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# CRS Report for Congress

## Sea-Based Ballistic Missile Defense — Background and Issues for Congress

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# Sea-Based Ballistic Missile Defense — Background and Issues for Congress


## Summary

In developing a global ballistic missile defense (BMD) system, the Department of Defense (DOD) currently is modifying 18 Navy cruisers and destroyers for BMD operations, and has placed a large BMD radar — the Sea-Based X-Band Radar (SBX) — on a modified floating oil platform. The eventual role for sea-based systems in the worldwide U.S. BMD architecture has not been determined. The issue for Congress for this report is: What should be the role of sea-based systems in U.S. ballistic missile defense?

Compared to other BMD systems, sea-based BMD systems offer potential strengths and limitations. Potential strengths include the ability to conduct BMD operations from advantageous locations at sea that are inaccessible to ground-based systems, the ability to operate in forward locations in international waters without permission from foreign governments, and the ability to readily move to new maritime locations as needed. Potential limitations of sea-based BMD systems include possible conflicts with performing other ship missions, higher costs relative to ground-based systems, and vulnerability to attack when operating in forward locations.

The Aegis BMD system in its current (i.e., Block 2004) configuration is intended to track ballistic missiles of all ranges, including intercontinental ballistic missiles (ICBMs), and to intercept shorter-ranged ballistic missiles. The current configuration is not intended to intercept ICBMs. Current DOD plans call for modifying 3 Aegis cruisers and 15 Aegis destroyers with the Aegis BMD capability by the end of 2009. Future versions of the system are to include a faster interceptor designed to intercept certain ICBMs. The Aegis BMD system has achieved seven successful exo-atmospheric intercepts in nine test flights. Japan is acquiring the Aegis BMD system; some other allied navies have expressed an interest in adding BMD capabilities.

For FY2007, the Administration requested $1,031.9 million in research and development funding for the Aegis BMD program; Congress appropriated $1,127.4 million — a $95.5-million increase over the requested amount.

The SBX has experienced technical issues that have delayed its movement from Hawaii, where it currently is located, to its intended homeport of Adak, Alaska.

Potential issues for Congress regarding sea-based BMD systems include the role of sea-based BMD systems in the eventual U.S. BMD architecture, whether to initiate a program to fully replace the canceled Navy Area Defense (NAD) program for sea-based terminal-defense operations, pacing and funding for Aegis BMD radar and missile upgrades, and whether the Aegis BMD development approach offers potential lessons for the ground-based midcourse development program. This report will be updated as events warrant.

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## Introduction

In developing a global ballistic missile defense (BMD) system, the Department of Defense (DOD) currently is modifying 18 Navy cruisers and destroyers for BMD operations, and has placed a large BMD radar — the Sea-Based X-Band Radar (SBX) — on a modified floating oil platform. The eventual role for sea-based systems in the world-wide U.S. BMD architecture has not been determined. The issue for Congress for this report is: What should be the role of sea-based systems in U.S. ballistic missile defense? Decisions that Congress reaches on this issue could affect U.S. BMD capabilities and funding requirements; the size, capabilities, and operational patterns of the Navy and the other services; and the shipbuilding industrial base.

The next section of this report provides background information on DOD's sea-based BMD systems. The section that follows presents potential issues for Congress relating to these systems. The final section summarizes recent legislative activity on the topic.

## Background

### Rationale for Sea-Based BMD Systems

*Why do DOD plans for BMD include sea-based systems? What are the potential strengths and limitations of sea-based BMD systems?*

DOD's overall BMD plan includes ground-based, sea-based, airborne, and space-based systems, each of which have potential strengths and limitations. DOD believes that a combination of these systems will provide a more capable BMD architecture.

**Potential Strengths.** Potential strengths of sea-based BMD systems compared to other BMD systems include the following:

- **Advantageous locations at sea.** Sea-based systems can conduct BMD operations from locations at sea that are potentially advantageous for BMD operations but inaccessible to ground-based BMD systems.

- **Base access and freedom of action.** Sea-based systems can be operated in forward (i.e., overseas) locations in international waters without need for negotiating base access from other governments, and without restrictions from foreign governments on how they might be used.

- **Visibility.** Sea-based systems can operate over the horizon from observers ashore, making them potentially less visible and less provocative.

- **Mobility.** Navy ships with BMD systems can readily move themselves to respond to changing demands for BMD capabilities or to evade detection and targeting by enemy forces, and can do so without placing demands on U.S. airlift assets.

Regarding the first of these potential strengths, there are at least four ways that a location at sea can be advantageous for U.S. BMD operations:

- The location might lie along a ballistic missile's potential flight path, which can facilitate tracking and intercepting the attacking missile.

- The location might permit a sea-based radar to view a ballistic missile from a different angle than other U.S. BMD sensors, which might permit the U.S. BMD system to track the attacking missile more effectively.

