China, will expand its missile capabilities in response.

The Bush Administration's plans raise a number of issues, many of which are examined in this report. The issues that have received attention in the 107th Congress, are: 1) U.S. compliance with the ABM Treaty and now the announced withdrawal from the Treaty; 2) a new acquisition concept for developing missile defense that does not lend itself readily to oversight, system definition, or cost and effectiveness analysis; and, 3) the restructuring of existing missile defense programs within the Missile Defense Agency (formerly BMDO).

This report replaces CRS Issue Briefs: *National Missile Defense: Issues for Congress* (CRS Issue Brief IB10034), and *Theater Missile Defense: Issues for Congress* (CRS Issue Brief IB98028). The report will be updated as needed.

Contents

List of Tables

Missile Defense: The Current Debate

Most Recent Developments

On February 16, the Missile Defense Agency (MDA) and the Army conducted an operational test of the Patriot Advanced Capability-3 (PAC-3) system at White Sands Missile Range in New Mexico. An earlier version of the missile, the PAC-2, successfully intercepted and destroyed a full-scale drone aircraft in this test. Simultaneously, a second PAC-2 missile, as well as a PAC-3 missile missed their targets, a sub-scale aircraft and a sub-scale cruise missile, respectively. The cause of the test failures is under investigation.

In early February 2002, the Administration announced it was requesting $7.8 billion for missile defense spending for FY 2003. This includes about $1.7 billion for the Terminal Defense Segment, $3.2 billion for the Midcourse Defense Segment, and $800 million for the Boost Defense Segment. Details are not yet publicly available.

On January 31, 2002, the Congressional Budget Office (CBO) released a study estimating a range of potential costs of several different types of national missile defense systems and components.

In early January 2002, the Ballistic Missile Defense Organization (BMDO) was redesignated the Missile Defense Agency. According to the Department of Defense, elevating BMDO to agency status "recognizes the national priority and mission emphasis on missile defense." The overall objectives of the MDA include "establishing a single program to develop an integrated missile defense system, assigning the best and brightest people to this work, and applying a capability-based requirements process for missile defense."

Overview

Issues for Congress

In July 2001, the Bush Administration presented to Congress the outlines of its proposed approach to missile defense. The Bush Administration's plan differs significantly from the approach pursued by the Clinton Administration. The issue for Congress was whether to approve, modify, or reject the Bush Administration's proposed approach for missile defense. (A section on current congressional action is found at the end of this report.) In general, Congress supported the President's FY 2002 request, making some adjustments in programs experiencing technical problems and reducing funding for programs that Congress was not yet willing to commit to for early or crisis deployment purposes.

Congress' decisions on these issues in FY 2002 and this coming year will likely have significant implications for U.S. military capabilities, arms control, defense funding requirements and the composition of U.S. defense spending, as well as U.S. relations with other countries.

Scope of Report

This report provides background information on the Bush Administration's proposed approach, and discusses key issues relating to it. Key issues raised in the next section include:

- **ABM Treaty issues:** What are the implications of the Administration's announcement to withdraw from the ABM Treaty? When and how will the Administration's program "bump up" against the limits in the ABM Treaty? What are the prospects for success in the discussions with Russia to move beyond the ABM Treaty and develop a new strategic framework?

- **Budget issues:** How will the money for missile defense be allocated among the different elements of the program? How will increased funding for missile defense affect funding for other programs in the defense budget?

- **Technology issues:** Will the United States be able to develop and deploy missile defenses that can intercept missiles of all ranges at all phases of their flights? If not, can a partial system be overcome even by rogue states? What are the key technological challenges? When might the research and development program give way to a deployment program? Will DOD's acquisition policy affect the planned incremental deployment strategy?

- **International issues:** How have other nations reacted to the new Administration's missile defense policy and why? What is the Bush Administration doing to address the concerns of U.S. allies and nations, such as Russia and China, who might feel threatened by U.S. missile defenses?

The final section of the report provides background information on the various parts of the Administration's proposed missile defense program. It includes program and budget data, and key technical challenges faced by the programs.

Missile Defense Prior to the Bush Administration

The United States has pursued the development of missile defenses for more than 50 years. Since the Reagan Strategic Defense Initiative (SDI) in 1985, the United States has spent almost $70 billion on missile defense programs and studies. Missile defense has proven to be a challenging and elusive endeavor. Moreover, the question of whether the United States should deploy extensive defenses to protect against

ballistic missile attack has been one of the most divisive political and national security issues of this generation.

The demise of the Soviet Union and the debate over the emergence of ballistic missile threats[1] from other nations changed the nature of the debate. For many, concerns about nuclear stability between the United States and Russia have receded as the two nations have expanded their areas of cooperation and improved their relationship. Instead, many now focus on concerns about a possible attack from an adversary who possesses only a few missiles and may not be deterred by fear of U.S. retaliation. Without a missile defense capability, some argue, the United States itself may be deterred from using its conventional forces to protect U.S. allies and friends. Similarly, the United States might be unable to combat aggressive or provocative actions on the part of "rogue states" armed with chemical, biological, or nuclear capable ballistic missiles.[2] Even acquisition of ballistic missiles by terrorists is today part of the policy debate.

The Clinton Administration responded to this changing security environment by pursuing the development and deployment of defenses that would protect U.S. allies and forces in the field from attack by shorter and medium-range ballistic missiles (theater missile defense – TMD). It also sought to develop for deployment a limited system to protect U.S. territory from attack by longer-range ballistic missiles (national missile defense – NMD). Its plans for NMD would have conflicted with the terms of the 1972 Anti-ballistic Missile (ABM) Treaty with the Soviet Union, which limits the United States and Soviet Union (now Russia) to a single, land-based system for defense against long-range ballistic missiles.[3] The Administration sought to preserve the basic framework of the ABM Treaty by negotiating modifications that would have permitted the deployment of a limited, land-based NMD site in Alaska. The Clinton Administration decided, however, that it would not proceed to deploy the site after failures in the flight test program and other technical concerns raised questions about the readiness of the technology.

Bush Administration's Proposed Approach

The Bush Administration sharply altered the debate over missile defense. In several speeches, President Bush indicated that he would pursue the development of technologies that could be deployed on land, at sea, and in space, and that would protect the United States, its allies, and its forces overseas from ballistic missile attacks from rogue nations. At the same time, the President stated that the United

---

[1] This report does not examine the debate over threats from weapons of mass destruction and their means of delivery *per se*. Please see other CRS products, including: *Nuclear, Biological, and Chemical Weapons and Missiles: The Current Situation*. CRS Report RL30699, by Robert D. Shuey; *China's Proliferation of Weapons of Mass Destruction and Missiles: Current Policy Issues*. CRS Issue Brief IB92056, by Shirley A. Kan.

[2] For example, see Kaplan, Lawrence F. Offensive Line: Why the Best Offense is a Good Missile Defense. *New Republic*. Mar. 12, 2001: 20-25.

[3] For a discussion of Treaty limits see the section: Treaty Limits and the Administration's Program, below.

States would have to "move beyond the constraints" of the ABM Treaty. He emphasized that "Russia is not our enemy," and, therefore, Russia should not be concerned about U.S. deployment of missile defenses. Instead of seeking to modify the ABM Treaty so that the United States could deploy limited missile defenses, the President said "we need a new framework that allows us to build missile defenses to counter the different threats of today's world."[4]

The Administration began to outline the details of its plans for missile defenses in July 2001, after submitting its amended defense budget for FY2002 to Congress. In that budget, the Administration requested $8.3 billion for missile defense, an increase of $3.1 billion or 61 percent over the amount Congress funded for FY2001. The Administration stated that it would explore a broader range of technologies and basing modes, "including land, air, sea, and space-based capabilities that had been previously disregarded or inadequately explored." However, as is described in more detail later in this report (See Table 1), the Administration appears to have essentially increased funding evenly for each of the missile defense and sensor technologies already in the defense budget. From a funding and programmatic perspective, the Administration did not appear to give increased priority to any particular program or introduce any major new research directions for FY2002 beyond what the Clinton Administration was already pursuing, except to accelerate the process and integrate key components. A similar argument can be made with respect to the proposed FY 2003 missile defense budget of $7.8 billion.

In its missile defense program, the Bush Administration has eliminated distinctions between theater and national missile defenses (TMD and NMD). Instead, according to General Kadish, the director of the Missile Defense Agency (MDA) formerly the Ballistic Missile Defense Organization (BMDO), the Administration has "developed a research, development, and test program that focuses on missile defense as a single integrated BMD system." Furthermore, the objective of this program is to "aggressively evaluate and develop technologies for the integration of land, sea, air, or space-based platforms" and to develop and deploy a global system of "layered defenses, capable of intercepting missiles of any range at every stage of flight – boost, mid-course, and terminal."[5]

Administration officials have highlighted two primary benefits of layered defenses. First, layered defenses would seek to provide the United States with more than one opportunity to target an attacking missile, thus arguably increasing the chance of shooting it down. (A critique of the layered defense concept is outlined in the section on Technology and Other Challenges.)

---

[4] George W. Bush, Remarks on Missile Defense, National Defense University, May 1, 2001.

[5] The boost phase of a missile's flight occurs immediately after launch, and lasts for 3-5 minutes for long- range missiles and one or two minutes for short-range missiles; it is the powered portion of the flight. The midcourse portion occurs after boost, outside the atmosphere and, for long-range missiles, can last up to 20 minutes. The terminal phase occurs when a missile or warhead re-enters the atmosphere; it lasts less than a minute for short-range missiles and a minute or two for longer-range missiles.

Second, the layers could complicate an attacker's ability to defeat the overall system. This is because countermeasures, which are intended to confuse or overcome defenses, that might be effective in one phase of a missile's flight might not work in other phases.

The Bush Administration has emphasized that its missile defense program will concentrate on "robust research and development" into a wide range of missile defense technologies. Unlike the Clinton Administration, the Bush Administration will not at this point identify an architecture that it will seek to deploy nor will it establish a schedule for the development and deployment of any particular system or element; but, a clear underlying objective is the early deployment of a defense against missiles aimed at U.S. territory. Because it has not identified the types of technologies or the numbers of interceptors and radars that it intends to deploy, the Administration will not provide any costs for the missile defense program or system. It emphasizes that cost estimates are premature under the new approach.

Administration officials have stated that this research and development effort is "designed to develop effective systems over time . . . and to deploy that capability incrementally." The program envisions the deployment of "different combinations of sensors and weapons" when these technologies "are proven through robust testing." These technologies could then be replaced by more effective or advanced systems when they become available. This approach is called an evolutionary acquisition strategy. This strategy differs from the way in which most military acquisition programs occur. It will likely be the subject of increased scrutiny. An analysis of this strategy and some of its implications follows in a subsequent section of this report.

During congressional testimony, Deputy Secretary of Defense Wolfowitz stated repeatedly that the United States would not violate the ABM Treaty, but that the Treaty stood in the way of the Administration's missile defense efforts. He noted that some of the tests or activities could "bump up" against the limits in the Treaty in "months' not years."[6] However, the Bush Administration also stated that the United States would have liked to reach an agreement with Russia that would allow these tests, and the eventual deployment of extensive missile defenses, to proceed without concern for the Treaty limits.

At a meeting in Italy in July, President Bush and Russia's President Putin agreed that the two nations would hold discussions that focused on both offensive weapons and defensive systems. Some interpreted this agreement to mean that the two nations would begin negotiations on new treaties that would limit offensive nuclear weapons and missile defenses. Administration officials stated clearly, however, that these were not negotiations, but consultations. They also stated that the Administration does not plan simply to seek modifications in the ABM Treaty, but also would not allow the Treaty to prevent research and development toward deployment even if that ultimately meant U.S. withdrawal from the Treaty.[7] Rather, the Bush Administration

---

[6] U.S. Department of State. Cable on Missile Defense Policy. Published by the Carnegie Endowment for International Peace, July, 2001.

[7] In late August 2001, for example, John Bolton, Undersecretary of State for Arms Control (continued...)

sought to convince Russia that the ABM Treaty is no longer relevant and that the two nations should agree to set it aside and replace it with a new framework for their relationship. According to some reports, the United States would share information about missile defense developments with Russia, but it would not accept any limits on research, development, testing, or deployment of its systems. Russia, however, did not accept the U.S. approach, and, on December 13, 2001, President Bush announced that the United States would withdraw from the Treaty. Actual withdrawal could take place as early as June 13, 2002.

Key Issues

ABM Treaty

Treaty Limits and the Administration's Program. The United States and the Soviet Union concluded and ratified the ABM Treaty in 1972[8] and agreed to a protocol that amended the Treaty in 1974.[9] The treaty, as amended, bound each nation to these central provisions:

- "not to deploy ABM systems for a defense of the territory of its country, not to provide the base for such a defense, ... [or] for defense of an individual region except as provided in Article III" (Article I);

- "not to develop, test, or deploy ABM systems or components which are sea-based, air-based, space-based, or mobile land-based" (Article V);

- "not to give missiles, launchers, or radars, other than ABM interceptor missiles, ABM launchers, or ABM radars, capabilities to counter strategic ballistic missiles or their elements in flight trajectory, and not to test them in an ABM mode" (Article VI);

- "not to deploy in the future radars for early warning of strategic ballistic missile attack except at locations along the periphery of its national territory and oriented outward" (Article VI); and

- "not to transfer to other States, and not to deploy outside its national territory, ABM systems or their components limited by this Treaty" (Article IX).

---

[7] (...continued)
and International Security, held out the possibility of invoking the withdrawal clause by November 2001 if "meaningful progress" with Russia was not achieved.

[8] TIAS 7503; 23 UST 3435 (1972).

[9] TIAS 8276; 27 UST 1645 (1976).

The Treaty does not bar the Parties from developing, testing, and deploying a fixed land-based ABM system. But it allows the deployment of such a system only around each nation's capital or around one ICBM complex (Article III). (The USSR chose to deploy its system around Moscow, while the United States chose to defend an ICBM complex in North Dakota. But the United States dismantled[10] its system within a few months.) Moreover, the Treaty also allows the Parties to continue to test and improve their fixed land-based ABM systems and components. But it limits each Party to a maximum of 15 ABM launchers at its test ranges and requires further agreement between the Parties for the establishment of new test ranges (Article IV).

According to Administration officials, the Bush Administration developed its missile defense program without consideration for the limits and provisions in the ABM Treaty. In testimony before the Senate Armed Services Committee, Deputy Secretary of Defense Paul Wolfowitz stated that the Administration sought to develop "the most capable possible defense" which would, at some point–sooner, rather than later–encounter the constraints of the ABM Treaty." The Administration has also asserted that it did not design any tests of its planned missile defense technologies "solely to exceed treaty constraints." But it went on to state that there was no intent to design tests or activities to conform to, or stay within, the confines of the Treaty.[11]

Several elements of the Administration's missile defense plan are in clear contrast to the provisions in the Treaty. First, the deployment of a defense designed to protect the entire United States from ballistic missile attack could be seen as inconsistent with the Treaty's ban on the deployment of ABM systems for the defense of the nation's territory. Even if the defense were limited in its numbers of interceptors and radars, so that it could not completely protect U.S. territory from a large attack, the system could still be seen as a base for the defense of the entire territory. Furthermore, the deployment of a layered defense that uses land-based, sea-based, and space-based components is inconsistent with the Treaty's ban on the deployment of sea-based, space-based, and mobile land-based ABM components. And finally, some of the tests planned for the coming year could conflict with the Treaty's ban on testing non-ABM systems in an ABM mode. The Bush Administration does not deny the existence of these potential conflicts; instead, they serve as evidence of the Administration's view that the United States has to move beyond the constraints in the ABM Treaty to provide an effective defense of the entire nation, its allies, and its forces overseas.

Compliance Questions. The Bush Administration has publicly identified three events that could raise questions about U.S. compliance with the ABM Treaty.[12] These include initial construction activities on a new test site at Ft. Greely in Alaska, a systems integration test combining data from ABM and non-ABM radars, and the

---

[10] Technically, Congress withdrew funding support for operating the ABM complex and the Army consequently removed the interceptor missiles, personnel, and other hardware, thus placing the site in caretaker status where it remains today.

[11] U.S. Department of State. Cable on Missile Defense Policy. Published by the Carnegie Endowment for International Peace, July, 2001. p. 3.

[12] The Senate Armed Services Committee included a provision in its version of the Defense Authorization Bill that would require congressional approval before funds could be spent on activities that might violate the ABM Treaty.

use of an Aegis Spy-1 radar to track an ICBM target during a missile defense test. The compliance issues involved with these plans are complex, in part because the Treaty does not contain precise definitions of the activities in question.

