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Missile Defense: The Current Debate

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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 substantially altered the debate over missile defenses. The Administration requested significant funding increases for missile defense programs (about 61 % 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, announced U.S. withdrawal from the 1972 Anti-ballistic Missile Treaty, and is planning to deploy an initial missile defense capability by 2004-2005.

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 will continue to receive attention are 1) ballistic missile proliferation; 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 deployment of a mid-course missile defense system in Alaska and California.

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

Missile Defense: The Current Debate

Most Recent Developments

On February 3, 2003, the Department of Defense (DOD) released the FY2004 defense budget, which included $9.1 billion for missile defense. The FY2005 missile defense budget would rise to $9.7 billion. A Pentagon official remarked that the FY2004 missile defense budget represents a move from a research program to "a true development program." In the request, the Administration asks Congress to fund the procurement of ten land-based interceptors to provide an "initial modest capability against North Korean missiles."

On May 22, 2003, the House and on June 14, 2003, the Senate passed their versions of the defense authorization bill, each approving about $9.1 billion for all missile defense programs. On July 8, the House passed its version of the defense appropriations bill, including $8.9 billion for missile defense. On July 14, the Senate began considering its version of the defense appropriations bill, which would currently provide $9.1 billion for defense-wide missile defense programs. Final action is pending.

Overview

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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 differed significantly from the approach pursued by the Clinton Administration. The issue for Congress at that time 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 has supported the President's approach, 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.

In December 2002, the Administration announced its decision to begin fielding initial missile defense capabilities in 2004-2005. Congress will be asked this year to provided funding support for the Administration's planned deployments. Congress's decisions likely will have significant implications for U.S. military capabilities, 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:

- **Ballistic Missile Proliferation**: Which countries of concern possess or are developing missiles that might threaten the United States, its military forces, or its friends and allies? What range of missile threats might U.S. missile defenses be required to counter in the near and mid-term?

- **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 latter sections of the report provide 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. The report concludes with a brief summary of congressional action on the missile defense budget.

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 $78 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 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.[1] 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 limited the United States and Soviet Union (now Russia) to a single, land-based system for defense against long-range ballistic missiles. 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 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."[2]

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

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

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

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 FY2003 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."[3]

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.)

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 has not yet identified an architecture that it will seek to deploy nor established 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

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[3] 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.

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 in July 2001, 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."[4] 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 2001, 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 at that time the Administration did not plan simply to seek modifications in the ABM Treaty, but it would not allow the Treaty to prevent research and development toward deployment even if that ultimately meant U.S. withdrawal from the Treaty.[5] Rather, the Bush Administration sought to convince Russia that the ABM Treaty was 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 from the 1972 ABM Treaty occurred June 13, 2002. The Administration announced it had a specific plan for deploying an initial missile defense capability on December 17, 2002.

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

[5] In late August 2001, for example, John Bolton, Undersecretary of State for Arms Control and International Security, held out the possibility of invoking the withdrawal clause by November 2001 if "meaningful progress" with Russia was not achieved.

Key Issues

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Ballistic Missile Proliferation

Overview. Currently, Russia and China are the only two countries that could attack the United States with ICBMs. Although other countries with short and medium range missile programs may aspire to join this club, there are factors other than scientific and infrastructure to consider. Variables such as the availability of financial resources, political will, availability of foreign material and technical assistance, and the affects of non proliferation and export control regimes all play a role in missile development. In this regard, countries discussed here other than Russia and China should be considered as potential future threats outside of their respective regions. Within their respective regions however, these countries, along with Russia and China, will present an ever increasing proliferation challenge to U.S. forces, friends, and Allies.

Ballistic missile proliferation has continued steadily over the past two decades presenting a variety of security challenges to the United States. The number of countries with operationally deployed intercontinental ballistic missiles (ICBMs) that could strike targets in the United States remains relatively small. There is, however, a fairly widespread and growing capability to launch shorter range missiles and a slowly evolving capacity to launch medium range missiles.[6] These short to medium range missiles could not only threaten U.S. forces on a regional basis but could also serve as a precursor for the development of longer range missiles over the course of the coming decades. The transition from short to medium range missiles to ICBMs is more a matter of technical expertise than of technology. The principal hurdles to developing longer range missiles are manufacturing larger propulsion systems and designing a missile with more than one stage. With an existing short or medium range ballistic missile infrastructure, overcoming these hurdles becomes an issue of having an experienced and qualified scientific and engineering staff. If a country does not have this expertise domestically, it can be imported. The United States routinely monitors ballistic missile development and deployment trends in a number of critical countries. The countries listed below are those critical countries addressed in the 2002 National Intelligence Estimate (NIE) on Foreign Ballistic Developments and the Ballistic Missile Threat Through 2015.

Russia. Russia has the most significant ballistic missile inventory of all countries of concern. Russia currently has approximately 700 ICBMs[7] capable of

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[6] *The Declining Ballistic Missile Threat*, Joseph Cirincione, Carnegie Endowment for International Peace, February 18, 2002, p. 6.

[7] Ballistic missiles are classified by range as follows:

Short Range Ballistic Missiles (SRBMs) = 150 - 799 kms.
Medium Range Ballistic Missiles (MRBMs) = 800 - 2,399 kms.
Intermediate Range Ballistic Missiles (IRBMs) = 2,400 - 5,499 kms.
Intercontinental Range Ballistic Missiles (ICBMs) = 5,500 kms and greater.

delivering over 3,000 nuclear warheads of various yields.[8] Russia also maintains a number of ballistic missile-capable submarines equipped with approximately 200 launchers that could deliver up to 900 nuclear warheads.[9] Despite these seemingly significant numbers, the Russian Strategic Nuclear Forces have been in critical decline over the past decade due to a variety of internal and external factors.

Because of slower than anticipated development and also in response to the United States withdrawal from the ABM Treaty, the Russian government has slowed the production of its new SS-27 ICBM (START II compliant with one nuclear warhead) and will instead retain a significant number of its older SS-18 and SS-24 ICBMs (each capable of carrying 10 multiple independent re-entry vehicles (MIRVs)) that were destined to be destroyed under START II ceilings. Russia will retain 154 liquid-fueled SS-18 Satan heavy ICBMs and 36 SS-24 Scalpel ICBMs that were supposed to be eliminated by 2007 under the provisions of START II.[10] Russia's SS-27 Topol-M ICBM was first deployed in 1997 and Russia had deployed 23 SS-27s in silos as of the end of 2000.[11] Although designed to carry one warhead, experts believe that with modifications the SS-27 could carry anywhere from 3 to 6 nuclear warheads. Russia claims to have developed missile defense countermeasures for the SS-27 allowing the SS-27 to penetrate any known missile defense. Such countermeasures could include global positioning technology and independent warhead maneuvering capability. It is important to note that independent sources have not substantiated Russian claims on the SS-27's penetration capabilities. Over the next 5 years, the Defense Intelligence Agency believes that Russia will focus its limited resources on the SS-27 program, the SS-26 short range ballistic missile (SRBM), and the submarine-launched SSN-23 and Bulava-30 ballistic missiles.[12]

China. China's current ICBM force consists largely of liquid propellant, single warhead, silo-based missiles. Approximately 20 of these missiles are CSS-4 missiles that can reach targets within the United States. About 12 CSS-3 ICBMs are deployed and are most likely intended as a deterrent force to Russia, Pakistan, and China.[13] China also has a number medium-range JL-1 submarine launched ballistic missiles (SLBMs). Concerned about the survivability of their ballistic missiles, China is focusing on the development of mobile, solid propellant ICBMs. The Intelligence Community projects that by 2015, most of China's land-based ICBMs will be mobile.[14]

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[8] *Foreign Missile Developments and the Ballistic Missile Threat Through 2015,* Unclassified Summary of a National Intelligence Estimate, Central Intelligence Agency, June 13, 2002, p. 10.

[9] Ibid.

[10] *Russia to Retain MIRVs Beyond Start II Deadline*, Jane's Defence Weekly, August, 28, 2002.

[11] *Russia: TOPOL-M ICBM Overview,* Center for Nonproliferation Studies, January 2001.

[12] *Inside the Ring,* Washington Times, November 15, 2002, p.11.

[13] *Foreign Missile Developments,* CIA, p. 11.

[14] Ibid.

China continues to develop solid-fueled DF-31 ICBMs for both silo and mobile basing, as well as for submarine deployment. China has tested CSS-5 medium-range ballistic missiles (MRBMs) with dummy warheads or what the Pentagon calls "penetration aids" designed to defeat missile defense systems. China is assessed to be capable of developing multiple reentry vehicles (MRVs) for its CSS-4 missiles in the next few years but MRV development for its new mobile ICBMS and SLBMs would face significant technical hurdles and would be extremely costly.[15] China continues to deploy short-range CSS-6 and CSS-7 missiles across the Straits of Taiwan. U.S. intelligence estimates that there are about 350 Chinese missiles deployed within about a 7 ½ minute flight time of Taiwan. Recently, China has offered to reduce the numbers of deployed missiles if Taiwan scales back its arms purchases from the United States. China has also exported missile technologies to Iran, Pakistan, North Korea, and Saudi Arabia.

Iraq. Western Intelligence believes that Iraq has upwards of 20 Al Hussein SRBMs and about a dozen transporter, erector, launchers (TELs) in breach of 1991's UN Security Council Resolution (UNSCR) 687.[16] Other organizations, such as the London-based Institute for Strategic Studies, suggest that this number could be closer to a dozen or fewer missiles.[17] Iraq has continued its short-range missile program, which is permitted under UNSCR 687, but U.S. and British Intelligence believe that they are working on extending the range of these missiles in excess of the 150 km range permitted. Iraq has also rebuilt previously-destroyed facilities and constructed new facilities designed to produce solid propellants and to test missile engines with ranges in excess of 1,000 kms.

Iran. Iran has one of the largest missile inventories in the Middle East. Iran has a few hundred SRBMs consisting mostly of SCUD-Bs, SCUD-Cs, and Chinese CSS-8 missiles. Iran has also successfully tested and deployed a small number of Shahab-3 MRBMs that could strike targets in Israel, Turkey, and most of Saudi Arabia. The Shahab-3 is based on the North Korean No Dong missile and is believed to have a range of 1,300 kms.[18] Iran has also publically acknowledged the development of the Shahab-IV as a ballistic missile (later reclassified as a space launch vehicle (SLV)) with an estimated range of 2,200 kms.[19] Iran is also believed to be developing a Shahab-V with an unspecified range. In all cases, Iran's continuing development of its missile program will rely heavily on Russian, Chinese, and North Korean assistance. Despite Iran's current efforts, most U.S. intelligence agencies believe that

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[15] Ibid.

[16] *Iraq's Weapons of Mass Destruction: The Assessment of the British Government,* September 24, 2002, p. 27.

[17] *Iraq's WMD - A Net Assessment,* The International Institute for Strategic Studies, September 9, 2002, p. 66.

[18] *Ballistic Missile Capabilities in the Middle East,* Carnegie Endowment for International Peace, April 26, 2002, p. 2.