- If a potential adversary's ballistic missile launchers are relatively close to its coast, then a U.S. Navy ship equipped with BMD interceptors that is operating relatively close to that coast could attempt to defend a large down-range territory against potential attack by ballistic missiles fired from those launchers.[1] One to four Navy ships operating in the Sea of Japan, for example, could attempt to defend most or all of Japan against theater-range ballistic missiles (TBMs)[2] fired from North Korea.

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[1] The ship's potential ability to do this is broadly analogous to how a hand casts a shadow in a candle-lit room. The closer that the hand (i.e., the Navy ship) is moved to the candle (the ballistic missile launcher), the larger becomes the hand's shadow on the far wall (the down-range area that the ship can help defend against ballistic missile attack). In BMD parlance, the area in shadow is referred to as the defended footprint.

[2] TBMs include, in ascending order of range, short-range ballistic missiles (SRBMs), which generally fly up to about 600 kilometers (about 324 nautical miles), medium-range ballistic missiles (MRBMs), which generally fly up to about 1,300 kilometers (about 702 nm), and intermediate-range ballistic missiles (IRBMs), which generally fly up to about 5,500 kilometers (about 2,970 nm). Intercontinental ballistic missiles (ICBMS) are longer-ranged missiles that can fly 10,000 kilometers (about 5,400 nm) or more. Although ICBMs can be used to attack targets within their own military theater, they are not referred to as TBMs.

- If a Navy ship were equipped with very fast interceptors (i.e., interceptors faster than those the Navy is currently deploying), and if that ship were deployed to an overseas location relatively close to enemy ballistic missile launchers, the ship might be able to attempt to intercept ballistic missiles fired from those launchers during the missiles' boost phase of flight — the initial phase, during which the ballistic missiles' rocket engines are burning. A ballistic missile in the boost phase of flight is a relatively large, hot-burning target that might be easier to intercept (in part because the missile is flying relatively slowly and is readily seen by radar), and the debris from a missile intercepted during its boost phase might be more likely to not fall on or near the intended target of the attacking missile.

**Potential Limitations.** Potential limitations of sea-based BMD systems compared to other BMD systems include the following:

- **Conflicts with other ship missions.** Using multimission Navy cruisers and destroyers for BMD operations might reduce their ability to perform other missions, such as air-defense operations against aircraft and anti-ship cruise missiles (ASCMs), land-attack operations, and anti-submarine warfare operations, for four reasons:
  — Conducting BMD operations might require a ship to operate in a location that is unsuitable for performing one or more other missions.
  — Conducting BMD operations may reduce a ship's ability to conduct air-defense operations against aircraft and cruise missiles due to limits on ship radar abilities.
  — BMD interceptors occupy ship weapon-launch tubes that might otherwise be used for air-defense, land-attack, or anti-submarine weapons.
  — Launching a BMD interceptor from a submarine might give away the submarine's location, which might make it more difficult for the submarine to perform missions that require stealthy operations (and potentially make the submarine more vulnerable to attack).

- **Costs relative to ground-based systems.** A sea-based system might be more expensive to procure than an equivalent ground-based system due to the potential need to engineer the sea-based system to resist the corrosive marine environment, resist electromagnetic interference from other powerful shipboard systems and meet shipboard safety requirements, or fit into a limited space aboard ship. A BMD system on a ship or floating platform that is dedicated to BMD operations might be more expensive to operate and support than an equivalent ground-based system due to the maintenance costs associated with operating the ship or platform in the marine environment and the need for a crew of some size to operate the ship or platform.

- **Ship quantities for forward deployments.** Maintaining a standing presence of a Navy BMD ship in a location where other Navy missions do not require such a deployment, and where there is no nearby U.S. home port, can require a total commitment of several Navy ships, due to the mathematics of maintaining Navy ship forward deployments.[3]

- **Vulnerability to attack.** A sea-based BMD system operating in a forward location might be more vulnerable to enemy attack than a ground-based system, particularly a ground-based system located in a less-forward location. Defending a sea-based system against potential attack could require the presence of additional Navy ships or other forces.

- **Rough waters.** Very rough waters might inhibit a crew's ability to operate a ship's systems, including its BMD systems, potentially creating occasional gaps in BMD coverage.

## Arms Control Considerations

*Do arms control treaties limit sea-based BMD systems?*

No arms control treaty currently in force limits sea-based BMD systems. [4]

## Aegis BMD Program[5]

*What is the Aegis BMD program?*

**Program Origin.** The Aegis Ballistic Missile Defense (Aegis BMD) program is DOD's primary sea-based BMD program. The program was created by the Missile

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[3] For more on the mathematics of Navy ship forward deployments, see CRS Report RS21338, *Navy Ship Deployments: New Approaches — Background and Issues for Congress*, by Ronald O'Rourke.