The first of these events raises questions because of the location and intent of the site in Alaska; the latter two raise questions about the capabilities of non-ABM radars to perform ABM missions and the Treaty's prohibition on testing them "in an ABM mode." The ABM Treaty does not include a definition of tested in an ABM mode. However, at the time it was concluded in 1972, the U.S. delegation made a unilateral statement describing its understanding of the meaning of "tested in an ABM" mode. The Soviet Union neither joined nor objected to this U.S. unilateral interpretation. The United States stated that:

> ... we note that we would consider a launcher, missile, or radar to be "tested in an ABM mode" if, for example, any of the following events occur: (1) a launcher is used to launch an ABM interceptor missile, (2) an interceptor missile is flight tested against a target vehicle which has a flight trajectory with characteristics of a strategic ballistic missile flight trajectory, or is flight tested in conjunction with the test of an ABM interceptor missile or an ABM radar at the same test range, or is flight tested to an altitude inconsistent with interception of targets against which air defenses are deployed, (3) a radar makes measurements on a cooperative target vehicle of the kind referred to in item (2) above during the reentry portion of its trajectory or makes measurements in conjunction with the test of an ABM interceptor missile or an ABM radar at the same test range.[13]

In 1978 the United States and Soviet Union adopted a definition of "tested in an ABM mode" in the SCC that, in part, echoes this unilateral statement. They agreed that a component tested in an ABM mode would include an ABM:

- launcher that has been used to launch an ABM interceptor missile
- interceptor missile that has either been launched from an ABM launcher and guided by an ABM radar or that has intercepted a strategic ballistic missile in flight trajectory while guided by an ABM radar
- radar that has tracked a strategic ballistic missile in flight trajectory and guided an interceptor missile toward it.[14]

Further clarification was sought during the 1990s when the United States and Russia negotiated two Agreed Statements on Demarcation that sought to define the difference between ABM and TMD systems, and could help distinguish whether a TMD system had been tested "in an ABM mode." These agreements do not limit the capabilities of TMD interceptors, but they define an ABM target missile as one that has a range greater than 3,500 kilometers and a speed greater than 5 kilometers per second. If TMD systems are tested against targets with these capabilities, they would

---

[13] 23 UST 3460-61.

[14] SCC, *Agreed Statement of November 1, 1978.*

be considered to be "tested in an ABM mode" or ABM systems subject to the limits in the Treaty. The Clinton Administration had agreed to consider these statements to be amendments to the Treaty, even though it viewed them as simple clarifications, and to submit these statements to the Senate for advice and consent. But it had not done so by the end of its term.

Midcourse Test Bed: Ft. Greely, Alaska Site. The Administration intends to construct a new test bed for its missile defense program that includes two sites in Alaska. This test bed would include 5 silos that could launch interceptor missiles from Ft. Greely and two silos at Kodiak Island that could launch interceptors or target missiles. The test bed would also use at least three large phased-array radars – an upgraded Cobra Dane radar at Shemya, Alaska, an upgraded radar at Beale Air Force Base in California, and a new X-Band radar that would be constructed in the mid-Pacific. Preliminary efforts to clear trees and prepare roads at the Ft. Greely Army base are underway, but construction of facilities and silos would not begin until the weather clears in the Spring of 2002.[15]

According to the Administration, this new test bed would achieve several objectives. It would allow the testing of missile defense interceptors at different trajectories, which could provide more realistic assessments of their capabilities; it would allow tests with more complex engagement scenarios, including those that would allow the launch of multiple interceptors at incoming targets; it would allow DOD to practice operations and maintenance activities and assess how Arctic conditions might affect system components; and it might provide a rudimentary operational capability by 2004 if emerging threats required such a system.

An ABM system in Alaska (i.e., one designed to intercept long-range ballistic missiles) is not permitted under the terms of the ABM Treaty. The Treaty permits such a site around Washington, D.C. or within a certain specified area containing ICBM silos. But the Treaty permits the construction of a test facility in a location such as Alaska. In general, the Treaty allows the Parties to continue to test and improve their fixed land-based ABM systems and components at current ***or additionally agreed*** test ranges," as long as there are no more than 15 ABM launchers at its test ranges. In 1978, in an Agreed Statement negotiated in the SCC, the Parties agreed that additional test ranges could be established without further negotiation as long as their establishment was consistent with the objectives and provisions of the Treaty" and, in particular, did not violate Article I, which includes the prohibition on defenses that could provide the base for a national defense.

Because the Administration has stated that the facilities in Alaska could become a rudimentary ICBM defense capability, their planned construction raised compliance questions. It is not clear at what point, however, construction would constitute a violation. The Treaty does not define "construction" or indicate when in the construction process a violation would occur. Lawyers in the Clinton Administration sought to address this compliance question in support of the possibility that the

---

[15] A $9 million contract was awarded on Aug. 17, 2001, to a native Alaskan company (Aglaq Construction Enterprises) for clearing trees, grading the site, and installing preliminary utilities and road structures.

President would authorize construction of an ABM radar in Shemya, Alaska.[16] Most experts agree that early activities, such as clearing and grading land, would not violate the treaty because these activities could precede any type of construction activity. But the lawyers in the Clinton Administration and outside experts never agreed on when some construction activities, such as excavation or the pouring of concrete in support of an ABM site, would violate the Treaty.

Some Russian officials and other arms control advocates have stated that they would consider any ground-breaking activities in Alaska a violation of the Treaty. And, even if the early activities were only a "sign" of U.S. intentions to violate the Treaty, the pouring of concrete into silos would certainly be a violation because "pouring concrete is an irreversible operation."[17] This question, however, is no longer relevant because the Bush Administration announced that the United States will withdraw from the Treaty in June 2002, as construction on the silos begins.

PAC-3 System Integration Test. The Pentagon planned a test of the Patriot PAC-3 system in February 2002 that could have raised questions about the ABM Treaty's ban on testing non-ABM systems in an ABM mode. During this test, three targets were to tracked by radars associated with Aegis, Patriot PAC-3, and THAAD systems. According to a fact sheet provided to the Senate Armed Services Committee by BMDO, an ABM radar at the Kwajalein Missile range was going to also track each target. This radar was not going to communicate with the other radars, so this tracking information would not be used to help the PAC-3 system intercept its target.

However, according to BMDO, the data collected by the ABM radar would support all TMD programs by providing information about how the interceptors and the target missiles behave. Because ABM and non-ABM radars would operate at the same time, and track the same objects, the non-ABM radars could be considered to be "tested in and ABM mode," according to the unilateral interpretation offered by the United States in 1972. The details of the test, though, could affect the determination of whether or not it is consistent with the ABM Treaty. This test took place on February 16, 2001, with two of the three planned intercepts failing to hit their targets.

During the 1980s, however, the United States indicated that it *did* consider concurrent testing of ABM and non-ABM radars to be a violation of the ABM Treaty. In several Compliance Reports that Presidents Reagan and Bush submitted to Congress, the United States expressed concerns about Soviet tests that operated ABM radars and non-ABM, air-defense radars concurrently. The reports state clearly that the United States had pursued the quoted definitions of "tested in an ABM

---

[16] Sirak, Michael C. U.S. Considers Impact of Construction Schedule on NMD Decision. *Inside the Army*. May 8, 2000. p. 1.

[17] Baker, Peter. Russia Says Alaska Test Site Violates ABM Treaty. Washington Post, July 20, 2001. p. A23.

mode" precisely so that the Treaty would constrain the Soviet Union's ability to upgrade its air-defense systems to have an ABM capability.[18]

Aegis Spy-1 Tracking an ICBM Test.[19] According to information provided to the Senate Armed Services Committee, BMDO plans to use an Aegis Spy-1 radar to track an ICBM target missile after its launch from Vandenberg Air Force Base during a missile defense intercept attempt from the Kwajalein Missile Range. Initially, this event was to occur during IFT-7 (Integrated Flight Test-7), which was scheduled for October 2001. For technical reasons, this test was delayed until later. Although the Aegis radar may be connected to the test's command and control system, its data reportedly would not be used in the intercept attempt. However, this test would allow BMDO to assess the ability of an Aegis radar to track ICBM-range targets and to formulate options for the further development of Aegis radars. BMDO has also indicated that, in the future, it might conduct other tests that integrate Aegis Spy-1 radars into ABM tests and operate them at the ABM Test range (both at Kwajalein and at the new Ft. Greely site).

The Aegis Spy-1 radar is a part of the Navy's air defense system, and is being considered to assist in a proposed naval short-range missile defense system. The Aegis radar is not an ABM radar, but could be considered to be tested in an ABM mode if it tracks an ICBM-range target, especially during an interceptor test. However, details of the test could affect the determination about its compliance with the Treaty and the foregoing interpretations. Furthermore, the statements quoted above are not a part of the formal text of the Treaty. Hence, it is not clear that the United States would be in violation of the Treaty if it conducted a test that was inconsistent with these statements.

In late October 2001, Secretary of Defense Rumsfeld stated that this test had been delayed because there were concerns among some in the Pentagon that it could violate the ABM Treaty. The President and others in his Administration have stated that the United States would not violate the Treaty, but would seek Russia's approval or would withdraw from the Treaty if necessary. When observers highlighted information indicating that the Ballistic Missile Defense Organization had delayed the test for technical reasons, not treaty reasons, Secretary Rumsfeld agreed, but stated that the concerns about the Treaty would eliminate the Aegis portion of the test when the flight occurred later in the year. A test that included tracking with an Aegis radar now is not scheduled to occur until Spring 2002. Some observers noted that Secretary Rumsfeld may have highlighted the Treaty implications of the test, in part, to indicate that the ABM Treaty had already affected the Administration's missile defense plan and to support arguments that the United States needed to withdraw from the Treaty soon.

---

[18] See, for example, U.S. Arms Control and Disarmament Agency. Soviet Noncompliance with Arms Control Agreements. September 27, 1990. pp. 14-16.

[19] The summary here, and in the next two sections, is derived from point papers that BMDO provided to the Senate Armed Services Committee with the prepared testimony of Deputy Secretary of Defense Wolfowitz on July 17, 2001.

The Department of Defense Compliance Review Group (CRG) has evaluated these three activities and sent its preliminary findings to Deputy Secretary Wolfowitz. Reports indicate that it did find the use of the Aegis Spy-1 radar to track an ICBM intercept test to be in violation of the Treaty. According to the Pentagon, Deputy Secretary Wolfowitz could weigh a number of options to address the concerns, from delaying the activity in question to opening a broader discussion within the government's interagency process to determine how to proceed.[20] A broader interagency review may also address questions about the interpretation of the Treaty and its negotiating record. Construction activities scheduled for spring 2002 in Alaska may be viewed by Administration officials as driving the need to invoke the requisite 6-month withdrawal notice. Others might suggest this is part of a strategy to discourage the Russians from prolonged negotiations.

The Senate Armed Services Committee included a provision, in its version of the FY2002 Defense Authorization Bill, (S. 1416), that would have required approval by a joint resolution of Congress before any funds could be spent on activities that would violate the ABM Treaty. The Republican Members of the Committee strongly opposed the provision and Secretary of Defense Rumsfeld suggested that it could lead to a Presidential veto of the Defense Authorization Bill. In the wake of the attacks on the World Trade Center and Pentagon, and in the interest of prompt passage of the Defense Authorization Bill, Senate leaders agreed to remove the provision from the Bill. At the time, Senator Levin, Chairman of the Armed Services Committee, stated that he would introduce free-standing legislation to achieve this objective.

Legal Status and Withdrawal. On December 13, 2001, President Bush announced that he had given notice to Russia's President Putin that the United States would withdraw from the ABM Treaty; with the 6-months notice required by the Treaty, this withdrawal would take effect in June 2002. The United States had sought to reach a cooperative solution with Russia, presumably so that Russia would either allow unlimited missile defense tests or agree to "set aside" the Treaty with the United States (this is discussed in more detail below). But these discussions failed to produce an agreement.

Article XV of the Treaty states that either party can withdraw "if it decides that extraordinary events related to the subject matter of this Treaty have jeopardized its supreme interests" (Article XV). Withdrawal requires six-months advance notice that includes a statement of the events that have necessitated withdrawal. In the past, Presidents have often given notices of withdrawal from various treaties on their own authority without the participation of either the Senate or the Congress as a whole. But some analysts argue that withdrawal from a treaty of this importance requires Senate or Congressional authorization.[21] The Administration did not seek congressional approval, but simply informed Members of its intention to withdraw.

---

[20] Department of Defense, News Briefing. Rear Adm. Craig R. Quigley. July 31, 2001.

[21] For a description of the variety of ways in which the United States has terminated treaties in the past, see the Congressional Research Service, *Treaties and Other International Agreements: The Role of the United States Senate*, (S. Comm. Print 106-71) (January, 2001), pp. 198-208.

Some analysts, and some Members of Congress, argue that the Administration did not need to withdraw from the ABM Treaty. They argue instead that the ABM Treaty ceased to be in force after the demise of the Soviet Union. This view is based, in part, on the contention that international law affords the successor states of the Soviet Union a "clean slate" with respect to its treaty rights and obligations. It is based as well on the contention that key provisions of the Treaty can no longer be performed because the treaty can no longer be applied to the entire territory of the former Soviet Union and because a bilateral treaty cannot automatically be converted into a multilateral treaty. Changes in a treaty that are that dramatic, it is said, mean that the old treaty no longer exists. Others argue, however, that international law, as well as all of the (former Soviet) states that are relevant to the ABM Treaty, recognize a continuity of treaty obligations for the successor states of the Soviet Union and particularly of its arms control treaties, that it is a constitutional prerogative of the Executive Branch to decide whether particular treaties remain in force, and that necessary changes to the ABM Treaty can be made either through agreements negotiated by the Executive Branch or by amendments subject to the advice and consent of the Senate.

The first Bush Administration and the Clinton Administration operated as if the ABM Treaty remained in force. The current Bush Administration did the same, hence it gave notice of the U.S. withdrawal from the Treaty to eliminate constraints that would impinge on planned U.S. missile defense tests. To make clear which of the new states succeeded to the rights and obligations of the Soviet Union under the Treaty, the Clinton Administration negotiated a Memorandum of Understanding on Succession (MOUS) that designated not only Russia but also Belarus, Kazakstan, and the Ukraine as the successor states. Some in Congress argued that this MOU was an amendment to the Treaty and required that it be submitted to the Senate for advice and consent. The Clinton Administration did not do so before it left office, however, because it feared it would be defeated. Instead, the Administration stated that it would assume Russia was the successor to the Soviet Union, as it was in a significant number of other arms control, tax, and trade treaties.

Discussions with Russia. When they met after the G-8 summit in Genoa, Italy in late July 2001, Presidents Bush and Putin agreed that the two nations would resume discussions on offensive weapons and missile defenses. These discussions began with consultations in Washington in early August, during which time Pentagon officials provided the visiting Russians with detailed descriptions of its missile defense plans and technologies, meetings between Secretary of Defense Rumsfeld and President Putin and Minister of Defense Ivanov in mid-August and further discussions between high-ranking officials later in August and September.[22]

The Bush Administration did not view these discussions as the opening round in a formal negotiating process that might produce a new treaty limiting offensive nuclear weapons or missile defenses. The President and officials in his Administration have often said, “Russia is not our enemy,” and that, in the absence of an adversarial relationship, formal arms control agreements are no longer needed to manage the relationship between the two nations. Instead, some analysts suggest that the United

---

[22] U.S. - Russian Defense Officials Meet. *New York Times* on the Web. August 8, 2001.

States may be seeking a more informal process where the two sides simply inform each other of their plans and programs.[23] Furthermore, the United States would have liked Russia to agree to set aside the ABM Treaty, or to have both parties withdraw from it together, so that the United States could proceed with missile defense. The Administration did not intend to let these talks drag on or delay its missile defense plans. President Bush stated that, if the two sides could not soon reach an agreement to set the Treaty aside together, the United States would withdraw and deploy defenses.[24] In meetings with Russian officials, Undersecretary of State John Bolton seemed to indicate that time would run out in November, when Presidents Bush and Putin were scheduled to meet in Texas. Other Administration officials denied the existence of a firm deadline, but President Bush stated that the United States would withdraw from the ABM Treaty according to our own timetable.

Russia, on the other hand, would prefer to keep some form of Treaty regime in place. It acknowledges that the world has changed and that the relationship with the United States has changed, but it continues to place a value on the predictability and formality offered by arms control agreements. Reports indicate that it might have been willing to permit more extensive testing of missile defense systems, and to relax the definitions in the Agreed Statements on Demarcation so that the United States could test systems designed to destroy shorter-range missiles against a wider range of targets. But, even if it may now be willing to modify the ABM Treaty so that the United States can conduct these tests, it does not favor an environment in which the United States can deploy missile defenses without limitations.