[19] Ibid.

Iran will not be able to launch an ICBM/SLV until the later half of this decade while one agency says that a successful test launch is unlikely prior to 2015.[20]

North Korea. North Korea's recent actions in relation to the Agreed Framework and possible "reconsideration of the missile testing moratorium" could foreshadow their resumption of missile testing. The two-stage Taepo Dong 2, which some believe could deliver a several hundred kilogram nuclear payload to Alaska, Hawaii, and parts of the continental United States may be ready for flight testing in the near future.[21] If North Korea can successfully integrate a third stage, this could boost the Taepo Dong's range to 15,000 km — sufficient range to strike all of North America.[22] North Korea also has hundreds of SCUD and No Dong missiles that pose a significant WMD threat to U.S. and allied military forces in the region. North Korea has continued to export ballistic missiles and associated technology, most notably to Pakistan and Yemen. On December 11, 2002 the Spanish military intercepted 15 SCUD missiles at sea bound for Yemen. This was later determined to be a legal shipment and was allowed to proceed. North Korea is also believed to be training missile engineers and technicians, most notably Syrian, in the domestic production of SCUD missiles.

India. India continues their aggressive domestic development of ballistic missiles, primarily to establish a nuclear deterrent to Pakistani first use of nuclear weapons and as a hedge against a confrontation with China.[23] The Prithvi I, a single-stage, liquid fueled, road-mobile missile, is currently India's only deployed ballistic missile.[24] India also continues to develop the Prithvi II, a 250 km SRBM. India has tested the Agni-series of MRBM with a reported range of 2,000 km. These Agni-series of missiles will likely become operational in the next few years and will become the mainstay of India's MRBM forces.[25] India has a domestic space launch vehicle program referred to as the Surya program. Intelligence sources believe that India could convert this SLV into an ICBM within one to two years after the decision had been made to do so.[26] India is actively developing the Sagarika SLBM and is attempting to buy or lease nuclear submarines with the intent of modifying the submarines to accommodate SLBMs.

Pakistan. Pakistan's pursuit of missile-delivered nuclear weapons is a considered by many experts as a deterrent to India's nuclear program as well as their numerically-superior conventional forces.[27] Like India, Pakistan is developing an indigenous ballistic missile production capacity and has a variety of missiles. The

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[20] *Foreign Missile Developments,* CIA, p. 13.

[21] Ibid., p.12.

[22] Ibid.

[23] Ibid., p.17.

[24] Ibid.

[25] Ibid.

[26] Ibid.

[27] *Foreign Missile Developments,* CIA, p. 18.

short range (80 km) Hatf I is a simple solid propellant missile designed not only for domestic use but also for export. The Hatf III (modified Chinese M-11 missile) is a single-stage, solid propellant missile with a range of at least 300 kms. Pakistan also has a number of No Dong missiles (renamed Ghauri) from North Korea with a range of 1,500 km. Pakistan is developing and testing Ghauri 2 and Ghauri 3 missiles with reported ranges of 2,000 and 3,000 kms, respectively.[28] Pakistan is also developing the road-mobile, two-stage solid propellant Shaheen II with a reported range of 2,500 kms.[29]

Libya. UN sanctions from 1992 to 1999 are believed to have severely limited Libya's ability to obtain the requisite expertise, materials, and equipment to continue its development of MRBMs and ICBMs.[30] Since the removal of sanctions in April 1999, Libya has actively attempted to refurbish its aging SCUD force as well as obtain complete, long-range missile systems through a variety of foreign suppliers. Reports suggest that Libya may have received No Dong MRBMs from North Korea, but this has not been confirmed by Western intelligence sources.[31] Libya may be working on its Al Fatah missile that it claims has a 1,000 km range (U.S. intelligence believes the range is closer to 200 kms.) but this missile has not yet been tested.[32]

Syria. Syria possesses an extensive mobile SCUD-B, SCUD-C, and SS-21 SRBM arsenal.[33] These systems could allow Syria to strike deeply into the territories of potential regional adversaries Israel, Iraq, Turkey, and Jordan.[34] Although Syria has not shown any overt interest in acquiring longer-range missiles, it is possible that as regional security prospects continue to deteriorate, Syria may attempt to acquire longer-range systems such as the No Dong MRBM.

Technical Issues & Acquisition Strategy

Hit-to-Kill. (*Steven A. Hildreth, Specialist in National Defense*) 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.

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[28] *Third World Ballistic Missiles,* Teal Group World Missiles Briefing, August 2002.

[29] *Foreign Missile Developments,* CIA, p. 18.

[30] *Ballistic Missile Capabilities,* Carnegie Endowment, p. 3.

[31] Ibid.

[32] Ibid., p. 4.

[33] Ibid.

[34] Ibid.

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. (*Steven A. Hildreth, Specialist in National Defense*) 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.[35] 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.[36] Moreover, it is argued,[37] 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

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[35] 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.

[36] 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.

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

> 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 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).

Acquisition Strategy & Congressional Oversight. (*Gary Pagliano, Specialist in National Defense*) Some observers, particularly critics of the missile defense program, have expressed concern that the Administration's overall approach for managing the program could hinder Congress's ability to conduct effective oversight of it. Three areas of the Administration's management approach are at issue: The first concerns the Administration's plan to use evolutionary acquisition with spiral development to develop and acquire missile-defense systems. The second concerns a DOD directive that exempts the missile defense program from certain reporting requirements that are normally applied to major defense acquisition programs. The third concerns a decision to classify certain missile defense testing and program information.

The Administration and its supporters argue that these three developments are needed to help the program proceed expeditiously and to help prevent potential adversaries from learning how to evade or overcome U.S. missile-defense systems when they are deployed. Critics argue that these three factors could reduce Congress's ability to understand, track, and thereby conduct effective oversight of the Administration's missile defense program. Each of these three developments is discussed below.

Evolutionary Acquisition with Spiral Development. (*Gary Pagliano, Specialist in National Defense*) In presenting its new missile defense program to Congress in 2001, the Administration announced that missile defense systems would be developed and acquired under a relatively new approach called evolutionary acquisition with spiral development, or spiral development for short. As discussed in another CRS report,[38] spiral development is an outgrowth of the defense acquisition reform movement of the 1990s, and represents a departure from the

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[38] CRS Report RS21195, *Evolutionary Acquisition and Spiral Development in DOD Programs: Policy Issues for Congress*, by Gary J. Pagliano and Ronald O'Rourke. Washington, 2002. (Updated periodically) 6 p.

traditional DOD approach for developing and acquiring major weapon systems. Spiral development is aimed at achieving certain widely accepted defense-acquisition goals, including the following: (1) getting usable increments of a weapon capability into service sooner; (2) mitigating technical risk in acquisition programs involving new or emerging technologies; (3) taking advantage of user feedback in terms of determining how to modify and improve the system; and (4) facilitating the incorporation of new technologies into the system design during the system's life cycle.

Missile defense was the first major weapon acquisition program to be publicly linked with spiral development. DOD officials, however, have stated that they want spiral development to be the new "default" (i.e., standard) acquisition strategy for major weapons acquisition programs, and have since announced their intention to apply spiral development to other major weapon acquisition programs, such as the Navy's DD(X) next-generation surface combatant program.

Under an evolutionary acquisition strategy, a basic version of a weapon system is developed and 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.

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 familiar 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 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 FY2002 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]

The Administration and its supporters argue that the use of spiral development for the missile defense program (or other weapon acquisition programs) will not prevent Congress from conducting effective oversight, and could even improve Congress's oversight ability in some respects, because Congress will retain its role in approving each block, or segment, in a spiral development program, and because the information that DOD provides for the block to be approved will be more reliable than the potentially speculative information it might present under the traditional acquisition approach about what the entire program might look like from beginning to end.

Critics of the Administration's plan to use spiral development argue that it could reduce Congress's ability to provide effective oversight by putting Congress in the position of approving the start of a program whose outlines are only vaguely defined, because the lack of an original estimate of the program's overall quantities, cost, schedule, and cost would deprive Congress, years later, of a benchmark against which to measure performance of the program, and because the built-in potential for changes in a spiral development program could make funding projections for spiral development programs more volatile than funding projections for traditional development programs.[40]

Exemption from Reporting Requirements. (*Gary Pagliano, Specialist in National Defense*) In January 2002, the Secretary of Defense issued a

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[39] Statement of Lt. Gen. Ronald T. Kadish, USAF, Director, Ballistic Missile Defense Organization, on The Ballistic Missile Defense Program, Amended FY2002 Budget, Before the Senate Armed Services Committee, July 12, 2001, pages 2-3, 6-8, 14. Emphasis as in the original.

[40] See, for example, Hitchens, Theresa. The Unknown Spiral. *Defense News*, March 11-17, 2002: 13.

memorandum exempting the missile defense program from certain reporting requirements normally applied to major defense acquisition programs (even those that employ spiral development). The Administration's stated intent in issuing this directive was to help streamline the management and oversight of the missile defense program and thereby enable it to proceed more expeditiously. This objective is consistent with the Administration's interest in fielding missile defense systems without delay. Critics of the Administration's missile defense program, however, argue that the directive will deprive Congress of key program information and thereby reduce the ability of Congress to conduct effective oversight of the program.[41]

Information To Be Classified. (*Gary Pagliano, Specialist in National Defense*) In May 2002, the Administration announced that certain information about the missile defense program, including details about developmental tests, will henceforth be classified, and, therefore would not be released to the public. Administration officials argue that classifying the information will help prevent potential adversaries from learning about the technical characteristics of U.S. missile defense systems and using that information to design ballistic missiles with features designed to evade or overcome U.S. defenses. Critics of the decision argue that some of the information the Administration has decided to classify, such as basic details about early developmental tests, would be of no practical use to a potential adversary, and that the Administration's actual motive in limiting access to the information is to shield the missile defense program from public scrutiny and criticism.[42]

Legislation for FY2003. (*Gary Pagliano, Specialist in National Defense*) The Senate Armed Services Committee, in marking up the FY2003 defense authorization bill (H.R. 4546/S. 2514), included a series of provisions (Sections 221-224) that would require detailed reports on various aspects of the missile defense program. These provisions appear aimed in part at providing Congress has with information to support its missile defense oversight activities. For example, in connection with Section 222, which establishes reporting requirements for the midcourse segment of the missile defense program, the committee stated the following in its report (S.Rept. 107-151 of May 15, 2002) on S. 2514:

> In a January 2, 2002 memorandum from the Secretary of Defense restructuring the Department's ballistic missile defense program, the Secretary stated that the "special nature of missile defense development, operations, and support calls for non-standard approaches to both acquisition and requirements generation." As such, the Secretary has exempted missile defense programs from the Department's traditional acquisition directives and processes that require

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[41] See, for example, Bradley Graham, Rumsfeld Pares Oversight of Missile Defense Agency, *Washington Post*, February 16, 2002, p. A2; Milligan, Susan. Critics Fault Rumsfeld For Cutting Oversight Of Antimissile Plan. *Boston Globe*, March 9, 2002: 3.