[4] The U.S.-Soviet Anti-Ballistic Missile (ABM) Treaty, which was in force from 1972 until the United States withdrew from the treaty in 2002, prohibited sea-based defenses against strategic (i.e., long-range) ballistic missiles. Article V of the treaty states in part: "Each Party undertakes not to develop, test, or deploy ABM systems or components which are sea-based, air-based, space-based, or mobile land-based. " Article II defines an ABM system as "a system to counter strategic ballistic missiles or their elements in flight trajectory...." For more on the ABM Treaty, see CRS Report RL30033, *Arms Control and Nonproliferation Activities: A Catalog of Recent Events*, by Amy F. Woolf, coordinator, et al. The United States withdrew from the ABM Treaty in 2002, according to the treaty's procedures for doing so. For a discussion, see CRS Report RS21088, *Withdrawal from the ABM Treaty: Legal Considerations*, by David M. Ackerman.

[5] Unless otherwise stated, information in this section is taken from an April 2006 Missile Defense Agency (MDA) briefing on the Aegis BMD program — "Aegis Ballistic Missile Defense, Aegis BMD Update and Plans, Briefing to the Future Naval Plans & Requirements Conference," Scott Perry, Aegis BMD [Program Office], April 26, 2006, 22 pp.

Defense Agency (MDA) in 2002. Earlier names for the program include the Sea-Based Midcourse program, the Navy Theater Wide Defense program, and the Sea-Based Upper Tier program. The program is the successor to earlier sea-based BMD development efforts dating back to the early 1990s.[6]

The Aegis BMD program office is an MDA directorate that reports directly to the director of MDA. MDA provides direction, funding, and guidance to the Aegis BMD program office and is the acquisition executive for the program. To execute the program, the Aegis BMD program office was established as a Naval Sea Systems Command (NAVSEA) field activity. NAVSEA provides administrative support (e.g., contracting, comptroller, and security) to the Aegis BMD program office.

**Intended Capabilities.** The Aegis BMD system in its current configuration (called the Block 2004 configuration; see discussion below) is designed to:

- detect and track ballistic missiles of any range, including ICBMs, and

- intercept short-, and medium-range ballistic missiles (SRBMs and MRBMs above the atmosphere (i.e., exo-atmospherically) during their midcourse phase of flight.

When tracking ICBMs, Aegis BMD ships are to act as sensor platforms providing fire-control-quality tracking data to the overall U.S. BMD architecture.

The Aegis BMD system in its current configuration is *not* designed to:

- intercept intercontinental ballistic missiles (ICBMs) or

- intercept ballistic missiles inside the atmosphere, during either their initial boost phase of flight or their final (terminal) phase of flight.

In contrast to the current configuration of the Aegis BMD system, the ground-based midcourse BMD program, with interceptors based in Alaska and California, is designed to intercept ICBMs in the midcourse phase of flight. Discussions comparing the current configuration of the Aegis BMD system and the ground-based

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[6] The Aegis BMD program is the successor to the Aegis LEAP Intercept (ALI) Flight Demonstration Project (FDP), which in turn was preceded by the Terrier Lightweight Exo-Atmospheric Projectile (LEAP) Project, an effort that began in the early 1990s. Terrier is an older Navy SAM replaced in fleet use by the Standard Missile. Although succeeded by the Standard Missile in fleet use, the Navy continued to use the Terrier missile for development and testing.

As mentioned in an earlier footnote (see section on arms control considerations), the ABM Treaty, which was in force until 2002, prohibited sea-based defenses against strategic (i.e., long-range) ballistic missiles. Navy BMD development activities that took place prior to 2002 were permissible under the ABM treaty because they were not aimed at developing technologies for countering long-range ballistic missiles.

midcourse program have not always noted this basic difference in the kinds of ballistic missiles they are intended to intercept.

**Aegis Ships.** The Aegis BMD system builds on the capabilities of the Navy's Aegis ship combat system, which was originally developed for defending ships against airborne, surface, and subsurface threats.[7] The Aegis system was first deployed by the Navy in 1983 and has been updated several times since. The part of the Aegis combat system for countering airborne threats is the called the Aegis Weapon System. Key components of the Aegis Weapon System relevant to this discussion include the following:

- the SPY-1 radar — a powerful, phased-array, multifunction radar that is designed to detect and track multiple targets in flight, and to provide midcourse guidance to interceptor missiles;
- a suite of computers running the Aegis fire control and battle-management computer program; and
- the Standard Missile (SM), the Navy's longer-ranged surface-to-air missile (SAM), so called because it was first developed many years ago as a common, or standard, replacement for a variety of older Navy SAMs.[8]

The version of the Standard Missile currently used for air-defense operations is called the SM-2 Block IV, meaning the fourth upgrade to the second major version of the Standard Missile. The Navy is developing a new version of the Standard Missile for future air-defense operations called the SM-6 Extended Range Active Missile (SM-6 ERAM).