In spite of these differences, the two sides seemed to reach some common ground in September and October, 2001, in preparation for the summit in Washington and Crawford in mid-November. Reports in the weeks before the meeting indicated that the United States was willing to remain a party to the ABM Treaty, and delay its presumed withdrawal until it planned to deploy missile defenses, as long as Russia was willing to permit the United States to conduct the testing program it deemed necessary. Some analysts assumed this agreement would produce formal amendments to the ABM Treaty, but the Administration apparently sought a less formal agreement where Russia would quietly accept the U.S. testing program in exchange for a delay in the U.S. withdrawal from the Treaty.

However, Presidents Bush and Putin did not announce this type of agreement after their meetings in Washington and Crawford. Instead, they agreed that they would continue to disagree about their differences over the ABM Treaty. President Putin did indicate that he understood U.S. concerns about emerging threats and he stated that differences over the ABM Treaty should not lead to a breakdown in the new, cooperative relationship between the two nations. Some analysts interpreted these comments to mean that Russia might still turn a blind eye if the United States conducted tests that were inconsistent with the ABM Treaty, even in the absence of a formal agreement. Nevertheless, because these tests scheduled to occur and

---

[23] Gordon, Michael. White House Finding Putin a Friend Indeed. *New York Times*. July 23, 2001. p. 1.

[24] Sammon, Bill. Bush Won't Let ABM Treaty Derail Missile Defense. *Washington Times*, July 24, 2001. p. 1.

construction at the Fort Greeley site should begin before the middle of 2002, the Bush Administration had to decide how to proceed. These events reportedly lead the President to announce, on December 13, that the United States would withdraw from the Treaty.

Budget and Program

Budget Allocation and Program Restructuring.

The missile defense program was restructured effective Oct. 1, 2000–the new fiscal year. Some programs were supposed to be moved to the military services; BMDO argued these were more mature programs that were developed out of an air defense capability and should be returned to the services for advanced development and acquisition.[25] In the end, Congress did not authorize these program transfers to the services. Other programs were moved from the Air Force to BMDO and now the MDA.

The restructuring had been proposed for several reasons. The principal ones were that BMDO wanted to focus primarily on the various phases of a ballistic missile's flight trajectory (as opposed to its range–theater vs. long-range–which was the case previously), and take advantage of the concept of layered defense. The layered defense concept is designed to employ multiple missile defenses at various portions of an attacking missile's flight to enhance the probability of its destruction. This concept is examined in more detail later. The new, major program elements (which are also detailed more fully in the final section of this report) within BMDO are:

- **Boost Defense Segment**, which includes Air-Based Boost (also known as the Air Force Airborne Laser, or ABL) and Space-Based Boost (also known as the Air Force Space Based Laser Experiment and the BMDO Space-Based Laser Experiment);

- **Midcourse Defense Segment**, which includes Ground-Based Midcourse (also known as the BMDO National Missile Defense, or NMD, and Sea-Based Midcourse (also known as the BMDO Navy Theater Wide, or NTW);

- **Terminal Defense Segment**, which includes Ground-Based Terminal (also known as the Army Theater High Altitude Area Defense, or THAAD), and the Israeli Arrow Deployability Program (ADP); and

- **Sensors Segment**–includes the Space Sensor (also known as the Space-Based Infrared System-Low , or SBIRS-L) and International Cooperation (known also as the Russian-American Observation Satellite, or RAMOS–a joint, non-missile defense program).

---

[25] These include the Patriot PAC-3/MEADS program, which were to be run by the Army, and the Navy Area Defense program (since cancelled).

The Bush Administration requested $8.3 billion for missile defense in FY2002, an increase of about 61 percent above that approved by Congress for FY2001. The Administration argued this increase was necessary to enhance previously inadequately funded missile defense programs, accelerate near-term missile defense options, allow for more realistic testing of missile defense elements, and explore new missile defense concepts. The Administration and BMDO further argued that each missile defense program was carefully assessed and funding for each program was based on objective needs for FY2002.

A budgetary analysis, however, suggests that the percentage share of the budget total devoted to each major program element (e.g., boost,[26] midcourse,[27] terminal,[28] sensors,[29] BMD Technology,[30] and headquarters[31]) as a function of the total missile defense budget, is virtually identical to that approved by Congress for FY2001. (This does not include the FY 2001 Supplemental, which would change these percentages marginally.) See Table 1.[32] The only apparent difference between the two is the large increase in funding for the program elements.

More recently, the Pentagon announced the redesignation of BMDO as the Missile Defense Agency (MDA). Elevating BMDO to agency status is designed to demonstrate the national priority and mission emphasis on missile defense. The overall objectives for missile defense include: establishing a single program to develop an integrated missile defense system; assigning the best personnel to this effort, and applying a capability-based requirements process for missile defense, according to the Department of Defense. The MDA will develop the missile defense system and baseline its capability and configuration. The military services will procure the system and provide for operations and support.

---

[26] Includes: boost defense segment, Airborne Laser, and Space-based laser.

[27] Includes: BMD midcourse, NMD, and NTW.

[28] Includes: BMD terminal segment, Patriot PAC-3, MEADS, NAD, THAAD.

[29] Includes: BMD sensors, SBIRS-L, International Cooperation.

[30] Includes: BMD segment, BMD technology, BMD support and technology.

[31] Includes: BMD headquarters.

[32] Comparisons reflect the April estimate for FY2001 and the FY2002 Amended budget request; effects of the FY2001 supplemental appropriations are not included. Funding includes RDT&E, procurement, and military construction.

Table 1. Changes in Missile Defense Funding FY2001 vs. FY2002[33]

(millions of dollars or percent)

Program Elements	FY2001 Estimated Funding	FY2002 Amended Budget Funding	FY2002 Enacted	FY2001 Share of total	FY2002 Enacted Share of total	FY2002 Enacted vs. FY2001 % change
Terminal	1,399.4	2,240.9	1,975.5	27%	26%	41%
Midcourse	2,411.3	3,940.5	3,820.5	47%	49%	58%
Boost	304.0	685.4	609.4	6%	8%	100%
Sensors	274.2	495.6	340.6	5%	4%	24%
BMD Technology	745.3	912.5	960.2	15%	12%	29%
Headquarters	4.7	34.3	34.4	0%	0%	627%
TOTAL	**5,139.0**	**8,309.3**	**7,740.6**	**100%**	**100%**	**51%**

The $3.1 billion increase received considerable congressional attention, especially prior to the events of September 2001. Although some missile defense advocates may have questioned its adequacy, many supported the Administration's efforts to advance missile defense development and possible deployment as quickly as possible, in part due to perceived, near-term threats from weapons of mass destruction and their means of delivery. Others, however, were beginning to question the ability of the Defense Department and defense contractors to absorb such large increases in missile defense spending in a single year. Still others questioned the propriety of such large Program Elements (e.g., $3.94 billion for the Midcourse PE and $2.2 billion for the Terminal PE).

The Senate Armed Services Committee, in its version of the FY2002 Defense Authorization Bill (S. 1416), eliminated $1.3 billion of the requested funding for ballistic missile defense. In its report, the Committee argued that this funding was "poorly justified and would be better used elsewhere in the Department." The Committee also questioned the Administration's reorganization of the program elements for missile defense, arguing that the consolidation of programs would allow for the easy transfer of funds without congressional oversight. It allowed the change to stand, but it required that the Administration submit detailed reports outlining their annual plans for missile defense spending.

A major practical effect of this restructuring is that it eliminates the distinction between national (i.e., defenses designed to destroy long-range missiles or warheads) and theater missile defense (i.e., defenses designed to destroy short- and medium-range missiles or warheads). The Administration argues such distinctions serve little purpose and actually encumber meaningful development of layered missile defenses.

Critics charge that by blurring these distinctions at least two important concerns are raised. First, distinctions between prohibited NMD activities under the ABM

---

[33] Adapted from Table 7 in: Appropriations and Authorization for FY2002: Defense. CRS Report RL31005, August 9, 2001, coordinated by Amy Belasco, Mary Tyszkiewicz, and Stephen Daggett.

Treaty are now blurred with permitted TMD activities; the Treaty becomes less meaningful. Second, more successful TMD intercept tests are now mixed in with far more ambiguous NMD test activities, leading to inferences about NMD success that are more ambiguous.

Defense Budget Competition. Increased funding for missile defense also will likely intensify already-keen competition within the Defense Department for scarce resources. In addition to missile defense, the Pentagon is facing rising funding demands for many other priorities, including military operations in response to the September 11, 2001 terrorist attacks; rapidly rising costs for personnel pay and benefits; particularly health care; continued, apparently unabated growth in the cost of operation and maintenance of equipment and facilities; maintenance, refurbishment and replacement of buildings and facilities; and procurement of new weapons and equipment, both to "recapitalize" existing weapons procured primarily in prior years and to "transform" the force with advanced intelligence, surveillance, and communications equipment, new munitions, and other programs. The Administration is also expanding efforts in areas such as homeland defense (especially after September 11, 2001), cyberwarfare, and defense against cruise missiles.

Supporters of DoD programs other than missile defense – including, by some accounts, some senior leaders within the military services – are concerned that the Administration's missile-defense plan might be financed at the expense of other important DoD programs. Last year, some critics of the Administration's proposal to increase funding for missile defense proposed reducing the Administration's FY2002 funding request for missile defense and applying the freed-up funding to other programs, such as readiness-related programs, procurement programs for aircraft, ships, and ground-combat equipment, or emerging DoD priorities such as homeland defense, counterterrorism, or cyberwarfare. After September 11, these contentious proposals were shelved. Instead, the Senate included a provision in its version of the FY2002 defense authorization bill (S. 1438) that permitted the President to use up to $1.3 billion of missile defense funds to combat terrorism, and that measure was incorporated into the conference agreement on the authorization. The final appropriations bill, however, did not include such a provision.

This year, despite large proposed increases on overall defense spending, some lawmakers on the congressional defense committees have complained that the proposed level of funding for some programs is inadequate. The most vocal complaints have come from Members of Congress from shipbuilding states. The Navy is requesting only five new ships in FY2003 and has delayed shipbuilding plans in future years, including, notably the planned production start of the next aircraft carrier. Only at the very end of the FY2003-2007 five-year Pentagon plan will projected ship purchases reach the rate of 8 to 10 ships per year needed, in principle, to maintain a Navy of 300 ships with an average service life of 35 years (i.e., 300 ships divided by 35 years per ship = 8.6 new ships per year needed to sustain the fleet).

Similarly, production rates for fighter aircraft and helicopters are not near sustaining levels, studies persistently point to airlift shortfalls, the Army has proposed terminating 18 small programs, some of which are popular in Congress, and some legislators complain that munitions production remains inadequate, despite a

substantial boost in the budget, pointing out that stockpiles have been drained by a relatively small war in Afghanistan. Meanwhile, each of the military services wants an increase in the number of active duty personnel to cope with the ongoing pace of operations. The Army is looking for the largest increment, seeking to add as many as 40,000 troops to the 480,000 now in service.

As a result, the funding priority that the Administration has given to missile defense may again be a matter of some debate in Congress. Potential issues for Congress include the following:

- Does the Administration's proposed FY2003 level of missile defense funding come at the expense of other equal- or higher-priority defense DoD programs? If so, what are these programs, and should FY2003 funding be shifted from missile defense into these programs?

- What is the risk in future years that funding demands for missile defense will crowd out funding demands for other important DoD programs, particularly procurement programs? How well can this risk be calculated when the potential longer-term costs of the missile defense program cannot be estimated?

- If reductions elsewhere in the defense budget may be needed to finance missile defense, which programs should be reduced?

- What effect will the Administration's proposed spiral acquisition strategy – and the resultant inability to provide estimates of the potential longer term costs of the missile-defense program – have on DoD's ability to create a reliable Future Years Defense Plan (FYDP) and to conduct other long-range program and budget planning? What effect, if any, will this have on Congress' ability to rely on the FYDP to understand the potential composition of the defense budget in future years?

Technical Issues and Acquisition Strategy

Technology and Other Challenges.

Hit-to-Kill. The concept of kinetic kill or hit-to-kill has been a primary focus of the missile defense program since the conception of the SDI in the early 1980s. Previously, the United States pursued missile defense concepts that employed nuclear weapons as interceptors. More conventional explosive warheads were used to develop the PAC-2 system used in the Persian Gulf war against Iraqi Scud missiles. Advanced and exotic concepts, such as various lasers, were largely deemed impractical during the late 1980s and early 1990s.

A kinetic kill interceptor would seek to destroy its intended target through a direct collision at relatively high speeds. The force of the impact would then destroy the attacking missile or warhead, render it inoperable, or divert it from its intended target. With such an approach, a near-miss has the same practical affect as a large distance miss–the target is not destroyed.

Kinetic kill as a concept for destroying short- and medium-range ballistic missiles appears to be in the process of proving itself. After a string of failed intercept tests, the THAAD program finally began a series of successful tests. Barring major, unforseen technical or engineering problems, it appears that a kinetic kill warhead for THAAD can be developed. The same is true of the PAC-3 system. The next generation Patriot interceptor seems to be proving the concept of kinetic kill for short-range missile defenses, despite the most recent test failures in February 2002.

The key question remaining, however, centers around levels of effectiveness, particularly in wartime. Under test-range conditions, most military systems perform better than they do in an operational environment. The Patriot system used in Desert Storm is a notable example. Prior to the war, Patriot successfully intercepted 17 of 17 very different targets under a variety of test range conditions. Patriot encountered a vastly different operational environment when deployed, and its success or failure during the war is still debatable, and, according to experts, probably ultimately unknowable.

Kinetic kill as a concept for destroying long-range ballistic missiles is even more problematic at this stage. There is no unambiguous, empirical evidence to support the contention that kinetic kill for ICBM defense will work. Missile defense advocates argue that since the mid-1980s, a string of such tests have occurred with varying degrees of success; some have failed to achieve interception, while others were deemed successful.

But in almost every case, post-test doubts have been raised. Critics have charged that test results over the past two decades have been exaggerated by false claims of success and promises of performance that later proved false. Many tests were proven to have had their targets significantly enhanced to ensure the likelihood of success.

Some missile defense advocates say this may be true. But kinetic kill for ICBM defense is comparable to where kinetic kill was for systems such as PAC-3 several years ago. They maintain, therefore, that continued development, and especially more realistic testing, is needed to ensure that the kinetic kill concept for long-range missiles can eventually be deployed.

Layered defenses. The concept of layered defense, which dates back to at least the 1960s, and was developed more systematically in the 1980s, envisions deploying several missile defense systems, each designed to intercept an attacking missile or warhead at a different stage of its flight trajectory. The concept arguably would allow for multiple intercept opportunities. Although this presents the possibility that one element of the system may not work as intended, proponents argue that multiple intercept opportunities significantly *increase* the chance that an attacking missile or warhead will be destroyed.

Proponents of layered defenses argue that each layer is able to attack a different vulnerability of the attacking ballistic missile and that, because each layer is statistically independent of every other layer, the probability of a warhead getting through all of the layers (1 to N) can be given by a simple multiplication of the

probabilities of surviving each independent attack.[34] This analysis would readily lead to a conclusion that a defense with three layers, for example, might let extremely few missiles or warheads get through.

Other analysts, however, would argue that this is a wrong conclusion. In the first place, there is no empirical evidence of an air defense system with a probability of intercept (P_i) much greater than about 30 percent (or 0.3). So one might conclude more realistically that the probability that an attacking missile or warhead will survive is closer to 34 percent.[35] Moreover, it is argued,[36] even if one assumes that each layer *is* 90 percent effective, the layered defense model fails because the layers are *not* statistically independent for at least two reasons:

- Each attacking warhead or missile must encounter each of the layers in order, so the performance of one layer will affect the performance of the next layer and so on. For example, if the first layer underperforms because some countermeasure is unexpectedly successful, then the second layer will be required to deal with more simultaneous targets than expected; if one missile or warhead avoids interception, that may mean that circumstances are favorable for the next missile to get through also. Even if each layer is over designed by a factor of about 2, failure of one layer can still lead to saturation of the next. For example, if we expect the terminal layer to have to handle ten warheads, we might design it to handle 20, but if earlier layers then fail so that the terminal layer is presented with 30 targets, at least ten warheads will get through to their intended destination even if the terminal layer works perfectly. The failure of an early layer would thus result in the collapse of the missile defense system: the layered 'pyramid' defense is balanced on its vertex, rather than set firmly on its base

- Until a layered defense has been tested under realistic conditions, when it must engage warheads nearly simultaneously in each layer, it is unrealistic for defense planners to assume that there are no problems of command and control among the layers, and that unknown variables do not operate to degrade the system in unpredicted ways. Such a test would be expensive and difficult to achieve, requiring the multiple simultaneous launch of several ICBMs

The probability of an attacking warhead surviving intercepts by three "correlated" layers cannot be known without making assumptions about the

---

[34] For example, suppose that a missile defense system consists of three independent layers, each with a kill probability of 90%. Then the probability of surviving each layer is 10 percent (or 0.10), and the probability of surviving all three layers is 0.10 x 0.10 x 0.10 = 0.001. In other words, in such a system only one missile in a thousand will get through.