[42] See, for example, Graham, Bradley. Secrecy On Missile Defense Grows. *Washington Post*, June 12, 2002: A10; Duffy Thomas. Levin Questions Missile Defense Agency's Classification Policy. *Inside Missile Defense*, June 12, 2002: 1; Coyle, Philip E. Why the Secrecy Shield? *Washington Post*, June 11, 2002; Richter, Paul. Missile Data To Be Kept Secret. *Los Angeles Times*, June 9, 2002: 1.

certain programmatic information be developed to assist in oversight of programs within the Department.

The committee is concerned that the exemption of missile defense programs from these acquisition processes has also resulted in the elimination of certain reports to Congress on missile defense programs. These reports are critical to congressional understanding and oversight for missile defense programs, and are required for all other major defense acquisition programs....

Until the fiscal year 2002 budget submission, all information required by sections 2431 and 2432 of title 10, United States Code had been submitted to Congress for all major ballistic missile defense programs. However, neither the fiscal year 2002 budget submission nor the fiscal year 2003 submission included such information. Both the Under Secretary of Defense for Acquisition, Technology and Logistics Pete Aldridge and the Director of the Missile Defense Agency Lieutenant General Ronald Kadish have testified to the committee that they intend to provide Congress with the information it needs. This committee provision, therefore, would establish the minimum congressional requirements for information on the Midcourse Defense program. (Page 124)

In addition, the committee's markup included a provision that establishes a pilot program for spiral development of major systems (Section 803) and a provision establishing a reporting requirement for what the committee termed "incremental acquisition" programs (Section 802). In its report on the bill, the committee stated, in connection with Section 803:

The committee believes that properly structured spiral development programs can play an important role in enabling the Department of Defense (DOD) to rapidly field new technologies. The General Accounting Office (GAO) has undertaken an extensive review of weapons systems acquisition issues at the request of the committee and has concluded that a "an evolutionary, or phased, approach to developing" weapons systems could lead to significantly improved outcomes.

At the same time, GAO has testified that, "Measures for success need to be defined for each stage of the development process so that decision-makers can be assured that sufficient knowledge exists about critical facets of the product before investment [of] more time and money." The committee believes that DOD must take a disciplined approach to spiral development to ensure that both Congress and the Department have the information they need to make acquisition and budget decisions.

To ensure that the Department develops a disciplined approach to spiral development, the provision recommended by the committee would authorize the Secretary of Defense to conduct spiral development programs on a pilot basis. Under this pilot approach, the Secretary would be required to issue guidance on how spiral development programs will be designed to meet key acquisition system objectives and to approve spiral development plans laying out the program strategy and the cost, schedule and performance goals for each spiral development program.

The committee expects that all spiral development programs for major systems will be conducted in accordance with the guidance issued by the Secretary pursuant to this section. (Page 335)

In connection with Section 802, the committee stated:

> The committee supports the Department's effort to build more flexibility into the acquisition process and develop weapons systems in more manageable steps. At the same time, the committee believes that the Department must take a more disciplined approach to incremental acquisition and spiral development to avoid losing control over the acquisition process.... The committee expects the Department to develop a disciplined approach to ensure that both the specific requirements and the key objectives of applicable laws and regulations will be met by all incremental acquisition programs. (Page 334)

International Response

Russian Hesitancy and Opposition. (*Amy Woolf, Specialist in National Defense*) 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.[43] 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.[44] 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

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

[44] 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 argued that President Putin might have been willing to accept U.S. proposals to set aside the ABM Treaty and replace it with a new, less formal framework. Others, however, did not believe that Russia ever 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 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 withdrew from the ABM Treaty. President Putin referred to the U.S. withdrawal 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. (*Paul E. Gallis, Specialist in European Affairs*) Most U.S. allies in Europe continued 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 did not find persuasive that the attack of September 11, 2001 strengthened 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 remain 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, when 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, such as Italy and Spain, have endorsed the Administration's missile defense plans.

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.[45]

The Europeans remain quietly critical of the Administration's missile defense program and the decision to abrogate the ABM Treaty. However, U.S. cooperation with Russia in Afghanistan, combined with NATO's decision in late February 2002 to establish a more substantial joint council with Russia, have softened concern among the allies that the Administration was ignoring or marginalizing Moscow. At the same time, the Administration's reluctance to use treaties to manage arms control has sustained a European belief that the United States will push aside potential international agreements that might limit Washington's arms policies.

Diverse Reaction in Asia and the Pacific. (*Richard P. Cronin, Specialist in Asian Affairs*) 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, qualified but increasing interest in Japan, and support from Australia and India.

Chinese Opposition. (*Richard P. Cronin, Specialist in Asian Affairs*) The People's Republic of China (PRC) opposes U.S. missile defense policy but its criticisms have been muted since the September 11, 2001, terrorist attacks and the confrontation with Iraq that heated up in the Summer of 2002. These objections have not changed, however. A Chinese Defense White Paper released in late 2002

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[45] 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.

reportedly discusses U.S.-Japan BMD cooperation obliquely, referring to "certain countries," but also expresses regret for the abrogation of the U.S.-USSR ABM Treaty and restates its "resolute opposition" to the acquisition of a TMD capability by Taiwan.[46] 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.[47] 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, most prominently North Korea. 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. This would weaken China's ability to deter the United States from becoming directly involved in any future conflict with Taiwan.

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 naval and air capabilities as more technologically advanced and more operationally effective that its own. 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.

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[46] "China Warns Missile Defense Threatens Regional Peace," *Kyodo News* (Japan), Dec. 9, 2002.

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

Increasing Japanese Interest in BMD Cooperation. (*Richard P. Cronin, Specialist in Asian Affairs*) Although polling data indicate that the Japanese public is deeply troubled by the Bush Administration's accelerated missile defense program, senior Liberal Democratic Party (LDP) politicians and Defense Agency have indicated increasing interest in BMD cooperation and the acquisition of a theater-range missile defense capability. Initially, Tokyo responded to the Bush Administration's revised approach to BMD by employing the time-honored Japanese expression of "understanding" U.S. policy, which does not carry the connotation of support.[48] 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.

Interest in BMD cooperation on the part of the Japanese government and the ruling LDP has grown sharply since the revelations last fall that North Korea had a covert uranium enrichment capability. The issue of BMD cooperation reportedly occupied a prominent place on the agenda in the periodic "two-plus-two" meetings in Washington in mid-December 2002 involving the U.S. Secretaries of State and Defense and their Japanese counterparts. The talks are held under the framework of the bilateral Security Consultation Committee (SCC). During his visit to Washington the head of the Japan Defense Agency, a sub-cabinet entity under the overall direction of the Prime Minister, also visited the Pentagon's Missile Defense Agency. The Japanese delegation apparently remained non-committal about Tokyo's longer term plans, but expressed continuing interest in research and development cooperation. Prime Minister Koizumi made similarly vague remarks on December 18, 2002.[49]

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

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[48] 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.

[49] "SCC: Japan Clarifies Cooperation in MD Initiative," *Manichi Shimbun* (Japanese daily), Dec. 18, 2002: 3; "Koizumi: A Decision Will Come After Studying Various Factors," *Sankei Shimbun* (Japanese daily), Dec. 19, 2002: 5..

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 have long been split over the issue. Although recent revelations regarding North Korea's nuclear program and Pyongyang's threat to end a unilateral moratorium on testing long range missiles that dates from September 1999. This would break a promise made to Prime Minister Koizumi during his state visit to Pyongyang, in September 2002, that the moratorium would be continued. While these developments have tended to narrow the split in Japan over missile defense cooperation, a number of issues still block full cooperation. 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 (replaces the Navy Theater Wide program). 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 long-standing Cabinet legal interpretation that views "collective defense" as violating Article 9 of the "Peace Constitution" adopted during the post-World War II American occupation. 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. During 2001 Japan 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.[50] 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. After boosting spending in fiscal year 2002, the budget for cooperation reportedly has been reduced to about $15 billion in the proposed 2003 defense budget, a decline of 72.5 percent from the current fiscal year (ends March 31, 2003).[51]

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

[51] "Slight Cut in Defense Budget Proposed for FY 2003+," *Kyodo News*, Dec. 19, 2002.

Cautious Australian Support. (*Richard P. Cronin, Specialist in Asian Affairs*) The politically conservative Liberal Party government headed by 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 relations under the ANZUS Treaty, which marked its 50th anniversary in 2001. Australia regards its security alliance with the United States as the anchor of its security policy. Australia also desires to benefit from enhancements to the U.S. defense "umbrella." Among other security implications, Australian officials note that their territory is within range of North Korea's Taep'o-dong 2 missile, and they would be concerned if this system were to be successfully developed and deployed. At the same time, the Howard government, though not all members of the cabinet, reportedly have some qualms about missile defense cooperation, especially the possibility of prompting China to increase the number of its ICBMs.

The Howard government was also troubled by the Bush Administration's decision to abrogate the ABM Treaty, which Canberra has long regarded as a cornerstone of strategic nuclear stability. Australian officials say that their concerns were eased somewhat by the fact that Russia ultimately joined in what had begun as a unilateral move by the Bush. Administration. Reportedly, in a report leaked in February 2002, the Australian Office of National Assessments (ONA) has found that "The introduction of an NMD system in the US would not be in Australia's diplomatic or security interests," especially because it could provoke a regional arms race. The same document reportedly argued that the main threats to Australian security were not long-range ballistic missiles but by the proliferation of short and medium range missiles in an environment where nuclear, chemical, and biological weapons were also being developed.[52]

The Australian government has indicated that it understands the reasons for the accelerated American commitment to deploy a rudimentary system as early as 2004, and also that why U.S. concerns have strengthened since the September 11, 2001 terrorist attacks,. The Howard government has not formally endorsed U.S. BMD policy, but some statements by cabinet officials have been supportive. Foreign Minister Alexander Downer stated in an interview in Adelaide in May 2001, on the eve of a visit by U.S. Assistant Secretary of State for East Asia and the Pacific, James Kelly, that he not only supported missile defense but also that the ABM Treaty was a Cold War relic.[53] Other reports indicate that Downer raised a number of Australian concerns in the talks with Kelly.[54] Australian public attitudes are mixed. The ruling Liberal Party is generally more sympathetic to the U.S. position, while the Labor Party is divided between those who oppose any participation in the U.S. missile

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[52] Mark Forbes, Defence Correspondent, *The Age* (Melbourne), Feb. 5, 2002.

[53] Downer reportedly said that missiles kill people but missile defense systems do not. "Even the simplest mind can work that one out," he said. "Downer Supports Missile Defence Plan Ahead of Talks with US," Australian Broadcast Network, *ABC News Online*.