U.S. Navy ships equipped with the Aegis system include Ticonderoga (CG-47) class cruisers and Arleigh Burke (DDG-51) class destroyers. A total of 27 CG-47s were procured for the Navy between FY1978 and FY1988; the ships entered service between 1983 and 1994. The first five, which were built to an earlier technical standard, were judged by the Navy to be too expensive to modernize and were removed from service in 2004-2005. The Navy currently plans to keep the remaining 22 ships in service to age 35.

A total of 62 DDG-51s were procured for the Navy between FY1985 and FY2005; the first entered service in 1991 and the 62$^{nd}$ is scheduled to enter service in late 2010 or early 2011. The Navy currently plans to keep them in service to age 35.

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[7] The Aegis system is named after the mythological shield carried by Zeus.

[8] For more on the Aegis system and its principal components as originally deployed, see CRS Report 84-180 F, *The Aegis Anti-Air Warfare System: Its Principal Components, Its Installation on the CG-47 and DDG-51 Class Ships, and its Effectiveness*, by Ronald O'Rourke. (October 24, 1984) This report is out of print and is available directly from the author.

Between 2010/2011, when the 62nd DDG-51 enters service, and 2021, when the first of the 22 remaining CG-47s reaches age 35, the Navy plans to maintain a force of 84 Aegis ships — 22 cruisers and 62 destroyers.

Sales of the Aegis system to allied countries began in the late 1980s. Allied countries that now operate, are building, or are planning to build Aegis-equipped ships include Japan (the first foreign buyer, with 4 destroyers in service and 2 more under construction), South Korea (3 destroyers under construction or planned), Australia (3 destroyers planned), Spain (4 frigates in service and 1 or 2 more planned), and Norway (1 frigate in service and 4 more under construction or planned).[9] The Norwegian frigates are somewhat smaller than the other Aegis ships, and consequently carry a reduced-size version of the Aegis system that includes a smaller, less-powerful version of the SPY-1 radar.

**Modification Schedule and Initial Deployments.** ***Modifications to Aegis Ships for BMD Operations.*** Modifying an Aegis ship for BMD operations involves making two principal changes:

- changing the Aegis computer program to permit the SPY-1 radar to detect and track high-flying ballistic missiles; and
- arming the ship with a BMD version of the Standard Missile called the SM-3 Block 1A.

A ship with the first modification is referred to as having a long-range search and track (LRS&T) capability. A ship with both modifications is referred to as an engage-capable ship. Modifying each ship reportedly takes about six weeks and costs about $10.5 million.[10]

The SM-3 Block IA is equipped with a kinetic (i.e., non-explosive) warhead designed to destroy a ballistic missile's warhead by colliding with it outside the atmosphere, during the enemy missile's midcourse phase of flight. It is intended to intercept SRBMs and MRBMs. An improved version, the Block IB, is to offer some capability for intercepting intermediate-range ballistic missiles (IRBMs). The Block IA and IB do not fly fast enough to offer a substantial capability for intercepting ICBMs.[11]

A faster-flying version of the SM-3, called the Block II/IIA, is now being developed (see discussion below). The Block II/IIA version is intended to give Aegis BMD ships a capability for intercepting certain ICBMs.

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[9] Source: *Jane's Fighting Ships 2006-2007*. Numbers of ships are planned eventual totals.

[10] Jack Dorsey, "Navy On Front Line Of Missile Defense," *Norfolk Virginian-Pilot*, Oct. 21, 2006.

[11] Longer-range ballistic missiles generally fly faster than shorter-range ballistic missiles. Consequently, intercepting a longer-range missile generally requires a faster-flying interceptor than is required for intercepting a shorter-range ballistic missile. The SM-3 Block IA and 1B fly fast enough to intercept TBMs, but not fast enough to provide an effective capability for intercepting ICBMs.

***Modification Schedule.*** Current DOD plans call for modifying 18 U.S. Aegis ships — 3 cruisers and 15 destroyers — with the Aegis BMD capability. **Table 1** shows the planned installation schedule as of October 2006. Under this schedule, some of the 18 ships will be modified in two steps, with the LRS&T capability being added first, and the SM-3 missile being added at a later point. Thus, in **Table 1**, some ships shown as LRS&T ships in earlier years migrate to the engage-capable category in later years. As can be seen in the table, the schedule calls for the Navy to have 10 LRS&T ships plus 6 engage-capable ships by the end of calender 2006 — with all 16 ships reportedly to be based in the Pacific Fleet, at least for the time being, according to one report[12] — and 18 engage-capable ships by the end of calendar 2009.