[35] 0.7 x 0.7 x 0.7 = 0.343; that is, 34% of the missiles or warheads would survive this layered missile defense system.

[36] A critique of the layered defense concept is developed by: Zimmerman, Peter D. Pork Bellies and SDI. *Foreign Policy* (Summer 1986): 76-87.

mechanism of the correlation and non-independence of the layers. In general, critics conclude the performance of the system may be no better than the performance of the best layer, and then only if that layer is not saturated by the sheer numbers of missiles, warheads, or countermeasures.

Layered defense proponents are likely to understand, and perhaps agree, with many of these points. But supporters will respond by suggesting these issues can be adequately addressed in the design of a missile defense architecture and adjustments made during its development (see below).

Evolutionary Acquisition Strategy with Spiral Development.

Background. The Administration is proposing an acquisition strategy for missile defense that represents a departure from traditional DoD acquisition practices. The proposed approach, called evolutionary acquisition strategy, would not use many of the program milestones and reviews that have long been required for previous major DoD weapon acquisition programs. Evolutionary acquisition is a product of the defense acquisition reform movement and, like other defense acquisition reform initiatives, is aimed at shortening weapon-development times while taking into account the rapidly changing technology environment.[37] Although there appears to be widespread consensus for streamlining the often-cumbersome DoD acquisition system, the Administration's response to this for missile defense–to employ an evolutionary acquisition strategy–raises potentially significant issues for Congress, particularly regarding program and congressional oversight.

Under an evolutionary acquisition strategy, a basic version of a weapon system is fielded with the intent of subsequently developing and deploying more capable versions of the system as technology and requirements are further refined. A critical aspect of evolutionary acquisition is spiral development, under which the various elements of a weapon system evolve incrementally over time in an iterative manner. Instead of attempting to develop a system that will, upon first deployment, fully satisfy a detailed military requirement, systems under an evolutionary acquisition strategy would be developed, tested, deployed, and modified in a cyclic process that, in principle, would permit weapons developers to incrementally work toward a final system configuration that is eventually capable of meeting its required objectives. Evolutionary acquisition aims to rapidly develop and field useful increments of capability and exploit user feedback in developing additional increments of

---

[37] Evolutionary development is an outgrowth of an effort begun by then-Secretary of Defense William Perry in 1994 to streamline DOD's acquisition system, particularly in recognition that future weapon systems would depend in large part on rapidly changing commercial technology. DOD at that time began to shift from a reliance on DoD-unique military specifications to more commercial-oriented performance standards, removed other bureaucratic obstacles to engage the commercial sector, and adopted best business practices, all to align itself more with the way the private sector operated. A key objective of defense acquisition reform is to reduce the average time needed to develop a complex weapon system – currently more than 11 years – to between 5 and 7 years.

capability.[38] Weapon life-cycle affordability is an additional stated objective of evolutionary acquisition. DoD has recently developed guidelines for managing weapon-development programs employing evolutionary acquisition.

A distinct characteristic of evolutionary development is a reduced ability, particularly at the outset of a program, to define what the deployed system might look like at various points in the future. Rather than attempting to define final configuration at the outset, evolutionary development consciously treats this issue as an open question to be addressed over time as elements of the system are developed, deployed, evaluated, and modified. In this sense, the Administration's proposed missile defense effort is more of an evolving concept than a typical military system in development.

The Administration's missile defense plan would apply evolutionary acquisition and spiral development to an entire family of system development efforts related to the common mission of missile defense. Under the Administration's plan, missile defense systems would be built, tested, deployed, and evaluated incrementally. The final missile defense system or architecture–that is, the numbers and characteristics of the land-, sea-, air-, and space-based system involved–would be determined gradually over the course of several years. During this period, systems capable of performing similar portions of the missile defense mission (i.e., the boost phase, the midcourse phase, or the terminal phase) would be in implicit competition with one another for places in the final system configuration.

The Administration's plan to employ this acquisition strategy for missile defense is consistent with its view that missile defenses are urgently needed. The Administration argues that deploying missile defenses sooner with less capability than later versions is desirable because any improvement in U.S. missile defense capabilities would complicate enemy planning and thereby strengthen deterrence against ballistic missile attacks. The Administration also argues that the strategy is appropriate for weapon acquisition programs, such as missile defense, where the fundamental technologies involved are less technically mature than they are for well-established types of weapons, such as aircraft and ships.

A major consequence of the Administration's proposed evolutionary acquisition strategy is that the missile-defense program would not feature the well-defined phases and milestones of the traditional DoD acquisition system. Another consequence, already reflected in DoD testimony, is that BMDO cannot provide Congress with a description of its final missile defense architecture, the capabilities of any near- or longer-term system, the specific dates by which most elements of the emerging architecture are to be tested and deployed, an estimate of the eventual total cost of

---

[38] Evolutionary acquisition has been described as a strategy for accommodating constant change throughout the process of developing, deploying and continual operation of a weapon system. A spiral development process might include an iterative set of sub-processes such as: establishing performance objectives, designing, coding/fabricating/integrating, experimenting, testing, assessing operational utility, making tradeoffs, and delivering the system. (Evolutionary Acquisition For C2 Systems. Air Force Instruction 63-123. April 1, 2000. Secretary of the Air Force.)

the missile-defense program, or estimates of the amounts of funding that the program will require in individual years beyond FY2002.

Lt. Gen. Ronald Kadish, Director of BMDO (now MDA), stated the following to the Senate in July 2001 in introducing the Administration's missile-defense plan:

> But before I proceed to describe the new program in detail, I would like to make clear what this program does *not* do. It does not define a specific architecture. It does not commit to a procurement program for a full, layered defense. There is no commitment to specific dates for production and deployment other than for lower-tier terminal defense systems....
>
> First, we are recommending a broad, flexible approach to RDT&E that allows us to explore multiple development paths and to reinforce success based on the best technological approaches and the most advantageous basing modes in order to hedge against the inherent uncertainty of the ballistic missile defense challenge. Second, we are recommending an acquisition approach that is evolutionary, one that will allow us to field systems incrementally once they are proven through realistic testing. And third, rather than committing to a single architecture as we have done in the past, we will deploy over time different combinations of sensors and weapons consistent with our national strategic objectives....
>
> This robust RDT&E program aims to demonstrate what does and does not work. Those activities showing the greatest promise will receive greater resource emphasis. Our progress will inform an annual high-level decision-making process that will steer the BMD program in the most promising direction, taking into account optimal approaches and the most reliable information on costs, allowing informed research, production, and deployment decisions.…
>
> The business of missile defense requires coping with a number of technological, developmental, acquisition, and threat uncertainties. For this reason, I cannot tell you today what exactly the system will look like 15, 10, or even 5 years from now. This system will take shape over time. We do not intend to lock ourselves into a highly stylized architecture based on either known technologies or hoped for advances in technology that will take a decade or more to complete. We intend to go beyond the conventional build-to-requirements acquisition process....
>
> Specific system choices and time lines will take shape over the next few years through our capability-based, block approach. We will increase our capability over time through an evolutionary process as our technologies mature and are proven through testing. The block approach allows us to put our best, most capable technologies "in play" sooner than would otherwise be possible. We have organized the program with the aim of developing militarily useful capabilities in biannual blocks, starting as early as the 2004-2006 time frame....
>
> We must deviate from the standard acquisition process and recognize the unprecedented technical challenges we are facing. We do not have major [missile] defense acquisition programs in the FY 2002 budget. We do not have program activities with traditional fixed milestones and clearly marked phases showing the road to production.

> The new approach to BMD development features more streamlined, flexible management through comprehensive and iterative reviews. We will establish yearly decision points to determine the status of the available technologies and concept evaluations in order to be in a position to accelerate, modify, truncate, or terminate efforts in a particular area. This comprehensive annual review process will also help us make decisions to shape the evolving systems and allocate resources to optimally support them.[39]

Issues for Congress. Potential issues for Congress regarding the use of evolutionary acquisition and spiral development in the missile-defense program include the following:

- Evolutionary acquisition with spiral development is a relatively new and untried strategy. Is it the best acquisition strategy for the Administration's high-priority missile defense effort? What are the comparative strengths and weaknesses of evolutionary acquisition and the traditional DoD acquisition system when applied to missile defense? Are there any risks in choosing a large program such as missile defense as one of the first programs to employ this acquisition strategy? Compared to a traditional acquisition strategy, what effect would the adoption of an evolutionary acquisition strategy have on time lines for deploying missile defense capabilities, especially in the nearer term? What effect would it have on mitigating the program's technical risks, and on using implicit competition between candidate systems to improve the effectiveness of the overall missile-defense architecture? If there are reasons to not use a traditional acquisition strategy for missile defense, is evolutionary acquisition the only alternative?

- A challenge for DoD, and for the Congress in performing its oversight role, is to reach a workable system of accountability for systems being developed under an evolutionary strategy. What effect might the use of an evolutionary acquisition strategy have on Congress' ability to conduct oversight of missile defense development and procurement? Would such a strategy provide Congress with sufficient opportunities and information to perform its oversight role effectively? From a congressional perspective, what might be the risks of approving the start of a large program for which there is no defined final architecture, few specific time lines, and no precise estimates of potential total cost? To what extent, if at all, was the Administration's choice of an evolutionary acquisition influenced, as some critics contend, by the knowledge that it might relieve the Administration of the responsibility for providing specific

---

[39] Statement of Lt. Gen. Ronald T. Kadish, USAF, Director, Ballistic Missile Defense Organization, on The Ballistic Missile Defense Program, Amended FY 2002 Budget, Before the Senate Armed Services Committee, July 12, 2001, pages 2-3, 6-8, 14. Emphasis as in the original.

> answers to congressional questions regarding system architecture, effectiveness, time lines, and cost?[40]

Legislation for FY2002. The Senate Armed Services Committee, in its report (S.Rept. 107-62 of September 12, 2001) on the FY2002 defense authorization bill (S. 1416), stated:

> Despite the large proposed funding increase [for missile defense], the Department of Defense has been extremely vague about its plans for missile defenses. No specific multi-year plan has been proposed. Rather, the Department expects to decide how to proceed with missile defense as it goes along.... These are inadequate justifications for the expenditure of billions of dollars of taxpayer money.... Congress needs to know the general and specific plans for expenditure of missile defense funding, as well as the objectives and projected outyear costs of programs that are begun now. (Page 130)

The committee recommended a provision (Section 223) that would require the Secretary of Defense to submit a baseline document for the ballistic missile defense research and development program for the FY2003-FY2007 Future Years Defense Plan (FYDP) submitted to Congress in February 2002 along with the proposed FY2003 defense budget. (See page 133 of the committee's report.)

The conference report (H.Rept. 107-333 of December 12, 2001) on the FY2002 defense authorization bill (S. 1438) included a provision (Section 232) that, among other things, requires the Secretary of Defense to submit to the congressional defense committees, by February 1 each year, a statement of the cost, schedule, testing, and performance goals for DoD's ballistic missile defense programs for the period covered by the FYDP submitted to the Congress that year (Section 232(c)). The Comptroller General, at the end of FY2002 and FY2003, is to assess the extent to which BMDO (now MDA) has achieved the goals established for the fiscal year in question, and report that assessment to the congressional defense committees by February 15, 2003 and February 15, 2004 (Section 232(g)). The provision also requires the Secretary of Defense to submit to the congressional defense committee an annual program plan, including funding and scheduling data, for "activities planned to be carried out for each missile defense program that enters engineering and manufacturing development" (Section 232(d)). The section also establishes requirements for certain DoD offices to conduct certain annual internal reviews of the program and to report the results of those reviews to the Secretary of Defense and the Director of BMDO (now MDA) (Section 232((e)).

The House Appropriations Committee, in its report (H.Rept. 107-298 of November 19, 2001) on the FY2002 defense appropriations bill (H.R. 3338) stated that the Administration's missile defense plan proposed

> eventually buying and fielding these systems using RDT&E appropriations. The Department's intent is to be able to explore new technologies without an official requirements document and without committing to buy a specific number of

---

[40] For more on this issue, see, for example, Bradley Graham, Rumsfeld Pares Oversight of Missile Defense Agency, *Washington Post*, February 16, 2002, p. A2.

> systems, as would be required with a major defense acquisition program. This approach is currently used by the Department for technology demonstrations where prototypes are developed in limited quantity as a proof of concept. However, to acquire entire systems under RDT&E would violate fiscal policy, undermine basic program management principles and ignore the distinction between appropriations. Therefore, the Committee retains the Department's proposed structure for those technologies that have not yet demonstrated a suitable prototype. However, the Committee directs that funding for a program's EMD [engineering and manufacturing development] activities, and beyond, be budgeted in a separate program element; the program be designated a major defense acquisition program and be subject to the requirements of Milestone II and Milestone III or their equivalents. As the law requires, the actual acquisition of the hardware would be done with procurement funding. (Page 251)

The committee also directed DoD to submit more detailed justification material for the missile defense program as part of its future budget requests, including information on annual missile defense program funding requirements, detailed schedules, test events, and (for missile defense programs that are already major defense acquisition programs) the number of systems to be acquired, the expected performance, the unit cost, and the cost to completion of the program. The committee also directed DoD to "present an overall timeline for its future [missile defense] architecture highlighting when each system in that architecture will go into production as well as a comparable threat timeline indicating which threat systems are expected to be deployed and in what quantities." (Page 252.)

The conference report (H.Rept. 107-350 of December 19, 2001) on the FY2002 defense appropriations bill (H.R. 3338) states:

> The conferees support the efforts of the Department [of Defense] to devise a management structure that facilitates integration of the various ballistic missile defense research and development efforts. The Department, however, is cautioned against implementing a management structure and related decision-making process that limit adequate oversight of the program by the Pentagon's operational testing, financial, and programmatic review groups. Also, the conferees will continue to monitor this program's management activities to ensure Congressional oversight. (Page 385)

Ft. Greely Midcourse Alternative. The stated purpose of the Ft. Greely, Alaska, deployment is to provide a realistic test-bed for interceptor missiles linked to the sensor and computer networks of the NMD system. Building and operating a missile silo test-bed in an arctic environment would also be beneficial, according to BMDO. The Administration has stated that the interceptors at Ft. Greely could provide a rudimentary, limited missile defense capability against a rogue-state ICBM in the 2004-2005 period although this contention is disputed. But the principal purpose of the first facilities to be built at Ft. Greely is clearly the testing of the C^3I system and the interoperability of the launcher software with the acquisition, tracking, and targeting systems of an early missile defense system.

Because no live-fire tests from Ft. Greely are contemplated, however, some will argue there is no reason to construct missile launchers today. Rather, the argument goes, the role of the silo launchers could be played equally well by a simple above-

ground structure in which the developmental hardware for the launcher (including equipment and software to transfer information to the interceptor) could be installed. Indeed, to some this would be a better test bed because the equipment could be reconfigured, replaced, or modified far more rapidly and cheaply than could equipment built into a silo launcher. This has the added benefit of being consistent with the evolutionary acquisition strategy the Administration is pursuing. Given that even the interceptor missile is not itself fully defined, critics will charge it is foolish to build launchers today–when those sunk costs and bored holes might well inhibit any necessary redesign or modification of the final flight hardware. Such a technical compromise, they contend, may also alleviate some ABM Treaty compliance concerns with respect to the Ft. Greely site.

International Response

Russian Hesitancy and Opposition. Even before the Clinton Administration began to focus on a decision on missile defense deployments, Russian officials strongly and consistently objected to U.S. missile defense plans. They argued that the 1972 ABM Treaty remain the "cornerstone of strategic stability," and that missile defenses not permitted by the treaty would not only upset international stability but also undermine Russia's nuclear deterrent.[41] Russian officials also argued that U.S. withdrawal from the ABM Treaty would precipitate Russia's withdrawal from a range of nuclear arms control agreements, including the Intermediate-Range Nuclear Forces (INF) Treaty and the Strategic Arms Reduction Treaties (START I and START II). Russian leaders said they may might also feel compelled to build up their offensive nuclear weapons, or at least deploy multiple warheads on new single-warhead SS-27 missiles, to overcome U.S. missile defenses. Hence, according to the Russian view, U.S. withdrawal from the ABM treaty could precipitate a renewed and broader arms race.