[54] Mark Forbes, Defense Correspondent, *The Age* (Melbourne), Feb. 6, 2002.

defense effort, and those who only oppose research and development cooperation.[55] The "shadow" Labor defense minister, Kevin Rudd, has openly opposed missile defense cooperation.[56]

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.) Reportedly, the classified ONA report noted above partly based its negative view of missile defense cooperation on the fact that the Pine Gap facility would inevitably would play a key role in providing early warning for U.S. national missile defense.[57] 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. (*Richard P. Cronin, Specialist in Asian Affairs*) 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 redirected 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 stops in Tokyo and Seoul. India's response, which would have been almost inconceivable during the Cold War era, appears to be based on a number of considerations. First, the Bush Administration appeared 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 had 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 appeared willing to tacitly grant India 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 hopes one day to obtain a missile defense capability of its own with U.S. assistance. Finally, the Administration's proposal to substantially reduce U.S. missile inventories

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[55] In an article in the *Canberra Times* on Dec. 23, 2002, Philip Dorling, a former Labor Party government disarmament expert and the opposition foreign policy advisor during 1996-2000 emphasized concern that the new U.S. BMD policy would lead to the militarization of outer space and cause China and Russia to develop anti-satellite systems, and would prompt China to increase the size of its ICBM force, thus prompting a strategic arms race in the Asia-Pacific Region. The latter development, he argued, might for the first time since the end of the Cold War put Australian cities back on potential nuclear target lists, this time China's.

[56] Kevin Rudd, Shadow Minister for Foreign Affairs, "Why Does the Howard Government Ignore Its Own Intelligence Advice," Australian Labor Party Media Statement — Feb. 5. 2002.

[57] Mark Forbes, Defence Correspondent, *The Age* (Melbourne), Feb. 5, 2002.

fit 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 gave given the Indian Government some defense against criticism that it has completely reversed a policy of nearly three decades. Russia's subsequent decision to jointly abrogate the ABM Treaty also has made it easier for the Indian government to support missile defense.

The Bush Administration's policy as it was being developed in the Summer of 2001 appeared to recognize frankly that India's nuclear and missile capability was a reality, and to seek 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 Administration had expressed its desire to remove the remaining anti-nuclear sanctions, completing a fundamental 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. Reportedly, the Administration was wrestling during the summer of 2001 with the issue of whether to eliminate remaining sanctions against Pakistan at the same time. Following the September 11, 2001 terrorist attacks, the Administration agreed, with congressional support, to remove all remaining sanctions on both countries in the interest of maximizing support for the anti-terrorist campaign, especially regarding the need for Pakistani support for operations in Afghanistan and against terror cells operating in Pakistan itself.[58]

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 in the Summer of 2001 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.[59] 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.

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[58] *BBC News*, "US Lifts India and Pakistan Sanctions," Sept. 23, 200l; Dianne Rennack., "India and Pakistan: Current U.S. Economic Sanctions." CRS Report for Congress, RS20995 [updated Feb. 11, 2002.]

[59] 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).

Several developments in 2002 and early 2003 have raised new questions about Indian support for U.S. BMD policy and the Bush Administration's own interest in missile defense cooperation, to the extent that this was ever a part of U.S. policy. First, the urgent need for anti-terrorist cooperation with Pakistan has made BMD cooperation less attractive. Pakistan, naturally, will view any U.S.-India BMD cooperation as a "tilt" to New Delhi which might further antagonize Pakistan's predominantly Islamic population, especially fundamentalists who already have strongly criticized the Musharraf government and opposed U.S. anti-terrorist and Mid-East policies. Second, a series of provocative missile tests and threatening comments by Indian and Pakistani officials in late 2002 and early 2003, coupled with a narrow brush with war in Kashmir in mid-2002, raise critical issues about lending any support to India's ambitions for its own missile defense system.

Such concerns already have led the Bush Administration to oppose India's bid to purchase critical components of the Israeli Arrow missile defense system. If and when this system is successfully developed and deployed, it is expected to have the capability to defeat precisely the kind of short and medium range missiles fielded by Pakistan. Reportedly, the Administration's opposition to the sale of the Arrow components, which were co-developed with some U.S. technology and about $1.6 billion in U.S. funds, caused a "cool" Indian reception when Secretary of State Colin Powell visited New Delhi in August 2002.[60]

Background on Major Missile Defense Programs

Boost Defense Segment

Air-Based Boost. (*Daniel Morgan, Analyst in Science & Technology, and Christopher Bolkcom, Specialist in National Defense*) 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."

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[60] Ramtanu Maitra, "An Arrow to Washington's Heart." *Asia Times*, Aug. 20, 2002.

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. 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.

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 FY2002 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.

For FY 2003, MDA requested $598 million for the ABL in the FY2003 budget. The House Armed Service Committee recommended $520.5 million, a reduction of $77.5 million. The committee raised concerns about escalating costs, as well as a two year delay in the lethal shot down of a missile from 2003 to 2005. The Senate Armed Service Committee recommended a $135 million reduction for similar reasons expressed by House. The Senate Committee also directed MDA to delay the purchased of a second aircraft until ABL completes the test scheduled for the first aircraft. Despite these concerns, the Authorization Conference report (107-772) provided full funding of $598 million, without comment. Initially, House and Senate appropriators recommended funding reductions for ABL, but restored full funding for ABL in conference.

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 2005. BMDO states this half-power ABL could be available for deployment as an emergency capability immediately following lethality demonstrations scheduled for late 2005. 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 between FY2009 and FY2011, depending on the results of additional operational testing.

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 2005. 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 FY2000 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." However, this schedule is likely to change due to the two year delay for the lethal shoot-down.

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. (*John D. Moteff, Specialist in Science & Technology Policy*) 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. Two concepts are under development: a space-based laser (SBL) and space-based kinetic weapons. Both concepts have been under development to varying degrees since before SDI in the early 1980s. Congressional funding support for this portion of the program is waning.

In FY2002, the Bush Administration had requested $170 million for space-based laser development, with much of that directed toward the development of an Integrated Flight Experiment, to be conducted in space and initially scheduled for 2012, and the construction of a test facility to be located at Stennis Space Flight Center. However, Congress, concerned that the technology was not mature enough to warrant the development of the flight experiment at this time, appropriated only $30 million for the program. As a result, the Integrated Flight Experiment (which was projected to cost between $1 billion and $3 billion) and the test center were cancelled. The Bush Administration's FY2003 request for the space-based laser was $34 million, and directed primarily at reducing technical risks associated with key components (the megawatt hydrogen-fluoride laser, mirrors, beam controls, pointing/tracking/fire controls, etc.). Congress reduced the request by $10 million in its FY2003 appropriations.

The space-based kinetic energy component of the space-based boost phase intercept portion of the program is designed to further develop the key component

technologies including the kinetic kill vehicle, boosters, sensors, battle management and control, and platform integration. Development work and experiments are to help reduce the technical risks and lead to a design decision in FY2006 or later. This element was a new start in FY2002 and received $23 million. The Bush Administration requested $53million for FY2003 and had proposed major increases in the program in the out-years. Congress cut the request by $50 million. In its appropriations report, the House Appropriations Committee stated that greater emphasis should be placed on accelerating the manufacture of existing systems, such as the PAC-3, and on accelerating the development of other more mature technologies.

There are a number of issues associated with space-based boost phase intercept. Any such system could also function as a anti-satellite weapon, an issue that remains 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. Although no longer a constraint, when the ABM Treaty was in force, testing and deploying these systems in an ABM mode had been prohibited.

Sea-Based Boost. (*Ronald O'Rourke, Specialist in National Defense*) 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 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 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.

Although the Sea-Based Boost program is not yet well defined, a robust sea-based boost system would likely require an interceptor missile with:

- a much higher maximum speed, or burn-out velocity (perhaps 6 to 8 kilometers per second [kps]) than that of the SM-3 interceptor missile now being developed for the Sea-Based Midcourse system (which has a maximum speed of a bit more than 3 kps);

- a high rate of acceleration to maximum speed, to help meet the short engagement times associated with boost-phase intercepts; and

- 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 first two characteristics will likely require either a major modification to the existing SM-3 missile design or the development of an entirely new missile with a diameter of up to 27 inches. Whether a modified SM-3 or an entirely new design, a higher-speed missile developed for the Sea-Based Boost program might prove suitable, with a different kill vehicle, for use as an improved interceptor for the Sea-Based Midcourse system. Conversely, a higher-speed missile developed for an improved Sea-Based Midcourse system might prove suitable, with a different kill vehicle, for use as the interceptor for the Sea-Based Boost system. (See section on the Sea-Based Midcourse program.) Using the same basic interceptor missile for both programs could reduce total sea-based missile defense costs.

It may also be possible, as a near-term stopgap measure, to develop a more limited boost-phase capability based on the SM-3 missile. Although the SM-3 was designed to intercept slower-moving theater-range ballistic missiles rather than faster-moving intercontinental ballistic missiles (ICBMs), the SM-3 may have some potential to intercept certain ICBMs — specifically, those that are fired from coastal launch pads — during the later (i.e., exoatmospheric) part of their boost phase, before they have attained their maximum speeds.

A mid-2002 discussion of the sea-based boost concept stated:

> Although the radar currently in place on Aegis combatants has enough power and resolution to detect and track ICBMs during the boost phase, the navy has optimized the system's performance and displays to defend against targets such as cruise missiles and missiles launched from airplanes. The required modifications for ICBM defense are not trivial, but they are achievable. What is totally missing at present is a suitable boost-phase missile interceptor.
>
> Some U.S. Navy officials proposed using SM-2 Block IV[61] missiles to engage boosting ICBMs in the upper atmosphere; that proposal, however, was fraught with a great deal of technical risk and required the ship to be within 50 kilometers of the launch site, making the ship itself vulnerable. A more practical approach may be developing a missile interceptor intended to engage the boosting ICBM later in its boost phase above the atmosphere, allowing ships to be as much as 1,000 kilometers from the launch site.

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[61] Due to an apparent production error, the article as published in original form mistakenly identified the missile being referred to at this point as the SM-1, which a very old version of the Standard missile that has no potential for missile defense. When the article reprinted later by a different publication, the reference was corrected to refer to the SM-2 Block IV, which is a new version of the Standard missile intended for intercepting aircraft and cruise missiles.