**Table 1. Aegis BMD Installation Schedule**
(as of October 4, 2006)

| | Cumulative total by end of calendar year | | | | | |
|---|---|---|---|---|---|---|
| | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** |
| ***LRS&T ships*** | | | | | | |
| CG-47s | 1 | 0 | 0 | 0 | 0 | 0 |
| DDG-51s | 5 | 9 | 10 | 8 | 1 | 0 |
| Subtotal | 6 | 9 | 10 | 8 | 1 | 0 |
| ***Engage-capable ships*** | | | | | | |
| CG-47s | 0 | 2[a] | 3 | 3 | 3 | 3 |
| DDG-51s | 0 | 0 | 3 | 6 | 14 | 15 |
| Subtotal | 0 | 2[a] | 6 | 9 | 17 | 18 |
| ***Total LRS&T Engage-capable ships*** | | | | | | |
| | 6 | 11 | 16 | 17 | 18 | 18 |

**Source:** U.S. Navy data provided to CRS by Navy Office of Legislative Affairs, October 11, 2006.
a. Emergency (i.e., preliminary) engage capability.

***Initial Deployments.*** LRS&T Aegis destroyers began operating in September 2004. Engage-capable Aegis cruisers began operating in September 2005.[13]

**Development, Testing, and Certification.** ***Block Development Strategy.*** Consistent with the approach used for other parts of DOD's BMD acquisition effort, the Aegis BMD system is being developed and deployed in a series of increasingly capable versions, or blocks, that are named after their approximate anticipated years of deployment:

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[12] Jack Dorsey, "Navy On Front Line Of Missile Defense," *Norfolk Virginian-Pilot*, Oct. 21, 2006.

[13] The engage-capable cruisers conducted their first operations with an emergency (i.e., preliminary) version of the engagement capability.

- The current **Block 2004** version includes the SM-3 Block IA missile and a version of the Aegis computer program called Aegis BMD 3.6, which allows the ship to perform BMD operations and other warfare operations (such as air defense) at the same time. (The previous 3.0 version of the computer program did not permit this.)[14] The Block 2004 version is intended to counter SRBMs and MRBMs.

- The **Block 2006/2008** version is to include various improvements, including the Block IB version of the SM-3 and the Aegis BMD signal processor (Aegis BSP) — a radar signal and data processor that improves the SPY-1's ballistic missile target-discrimination performance. The improvements are intended to, among other things, give the system a limited ability to intercept IRBMs.

- The **Block 2010/2012/2014** version is to include further improvements, including the Block II version of the SM-3 around 2013, and the Block IIA version in 2015. The improvements are intended to, among other things, give the system some ability to counter ICBMs. This version will also incorporate changes intended to make the system suitable for broader international ship participation.

***Flight Tests.*** From January 2002 through December 2006, the Aegis BMD system has achieved seven successful exo-atmospheric intercepts in nine flight tests. The ninth flight test, on December 7, 2006, was not successful, and was the first unsuccessful flight test since June 2003.

Another CRS report, based on historical flight test data provided by MDA to CRS in June 2005, summarizes early sea-based BMD tests as follows:

> The Navy developed its own indigenous LEAP program, which flight tested from 1992-1995. Three non-intercept flight tests achieved all primary and secondary objectives. Of the five planned intercept tests, only the second was considered a successful intercept, however. Failures were due to various hardware, software, and launch problems. Even so, the Navy determined that it achieved about 82% of its primary objectives (18 of 22) and all of its secondary objectives in these tests.[15]

Regarding the Aegis BMD program's development approach, the Aegis BMD program office states:

> We have an expression in the Navy and the Aegis BMD program, "test a little, learn a lot." Test more and more and more.... More importantly, the Navy has chosen to work with the Test and Evaluation community to get the most

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[14] For further discussion of the multimission capability of the 3.6 program see Christopher P. Cavas, "U.S. Warships To Get Missile Defense Upgrades," *Defense News*, Oct. 9, 2006: 4.

[15] CRS Report RL33240, *Kinetic Energy Kill for Ballistic Missile Defense: A Status Overview*, by Steven A. Hildreth.

> operationally relevant scenarios we can. The [engage-capable Aegis cruiser] USS Lake Erie, on our last few shots, was on a simulated patrol mission. It had a window of vulnerability — read hours — that they could launch. That was all the pre-alert they had, with the exception that the captain was notified of that launch time for safety. Only the ships' crews man the consoles; there are no technicians there from outside to help the crew. The forward deployed [BMD-equipped Aegis] ships are operating with this capability.[16]

MDA similarly states that:

> The test program for Aegis BMD has focused on the philosophy of "test a little, learn a lot" since its inception in the early 1990's with the TERRIER Lightweight Exo-Atmospheric Projectile (LEAP) Project. TERRIER LEAP included four flight tests between 1992 and 1995, and was successful in demonstrating that LEAP technology could be integrated into a sea-based tactical missile for exoatmospheric ballistic missile defense.
>
> The lessons learned from TERRIER LEAP evolved into the Aegis LEAP Intercept (ALI) Flight Demonstration Project (FDP), the goal of which was to utilize the Aegis Weapons System and Standard Missile 3 (SM-3) to hit a ballistic missile in the exoatmosphere. The ALI test objectives were achieved with two successful descent phase intercepts of a ballistic missile during Flight Mission 2 (FM-2) and FM-3 in January 2002 and June 2002 respectively firing an SM-3 from the [Aegis cruiser] USS LAKE ERIE.
>
> The transition of ALI to an Aegis BMD capability commenced with FM-4 in November of 2002 with USS LAKE ERIE, executing the first successful ascent phase intercept of a short range ballistic missile (SRBM) by the Aegis BMD element.[17]

**Table 2** below summarizes seven ALI and Aegis BMD flight tests (called FTM-2 through FTM-8, with the FTM standing for "flight test mission[18]) conducted between January 2002 and November 2005. As shown in the table, 6 of the 7 tests resulted in successful intercepts.

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[16] A. Brad Hicks, *Aegis Ballistic Missile Defense (BMD) System*. Washington, George C. Marshall Institute, 2005(?). (Washington Roundtable on Science & Public Policy, December 19, 2005) p. 13.

[17] "Aegis Ballistic Missile Defense," MDA fact sheet, January 30, 2004.

[18] In some presentations, the flight tests are referred to as FM-2, etc., without the "T."

## Table 2. ALI and Aegis BMD Flight Tests

| Test name | FTM-2 | FTM-3 | FTM-4 | FTM-5 | FTM-6 | FTM-7 | FTM-8 |
|---|---|---|---|---|---|---|---|
| Date | 1/22/02 | 6/13/02 | 11/21/02 | 6/18/03 | 12/11/03 | 2/24/05 | 11/17/05 |
| Target apogee | 300km | 300km | 160km | 160km | 160km | 160km | 227km |
| Target range | 500km | 500km | 600km | 600km | 600km | 600km | 925km |
| Aegis computer program | ALI 1.2 | ALI 1.2 | ALI 2.0 | ALI 2.0 | ALI 2.2.2 | BMD 3.0 | BMD 3.0 |
| SM-3 version | Block 0 | Block 0 | Block 0 | Block 0 | Block 0 | Block 1 | Block 1 |
| Engagement sequence | Uncued | Uncued | Uncued | Cued* | Cued* | Uncued | Uncued |
| Intercept down range | 430km | 430km | 250km | 250km | 482km | 250km | 462km |
| Intercept cross range | 240km | 240km | 200km | 150km | 248km | 150km | 150km |
| Crew disclosure | Yes | Yes | Yes | Yes | No | No | No |
| Ship's heading | Steady | Steady | Steady | Steady | Maneuv-ering | Maneuv-ering | Maneuv-ering |
| Target flight phase | Descent | Descent | Ascent | Ascent | Descent | Descent | Descent |
| Lethal aimpont | No | No | Aimpoint shift | Yes | Yes | Yes | Yes |
| **Kinetic warhead intercept** | **Yes** | **Yes** | **Yes** | **No** | **Yes** | **Yes** | **Yes** |

**Source:** "Aegis Ballistic Missile Defense, Aegis BMD Update and Plans," Briefing to the Future Naval Plans & Requirements Conference, Scott Perry, Aegis BMD [Program], April 26, 2006, slide 11.
* Aegis ship to Aegis ship and external sensor to Aegis ship.

On June 22, 2006, an eighth Aegis BMD flight test called FTM-10 resulted in a seventh successful exo-atmospheric intercept in eight attempts. This was the first test to use the Aegis 3.6 computer program.[19]

MDA states that the ninth test, called FTM-11, conducted on December 7, 2006,

> was not completed due to an incorrect system setting aboard the Aegis-class cruiser USS Lake Erie prior to the launch of two interceptor missiles from the ship. The incorrect configuration prevented the fire control system aboard the

[19] For additional information on this test, see Missile Defense Agency, "Missile Defense Test Results in Successful 'Hit To Kill' Intercept,"June 22, 2006 (06-NEWS-0018); the Johns Hopkins University Applied Physics Laboratory press release, "Ballistic Missile Defense Flight Test a Success," June 23, 2006, the Lockheed Martin press release, "Aegis Ballistic Missile Defense Weapon System Guides Missiles to Seventh Successful Target Intercept," June 22, 2006; Zachary M. Peterson, "Navy And Missile Defense Agency Intercept Separating Target," *Inside the Navy*, June 26, 2006; and "Take Two: Missile Defense Test A Success," *NavyTimes.com*, June 23, 2006.

ship from launching the first of the two interceptor missiles. Since a primary test objective was a near-simultaneous launch of two missiles against two different targets, the second interceptor missile was intentionally not launched.