During meetings with the Clinton Administration, Russian officials refused to discuss U.S. proposals for modifications to the ABM Treaty that would have permitted the deployment of a limited, land-based missile defense site in Alaska. Some observers believe that Russia's resistance was due, in part, to Russia's belief that the Clinton Administration was not committed to the deployment of missile defenses and therefore, would not withdraw from the ABM Treaty.

More recently, however, Russia has appeared more willing to consider changing the Treaty. In mid-July 2001, President Putin suggested that the United States and Russia might be able to reach an agreement on missile defenses, as long as the resulting agreement did not upset existing arms control regimes.[42] Then, in late July, Presidents Putin and Bush agreed to begin consultations on missile defenses and strategic offensive weapons, with the objective of reaching agreement on a new framework that Administration officials argued might replace the ABM Treaty. After that meeting, Russia's Defense Minister Ivanov stated that he might recommend that

---

[41] For a detailed review of Russia's reaction to U.S. missile defense plans, see *National Missile Defense: Russia's Reaction*. CRS Report RL30967, by Amy F. Woolf.

[42] Perlez, Jane and Michael Wines. Few Missile Defense Details Emerge After Powell Talks. *New York Times*, July 19, 2001.

Russia accept some changes to the Treaty if the changes would not harm Russia's national security.

Many observers interpreted these changes to indicate that Russia understood that its objections would not stop the Bush Administration's plans to deploy missile defenses or withdraw from the ABM Treaty. Some have argued that President Putin may be willing to accept U.S. proposals to set aside the ABM Treaty and replace it with a new, less formal framework. Others, however, do not believe that Russia has altered its fundamental opposition to U.S. missile defenses and that it continues to support the ABM Treaty. They conclude that, instead of appearing weak by objecting to an inevitable event, President Putin has decided to participate in discussions to bolster his nation's standing as a strategic partner with the United States, to demonstrate to others, especially in Europe, that he is willing to make "responsible compromises," and to try to shape and possibly limit the missile defense system that the United States eventually deploys. This strategy could have advised the apparent Russian willingness, in the weeks before the summit between Presidents Bush and Putin in mid-November, to allow U.S. missile defense tests, as long as the Treaty remained in place to limit defense deployments. Nevertheless, the summit did not produce this type of agreement and the United States informed Russia of its withdrawal from the ABM Treaty on December 13. President Putin referred to the U.S. decision as a mistake, but he, and many of his advisors, noted that this development should not undermine the broader U.S.-relationship. Hence, in spite of earlier warnings of dire consequences, Russia appears resigned to the demise of the ABM Treaty.

Mixed Allied Views in Europe. Most U.S. allies in Europe continue to oppose U.S. withdrawal from the ABM Treaty and the building of a missile defense system, although their opposition softened and became more nuanced since Spring 2001. They do not find persuasive that the attack of September 11, 2001, strengthens the argument for missile defense. In general, the allies support a continued treaty regime between the United States and Russia that provides structure to the strategic weapons balance. A U.S.-Russian agreement to reduce nuclear forces has been greeted with relief in Europe, but most allies are quietly critical of the U.S. decision to abandon the ABM Treaty, which they view as an act of "unilateralism."

In general, most U.S. allies in Europe have argued that robust missile defenses, if coupled with unilateral abrogation of the ABM Treaty, would likely upset stability, ignite arms races, and undermine international non-proliferation objectives. They tend to view the Administration's effort to move forward with missile defense as too narrow an effort to confront the problem of proliferation of weapons of mass destruction and their means of delivery. In their view, a broader effort is necessary; for example, they believe that the United States should not have refused to sign the Biological Weapons Protocol.

Many European governments voiced their views on missile defense during President Bush's trip to Europe in June 2001. Although grateful that the Administration agreed to consult with them over missile defense, many European officials complained that the meetings were vague on details for Administration plans and that their views were not taken into account. However, some governments have endorsed the Administration's missile defense plans, such as Italy and Spain. The

responses of France, Germany, and Britain ranged from critical to reserved. While each of these governments acknowledges a growing ballistic missile threat from "rogue states," particularly Iraq, they do not believe that missile defense can provide necessary security.

France is the most forceful EU critic of missile defense. President Jacques Chirac calls the ABM Treaty the "strategic pillar" of arms control; in his view, its abrogation will undermine nuclear deterrence and impel countries to build weapon systems able to penetrate a missile defense system. France, a nuclear power, believes that deterrence remains effective against countries such as Russia as well as Iraq. German Chancellor Gerhard Schroeder also acknowledges potential missile threats from such countries as Iraq, but believes that economic and diplomatic engagement can counter such threats. Germany is one of several EU countries, for example, seeking expanded trade relations and political contact with Iran. British officials are generally more agnostic on missile defense, but the Labor government of Prime Minister Tony Blair presented the Bush Administration with a report signed by approximately 250 Labor Members in the House of Commons in July 2001 that was critical of missile defense. Prime Minister Blair has said that Mr. Bush is right to raise missile defense as part of "new and imaginative solutions" to the proliferation of weapons of mass destruction, but has also called for a structured approach through arms control agreements to achieve this end.[43]

Diverse Reaction in Asia and the Pacific. The Administration's missile defense policy has received a very mixed reception among the countries of the Asia-Pacific region. Reaction has ranged from harsh criticism from China through expressions of anxiety in Southeast Asia, "understanding" in Japan, and support from Australia and India.

Chinese Opposition. The People's Republic of China (PRC) opposes U.S. missile defense efforts strongly and vociferously. The PRC's objections are at least three-fold: First, Chinese civilian and military leaders are concerned that the possession by the United States of an ICBM defense capability would seriously degrade the effectiveness – and hence the deterrent value – of China's 20-25 CSS-4 liquid fueled ICBMs, their only missiles with sufficient range to reach the continental United States.[44] Although the Bush Administration has emphasized that its long-range missile defense effort is designed primarily to deal with small-scale attacks by "rogue" nations, Chinese policymakers assume that a protective shield against these nations in all probability would include enough interceptor missiles to threaten the viability of its own force.

---

[43] Interviews with officials of EU governments, summer 2001; "Les antimissiles deviennent l'enjeu d'un nouveau défi euro-atlantique," *Le Monde*, June 21, 2001, p. 17; "Bush tries to sell NATO on Missile Defense plan," *Washington Post*, June 14, 2001, p. A1; "'Star Wars' fears may test US-UK relations," *Financial Times*, July 11, 2001, p. 12. Some of these concerns echo European concerns of the 1980s. See *The Strategic Defense Initiative and U.S. Alliance Strategy*, Archived CRS Report 85-48, by Paul Gallis, Mark Lowenthal, and Marcia Smith, Feb. 1, 1985.

[44] For further information on China's missile capabilities, see CRS Report 97-391, *China: Ballistic and Cruise Missiles*, by Shirley A. Kan.

Second, the simultaneous pursuit by the United States of missile defenses against short- and theater-range ballistic missiles would allow U.S. forces in the Pacific to deploy a protective shield over Taiwan, thereby potentially negating China's ability to gain the upper hand in a cross-Strait confrontation with what it regards as a renegade province. China also appears concerned that the United States might transfer BMD technology to Taiwan.

Third, Beijing is concerned about U.S.-Japanese missile defense cooperation. Despite the fact that Japan possesses only a very limited offensive military capability, Beijing's strategists and many outside analysts regard Japan's forces as more technologically advanced and more operationally effective. China's frequently expressed concerns about a revival of Japanese militarism are in part political weapons in a struggle for regional influence, but they also reflect a strong, historical and emotionally-rooted wariness of Japanese intentions. Thus China remains highly suspicious of any developments that appear to make the U.S.-Japan security alliance more effective or that give Japan additional military capabilities.

American and foreign critics of the Bush Administrations missile defense effort cite the likelihood that China will respond to a U.S. missile defense capability by building more missiles with more sophisticated warheads–for instance by deploying multiple independent reentry vehicles (MIRVs) that would present more difficult targeting challenges. Supporters of the Administration's policy argue that, whatever the United States does, China already has plans to increase the size and sophistication of its ICBM force.

Noncommittal Japanese "Understanding". Although the Japanese government and public are deeply troubled by the Bush Administration's approach to missile defense, Tokyo has withheld criticism, employing the time-honored Japanese expression of "understanding" U.S. policy.[45] Japan's cooperation would be essential if the United States were to seek to develop an integrated regional missile defense architecture. Even an independent Japanese missile defense capability against short- and theater-range missiles, if it were interoperable with that of the United States, could enhance the ability of U.S. forces to mount a regional anti-missile defense. Unconstrained use of several current U.S. bases in Japan would also become important if the United States were to deploy a boost-phase missile defense capability to counter long-range missiles from North Korea – a prime concern of U.S. missile defense advocates.

Japan had engaged in discussions with the United States about cooperating on missile defense since the early mid-1980s, but had resisted committing itself until North Korea's August 1998 launch of a three-stage Taep'o-dong 1 medium-range missile, which passed over the main Japanese island of Honshu. In August 1999, U.S. and Japanese officials agreed to carry out joint research on elements of the Navy Theater-Wide (NTW) program (now known as the Sea-Based Boost program), an exo-atmospheric system that might be deployed on ships fielding the Aegis radar and

---

[45] For additional background and analysis concerning Japanese policy see CRS Report RL30992, *Japan-U.S. Cooperation on Theater Missile Defense*, by Richard P. Cronin and Y. Jane Nokano.

fire control system. (Japan already has four of these destroyers, and has budgeted for two more.)

Japanese defense policymakers and defense firms generally have been enthusiastic about non-strategic missile defense cooperation (i.e., missile defense designed to counter short- and theater-range ballistic missiles), but the political parties and the public are split over the issue. Many Japanese defense officials and observers see such cooperation as a counter to North Korea's missiles and an "alliance builder" with the United States. Other Japanese are fearful of aggravating relations with China or triggering an Asian missile race–concerns that are shared by many U.S. critics. Even missile defense advocates are concerned about the large costs associated with the proposed Sea-Based Midcourse effort. Moreover, if, as expected, this particular program leads to an expanded role in seeking to provide missile defenses against long-range missiles, then support in Japan is likely to erode quickly.

Japanese officials have indicated two serious concerns about the Bush Administration's decision to treat NMD and TMD programs as undifferentiated aspects of missile defense. First, the use of Japanese-supplied technology in the U.S. effort aimed at engaging ICBMs would violate a constitutional ban on "collective defense." Second, the new U.S. approach may concentrate resources on technologies that are less relevant to Japan's particular missile defense concerns. Japan is concerned only with the threat posed by theater-range missiles, whereas the Bush Administration has given first priority to achieving a near-term capability against long-range threats to the United States. In addition, Japan, like the countries of Southeast Asia, is concerned about the effect of the new missile defense policy on further polarizing Sino-U.S. relations, making Sino-Japanese relations more difficult.

For the time being, Japanese officials have avoided addressing the collective defense issue arising out of the changed U.S. missile defense strategy and have concentrated on protecting Japan's option to acquire a BMD capability. Towards that end, Japan has boosted its budget for BMD cooperation and signaled its intent to acquire the technology that could support a BMD capability on the two new Aegis destroyers that are under construction.[46] With regard to funding, Japan initially budgeted about $30-35 million annually for a five year period for research and development cooperation on the NTW program. In late August 2001, however, the JDA announced its intent to seek twice as much–$66.5 million at prevailing exchange rates–for the next fiscal year, which begins April 1, 2002. This increase is being sought despite severe overall pressures on the defense budget, which reportedly will only increase by 1.8% overall in fiscal year 2001.[47] For its part, the Department of Defense has included comparable funding in its future year defense plans.

Australian Support. The conservative government of Prime Minister John Howard has given cautiously phrased support to the Bush Administration's missile defense policy and more generally has welcomed the emphasis placed by the Administration on strengthening U.S. relations with Asia-Pacific allies. Canberra's support appears primarily a matter of promoting closer alliance relations, but it also

---

[46] *Tokyo Shimbun*, August 17, 2001: 1.

[47] *Nihon Keizai Shimbun* report cited in *Japan Digest*, August 30. 2001: 4-5.

stems from the desire to benefit from enhancements to the U.S. defense "umbrella." Among other concerns, Australian officials note that their territory is within range of North Korea's Taep'o-dong 2 missile, were it to be successfully developed and deployed. Australia has qualified its support for the new U.S. missile defense strategy by noting its preference that the issue of the ABM treaty be resolved between the United States and Russia by consensus, and not by a unilateral American abandonment of the treaty. Public attitudes are mixed. The Labor Party is divided between those who oppose any participation in the U.S. missile defense effort, and those who only oppose research and development cooperation.

A major issue in Australia is the question of what role the Pine Gap relay ground station, jointly operated by U.S. and Australian forces, would play in U.S. NMD. (Pine Gap has the capability of capturing and relaying satellite data on missile launches in the East Asian region.) For reasons that are unclear, the latest Australian defense white paper reportedly makes no reference to ballistic missile defense, though it does discuss a growing threat to its naval forces from supersonic anti-ship missiles. Apart from the opposition to missile defense of the Labor party, Australian policy over the longer run could be affected by several concerns. In the past, Australia has been uncomfortable when the United States emphasized alliance relations over multilateral fora such as the ASEAN Regional Forum, because from the Australian perspective such fora make its alliance cooperation with the United States more acceptable to Asian neighbors.

Uncharacteristic Indian Support. In a notable break with its traditional opposition to U.S. nuclear and missile policy initiatives, the Indian coalition government led by the Hindu-nationalist Bharatiya Janata Party (BJP) reacted warmly to the Bush Administration's missile defense policy. Indian leaders were pleased at being included in a May 2001 briefing tour of Asian capitals by Deputy Secretary of State Richard L. Armitage, which also included Tokyo and Seoul. India's response, inconceivable until very recently, appears to be based on a number of considerations. First, the Bush Administration appears willing, at least symbolically, to give India recognition that it has long sought–tacit admission to the "nuclear club" of the big powers. Second, and more concretely, the Administration has signaled its desire to seek congressional approval to relieve India of remaining sanctions that were imposed following its series of nuclear tests in May 1998; these include a ban on military sales and the transfer of controlled technology. Third, the Administration appears to have informally granted India long-sought recognition as the premier power in South Asia, and the status of a putative security partner. Fourth, India has a natural interest in any technology that could counter China's ballistic missiles, and may hope to one day obtain a missile defense capability with U.S. assistance. Last, but not least, the Administration's proposal to substantially reduce U.S. missile inventories fits in with India's long-standing insistence that it will not sign the Comprehensive Test Ban Treaty (CTBT) or participate in other anti-nuclear agreements until the major weapons powers substantially reduce their own arsenals. This gesture by the Administration has given the Indian Government some defense against criticism that it has completely reversed a policy of nearly three decades.

The Bush Administration's policy appears to recognize frankly that India's nuclear and missile capability is a reality, and seeks to engage constructively with a friendly democracy of significant military power and geostrategic weight. Whether or

not a *quid pro quo* for Indian support of its missile defense policy, the desire of the Bush Administration to remove the remaining anti-nuclear sanctions represents a significant reversal of basic American nuclear non-proliferation policy dating from the mid-1970s. Although the Clinton Administration and the 106th Congress had moved swiftly to waive most non-military sanctions against both India and Pakistan following their May 1998 nuclear tests, these legislative initiatives were rationalized on humanitarian grounds or out of consideration for American farmers and businesses. A number of critics of U.S. nuclear nonproliferation policy, however, have long called for "realism" about the inevitability that India will become a nuclear weapons power with strategic reach (and that Pakistan will become a regional nuclear power.) In this sense, the policy initiative could be viewed as the triumph of this point of view.

Some also see engagement with India as part of a *de facto* policy of seeking to counterbalance China's rising power by bolstering security ties with regional allies and other friendly states. Senior Administration officials insist that the new security initiative is not directed at China, but is related to shared U.S. and Indian values of democratic government and the common experience of multi-ethnicity.[48] Critics note that the Indian polity has long possessed these characteristics–a fact that did not heretofore reduce U.S. opposition to New Delhi's nuclear and missile programs. Hence, the Administration may be challenged by critics in Congress and elsewhere to further explain the basis for its policy change towards India.