> Developers could use the SM-3 test missiles being produced for the navy's midcourse risk-reduction effort as a starting point for suitable interceptor missiles. Successful boost-phase intercept missiles, however, would have to be faster than the test missiles....
>
> Using the modified SM-3 or wide-diameter missiles (fast-accelerating interceptors with high terminal speeds), the ship could be as far as 1,000 kilometers from the launch point. U.S. Navy ships thus equipped in international waters could engage missiles launched from all of North Korea or Iraq. The effectiveness of sea-based boost-phase missile interceptors against ICBMs launched from Iran would depend on the part of the country from which the ICBMs were launched. In some cases, U.S. forces would need ground-based or airborne supplements.
>
> A sea-based boost-phase capability has clear political advantages and some disadvantages. Its main advantage is the ability to provide a potential defense against ICBMs launched from North Korea and most parts of the Middle East. At the same time, sea basing would present no threat to Russia's and China's land-based ICBM deterrents because those launch points are far inland.
>
> As for disadvantages, a sea-based boost-phase system would potentially threaten Russia's submarine-launched deterrent, assuming a capability existed to estimate the general location of the submarine. Second, any boost-phase defenses would require the establishment of a "no-launch zone" or other special procedures over the rogue state and a willingness in extremis to delegate the engagement decision to the local U.S. commander. Both requirements may be difficult to sustain politically. Finally, any boost-phase concept would require launching the interceptors in the direction of the country launching the ICBMs as well as toward third parties that may not be involved. For example, launches against North Korean missiles with boost-phase missile interceptors would entail launches on azimuths toward both North Korea and China. When defending against Iraqi and Iranian missile launches, the boost-phase missile interceptors would fly over several countries on an azimuth toward Russia. Additionally, debris from the engagement (damaged warheads, spent interceptor boosters, and so forth) could have an impact on uninvolved countries.
>
> If the United States accepts these political disadvantages, the operational advantages of a sea-based boost-phase interceptor are significant. With the potential exception of Iran, these interceptors are most effective against the countries in need of dissuasion and deterrence, and they are less effective against former adversaries that need reassurance.[62]

MDA Director Kadish stated in July 2001 that the Sea-Based Boost program "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

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[62] Binnendijk, Hans, and George Stewart. Toward Missile Defenses from the Sea. *Washington Quarterly*, Summer 2002: 199-200. The article was later reprinted (with slight changes) under the same title in the June 2002 of *Defense Horizons*, a publication of the Center for Technology and National Security Policy of the National Defense University.

midcourse roles."[63] 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 also stated in July 2001 that MDA 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 some experiments in space with kinetic energy that build on the terrestrial side for airborne laser and a sea-based kinetic energy killer."[64]

In May 2002 it was reported that

> A modified Standard Missile-3 using a new kinetic kill vehicle now being developed by the Missile Defense Agency may be included in a series of experiments planned for fiscal year 2004 that will look at promising new approaches to defeat ballistic missiles during their boost phase, an MDA spokesman told *Inside the Navy* last week. MDA plans to spend over $2 billion through FY-07 to develop a boost-phase interceptor that could be launched from a Navy ship, according to agency budget documents....
>
> MDA spokesman Christopher Taylor told ITN that during FY-02 the agency and the Navy will develop mission requirements for early critical experiments (ECE) scheduled for FY-04. "Current options for the ECE missile include a modified Standard Missile-3 that incorporates the new Generation 1 boost kill vehicle under development as well as other more powerful boosters resulting from MDA's Broad Agency Announcement," he said.
>
> The Navy and MDA will also finish a concept definition and assessment study in FY-02 that looks at candidate kinetic energy boost elements of the Ballistic Missile Defense System, the layers, multiprogram architecture that will handle a whole range of ballistic missile threats from ICBMs to the very shortest range missiles.
>
> "This study, done in collaboration with the Missile Defense National Team, is assessing a broad range of boost concepts spanning the complete set of basing modes including sea, space, air and ground," Taylor said. "Our intent is to execute critical experiments in FY-03-05 to mitigate the risk in accomplishing the boost mission. These critical experiments may culminate in a focused demonstration of a particular basing mode depending on the results of the CD&A study and the early critical experiments."[65]

In early September 2002, it was reported that the Defense Science Board (a federal advisory committee that provides independent advice to the Secretary of Defense) had recommended in August 2002 that DOD focus its missile defense

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[63] 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.

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

[65] Duffy, Thomas. Study to Define Candidates for Sea-Based Boost-Phase Interceptor. *Inside the Navy*, May 20, 2002.

efforts on two main approaches: a ground-based midcourse system and a sea-based boost and ascent-phase system.[66]

In June 2002, it was reported that one

> boost-phase activity that's materializing involves modifying the lightweight exoatmospheric projectile (Leap) used as the kill vehicle in the sea-based midcourse defense system. It will gather data on a boosting target, according to Dean T. Gehr, missile defense business development manager for Raytheon. The goal is to conduct a flyby experiment and determine whether an infrared sensor can detect the missile. Leap's solid-fuel divert and attitude control system (Dacs) would likely be replaced with a larger, liquid fuel system that would give the kill vehicle more maneuverability.
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> While the boosting missile is easy to spot because of its large infrared signature, the weapon becomes encased in a plume of hot gases as it reaches higher altitude and thinner atmosphere. The seeker then has difficulty finding the missile. Modifications will likely be made to the IR sensor to look at the bright target, Gehr said. If the IR sensor alone can't do the job, it might have to be supplemented with an ultraviolet sensor or laser radar.
>
> For test purposes, the data-collection effort probably will use the Standard Missile SM-3, which is the interceptor for the sea-based midcourse system. Raytheon hopes a modified SM-3, with a 21-in. second stage, can serve as the interceptor in an operational configuration, but MDA officials have indicated they may need a dedicated missile. Notional performance for such a system would be 30g acceleration and speeds of 8 km./sec. velocity at burnout.[67]

In October 2002 it was reported that

> DOD and industry officials say [MDA] is leaning toward developing a 'multi-use' boost-phase interceptor with a speed of around 6km/s [6 kps] that could be launched from navy ships, but could also be operated from land, even airborne and potentially have space applications.
>
> "We have initiated experiments this year to demonstrate the capabilities of a kinetic-energy boost system," said Pat Sanders, programme executive officer for the MDA's overarching BMDS [Ballistic Missile Defense System]. "We expect to conduct tests to intercept a boosting missile no later than 2005." Later, the same interceptor booster may be evaluated with a different kill vehicle for mid-course use, DOD officials said.[68]

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[66] Graham, Bradley. Missile Defense Choice Sought. *Washington Post*, September 3, 2002: 1.

[67] Wall, Robert. Pentagon Eyes Additions To Anti-Missile Arsenal. *Aviation Week & Space Technology*, June 10, 2002: 20.

[68] Sirak, Michael. Sea-Based Ballistic Missile Defence: The 'Standard' Response. *Jane's Defence Weekly*, October 30, 2002.

Legislation for FY2003. The Administration's proposed FY2003 defense budget requested $796.927 million in Defense-wide research and development funding for boost-phase missile defense programs, including $89.6 million in research and development funding for the Sea-Based Boost program. The conference report (H.Rept. 107-732 of October 9, 2002) on the FY2003 defense appropriation bill (H.R. 5010) approved a total of $736.927 million, a $60-million reduction from the requested amount. Within this total approved amount, however, the $89.6-million request for the Sea-Based Boost program was approved without change. (Page 310)

Midcourse Defense Segment

Steven A. Hildreth, Specialist in National Defense

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.

Pacific Missile Defense Testbed. Until recently. The Administration had moved forward, but had not proposed a specific ground-based missile defense system. It had indicated the Pacific Missile Defense Testbed (also known as the Midcourse Test Bed) could provide a rudimentary ground-based ICBM defense contingency capability beginning about 2004-2005.

In December 2002, however, DOD announced a specific program and timeline. The Administration said the United States would begin fielding initial missile defense capabilities in 2004-2005 to meet the near-term ballistic missile threats to the U.S. homeland, to U.S. deployed forces, and to counter ballistic missile threats to U.S. friends and allies. This initial capability would build on the planned Pacific Missile Defense Testbed and would serve as a starting point for deploying increasingly effective missile defenses over time, according to the Administration.

The initial set of capabilities in mind for 2004-2005 include:

- up to 20 ground-based interceptors designed to intercept and destroy ICBMs during the midcourse phase of their flight. These interceptors would be based at Ft. Greeley, Alaska (16 interceptors) and Vandenberg Air Force Base, California (four interceptors);
- up to 20 sea-based interceptors deployed on existing Aegis ships to try and intercept ballistic missiles in the first few minutes after they are launched (i.e., during their boost and ascent phases of flight);
- deployment of air-transportable PAC-3 systems designed to intercept short and medium-range ballistic missiles; and

- land, sea, and space-based sensors, including existing early warning satellites, an upgraded radar now located at Shemya, Alaska, a new sea-based X-band radar, upgraded existing early warning radars in the UK and Greenland, and use of other sensors now on Aegis cruisers and destroyers.

These capabilities could be improved upon through additional measures such as additional interceptors of varying capabilities and basing platforms. Ground was broken for the Ft. Greely site on June 5, 2002, for missile silos and support buildings. The initial ground-based midcourse parts of the testbed are to be constructed by September 20, 2004. The test bed will serve to validate the ground-based midcourse concept and to improve the realism if interceptor tests, according to DOD. Other key parts of the testbed are planned or are under construction in Alaska, California, Colorado, the Republic of the Marshall Islands.

Costs. System costs have not been provided. These costs may also not become available because of the evolutionary acquisition strategy adopted for missile defense. Nonetheless, there is a useful point of reference in terms of costing a midcourse system. 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 FY2026). The Initial Operational Capability (IOC) for this system was 2005.

Recent Tests & Technical Challenges. The NMD or ground-based midcourse 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.

On Dec. 11, 2002, the Missile Defense Agency announced it could not complete a planned intercept test because the kill vehicle and the booster rocket failed to separate. This was the 8th intercept of the ground-based midcourse research and development program. The first test on Oct. 3, 1999 successfully intercepted its intended target. The 2nd test occurred on Jan. 19, 2000; an intercept was not achieved because of a problem with the on-board cooling system. The 3rd test on July 8, 2000 also failed to intercept its target because the kill vehicle failed to separate from the booster rocket. The 4th test, on July 14, 2001, successfully intercepted its target, as did the 5th and 6th tests on Dec. 3, 2001 and March 15, 2002, respectively. 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." The 7th test on Oct. 14, 2002 was

also deemed a success and for the first time a ship-based SPY-1 radar was used to track a long-range target.

Sea-Based Midcourse.

Ronald O'Rourke, Specialist in National Defense

Aegis Sships and SM-3 Interceptor. The Sea-Based Midcourse program is the successor to the Navy Theater-Wide (NTW) program (which was also called the Navy Upper Tier program). MDA Director Kadish stated in his July 2001 testimony to Congress on the Administration's new missile defense program that "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]. By engaging missiles in early ascent, sea-based systems also offer the opportunity to reduce the overall BMD System's susceptibility to countermeasures."[69]

MDA plans to spend about $3.3 billion on the Sea-Based Midcourse program between FY2003 and FY2007. Major contractors for the program include Raytheon Missile Systems of Tucson, Arizona (the prime contractor for the development of the interceptor missile), and Lockheed Martin Naval Electronic and Surveillance Systems of Moorestown, New Jersey (which manages the development of the shipboard Aegis Weapon System).

The Sea-Based Midcourse system, like the earlier NTW program, would be based on the Navy's Aegis ships, which are equipped with the powerful SPY-1 radar.[70] The Navy's NTW program was designed to intercept theater-range 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. Achieving a capability against theater-range ballistic missiles involves modifying the SPY-1 radar to improve its ability to detect and track ballistic missiles and developing a new version of the Standard Missile interceptor 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 maximum 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.

MDA Director Kadish's July 2001 testimony and subsequent statements suggest that the Administration's plan for Sea-Based Midcourse is to proceed with

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[69] 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.