The planned test was to involve the launch of a Standard Missile 3 against a ballistic missile target and a Standard Missile 2 against a surrogate aircraft target. The ballistic missile target was launched from the Pacific Missile Range Facility, Kauai, Hawaii and the aircraft target was launched from a Navy aircraft. The USS Lake Erie (CG 70), USS Hopper (DDG 70) and the Royal Netherlands Navy frigate TROMP were all successful in detecting and tracking their respective targets. Both targets fell into the ocean as planned.

After a thorough review, the Missile Defense Agency and the U.S. Navy will determine a new test date.[20]

A news article about the test stated:

"You can say it's seven of nine, rather than eight of nine," Missile Defense Agency spokesman Chris Taylor said of the second failure in tests of the system by the agency and the Navy....

The drill was planned to demonstrate the Navy's ability to knock down two incoming missiles at once from the same ship.

"In a real world situation it is possible, maybe even probable, that in addition to engaging a ballistic missile threat that was launched, you may be engaging a surface action," said Joe Rappisi before the test. He is director for the Aegis Ballistic Missile Defense system at Lockheed Martin, the primary contractor for the program.

The test would have marked the first time a ship has shot down one target in space and another target in the air at the same time.

The test presented a greater challenge to the ship's crew and the ballistic missile defense system than previous tests, Rappisi said. The multiple target scenario is also closer to what sailors might actually face in battle.

The U.S. Pacific Fleet has been gradually installing missile surveillance and tracking technology on many of its destroyers and cruisers amid concerns about North Korea's long-range missile program.

It is also installing interceptor missiles on many of its ships, even as the technology to track and shoot down incoming missiles is being developed and perfected.

The Royal Netherlands Navy joined the tracking and monitoring off Kauai to see how its equipment works. The Dutch presence marked the first time a European ally has sent one of its vessels to participate in a U.S. ballistic missile defense test.[21]

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[20] Untitled Missile Defense Agency "For Your Information" statement dated December 7, 2006 (06-FYI-0090).

[21] David Briscoe, "Test Interceptor Missile Fails To Launch," *NavyTimes.com*, December
(continued...)

Another news article stated:

> An e-mail issued by the Missile Defense Advocacy Alliance, a lobbying organization based in Alexandria, VA, said the test has been delayed until spring due to "operational factors."...
>
> Philip Coyle, a former head of the Pentagon's testing directorate, gives the Navy credit for "discipline and successes so far" in its sea-based ballistic missile defense testing program. Coyle is now a senior adviser at the Center for Defense Information.
>
> "The U.S. Navy has an enviable track record of successful flight intercept tests, and is making the most of its current, limited Aegis missile defense capabilities in these tests," Coyle told [*Inside the Navy*] Dec. 7.
>
> "Difficulties such as those that delayed the latest flight intercept attempt illustrate the complexity of the system, and how everything must be carefully orchestrated to achieve success," Coyle added. "Nevertheless, this particular setback won't take the Navy long to correct."[22]

***Certification.*** On September 11, 2006, the Navy and MDA certified the version of the Aegis BMD system using the Aegis BMD 3.6 computer program for tactical deployment.[23]

***SM-3 Block II/IIA Missile.*** Under a memorandum of agreement signed in 1999, the United States and Japan have cooperated in researching technologies for the Block II/IIA version of the SM-3. The cooperative research has focused on risk reduction for four parts of the missile: the sensor, an advanced kinetic warhead, the second-stage propulsion, and a lightweight nose cone.

In contrast to the Block IA/1B version of the SM-3, which has a 21-inch-diameter booster stage but is 13.5 inches in diameter along the remainder of its length, the Block II/IIA version would have a 21-inch diameter along its entire length. The increase in diameter to a uniform 21 inches is to give the missile a burnout velocity (a maximum velocity, reached at the time the propulsion stack burns out) that is 45% to 60% greater than that of the Block IA/IB version.[24] The Block IIA

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[21] (...continued)
8, 2006.

[22] Zachary M. Peterson, "Sea-Based Missile Defense Test Fails Due To 'Incorrect Configuration,'" *Inside the Navy*, December 11, 2006.

[23] See Missile Defense Agency, "Aegis Ballistic Missile Defense Weapon System Gains Fleet Certification," September 1, 2006 (06-FYI-0082); and Lockheed Martin, "Aegis Ballistic Missile Defense Weapon System Gains Fleet Certification," September 11, 2006.