Background on Major Missile Defense Programs

Boost Defense Segment

Air-Based Boost. The Air-Based Boost program, more commonly known as the Airborne Laser (ABL), would use a high-power chemical laser mounted in a modified Boeing 747 aircraft to shoot down theater missiles in their powered boost phase of flight. The laser would seek to rupture or damage the missile's booster skin to cause the missile to lose thrust or flight control and fall short of the intended target before decoys, warheads, or submunitions are deployed. The ABL's intended range is several hundred kilometers. Major subsystems include the lethal laser, a high-precision tracking system for keeping the laser beam on target, and an adaptive optics system that compensates for atmospheric effects to keep the beam tightly focused.

The ABL program was transferred to BMDO, now the MDA, from the Air Force. The MDA states there is no current system or architecture envisioned for missile defense, including specifics for the ABL. But the Director of BMDO, in congressional testimony, has stated that "BMDO will evaluate the most promising projects" for boost-phase defense "to provide a basis for an architecture decision between 2003 and 2005."

The most recent Air Force concept envisioned a fleet of seven aircraft. Five of these aircraft would deploy to a theater to support two 24-hour combat air patrols.

---

[48] Department of State, International Information Programs, *Transcript Excerpts: Armitage on Mideast, South Asia*. Washington File, Aug. 17, 2001 (Excerpts from August 17 Sydney Media Roundtable).

These aircraft would be positioned behind the friendly line of troops and moved closer toward enemy airspace as local air superiority is achieved. The most recent cost estimate was $10.7 billion (life cycle costs), which includes an estimated $1.6 billion for the current program development and risk reduction phase.

Funding for FY2001 was $387 million, including a supplemental appropriation of $153 million approved in July 2001. Both the House and Senate armed services committees and the Senate Appropriations Committee increased funding for the ABL above the original FY2001 request.

BMDO requested $410 million for the ABL in FY2002 to support an increased level of near-term testing and technology development. Although the House and Senate authorization reports each recommended reduced funding, the final FY 2002 appropriation increased ABL funding to $484 million because the program had been slipping and many in Congress wanted the ABL to get back on schedule. Although details are not yet available, one report suggests that the MDA will request $598 million for the ABL in the FY 2003 budget.

The contractor team consists of Boeing, Lockheed Martin, and TRW. Boeing is responsible for the aircraft and for overall management, including systems integration. Lockheed Martin is responsible for the beam control systems, including target tracking and atmospheric compensation. TRW is responsible for the lethal laser and for ground support systems. There are numerous subcontractors.

The system currently under development will attempt its first missile shoot-down test in 2003. BMDO states this half-power ABL could be available for deployment as an emergency capability immediately following lethality demonstrations scheduled for late 2003. If all goes according to schedule, this system and the next two could provide an initial operating capability – one aircraft on station, one preparing to arrive on station, and one on ground alert – by FY2009.

Congressional concerns about the ABL have centered on two main issues: the maturity of key technologies and the concept of operations. First, although proponents contend that the ABL employs mature technology, others characterize key aspects (particularly the atmospheric compensation system) as experimental. Critics also claim that the tests needed to resolve this question, which are being conducted concurrently with the development of the technology, will not take place until 2003. This date is after a second aircraft is scheduled to be ordered, and just months before the first shoot-down test. The compressed and concurrent nature of this schedule also is an issue of concern. The Defense Department's Office of Test and Evaluation informed Congress in its FY 2000 annual report (January 2001) that the 24-month EMD (Engineering, Manufacturing, and Development) program is "alarmingly short....[the schedule] allows for no technical problems or test failures, and the many integration and test activities cannot all physically be accomplished in the time allotted for EMD."

Second, there is disagreement about whether the ABL would be operationally effective, even if its technology performs as planned. The ability of the ABL to destroy enemy missiles at its intended range depends on a number of factors, including atmospheric conditions between the laser and the target, possible enemy

countermeasures, and the worldwide trend towards deployment of longer-range missiles for theater operations. Possible technical countermeasures include hardening the missile casing, spinning the missile, or applying a polished finish to the missile.

In addition, the ability to deploy ABL aircraft during crisis or war will depend on the ability to provide a relatively safe area of operations through air superiority. It is not clear whether enemy forces would wait for this to happen and render their ballistic missile forces more vulnerable, or see incentives to launch their missiles before ABL systems were deployed, or whether an opponent might choose to wait out a crisis because a force of ABL aircraft probably would not be deployed on 24-hour combat patrols indefinitely.

Space-Based Boost. The mission of the Space-based Boost intercept portion of the program is to develop the capability of shooting down ballistic missiles of any range in their boost phase (i.e., before the missiles have released their payload) from platforms located in orbit. The primary effort is focused on developing a space-based laser (SBL), the components of which have been under development since before SDI in the early 1980s. In addition, research and development in space-based kinetic weapons is to be reconstituted. Other missions for the SBL in the past have included surveillance, target detection and designation, and air defense.

The FY 2002 amended budget request for this element of the program is $190 million; SBL activities account for $170 million. The other $20 million requested would go toward study and definition of potential kinetic energy boost phase interceptor concepts and a space-based kinetic energy experiment (SBX) to demonstrate them.

The primary objective of the SBL activity is to able to conduct a SBL Integrated Flight Experiment (an in-orbit demonstration) in the 2011-2013 time frame. Activities include risk-reduction development of component subsystems (a megawatt hydrogen-fluoride laser, mirrors, beam controls, pointing/tracking/fire controls, etc.), component integration, ground testing, launch integration and on-orbit testing. Funding also would go toward the construction of a new SBL Test Facility (which is to be built at the Stennis Space Flight Center in Mississippi). The Administration has not released a total life-cycle cost required to achieve this goal. In the past, estimates have suggested that the test could be accomplished with a 5 to 6 year program costing between $1 billion and $3 billion. Those estimates are generally seen as overly optimistic today. Note, too, that this just covers the demonstration experiment. The design, development, testing, launch, and operation of a constellation of a dozen or more SBL satellites would require additional funding.

The contract team working on the SBL include divisions of TRW, Boeing, and Lockheed Martin located in California.

There are a number of issues associated with space-based boost phase intercept. Perhaps the primary one is that testing and deploying these systems in an ABM mode has been prohibited by the ABM Treaty. Any such system could also function as a anti-satellite weapon, which issue has also been highly controversial. The desirability of stationing weapons in space generates differing opinions. Also, the technical hurdles associated with space-based interceptors – especially lasers, with

their weight, size, and reliability constraints – are difficult. Feasibility is not yet certain, hence the need for the demonstration programs. At the very least, how long it will take to overcome those hurdles and at what cost remains uncertain.

Congress was not supportive of the space-based intercept portion of the boost phase segment of the program. The House, in considering the defense authorization bill, voted to cut $120 million from the space-based intercept program. Rep. Spratt argued later that the cut was made because most Members wanted to see if the laser technology could prove itself first on an airborne platform before trying to put that technology on a space-based platform. This reduction was restored in conference. Nevertheless, in the end, Congress did not support the space-based intercept program in the defense appropriations bill. Congress voted to reduce the request for the space-based laser by $140 million ($120 million for the program and another $20 million for a space-based boost study), leaving $30 million to continue the program. The space-based kinetic intercept program was cut by $10 million (specifically for a study), leaving $10 million for that program. In all, $40 million was appropriated for the Space-Based Boost program

The large cut in the space-based laser program, unless somehow reversed, is likely to cause a major restructuring, if not cancellation, of the work on the SBL Integrated Flight Experiment. The cut also threatens to halt construction of the SBL Test Facility.

Sea-Based Boost. The Sea-Based Boost program was created by the Bush Administration in 2001 as part of its new missile defense program. (The general idea of using sea-based missiles to intercept enemy ballistic missiles in their boost-phase, however, goes back several years.) The Administration's $685 million FY2002 request for all Boost Defense Segment programs included $50 million for the program, which amount Congress approved in its final defense appropriations bill. The FY 2003 Boost Defense Segment request is about $800 million; at this time the specific request for sea-based boost is not publicly available, but is likely to be comparable to last year's request.

The sea-based boost program is not yet well defined. MDA Director Kadish stated in July 2001 that the project "is considering a high-speed, high-acceleration booster coupled with a boost kill vehicle. This same booster will be evaluated (with a different kill vehicle) for sea-based midcourse roles."[49] The program could be pursued as either a complement to air- and space-based boost-defense systems or a hedge against the possibility of technical problems in these other programs. General Kadish stated that BMDO is "going to institute concept studies and [is] looking at concepts on how to do the boost phase with kinetic energy, as a hedge against the directed energy, should we run into problems there. So we have some experiments in space with the space-based laser, and we're looking at whether we should be doing

---

[49] Statement of Lieutenant General Ronald T. Kadish, USAF, Director, Ballistic Missile Defense Organization, on The Ballistic Missile Defense Program, Amended Fiscal Year 2002 Budget, Before the Senate Armed Services Committee, July 12, 2001, page 26.

some experiments in space with kinetic energy that build on the terrestrial side for airborne laser and a sea-based kinetic energy killer."[50]

One press report stated that

> The approach [for Sea-Based Boost] differs greatly, however, from the boost-phase intercept concepts [previously] considered by the Navy. The service was eyeing its traditional Standard Missile interceptor as the baseline for any attempts to shoot down ballistic missiles during their first seconds of flight. The BMDO concept, however, is an entirely different missile."[51]

The sea-based boost-defense concept is of potential interest because forward-deployed Navy ships operating off the coasts of other countries might be close enough to certain ballistic missile launch sites of concern for high-speed, high-acceleration, ship-launched interceptors to fly inland from the ship and intercept enemy ballistic missiles during the boost phase. The interceptor would need a kill vehicle different from the Sea-Based Midcourse kill vehicle because the latter is designed to operate against a small and relatively cold target, while a boost-defense kill vehicle would need to be capable of operating against a large and hot-burning target.

The sea-based boost-defense concept appears most feasible for use against missiles launched from sites that are close or somewhat close to international waters, since this would reduce the distance that the interceptor would need to fly to reach the enemy missile and thereby increase the chance that the interceptor would reach it during its boost phase. The concept might thus have the most potential for intercepting missiles launched from countries such as North Korea, Libya, or perhaps Iran. The concept would appear to offer little potential for intercepting long-range Russian or Chinese missiles, whose launch sites are located deep inland, because these missiles are more likely to complete their boost phase before a ship-launched interceptor (even one with a high-speed, high-acceleration booster) could reach them.

Legislation for FY2002. In its report (H.Rept. 107-194 of September 4, 2001) on the FY2002 defense authorization bill (H.R. 2586), the House Armed Services Committee recommended reducing the funding request for Sea-Based Boost by $25 million, "reflecting the committee's view that concept definition and operational assessment should precede hardware design, development, and testing." (Page 235.)

In its report (S.Rept. 107-62 of September 12, 2001) on the FY2002 defense authorization bill (S. 1416), the Senate Armed Services committee recommended reducing the funding for the concept-definition portion of the request for Sea-Based Boost by $10 million. The committee stated that it "understands that the design of the new booster does not yet exist, and that the Navy has not been involved in the conceptual design process. Boost-phase technology is extremely challenging, and since boost-phase hardware does not yet exist, it is unlikely that actual tests of such

---

[50] Transcript of July 13, 2001 DoD news briefing on missile defense with Lt. Gen. Kadish.

[51] Wall, Robert. Pentagon Embraces Murky Missile Defenses. *Aviation Week & Space Technology*, July 23, 2001: 27.

hardware would be warranted or possible in the first year of such an initiative." The committee urged BMDO (now MDA) "to involve the Navy in sea-based boost concept development before proceeding further." (Page 213.)

Midcourse Defense Segment

Ground-Based Midcourse. The Ground-Based Midcourse Program, also known previously as the National Missile Defense (NMD) program, would use some number of ground-based interceptors to seek to defend all 50 states of the United States from a limited intercontinental-range ballistic missile attack. The kinetic kill warhead on the missile would seek to destroy its intended target through direct collision during the midcourse phase of the attacking missile or warhead. Major subsystems might include some number of existing and new radars and surveillance platforms, including the Aegis Spy-1 radar, existing early warning radars and a new X-Band radar, the space-based Defense Support Program, SBIRS (High and Low), and various Battle Management, Command, Control, and Communications ($BMC^{3)}$ components.

The Ground-Based Midcourse program is BMDO's proposed successor to the National Missile Defense (NMD) program. The Administration has not proposed a system at this juncture, but it has indicated the Midcourse Test Bed, in conjunction with the 5 proposed interceptor missiles to be deployed at Ft. Greely, could provide a rudimentary ground-based ICBM defense contingency capability beginning about 2004-2005. Some have suggested an additional capability a few years after this with about 50 missiles and the new X-Band radar. Boeing is the Lead System Integrator (LSI).

For point of reference, the Clinton Administration considered deploying a system of 100 ground-based interceptors in Alaska at a cost of about $36 billion (the life-cycle cost was estimated to be about $44.5 billion through FY 2026). The Initial Operational Capability (IOC) for this systems was 2005.

The Bush Administration requested $3.23 billion for the Ground-Based Midcourse program in FY2002, which Congress approved. Congress approved about $2 billion for FY 2001. In Congress, both House and Senate armed services committees added funds to the Clinton Administration's FY2001 NMD request for risk reduction measures in the program, and the Senate Appropriations Committee added some money for risk reduction and additional radar development.

The NMD program has witnessed a number of technical challenges. These include ongoing delays in testing the rocket booster, which in turn has adversely affected decisions on acquiring long-lead interceptor technologies. In addition, modeling and simulation tools that were supposed to aid the Clinton Administration in its decision whether to deploy a limited NMD in Alaska, were delivered too late to help in that decision. The Integrated Flight Test (IFT) program also has achieved uncertain results. Although many tests were called successful by the DoD, post-intercept test analyses have been considered more ambiguous. Much of this debate centers over the degree to which target missiles or warheads were artificially enhanced to make the intercept more likely. Program delays have occurred regularly. But, a great number of IFT objectives were designed to test other aspects of the

missile launch, missile flight, and interceptor performance. These other, non-intercept objectives were largely considered successful.

In early December 2001, BMDO announced a successful NMD intercept test over the central Pacific Ocean. BMDO stated this test is a major step in an "aggressive test program," and that it was the "third successful intercept test in five attempts."

Sea-Based Midcourse. The Sea-Based Midcourse program is the successor to the Navy Theater-Wide (NTW) program (which was also called the Navy Upper Tier program). The Administration's $3,200 million FY2003 request for Midcourse Defense Segment programs includes an amount not yet publicly available for the Sea-Based Midcourse program. Major contractors for the program are Boeing of Seattle, Washington, Lockheed Martin of Moorestown, New Jersey and Sunnyvale, California, Raytheon of Tucson, Arizona, and Thiokol of Promontory, Utah.

The Navy's NTW program was originally designed to intercept theater ballistic missiles during the midcourse phase of flight, so as to provide theater-wide (i.e., regional) defense of U.S. and friendly forces, vital military and political assets ashore, and large geographic areas. The system would be based on Navy Aegis ships.[52] It would involve modifying the Aegis ships' radars to improve their ability to detect and track ballistic missiles, and developing a new version of the Standard Missile known as the SM-3. Compared to the earlier SM-2 missile, the SM-3 would incorporate a third-stage rocket motor to give the missile a higher speed (i.e., a higher "burn-out velocity"), and a kinetic kill vehicle (KKV) called the Lightweight Exo-Atmospheric Projectile (LEAP) that destroys the enemy missile by colliding with it.

BMDO Director Kadish's July 12, 2001 testimony suggests that the Administration's plan for Sea-Based Midcourse is to proceed with development of the capability envisaged under the NTW program, deploy it, and work toward improving the system so that it can eventually be used against longer-range missiles:

> The Sea-Based Midcourse System is intended to intercept hostile missiles in the ascent phase of midcourse flight, which when accompanied by [the] ground-based system, provides a complete midcourse layer [of defense].... The Sea-Based Midcourse System will build upon technologies in the existing Aegis Weapon System and the Standard Missile infrastructures and will be used against short and medium-range threats. Funding in FY 2002 offers the ability to continue testing and enables a potential contingency sea-based midcourse capability that can grant limited defense to U.S. and allied deployed forces as an element of the BMD System Block 2004. To support this effort five flight tests of the sea-based

---

[52] Aegis ships are cruisers and destroyers equipped with the Aegis air defense system, the Navy's most capable surface-ship air-defense system. The Aegis system is a highly integrated combination of sensors (including the SPY-1 phased array radar, which is unique to Aegis ships), computers, software, displays, weapon launchers and weapons. The Navy's Aegis ships are the Ticonderoga (CG-47) class cruisers and Arleigh Burke (DDG-51) class destroyers.