[70] 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.

development and deployment of the capability envisaged under the NTW program, and then work toward improving the system so that it can eventually be used against faster-flying intercontinental ballistic missiles (ICBMs). MDA officials have indicated that if developmental testing goes well, the basic version of the Sea-Based Midcourse system (the NTW-like version capable of intercepting theater-range ballistic missiles) might be ready for deployment in 2005 or 2006. A more advanced version of the Sea-Based Midcourse system (a version capable of intercepting ICBMs) might be ready for deployment several years after that.

The basic version of the Sea-Based Midcourse system was successfully tested three consecutive times in 2002, achieving intercepts on Aries target ballistic missiles on January 25, June 13, and November 21. The June intercept occurred on the day that the ABM treaty expired and was the first to employ a sea-based Aegis radar to guide the interceptor to the target missile. Both the January and June tests involved descent-phase intercepts. Following the successful result of the June test, the flight test program was accelerated with the intention of deploying the system as a near-term defense against theater-range ballistic missiles in 2005 or 2006. The November test was the first in a series of six flight tests aimed at this goal, and was the first in which the Sea-Based Midcourse system intercepted a missile in its ascent phase. The remaining five tests in the series will involve more complex and stressing engagement scenarios. Three of these five tests are planned for 2003. The first may occur in April or May and the second in August; both are to involve ascent-phase intercepts. The tests will also explore the potential for the SM-3 to intercept ballistic missiles at lower altitudes in space, so that it can perform part of the mission that was to be performed by the now-cancelled Navy Area Defense (i.e., Lower Tier) program (see discussion in the Sea-Based Boost section).[71]

Improving the Sea-Based Midcourse system so that it can be used against ICBMs would likely involve making additional modifications to the Aegis ships' radars, including further improvements to the SPY-1 radar, which operates in the S band, and the potential addition of a new X-band shipboard radar called the high-power discriminator.

Improving the Sea-Based Midcourse system so that it can be used against ICBMs would also involve developing a larger and higher-speed missile than the SM-3, which has a maximum speed (i.e., burn-out velocity) of a bit more than 3 kilometers per second (kps). The Navy reportedly has been considering 3 different options for a higher-speed missile:[72]

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[71] Sea-Based Ballistic Missile Defense Test Successful. Navy News Service, November 22, 2002; Selinger, Marc. Sea-Based Midcourse System Intercepts First Ascending Target. *Aerospace Daily*, November 25, 2002; Duffy, Thomas. Navy Scores Third Straight Ballistic Missile Intercept During Hawaii Test. *Inside the Navy*, November 25, 2002; Sirak, Michael. Sea-Based Ballistic Missile Defence: The 'Standard' Response. *Jane's Defence Weekly*, October 30, 2002.

[72] 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

(continued...)

- **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 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.

In addition to the above missile options, Japan is participating in a cooperative development program with MDA to develop certain technologies that could be used to improve the SM-3.[73]

A higher-speed missile developed for an improved Sea-Based Midcourse system might prove suitable, with a different kill vehicle, for use as an interceptor for a Sea-Based Boost system. Conversely, a higher-speed missile developed for the Sea-Based Boost program might prove suitable, with a different kill vehicle, for use as

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[72] (...continued)
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).

[73] For more on Japan's role in ballistic missile defense, see CRS Report RL31337, *Japan-U.S. Cooperation on Ballistic Missile Defense: Issues and Prospects*, by Richard P. Cronin. Washington, 2002. (March 19, 2002) 32 p.

the interceptor for an improved Sea-Based Midcourse system. (See section on the Sea-Based Boost program.) Using the same basic interceptor missile for both programs could reduce total sea-based missile defense costs.

Sea-Based X-Band Radar. Independent of the Aegis-ship program described above, MDA announced on August 1, 2002 that it wants to build a large, sea-based, X-band missile tracking and engagement radar to support the Ground-Based Midcourse system. This sea-based radar would be built in lieu of a ground-based X-band missile defense radar. MDA wants the sea-based radar to be deployed by September 2005 as part of the Pacific missile defense development test bed. The sea-based radar option was selected over the alternative of building an additional ground-based X-band radar in large part because the ability to reposition a sea-based radar permits the creation of a numerous radar configurations that can support a variety of missile-defense development tests and emerging missile defense requirements. Boeing and Raytheon are main contractors for the radar, whose total acquisition has been estimated at about $900 million.[74] No funds specifically for the sea-based X-band radar were included in the FY2003 defense budge request.

Under MDA's plans, the X-band radar is to be carried aboard "a modified, fifth generation semi-submersible platform similar to those currently used in the oil exploration industry." The platform would have a length of 390 feet, a beam (width) of 238 feet, and a draft of 77 feet. It would displace 50,000 tons, which is about half the full load displacement of a U.S. Navy Nimitz-class aircraft carrier. It would have a deck area measuring 270 feet by 230 feet and would be able to relocate itself using electric thrusters. The X-band radar would sit on the deck, encased in a spherical shell.[75] The general concept of deploying large radars on sea-based platforms is not new: The United States over the years has outfitted and operated several merchant-type ships with large radars similar to MDA's proposed X-band radar to support flight tests of U.S. ballistic missiles and reportedly to learn about the characteristics of foreign ballistic missiles.

Legislation for FY2003. The Administration's proposed FY2003 defense budget requested $3,195.104 million for Defense-wide research and development work on ballistic missile midcourse defense programs, including the Sea-Based Midcourse program.

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[74] Sirak, Michael. Sea-Based Ballistic Missile Defence: The 'Standard' Response. *Jane's Defence Weekly*, October 30, 2002; Kerry Gildea. New Sea-Based Missile Defense Radar Passes Critical Design Review. *Defense Daily*, October 24, 2002; Selinger, Marc. MDA Plans for Sea-Based X-Band Radar Hit Snag With Congress. *Aerospace Daily*, October 11, 2002; Gildea, Kerry. MDA Lays Out Phased Plan To Get New Radar Into Testing In 2005. *Defense Daily*, August 6, 2002: 1; Weinberger, Sharon. MDA Chooses Sea-Based Radar for Missile Defense. *Aerospace Daily*, August 5, 2002; Gildea, Kerry. MDA Awards Boeing $33 Million To Start Work on Sea-Based X-Band Radar. *Defense Daily*, August 5, 2002.

[75] Duffy, Thomas, and Christopher J. Castelli. Appropriators Cast Wary Eye on Sea-Based X-Band Radar Initiative. *Inside the Navy*, October 21, 2002. The articles states that the quoted passage and the other information on the platform for carrying the X-band radar was taken from taken from a summary of the sea-based X-band radar program provided by the Navy to *Inside the Navy*.

In its report (S.Rept. 107-151 of May 15, 2002) on the FY2003 defense authorization bill (S. 2514), the Senate Armed Services Committee expressed concern regarding the Navy's plan for upgrading the radar capabilities of the Aegis ships that are to be equipped with the Sea-Based Midcourse system:

> For a number of years the Department of Defense has pursued two separate radar development efforts for the Navy Theater-Wide ballistic missile defense system, now called the Sea-based Midcourse system. Both efforts, one focusing on X-band radar technology and the other on S-band technology, have lacked a coherent focus and plan. Congress has repeatedly requested that the Department provide the overall plan for Sea-based Midcourse radar development. Last year's committee report urged the Ballistic Missile Defense Organization, now the Missile Defense Agency (MDA), to focus the radar development efforts and funding on the radar technology that the MDA determines is best suited for ballistic missile defense. The report also discussed the unique value of X-band radar technology for ballistic missile defense and quoted Lieutenant General Ronald Kadish, Director of the Missile Defense Agency, who stated that "in order to do the [ballistic missile defense] countermeasure problem you are going to need the kind of fine discrimination capability afforded by the X-band."
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> Despite urging by Congress during fiscal year 2002, the Department did not focus on a single radar technology and instead continued to fund both S- and X-band efforts. Furthermore, the X-band effort was not funded at a level commensurate with making adequate progress. The X-band high power discriminator radar effort received only $12.0 million in fiscal year 2002, resulting in the termination of many of the engineers working on the program, despite the fact that the high power discriminator technology is mature enough to be installed and demonstrated on a ship.
>
> The budget request for fiscal year 2003 included only $15.0 million in PE 63882C for X-band high power discriminator radar development. The committee believes that the X-band high power discriminator radar is essential to any robust near-term Sea-based Midcourse capability and is concerned that the proposed funding level is significantly lower than the level required to conduct prototype development and installation on a ship, the logical next step for the program. (Pages 235-236.)

In its report (H.Rept. 107-532 of June 25, 2002) on the FY2003 defense appropriation bill (H.R. 5010), the House Appropriations Committee stated that it "directs that the entire budget amount for the SPY-1 Solid State Radar is provided only for S-band development." (Page 310)

In its report (S.Rept. 107-213 of July 18, 2002) on the FY2003 defense appropriation bill (H.R. 5010), the Senate Appropriations Committee stated that

> from within funds provided for the Sea-based Midcourse Defense program, the Committee directs that not less than $80,000,000 be allocated to continue development of both the SPY-1 (S-Band) and X-Band radar systems. Though both of these radar development programs have been allocated funding in the President's request, the Committee has determined that the amounts allocated are not sufficient to keep these programs on track to meet future testing requirements. (Page 217)

The conference report (H.Rept. 107-732 of October 9, 2002) on the FY2003 defense appropriations bill (H.R. 5010) approved $3,185.504 million for Defense-Wide research and development work on midcourse defense programs, a net $9.6-million reduction from the Administration's request. Included in the total approved amount is a transfer of $22 million out of the midcourse account to the Navy's research and development account for work on S-band radar development, a $40-million reduction to the requested amount for the Sea-Based Midcourse Program, and a transfer of $30 million in funds from the Sea-Based Terminal Program into the midcourse account. (Page 310)

With regard to research on improved radars for the Navy's Aegis ships, the conference report states:

> The conferees agree to transfer $22,000,000 from the Missile Defense Agency's sea-based midcourse program to the Navy (PE 0604307N) only for the development of Solid State S-Band radar. In addition, the conferees agree that $10,000,000 in sea-based midcourse funds shall be made available for radar development, the exact technology to be decided by the agency after a careful consideration of relevant radar options. (Page 316)

With regard to the sea-based X-band radar, the conference report states:

> Subsequent to submission of the budget for fiscal year 2003, the Missile Defense Agency proposed acquisition of a sea-based X-band radar, in lieu of the land based concept previously funded by Congress. At this juncture, the conferees have little insight about the technical and cost feasibility of this initiative, or about the impact of this change on the schedule and test plan for the ground based mid-course segment. On that basis, the conferees direct that none of the funds provided for the ground based mid-course segment program may be obligated to acquire the proposed, foreign built sea-based platform until 30 days after the Director of the Missile Defense Agency provides a report to the congressional defense committees on the cost and schedule impact of this approach, including a comparison to the cost and capability of the previously proposed land based site and the technical criteria used to determine that a sea-based platform will provide effective test and operational performance for the missile defense system. (see pp. 316-317.)