> midcourse system are planned in FY 2002. Funding also begins concept development and risk reduction work for advanced capability blocks to include more robust capability against intermediate and long-range threats to complement Ground-Based Midcourse capabilities later this decade.[53]

When asked at a news briefing about when the Sea-Based Midcourse would become a working part of the BMD system, Kadish stated:

> There are two answers to that question. It could be relatively close, in the next five years, if you will, against short- and medium-range missiles, based on the results of the Aegis LEAP interceptor tests that are about to begin this September. Okay? Those [NTW components] were designed [for use] against shorter-range missiles.
>
> [Providing sea-based midcourse defense against] longer-range missiles is going to take more time, and we're going to aggressively pursue the complementary nature of that. And if we can find a very realistic approach to doing that more rapidly we will, but my expectation right now is that it will be the end of the decade before we can actually get those [improved sea-based midcourse] systems potentially into an [overall BMD] architecture, and maybe in the '07 and '08 time frame for tests. We'll just have to wait and see based on the results of this.

General Kadish also stated that "the sea-based tests start in September [2001], we have another one in December [2001], and then about one every other month after that, as I recall, depending on how successful they are.[54] The program is now in the middle of a series of nine test flights.

Improving the NTW system so that it can be used against longer-range missiles could involve making further modifications to the Aegis ships' radars. It would almost certainly involve developing a larger and higher-speed missile than the SM-3, which has a maximum speed (i.e., burn-out velocity) of between 3.0 and 3.5 kilometers per second (kps). The Navy reportedly has been considering 3 different options for a higher-speed missile:[55]

- **Faster SM-3**. This missile, also referred to as the SM-3 Block 1 or the Enhanced NTW missile, would extend the 21-inch diameter of

---

[53] Statement of Lieutenant General Ronald T. Kadish, USAF, Director, Ballistic Missile Defense Organization, on The Ballistic Missile Defense Program, Amended Fiscal Year 2002 Budget, Before the Senate Armed Services Committee, July 12, 2001, page 24.

[54] Transcript of July 13, 2001 DoD news briefing on missile defense with Lt. Gen. Kadish.

[55] Sources for information on missile options: Ratnam, Gopal. U.S. Navy To Play Larger Role In Missile Defense. *Defense News*, January 21-27, 2002: 10; Holzer, Robert. U.S. Navy Seeks Larger Share of Antimissile Funds. *Defense News*, April 9, 2001: 1, 44 (graphic on page 1); Sirak, Michael C. White House Decision May Move Sea-Based NMD Into Spotlight. *Inside Missile Defense*, September 6, 2000: 1; Holzer, Robert. DoD Weighs Navy Interceptor Options. *Defense News*, July 24, 2000: 1, 60 (graphic on page 1); Holzer, Robert. U.S. Navy Gathers Strength, Allies in NMD Showdown. *Defense News*, March 15, 1999: 1, 42 (graphic on page 1).

the SM-3's first-stage booster up through the second stage, but retain the Standard Missile's original 13.5-inch diameter above that point. It would have a range of 1,000 kilometers and a maximum speed of 4.5 kps, and it would carry an improved version of the NTW missile's LEAP KKV weighing about 30 kilograms.

- **Enhanced SM-3.** This missile, also referred to as the SM-3 Block 2 or the Improved 8-Pack missile, would increase the diameter of the Standard missile along its entire length to 21 inches – the maximum diameter that can be fired from the Mk 41 vertical launch system (VLS) installed on Aegis ships. (The Mk 41 VLS is installed on Navy ships in modules that each contain 8 missile-launch tubes, leading to the use of the term 8-pack.) This missile would have a range of 1,500 kilometers and a maximum speed of 5.5 kps, and it would carry a more capable KKV weighing about 40 kilograms.

- **New Missile.** This missile, also referred to as the Standard Missile 27 or the 6-Pack missile, would have a diameter of 27 inches and a longer length than the Standard Missile, and would be fired from a new VLS designed to accommodate missiles of that diameter and length. This new VLS could have 6 missile-launch-tube modules occupying the same deck area as the 8-tube modules of the current Mk 41 VLS, leading to the use of the term 6-pack. This missile would have a range of more than 1,500 kilometers and a maximum speed of 6.5 kps, and it would carry an even more capable KKV – either the same KKV being developed for the land-based NMD system or an advanced-technology KKV – weighing about 50 kilograms.

On January 25, 2002, a test flight of the NTW system achieved an apparently successful hit-to-kill against an Aries theater ballistic missile target using its LEAP KKV. This flight was the fourth in the planned series of nine test flights.[56]

In addition to the Aegis-ship program described above, the Administration has also stated that it will explore the concept of placing an X-band missile tracking and engagement radar (perhaps like the one planned for Alaska) on one or more ships as complements or substitutes for land-based X-band radars. The United States over the years has outfitted and operated several merchant-type ships with similar radars to support flight tests of U.S. ballistic missiles and reportedly to learn about the characteristics of foreign ballistic missiles.

Legislation for FY2002. In its report (H.Rept. 107-194 of September 4, 2001) on the FY2002 defense authorization bill (H.R. 2586), the House Armed Services Committee recommended reducing the funding request for the concept

---

[56] Wall, Robert. Intercept Starts Long Road To Sea-Based Missile Defense. *Aviation Week & Space Technology*, February 4, 2002; Interceptor Hits Target In Navy Anti-Missile Test. *Washington Post*, January 26, 2002: 5; Sea-Based Midcourse Test Completed. Department of Defense News Release No. 037-02, January 26, 2002.

definition studies portion of Sea-Based Midcourse by $30 million, stating that "The committee believes that ongoing, competitive radar development activities will greatly influence the course this effort will take." (Page 235.)

In its report (S.Rept. 107-62 of September 12, 2001) on the FY2002 defense authorization bill (S. 1416), the Senate Armed Services committee commented extensively on the Sea-Based Midcourse program and recommended reducing funding for various portions of the program. With regard to funding for procurement of interceptor missiles, the committee stated:

> The proposed interceptor procurement would start prior to the completion of the ambitious series of intercept tests of the system, planned for fiscal year 2002. Moreover, problems with the Navy Theater-Wide interceptor divert system, which is critical to the interceptor's ability to hit a target, call into question the reliability and affordability of the interceptor design. Therefore, the committee believes it would be unwise to procure extra interceptors at this time, and recommends a reduction of $100.0 million for that purpose.
>
> The budget request included $60.0 million for concept definition for the Navy Theater-Wide program. It is not clear to the committee why this much funding is required for concept definition work. Therefore the committee recommends a reduction of $50.0 million for Navy Theater-Wide concept definition.
>
> The budget request included $177.0 million for Block II risk reduction efforts, including funds for both S-band and X-band radar technology. The committee is encouraged that the Department of Defense is funding radar technology work for the Navy Theater-Wide program, but is concerned that [BMDO] has not yet decided which radar technology is best suited for ballistic missile defense.... Therefore, the committee recommends a reduction of $87.0 million for Navy Theater-Wide radar risk reduction efforts.
>
> The budget request included $260.0 million for Aegis Leap Intercept (ALI) testing of the Block I Navy Theater-Wide interceptor in fiscal year 2002. The committee is encouraged by the strong testing focus, but is concerned about the large increase in the funding for the ALI test program – almost double what was planned last year for fiscal year 2002. A total of five flight tests are planned in 2002 alone. This is a large number for any ballistic missile defense program – more than any other such program has achieved in a single year. Furthermore, the Block I interceptor has had developmental problems that have called into question the reliability and producibility of the interceptor's divert system, which is critical to the missile's ability to hit a target. As such, the likelihood of successfully conducting all five planned flight tests in fiscal year 2002 seem remote. Therefore the committee recommends a reduction of $110.0 million for the Aegis Leap Interceptor testing program. (Pages 215-216)

With reference to a more basic Block I version of the system and a later and more capable Block II version of the system, the committee directed

> the Secretary of Defense to submit a report to the congressional defense committees no later than April 30, 2002 on the Department's ultimate plans for the Navy Theater-Wide system. The report should indicate whether the Department still plans on pursuing a Block I variant of the system, and if so, provide technical and force structure details on the Block I and a quantitative analysis as to the military value of Block I. The report should also specify the planned date of deployment of the objective (Block II) Navy Theater-Wide system, the technical characteristics of the objective system (e.g., radar and missile type and performance), and the total planned objective force structure of ships and missiles. The report should also provide year-by-year and total life cycle cost estimates for the objective system and separate year-by-year and total life cycle costs for any planned Block I system. (Page 216)

In its report (H.Rept. 107-298 of November 19, 2001) on the FY2002 defense appropriations bill (H.R. 3338), the House Appropriations Committee recommended reducing funding for the Sea-Based Midcourse program by $96 million, stating, "The Department [of Defense] has not decided whether to continue this program beyond testing or to pursue one of several alternative missile designs instead. Therefore, the Committee believes it is inappropriate to buy five contingency missiles before the missile has been tested and before the Department has committed to this solution." (Page 249.)

Terminal Defense Segment

Ground-Based Terminal.

Patriot PAC-3. The Patriot PAC-3 (Patriot Advanced Capability-3, MIM-104 Patriot/ERINT) is the U.S. Army's primary medium-range air defense missile system and is considered a major system improvement over the Patriot used in the Gulf War, and of the subsequent PAC-2. It will target enemy short- and medium-range missiles in their mid-course or descent phase in the lower atmosphere, and will be used in conjunction with the longer-range THAAD. When all changes have been made, the PAC-3 will have a new hit-to-kill interceptor missile (the ERINT), improved communications, radar, and ground support systems. The first unit to be equipped with the final version is receive PAC-3 missiles in late 2001 at Fort Bliss, Texas. Full-rate production was scheduled to begin in late 2001, but slipped to late 2002.

In April 2000, the Pentagon projected costs of PAC-3 had increased by $102 million to $2.9 billion because of increased reliability and spares costs. A GAO report issued in July 2000 showed PAC-3 total program costs increased from $3.9 billion for 1,200 missiles planned in 1994 to $6.9 billion for about 1,012 missiles in the current plan. In April 2001, BMDO estimated the PAC-3 acquisition costs to be $10.1 billion. BMDO and the Army are attempting to cut the current cost of the missile to allow the purchase of additional missiles. In December 2000, the Army announced it had restructured the program to finish testing and begin full-rate production earlier. It also plans to increase the numbers purchased in the years 2003-2007. For FY2002, the Bush Administration requested $784 million for PAC-3, a 76% increase over the amounts requested and approved for FY2001. The Administration also transferred funding for the PAC-3 from BMDO to the Army. The House Armed Services

Committee, in its version of the FY2002 Defense Authorization Bill did not approve this transfer; this too was later sustained in Congress. Beginning in 1999, PAC-3 had a successful string of intercept flight tests destroying 10 of 11 targets, prior to the test failures in February 2002.

A major concern has been the rising costs of PAC-3. It has been argued that unit costs could be reduced by increasing the number of units purchased and increasing the pace of production. If more countries buy PAC-3, and if the MEADS program is fielded with PAC-3 missiles, unit costs would be further reduced. (Germany, the Netherlands, Japan, Israel, and Taiwan have Patriot systems and are in various stages of upgrading them. South Korea is considering buying Patriots and Germany and Italy are participating in MEADS, which would use Patriot missiles.)

In May 2000, DoD decided to stop development of PACM (designed to defeat cruise missiles) because PAC-3 and improvements being made to PAC-2 systems provide a more cost effective defense against ballistic and cruise missile threats. The decision has been controversial, particularly among companies that would have produced PACM. But the conference report on the FY2001 authorization bill noted no funds had been requested for PACM and instructed the Secretary of Defense to determine if PACM production is warranted.

The effectiveness of PAC-3, and other missile defenses, against countermeasures is also an issue. Russia has developed a guided warhead for the Scud missile that it claims has an accuracy of 10-20 meters, can defeat Patriot missile defenses, and is immune to jamming and electronic countermeasures. It was reported in March 2001 that Russia is offering this warhead for sale to a number of countries in the Middle East that have Scud missiles.

Theater High Altitude Area Defense (THAAD). The THAAD program is the U.S. Army's weapon system designed to destroy non-strategic ballistic missiles just before they reenter the atmosphere or in the upper atmosphere. The THAAD missile would use a single-stage, solid propellant rocket and a hit-to-kill interceptor designed to destroy the attacking missile with the kinetic energy of impact. Unlike lower-tier, shorter range systems, such as the Patriot PAC-3 and MEADS, THAAD is intended to help protect wider areas against missiles and falling debris of missiles, as well as possible nuclear, biological, or chemical materials.

In April 2000, the Pentagon released a Selected Acquisition Report stating the projected costs of THAAD had increased by $898 million to a total of $9.5 billion because of a revised estimating methodology. In April 2001, BMDO estimated THAAD acquisition costs to be $16.8 billion, and the life cycle costs to be $23 billion.

THAAD entered the Engineering and Manufacturing Development (EMD) phase in late June 2000. A more advanced version designed to defeat attacking missiles employing countermeasures was scheduled for 2011. In an accelerated development proposal the Army considered in 2000, the first THAAD unit equipped could be moved from FY 2007 to FY 2006. The Department of Defense is still studying this accelerated option. Simultaneously, DoD is relaxing the requirement that THAAD be able to intercept targets within and outside the atmosphere, raising

the altitude at which it must be able to conduct an intercept. The minimum intercept altitude had been 40 kilometers.

Earlier technological problems in THAAD's development jeopardized support for the system. But on June 10, 1999, after THAAD had failed in six previous interceptor flight tests, the first success was achieved. In each of those six previous unsuccessful intercept flight tests, a different subsystem had failed. On August 2, 1999, a second THAAD missile successfully intercepted a target missile.

After the second successful intercept, Lockheed Martin submitted a proposal for moving THAAD in EMD, but the Army Space and Missile Defense Command rejected the proposal in April 2000 because of management and testing plan deficiencies. Lockheed Martin addressed these problems, and the Army later recommended the Defense Acquisition Board (DAB) begin its review of THAAD advancing to EMD.

Because of concerns that the THAAD and NTW programs were not being tested against target missiles with the speed and other characteristics of likely enemy missiles (such as the North Korean Taep'o-dong 1), Rep. Vitter introduced legislation in 1999 (H.R. 2596) that would have required BMDO to make appropriate program management and technology adjustments in the NTW and THAAD programs. Similar legislation in the 107th Congress, such as H.R. 1282, was designed to help NTW and THAAD improve their likelihood of successful intercepts against more realistic test targets.

For FY 2002, the Bush Administration requested $922 million for THAAD, which was a 68% increase over the amount requested and appropriated for FY 2001 ($549.9 million), and a 32% increase over the amount requested for FY 2002 by the outgoing Clinton Administration. Congress cut THAAD funding by $50 million for FY 2002. This cut was directed at denying the Administration's request to acquire a limited number of THAAD contingency missiles. The estimated FY 2003 request for THAAD is about $1 billion; details will be forthcoming shortly.

Medium Extended Air Defense System (MEADS). The Medium Extended Air Defense System (MEADS), is a multinational, ground-based, mobile, air and missile defense system. It is essentially a composite of existing technologies with either similar or enhanced capabilities. It will cover the lower-tier of the layered air and theater missile defense and will operate in the division area of the battlefield to protect against various airborne threats. Distinguishing characteristics of MEADS are its stated ability to maneuver and deploy quickly and to provide 360-degree coverage. It will be able to accompany troops within the theater and will require less manpower and logistical support to operate than other missile defense systems. MEADS will use the Patriot PAC-3 missile with its hit-to-kill warhead, designed to intercept multiple and simultaneous short range ballistic missiles (SRBMs), low cross-section cruise missiles and aircraft, and unmanned aerial vehicles. MEADS will eventually replace the aging HAWK air defense system. In addition to fulfilling operational requirements for limited air defense, the program is also expected to reinforce interoperability of NATO forces and to reduce the U.S. burden of cost for helping to maintain European defense.

BMDO has been responsible for program direction and system architecture and integration. The Pentagon sought to shift the management of MEADS and PAC-3 to the Army from BMDO. Some question whether the Army will give the program sufficient budget priority to sustain development. The House Armed Services Committee did not approve this transfer in its version of the FY2002 Defense Authorization Bill, and this was upheld by Congress.

Under the initial May 1996 Memorandum of Understanding, Germany and Italy committed to fund 25 percent and 15 percent of the program, respectively, for the next 10 years. The German military has questioned the number of MEADS units it would need and whether it could afford them, the German Parliament balked at approving its share of development costs, and the German government then asked to have the program restructured to reduce its $22 billion cost, even if that required reduced capability. In July 2001, the NATO MEADS Management Agency granted a three-year, $216 million risk reduction contract to MEADS International (a team consisting of Lockheed Martin, Alenia Marconi, and the European Aeronautic Defence and Space Company). The United States will pay 55 percent of the risk reduction program, Germany 28 percent, and Italy 17 percent. The agreement was modified to divide German funding and commitment into three phases to ease the Defense Ministry's negotiations with Parliament. Germany has also decided to stop upgrading its Patriot batteries until it can determine whether MEADS will duplicate Patriot's capabilities. The definition phase of development has been extended three years thus putting deployment off till 2009.