Terminal Defense Segment

Ground-Based Terminal.

Steven A. Hildreth, Specialist in National Defense

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 a partial test failure in February 2002 (one PAC-2 missile intercepted a drone aircraft, while a second PAC-2 and a PAC-3 missile missed their intended targets). Subsequent successful intercepts occurred on March 21, April 25, and May 30, 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 FY2007 to FY2006. 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 FY2002, the Bush Administration requested $922 million for THAAD, which was a 68% increase over the amount requested and appropriated for FY2001 ($549.9 million), and a 32% increase over the amount requested for FY2002 by the outgoing Clinton Administration. Congress cut THAAD funding by $50 million for FY2002. This cut was directed at denying the Administration's request to acquire

a limited number of THAAD contingency missiles. The FY2003 request for THAAD is $935 million.

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 FY2001, 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.

Ronald O'Rourke, Specialist in National Defense

The sea-based terminal effort has undergone a number of recent changes. These are described below.

Cancellation of NAD Program. On December 14, 2001, DOD announced that it had canceled the Navy Area Defense (NAD) program, the program that was being pursued as the Sea-Based Terminal portion of the Administration's overall missile-defense effort. In announcing its decision, DOD cited poor performance, significant cost overruns, and substantial development delays.[76] DOD stated that the

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[76] 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 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. The modifications included 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. 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.

program's unit acquisition and unit procurement costs had risen 57 percent and 65 percent, respectively.[77]

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 NAD 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 defense acquisition program that DOD officials could recall having been canceled as a result of a decision to not certify under a Nunn-McCurdy unit cost breach.[78]

DOD stated that the cancellation of the program would "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.

Regarding termination costs for the NAD program, it was reported in early November 2002 that

> The Defense Department has granted Raytheon a three-month extension for submitting a formal proposal for termination costs tied to one of two contracts the company held under the canceled Navy Area missile defense program, according to a company spokeswoman and a DOD official....
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> At the time of the cancellation, Raytheon held two contracts — one for low-rate initial production [LRIP] and one for the engineering and manufacturing

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

[78] 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.

development [EMD] phase of the program. Under federal acquisition regulations, a contractor has one year from contract termination to submit a final termination proposal, the DOD official said. Raytheon was formally notified of the Area program's contract termination in January 2002 and the final settlement proposal would normally be received by January 2003, he said.

But Raytheon asked for the extension on the EMD contract "due to the large number of complex subcontracts associated with vendor parts on Standard Missile-2 Blk IVA," Raytheon spokeswoman Sara Hammond told Inside the Navy last week. The SM-2 Blk IVA missile carried the interceptor warhead the Navy was going to use for the Area program.

"As such, Raytheon expects to submit the LRIP proposal in January and the EMD contract in April 2003," Hammond said. The DOD official said that after the department receives Raytheon's final proposal, there would "be a period of negotiation, normally several months, until final settlement is reached."

At the time of the cancellation, sister publication Inside Missile Defense reported the Navy had estimated termination costs for Raytheon to be slightly more than $200 million. That breaks down to $106.9 million for the EMD contract and $95.3 million for the LRIP contract, according to the Navy figures. Both of those contracts were tied to the SM-2 Blk IVA development.[79]

Post-Cancellation Strategy. Following cancellation of the program, DOD officials stated that the requirement for a sea-based terminal system remained intact. This led some observers to believe that a replacement sea-based terminal defense program might be initiated. In May 2002, however, DOD announced that instead of starting a replacement program, MDA had instead decided on a two-part strategy to (1) modify the SM-3 missile to be used in the sea-based midcourse program to intercept ballistic missiles at lower altitude, and (2) modify the SM-2 Block 4 air defense missile (i.e., a missile designed to shoot down aircraft and cruise missiles) to cover some of the remaining portion of the sea-based terminal defense requirement. DOD officials said the two modified missiles could together provide much of the capability that was to have been provided by the NAD program. One aim of the modification strategy, DOD officials suggested, was to avoid the added costs to the missile defense program of starting a replacement sea-based terminal defense program.[80]

In June 2002, it was reported that engineers are "grappling with" the issue of

how to adapt the SM-3 to attack shorter range (100-300-km.) targets. Since the demise of the Navy Area Wide project that was designed for Scud-like targets, the Pentagon has looked for solutions to bridge the gap. One option is to have SM-3 take on part of the mission. To engage targets at shorter ranges, SM-3 would be modified so the missile has the flexibility not to fire its two-pulse third

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[79] Duffy, Thomas. Raytheon Gets Extension For Area Defense Termination Proposal. *Inside the Navy*, November 4, 2002.

[80] Ratnam, Gopal. U.S. Studies New Solution To Naval Missile Defense. *Defense News*, May 13-19, 2002: 4; Woods, Randy. DOD Scraps Navy Area Requirements, Will Expand Midcourse System. *Inside the Navy*, May 6, 2002.

stage, or fire just the first of two pulses. The goal is to be able to intercept the target near its apogee, outside the atmosphere where Leap[81] operates.

The Navy's Standard defense missile, the SM-2 Block 4, is viewed as another stopgap system, particularly for intercepting targets within the atmosphere. Testing will concentrate on three configurations — unmodified, software modifications to both the Aegis radar system and missile, and hardware and software changes.

Software adjustments being considered include adapting some of the [NAD] missile's autopilot and fuze modes to the SM-2 Block 4. The [NAD] interceptor, SM-2 Block 4A, had a high degree of commonality with the Block 4 air defense weapon.[82]

In October 2002, it was reported that

Upon cancellation of the Navy Area programme, the MDA commissioned industry and government teams to study successor options to the SM-2 Blk IVA. The teams found the most promising to be a modified Patriot Advanced Capability-3 missile with a booster and a programme to modify the SM-2 Blk IV - which lacks the infra-red sensor of the [NAD program's] IVA model - to give it terminal BMD capabilities. Both options were envisaged as hit-to-kill systems, unlike the SM-2 family, which has blast-fragmentation warheads. Earlier this year the MDA said it intended to pursue the SM-2 Blk IV route and conduct tests to assess its ability to defeat short-range ballistic missiles "as high in the endo-atmosphere as possible through a combination of software and hardware modifications"....

Senior navy officials... continue to speak of the need for a sea-based terminal BMD capability "sooner rather than later" and have proposed a path to get there. "The cancellation of the Navy Area missile defence programme left a huge hole in our developing basket of missile-defence capabilities," said Adm. [Michael] Mullen. "Cancelling the programme didn't eliminate the warfighting requirement. "The nation, not just the navy, needs a sea-based area missile defence capability, not to protect our ships as much as to protect our forces ashore, airports and seaports of debarkation" and critical overseas infrastructure including protection of friends and allies.

The service intends to begin funding a next-generation anti-air warfare (AAW) interceptor in FY04, which it calls the 'Extended-Range Active Missile', to fill the air-defence gap left by the termination of the [NAD program's] SM-2 Blk IVA. It will have a range approaching 200nm.... Unlike the dual-mission SM-2 Blk IVA, the new missile will be configured solely for AAW. The navy, however, wants the design to allow for the easy evolution to a separate terminal-phase BMD variant. "Our hope is that we will create a product there, that while fulfilling our air-defence needs, makes it an option for them [the MDA] to leverage if they choose to do it," said Adm [Philip] Balisle. "They will have to

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[81] This is a reference to the Light Exoatmospheric Projectile, the SM-3's kill vehicle. This kill vehicle was designed to work properly outside the atmosphere.

[82] Wall, Robert. Pentagon Eyes Additions To Anti-Missile Shield. *Aviation Week & Space Technology*, June 10, 2002: 20.

> make that decision in the context of the contribution to the [BMD] family of systems."[83]

Legislation for FY2003. The Administration's proposed FY2003 defense budget requested $169.974 million in Defense-wide research and development funding for terminal-phase ballistic missile defense programs, including $90 million for the Sea-Based Terminal program to develop alternatives to the NAD program.

In its report (H.Rept. 107-532 of June 25, 2002) on the FY2003 defense appropriation bill (H.R. 5010), the House Appropriation Committee stated, in regard to the request for the Sea-Based Terminal program, that

> The Administration has yet to present a final plan for how it would use these funds. In preliminary discussion the Department has recommended using some of these funds to conduct limited testing with the SM-2 Block IV missile and to extend the capabilities of the SM-3 missile. However, the Department terminated the Navy Area program because it did not believe that the SM-2 Block IV missile could provide a capability that was worth the cost. The Department has not demonstrated that this new approach would be an improvement. With regard to the SM-3 missile, the Department is still conducting preliminary tests to examine its performance against medium range theater ballistic missiles and may curtail development of this missile to pursue a larger and faster sea based missile. Until these basic issues are resolved it is premature to begin adding requirements to the system. (Pages 308-309)

The conference report (H.Rept. 107-732 of October 9, 2002) on the FY2003 defense appropriation bill (H.R. 5010) approved a total of $139.974 million in Defense-wide research and development funding for terminal-phase ballistic missile defense programs, a $30-million reduction from the requested amount. Within this approved total, the $90-million request for the Sea-Based Terminal program was reduced to $60 million, and the other $30 million was transferred to the Sea-Based Midcourse program. (see p. 310).

Sensors Segment

Marcia S. Smith, Specialist in Aerospace & Telecommunications Policy

The sensors program element includes funding for 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); and program operations. For FY2003, the request was $294 million for SBIRS-Low, $69 million for RAMOS, and $10 million for program operations, a total of $373 million. In the FY2003 DOD appropriations and authorization acts, Congress approved the full $294 million for SBIRS-Low and the $10 million for operations. Regarding RAMOS, the authorization act cut the request by $10 million, and the appropriations act cut it by $26 million, although it also added $7 million for RAMOS solar arrays.

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[83] Sirak, Michael. Sea-Based Ballistic Missile Defense: The 'Standard' Response. *Jane's Defence Weekly*, October 30, 2002.

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. For more on both SBIRS-High and SBIRS-Low, see CRS Report RS21148. 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 October 1, 2001 to emphasize that its primary objective is to support missile defense.

The mission of SBIRS-Low[84] is to track missiles from launch to intercept or reentry; discriminate between targets and decoys; transmit data to boost, midcourse and terminal defense systems that will cue radars and provide intercept handovers; and provide data for intercept hit/kill assessments.

Because of deep concerns about the technological readiness of SBIRS-Low, and escalating cost projections, Congress appropriated no funding for SBIRS-Low in FY2002 ($385 million had been requested). However, it appropriated $250 million for "Satellite Sensor Technology" and gave the Secretary of Defense discretion as to whether the funding should be spent on SBIRS-Low or other technologies. The decision was to continue with a restructured SBIRS-Low program.

On April 15, MDA Director General Ronald Kadish submitted the restructuring plan to Congress. The SBIRS-Low design last year envisioned a system consisting of between 20 and 30 satellites in low Earth orbit (the exact number had not been finalized). The first launch was projected for 2006. FY2003 DOD budget materials indicated that the launch would slip to 2008, but under the April 15 restructuring plan, two demonstration satellites will be launched beginning in FY2006 or FY2007. MDA is using its "spiral development" strategy for SBIRS-Low and these two research and development (R&D) satellites will have less capability than what was ultimately envisioned. In the late 1990s, DOD planned to launch three demonstration satellites, called the Flight Demonstration System (FDS), but terminated that effort in 1999 due to rising costs. Now, DOD is returning to the demonstration satellite approach. Sensors and flight structures built for the FDS satellites will be used for the R&D satellites identified in the restructuring plan. According to that plan, new technologies will be introduced as they mature, with incremental improvements in satellite lifetimes, focal plane arrays, and cryocoolers, for example.

Because the program recently was restructured, and there is no final system architecture, cost estimates are problematic. The General Accounting Office (GAO) reported[85] in February 2001 that DOD, using the system description at the time,

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[84] MDA, FY2003 RDT&E budget justification (R2-A Exhibit, Project 5041), available at: [http://www.dtic.mil/comptroller/fy2003budget/budget_justification/index.html].

[85] U.S. General Accounting Office. Space-Based Infrared System-Low at Risk of Missing (continued...)

estimated that the life-cycle cost for SBIRS-Low through FY2022 was $11.8 billion. A January 2002 Congressional Budget Office (CBO) report[86] 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. The April 15 restructuring plan did not include a new DOD cost estimate, but said that out-year funding estimates would be developed as part of the FY2004-2009 FYDP.

Two industry teams were chosen in 1999 for program definition and risk reduction (PDRR). The Spectrum Astro/Northrop Grumman team included Boeing, Lockheed Martin, and others. The TRW/Raytheon team included Aerojet, Motorola, and others. DOD had been expected to select one of the teams for the next phase (EMD) in mid-2002. However, as part of the April 15 restructuring plan, DOD decided to merge the two teams. TRW was named the prime contractor, and Spectrum Astro a major subcontractor, for the satellites. Competition at the sensor subcontractor level will continue, though. with Raytheon and Northrop Grumman pursuing independent parallel sensor development to demonstrate on-orbit performance with the series of R&D satellites.

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 crosslinks. 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.[87]

The House Appropriations Committee, reporting on the FY2002 DOD appropriations bill (H.Rept. 107-298, p. 250), cited a not-yet-released internal DOD study on ground- and sea-based alternatives to SBIRS-Low. The committee reported that the DOD study indicates ground based radars are a viable, lower cost, and lower risk, alternative. In the April 15 SBIRS-Low restructuring plan, MDA stated that it is investigating multiple sensor technologies in parallel, including land-, sea-, air-, and space-based platforms. It will evaluate the alternatives to determine the best sensor mix for meeting BMDS (Ballistic Missile Defense System) needs.

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[85] (...continued)
Initial Deployment Date. Washington, GAO, February 2001. GAO-01-06. p. 3.

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

[87] Robbins, *op cit*.

Recent Congressional Action

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FY2004 Request

On February 3, 2003, the Department of Defense announced that the Administration would ask Congress for $9.1 billion for missile defense spending for FY2004, and $9.7 billion for FY2005. As broken down, the FY2004 request includes:

- RDT&E (MDA) — $7.73 billion
  - — $241 million for BMD Technologies
  - — $152 million for Advanced Concepts
  - — $731 million for THAAD
  - — $3.6 billion for the Defense Segment
  - — $626 million for the Boost Defense Segment
  - — $148 million for International Coop Programs
  - — $408 million for BMD Sensors
  - — $301 million for BMD System Interceptors
  - — $611 million for BMD Test and Targets
  - — $344 million for BMD System Products
  - — $484 million for BMD System Core
  - — $69 million for Other Programs

- RDT&E (Army) — $495 million
  - — $175 million for Patriot PAC-3
  - — $45 million for Patriot Improvement
  - — $267 million for MEADS

- RDT&E (The Joint Staff) — $87 million for JTAMDO

- Military Construction — $3 million

- Procurement — $774 million
  - — $562 million for 108 Patriot PAC-3
  - — $213 million for Patriot Mods

FY2004 Authorization. On May 22, 2003, the House passed the FY2004 DOD Authorization bill (H.R. 1588). This bill authorized $9.085 billion for missile defense. The House approved several cuts from the Administration request in the following: overall funding for the BMD Technology Program Element, the BMDS Interceptor, the BMD Products Program Element, and the BMD Systems Core Program Element. The House approved several additions to the following: the AEGIS BMD program, the Sea-Based X-Band Radar program, and an additional 30 PAC-3 missiles (above the 108 missiles requested). The House also transferred MEADS from the Army to MDA.

On June 4, 2003, the Senate approved the FY2004 DOD Authorization bill (S. 1050). This bill includes $9.094 billion for missile defense. The Senate approved

several cuts from the Administration request in the following: the STSS program, the BMDS Interceptors program, and the MEADS program. The Senate approved several additions to the following: the Ground-Based Midcourse Defense Test Bed, the Airborne Infrared System, the X-Band Radar, the E-2 Search and Track program, the Missile/Air Defense Product Improvement program, and for Patriot modifications. The Senate also transferred MEADS funding (making a $35 million cut) and PAC-3 TMD acquisition funding from the Army.

FY2004 Appropriations. On July 8, 2003, the House passed the FY2004 DOD Appropriations bill (H.R. 2658). This bill provides $8.9 billion for missile defense. The House approved several cuts from the Administration request in the following: overall funding for the BMD Technology Program Element, the BMD Midcourse Defense Segment, the BMDS Interceptor, the BMD Products Program Element, the BMD Systems Core Program Element, and for Patriot-MEADS consolidation. The House approved several additions to the following: the Kinetic Energy Satellite program, the Sea-Based X-Band Radar program, the BMD Tests & Targets Program Element, several programs within the BMD Systems Core, and the Patriot PAC-3. Although the House defense authorization bill transferred the MEADS program from the Army to MDA, the House defense appropriations bill did not.

On July 14, 2003, the Senate began consideration of the FY2004 defense appropriations bill. Currently, the Senate bill provides $9.1 billion for missile defense programs. Cuts from the Administration's request were made in the following: the SSTS program, the BMDS Interceptors program, the BMD Products Program Element, and the BMD Systems Core Program Element. Additions were made in the following: the Kinetic Energy Satellite program and other BMD Technology programs, the Israeli Arrow program, (from $65 million requested to $155 million), funding for additional interceptors for the Ground-Based Midcourse Test Bed and funding for several other BMD Midcourse Defense Segment programs, the Airborne Infrared System, and for some programs in the BMD Systems Core Program Element. The Senate Armed Services Committee also transferred the PAC-3 and MEADS programs from the Army to the MDA and recommends their consolidation.

FY2003 Request

In early February 2002, Defense Secretary Rumsfeld announced that the Administration would ask for $7.8 billion for missile defense spending for FY2003. But when the MDA provided Congress details of its budget, the amount requested was considerably less ($6.7 billion). As they attempted last year, the Pentagon sought to remove the PAC-3 program and funding for it from the MDA to the Army. The total amount for Patriot (PAC-3 EMD, modifications, procurement and spares) is $859 million. MEADS was an additional $118 million. Therefore, the combined total request for missile defense spending for FY2003 is about $7.68 billion, and is the most accurate number.

As broken down, this year's total Defense Department request for

- the Terminal Defense segment request was $2.079 billion
  - — $66 million for Arrow
  - — $932 million for THAAD EMD
  - — $90 million for Sea-based Terminal
  - — $14 million for program operations
  - — $859 million for Patriot (PAC-3 EMD, Product Improvement and Mods, and Patriot Mods and Initial Spares)
  - — $118 million MEADS

- the Midcourse Defense segment request was $3.196 billion
- — $534 million for the Test Bed
- — $2.075 billion for the Ground-based Midcourse program
- — $427 million for the Sea-based Midcourse program
- — $160 million for program operations

- the Boost Defense segment request was $797 million
- — $90 million for Sea Boost
- — $598 million for Air Boost
- — $54 million for Space Boost
- — $35 million for the Space Based Laser
- — $20 million for program operations

- the Sensors segment request was $374 million
- — $294 million for SBIRS-Low
- — $70 million for RAMOS
- — $10 million for program operations

- the BMD System program request was $1.066 billion

- BMD Technology, Admin., and MILCON was $181 million

FY2003 Authorization. The House Armed Services Committee approved $7.784 billion for missile defense for FY2003 (H.R. 4546). This represented an additional $21 million to the Administration's request, and included a cut of $77.5 million for the ABL. The Committee also returned responsibility for MEADs and the PAC-3 program to the Missile Defense Agency (MDA). The House passed H.R. 4546 on May 10, 2002; an amendment offered by Rep. Spratt to prohibit deployment of nuclear-armed interceptors was defeated.

The Senate Armed Services Committee (SASC) approved $6.8 billion missile defense for FY2003 (S. 2514). This represented a cut of $814.3 million, mostly in system engineering and support activities, but also $135 million for the ABL. An amendment offered by Senators Levin and Warner would permit the President to allocate up to $814.3 million (the amount of the cut) either to missile defense or to counter-terrorism programs, with a stipulation that priority be given to counter-terrorism. The Committee added provisions to restore some of the testing and reporting procedures to Congress that the MDA had removed, such as annual cost and schedule information. Secretary of Defense Rumsfeld reacted by threatening that President Bush would veto the Defense Authorization Bill if the Committee's budget cuts and language remained in the final version of the bill. The Senate passed S. 2514

on June 27, 2002, with an amendment offered by Senators Stevens and Feinstein to prohibit development or deployment of nuclear-armed interceptors.

Conferees completed action on the FY2003 defense authorization bill (H.R. 4546), which agreement was passed in the House on November 12, 2002 and in the Senate on November 13, 2002. The bill includes language for DOD to provide Congress increased information about missile defense programs, testing, and costs. Congress also prohibited funds from being expended on nuclear-armed interceptor programs.

FY2003 Appropriations. The House Appropriations Committee approved $7.623 billion for missile defense for FY2003 (H.R. 5010). This represented a net cut of about $68 million from the Administration's request. Funding was denied for the sea-based terminal and RAMOS programs and cut for sea-based boost ($20 million), space-based boost ($40 million). Additional funds were provided for the Israeli Arrow program ($64 million) and PAC-3 testing and procurement ($95 million). Rep. Spratt offered an amendment on the floor, which passed, to reduce funding for the space-based interceptor program by $30 million and shift those funds to the ABL. The House passed H.R. 5010 on June 27, 2002.

The Senate Appropriations Committee largely followed the recommendations of the SASC in its bill (H.R. 5010). The Committee added $814.3 million for missile defense or counter-terrorism programs. The Senate reported H.R. 5010 on July 18, 2002.

House and Senate conferees reached agreement on October 9, 2002, and approved $7.6 billion for missile defense programs (H.R. 5010). They added $50 million for PAC-3 procurement and $70 million for the Arrow program, and reduced overall funding by $43 million. The House approved the conference report on October 10, 2002.