Responding to congressional criticism of the program's costs for FY 2001, Pentagon officials suggested that Germany and Italy coproduce the Patriot PAC-3 interceptor for incorporation into MEADS. In April 2000 it was reported that Germany and Italy had tentatively agreed to use the Patriot rather than a new interceptor, but still plan to develop a new seeker radar.

For FY2002, the Administration requested $74 million for development of MEADS, $20 million more than was appropriated for FY2001 (the defense authorization act for FY2001decreased the requested amount by $9.7 million.) In the final appropriations bill, funding for MEADS was cut slightly.

The Lockheed-Martin Corp. and the Hughes Aircraft and Raytheon Company consortium represented the U.S. partners of two competing international teams. Alenia of Italy, and European Aeronautic Defence and Space Company (formerly Daimler-Chrysler Aerospace) of Germany, represent the European group. In May 1999, the three governments selected the team headed by Lockheed Martin to develop MEADS. Target production and fielding dates were set for 2006 but have slipped to 2009.

In May 1996, France rescinded its initial commitment to fund 20 percent of the MEADS program. Despite budgetary constraints, however, France is still interested in developing missile defenses, perhaps an indigenous system. The United Kingdom is not a participant in the program and to date has taken no official position on it. The Netherlands and Turkey have also considered participating in the joint endeavor.

Sea-Based Terminal.

Cancellation of NAD program. On December 14, 2001, DoD announced that it had canceled the Navy Area Defense (NAD) program – the program being pursued as the Sea-Based Terminal portion of the Administration's overall missile-defense effort – due to poor performance, significant cost overruns, and substantial development delays. DoD stated, in announcing the cancellation, that the program's unit acquisition and unit procurement costs had risen 57 percent and 65 percent, respectively.[57]

In announcing the cancellation, DoD cited the Nunn-McCurdy provision, a defense-acquisition law passed in the 1980s. Under the law, a major defense acquisition program experiences what is called a Nunn-McCurdy unit cost breach when its projected unit cost increases by at least 15 percent. If the increase reaches 25 percent, the Secretary of Defense, to permit the program to continue, must certify that the program is essential to national security, that there are no alternatives to the program that would provide equal or greater military capability at less cost, that new estimates of the program's unit acquisition cost or unit procurement cost appear reasonable, and that the management structure for the program is adequate to control the program's unit acquisition or unit procurement cost.

Edward C. "Pete" Aldridge, the Under Secretary of Defense for Acquisition, Technology and Logistics – the Pentagon's chief acquisition executive – concluded, after examining the program, that he could not recommend to Secretary of Defense Donald Rumsfeld that he make such a certification. Rumsfeld accepted Aldridge's recommendation and declined to issue the certification, triggering the program's cancellation. This was the first time that a defense acquisition program had been canceled as a result of a decision to not certify under a Nunn-McCurdy unit cost breach.[58]

DoD stated that the cancellation of the program "will result in a work stoppage at some government and contractor facilities." Major contractors for the NAD program were Raytheon of Tucson, AZ, Lockheed Martin of Moorestown, N.J. and Middle River, MD, United Defense of Baltimore, MD, and Minneapolis, MN, Orbital Sciences of Dulles, VA and Chandler, AZ, and L-3 Communications of New York, NY. Major government field activities involved in the program were the Naval Surface Warfare Center (NSWC) at Dahlgren, VA, NSWC at Port Hueneme, CA, the Applied Physics Laboratory of Johns Hopkins University of Laurel, MD, and Lincoln Laboratories of the Massachusetts Institute of Technology of Lexington, MA.

The cancellation of the program will result in about $300 million in contract-termination costs. Congress, acting on the FY2002 defense budget in the week

---

[57] Acquisition cost is the sum of procurement cost plus research, development, test and evaluation (RDT&E) cost.

[58] Navy Area Missile Defense Program Cancelled. Department of Defense News Release No. 637-01, December 14, 2001; Dao, James. Navy Missile Defense Plan Is Canceled By the Pentagon. *New York Times*, December 16, 2001; Ratnam, Gopal. Raytheon Chief Asks DoD To Revive Navy Program. *Defense News*, January 14-20, 2002: 10.

following the announcement of the program's cancellation, reduced the Administration's request for the program to $100 million, leaving about $200 million in contract-termination costs apparently unfunded.[59]

DoD officials have stated that although the NAD program has been canceled, the requirement for a sea-based terminal system remains intact. DoD and the Navy are now exploring options for a potential replacement program. If pursued, a replacement program could resemble the original NAD program in some respects, and perhaps many. One option that may be considered would combine the booster stages (the "back end") of the SM-2 Block IV A missile that was being developed under the NAD program with the guidance section and KKV (the "front end") of the Army's PAC-3 terminal-defense missile.[60]

Background on the now-cancelled NAD program. The NAD program, also sometimes called the Navy Lower Tier program, was initiated several years ago. Prior to DoD's December 14, 2001 cancellation announcement, the Bush Administration's plan was to maintain the mission and system configuration of the NAD program as originally defined, but transfer the program from BMDO (now MDA) to the Navy on the grounds that the program was technically more mature and had evolved from an air defense mission.

The NAD program was to have been deployed on Navy Aegis ships and was designed to intercept short- and medium-range theater ballistic missiles (TAMS) in the final, or descent, phase of flight, so as to provide local-area defense of U.S. ships and friendly forces, ports, airfields, and other critical assets ashore. The program involved modifying both the Aegis ships' radar capabilities and the Standard SM-2 Block IV air-defense missile fired by Aegis ships. The missile, as modified, was called the Block IVA version.[61] The system was designed to intercept descending missiles within the Earth's atmosphere (endo-atmospheric intercept) and destroy them with the Block IVA missile's blast-fragmentation warhead.

---

[59] Weinberger, Sharon. Cancellation Of Navy Area TBMD Ends Advanced Intercept Work, Leaves DOD Owning Termination Fees. *Aerospace Daily*, December 18, 2001; Woods, Randy. Congress Provides No Money For Canceled Area Missile Defense. *Inside the Navy*, December 24, 2001.

[60] Weinberger, Sharon. Pentagon To Consider Resurrecting Navy Area Missile Defense Program. *Aerospace Daily*, December 20, 2001; Sirak, Michael. US DoD Studies Army Technology for Navy Missile. *Jane's Defence Weekly*, January 2, 2002: 8; Ratnam Gopal. Study Begins On Ways For Navy To Retake Missile Role. *Defense News*, January 7-13, 2002: 8; Keeter, Hunter. Service Officials: Navy Terminal-Phase Missile Defense Remains Requirement. *Defense Daily*, January 18, 2002: 2.

[61] The modifications include a new, thrust-vector-controlled booster, a stronger airframe, the addition of a dual-mode radio frequency/infrared [RF/IR] guidance sensor, an improved blast-fragmentation (i.e., explosive) warhead, and enhancements to the missile's autopilot-control system.

Sensors Segment

For FY2002, BMDO described the sensors program element as consisting of five projects: the Space-Based Infrared System-Low (SBIRS-Low); the Russian-American Observation Satellite, or RAMOS (an international cooperative project to develop new missile early warning sensor technology); Systems Integration and Engineering (SE&I) to integrate SBIRS-Low into the BMD system; test and evaluation of advanced radar technology; and program operations.

Of these projects, SBIRS-Low is the most visible and controversial. It is one component of the Space Based InfraRed System (SBIRS), which is designed to replace and enhance the capabilities of existing satellites that provide early warning of missile launches. Historically, U.S. early warning satellites have been placed in geostationary orbit, high above the equator (22,300 miles). SBIRS also will use satellites in that orbit, as well in highly elliptical orbits, and in low orbits. Hence, the SBIRS program is divided into two components: SBIRS-High and SBIRS-Low. SBIRS-High is managed by the Air Force and will not be discussed further here. Management of SBIRS-Low was moved from the Air Force to the Ballistic Missile Defense Office (now the Missile Defense Agency) effective Oct. 1, 2001 to emphasize that its primary objective is to support missile defense.

The mission of SBIRS-Low[62] is to track missiles from launch to impact or intercept; discriminate between targets and decoys; pass data to boost, midcourse and terminal defense projects that will be used to cue radars over-the-horizon and provide intercept handovers; and provide data for intercept hit/kill assessments.

Current cost estimates are problematic because DoD has not yet defined a system architecture (the number of satellites has not yet been finalized, for example). The General Accounting Office (GAO) reported in February 2001[63] that DoD estimated the life-cycle cost for SBIRS-Low through FY2022 at $11.8 billion.. A January 2002 Congressional Budget Office (CBO) report[64] estimated the cost through 2015 at $14-17 billion (of which $1 billion was appropriated prior to FY2002). In its report on the FY2002 DOD appropriations bill, the House Appropriations Committee reported (H. Rept. 107-298, p. 250) that the program's life cycle cost had grown from $10 billion to over $23 billion.

Two industry teams were chosen in 1999 for program definition and risk reduction (PDRR). The Spectrum Astro/Northrop Grumman team includes Boeing, Lockheed Martin, and others. The TRW/Raytheon team includes Aerojet, Motorola, and others. DOD had been expected to select one of the teams for the next phase

---

[62] BMDO, FY2002 RDT&E budget justification (R2-A Exhibit, Project 5020, PE0603774C), available at: [http://www.dtic.mil/comptroller/fy2002budget/budget_justification/index.html].

[63] U.S. General Accounting Office. Space-Based Infrared System-Low at Risk of Missing Initial Deployment Date. Washington, GAO, February 2001. GAO-01-06. p. 3.

[64] Congressional Budget Office. Estimated Costs and Technical Characteristics of Selected Missile Defense Systems, Jan. 2002 [http://www.cbo.gov].

(EMD) in mid-2002, and the satellites were to have been launched between 2006 and 2010. As discussed below, plans for the program are currently unclear.

The February 2001 GAO report raised questions over whether SBIRS-Low could meet its technical milestones. GAO concluded that five of six critical satellite technologies were too immature to ensure they would be ready when needed: the scanning infrared sensor, tracking infrared sensor, fore optics cryocooler, tracking infrared sensor cryocooler, and satellite communications cross-links. GAO also cited concurrency as a concern in that satellite development and production were scheduled to occur at the same time; the results of an on-orbit test would not be available until 5 years after the satellites entered production; and software would be developed concurrent with the deployment of the satellites and not be completed until more than 3 years after the first SBIRS-Low satellites were launched. Other critics cite the ability to discriminate between targets and decoys, and the ability to share information between satellites, as significant technical hurdles.[65]

Air Force and industry sources defend the program. In March 2001, Air Force Col. Michael Booen, SBIRS program manager, sharply criticized the GAO report because he said it was based on old information.[66] He asserted that a new approach to SBIRS deployment that involves more testing and an additional year for launching the satellites (5 years instead of 4), significantly reduces program risk. Industry sources have been quoted as insisting that SBIRS-Low does not require any new inventions — that the challenges are in the engineering, and can be solved.[67]

Concerns about technical maturity, schedule, and cost led Congress to scrutinize the program during deliberations on DOD's FY2002 budget. For FY2002, DoD requested $385 million for SBIRS-Low, and the final version of the FY2002 DOD authorization act (P.L. 107-107) provides full funding. That is not the case with the FY2002 appropriations act (P.L. 107-117), however. The House Appropriations Committee denied the entire request of $385 million for SBIRS-Low, calling current plans for SBIRS Low "a potential 'rush to failure....'" Instead, the committee created a new "Satellite Sensor Technology" line item funded at $250 million. The committee commented that ground-based radars might be an alternative and added $75 million for "Ground Sensor Technology." The Senate Appropriations Committee cut $120 million, but said the President could choose to add $120 million back to the program from $1.3 billion the committee added for missile defense or counter-terrorism activities. In the final version of the bill, Congress provided $250 million for Satellite Sensor Technology and said that the Secretary of Defense could choose to spend it on SBIRS-Low, other satellite sensor technology, or both.

DOD has not yet released details on how it will spend the FY2002 funding, or its FY2003 plans for SBIRS-Low or Satellite Sensor Technology.

---

[65] Carla Anne Robbins, Shot in the Dark: One Troubled System Shows Hurdles Facing Missile-Defense Plans, *Wall Street Journal*, 15 June 2001 (online edition).

[66] *Space News*, March 23, 2001, p 3, 20.

[67] Robbins, *op cit*.

Recent Congressional Action

FY2002

FY2002 Authorization. The House Armed Service Committee (HAS) approved the Administration's request for $8.3 billion for ballistic missile defense, making only minor adjustments in funding (H.R. 2586). The Committee disapproved, however, of DoD's proposal to transfer terminal defense programs – PAC-3, MEADS, and Navy Area Defense from BMDO to the services because of concern that the services would not adequately fund those programs.

During House debate over the FY2002 defense authorization bill, an amendment offered by Rep. Stump was adopted. It would reduce BMDO funding by $265 million, and transfer that money to counterterrorism and intelligence programs. Specifically, $145 million would be taken from the Mid-Course Segment and $120 million from the Boost Phase Segment.

The Senate Armed Services Committee (SAC) recommended several major changes to funding and management of ballistic missile defense in the FY2002 defense authorization bill (S. 1416).

- Establishing a new requirement that would prohibit spending for any missile defense activities that would conflict with the ABM Treaty (as determined by the President) would be contingent on Congress voting to approve such expenditures under special expedited procedures; and

- Reducing BMD funding by $1.3 billion on the basis that funding was premature or insufficiently justified, including major cuts to the following programs:

    - Airborne laser (-$80 million in a $410 million program);
    - Navy Theater-wide (-$347 million in a $596 million program);
    - Ground-based mid course system (-$330 million in a $3,231 million program);
    - Space Based Infrared system - Low (SBIRS-Low) (-$97 million in a $385 million program); and
    - THAAD (-$210 million in a $909 million program; and

- Permitting DoD to reorganize the funding of ballistic missile defense into large, aggregated program elements but requiring new reporting requirements on individual programs; and

- Allowing DoD to transfer three programs previously funded by the Ballistic Missile Defense Organization (BMDO) to the individual

services (i.e. PAC-3 (Army), MEADS (Army) Navy Area Defense (Navy), as well as the transfer of three Air Force programs to BMDO.

The restriction on funding of activities that would violate the ABM Treaty was highly controversial because the President signaled that he would veto the DoD Authorization Act if that provision were included.

After the terrorist activity on September 11th, Senator Levin, Chairman of the SAC, indicated that he would transfer that ABM Treaty-related restriction from the DoD authorization bill to a separate bill. This was done the week of September 22, when a new bill (S. 1438) was introduced to replace S. 1416.

The bill passed by the Senate, S. 1438, removed the controversial sections requiring congressional approval of activities that would violate the ABM treaty, as well as certain reporting requirements for BMD programs. Those sections were put in S. 1439, a separate bill that was filed at the same time. The rest of S. 1438 is the same as S.1416 (the bill that was reported by the SAC). Senators Levin and Warner offered an amendment to S. 1438 to restore the $1.3 billion cut from missile defense programs for: 1) RDT&E for missile defense; and 2) activities for combating terrorism. The President would be given discretion as to how to allocate these funds. This amendment was adopted by unanimous consent.

FY2002 Appropriations. The Senate Appropriations Committee included $8.3 billion for missile defense programs, and, as with the Senate authorization bill, permitted the President to reallocate $1.3 billion of this total to combat terrorism. The Senate approved this as well. The House Appropriations Committee approved $7.9 for ballistic missile defense programs, but transferred these programs to a new, separate appropriations title "Counter-terrorism and weapons of mass destruction." This was approved by the House.

In conference, $7.77 billion was approved. House and Senate conferees gave their support to Defense Department efforts to devise a management structure to facilitate integration of research and development, but cautioned against implementing a process that might limit adequate oversight by various Pentagon review groups and Congress. Finally, conferees agreed with House language that identified several special interest projects for purposes of reprogramming and budget justification material: Terminal Phase Systems (MEADS and ARROW); Midcourse Phase Systems (Ground-based Midcourse, Pacific Test Bed, and Sea-based Midcourse); Boost Phase Systems (Sea-based Boost, Air-based Boost, and Space-based Boost); and Sensors (Satellite Sensor technology and RAMOS.