[24] The 13.5-inch version has a reported burnout velocity of 3.0 to 3.5 kilometers per second (kps). See, for example, J. D. Marshall, *The Future Of Aegis Ballistic Missile Defense*, point paper dated October 15, 2004, available at [http://www.marshall.org/pdf/materials/259.pdf]; "STANDARD Missile-3 Destroyers a Ballistic Missile Target in Test of Sea-based Missile Defense System," Raytheon news release circa January 26, 2002,
(continued...)

version would also include an improved kinetic warhead.[25] MDA states that the Block II/IIA version could "engage many [ballistic missile] targets that would outpace, fly over, or be beyond the engagement range" of earlier versions of the SM-3, and that

> the net result, when coupled with enhanced discrimination capability, is more types and ranges of engageable [ballistic missile] targets; with greater probability of kill, and a large increase in defended "footprint" or geography predicted.... The SM-3 Blk II/IIA missile with it[s] full 21-inch propulsion stack provides the necessary fly out acceleration to engage IRBM and certain ICBM threats.[26]

MDA stated in 2005 that "The Block II/IIA development plan is undergoing refinement. MDA plans to proceed with the development of the SM-3 Blk II/IIA missile variant if an agreeable cost share with Japan can be reached.... [The currently envisaged development plan] may have to be tempered by budget realities for the agency."[27]

In March 2005, the estimated total development cost for the Block II/Block IIA missile was reportedly $1.4 billion.[28] In September 2005, it was reported that this estimate had more than doubled, to about $3 billion.[29] MDA estimates that the Block II version of the missile could enter service around 2013, and the Block IIA version in 2015.

***Cancellation of NAD Program.*** As a complement to the Aegis BMD system's capability for intercepting TBMs outside the atmosphere, during their midcourse phase of flight, there was at one time an additional program to develop a sea-based capability for intercepting TBMs in the final, or descent, phase of flight, after the missiles reentered the atmosphere, so as provide local-area defense of U.S. ships as well as friendly forces, ports, airfields, and other critical assets ashore. The

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[24] (...continued)
available on the Internet at [http://www.prnewswire.com/cgi-bin/micro_stories.pl?ACCT=683194&TICK=RTN4&STORY=/www/story/01-26-2002/0001655926&EDATE=Jan+26,+2002]; and Hans Mark, "A White Paper on the Defense Against Ballistic Missiles," *The Bridge*, summer 2001, pp. 17-26, available on the Internet at [http://www.nae.edu/nae/bridgecom.nsf/weblinks/NAEW-63BM86/$FILE/BrSum01.pdf?OpenElement]. See also the section on "Sea-Based Midcourse" in CRS Report RL31111, *Missile Defense: The Current Debate*, coordinated by Steven A. Hildreth.

[25] Source for information on SM-3: Missile Defense Agency, "Aegis Ballistic Missile Defense SM-3 Block IIA (21-Inch) Missile Plan (U), August 2005," a 9-page point paper provided by MDA to CRS, August 24, 2005.

[26] "Aegis Ballistic Missile Defense SM-3 Block IIA (21-Inch) Missile Plan (U), August 2005," op. cit, pp. 3-4.

[27] Ibid., p. 3.

[28] Aarti Shah, "U.S. Navy Working With Japanese On Billion-Dollar Missile Upgrade," *Inside the Navy*, Mar. 14, 2005.

[29] "Cost Of Joint Japan-U.S. Interceptor System Triples," Yomiuri Shimbun (Japan), September 25, 2005.

program was called the Navy Area Defense (NAD) program or Navy Area TBMD (Theater BMD) program, and before that, the Sea-Based Terminal or Navy Lower Tier program.

The NAD system was to have been deployed on Navy Aegis ships. The program involved modifying the SM-2 Block IV air-defense missile. The missile, as modified, was called the Block IVA version. The system was designed to intercept descending missiles endo-atmospherically (i.e., within the atmosphere) and destroy them with the Block IVA missile's blast-fragmentation warhead.

In December 2001, DOD announced that it had canceled the NAD program. In announcing its decision, DOD cited poor performance, significant cost overruns, and substantial development delays. DOD stated that the program's unit acquisition and unit procurement costs had risen 57% and 65%, respectively.[30]

Following cancellation of the NAD program, DOD officials stated that the requirement for a sea-based terminal BMD system remained intact. This led some observers to believe that a replacement for the NAD 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 intercept ballistic missiles at somewhat lower altitudes, and (2) modify the Navy's inventory of about 100 SM-2 Block IV air defense missiles to cover some of the remaining portion of the sea-based terminal defense requirement. The modified Block IV missile uses a blast-fragmentation warhead similar in concept to that used in the Israeli Arrow BMD interceptor. DOD officials said the two modified missiles could together provide much (but not all) of the capability that was to have been

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[30] Acquisition cost is the sum of procurement cost plus research, development, test and evaluation (RDT&E) cost. In announcing the cancellation, DOD cited the Nunn-McCurdy provision, a defense acquisition law enacted in 1981. Under the provision as it existed in 2001, a major defense acquisition program experienced what is called a Nunn-McCurdy unit cost breach when its projected unit cost increased by at least 15%. If the increase reached 25%, 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. ("Navy Area Missile Defense Program Cancelled," Department of Defense News Release No. 637-01, December 14, 2001; James Dao, "Navy Missile Defense Plan Is Canceled By the Pentagon," *New York Times*, December 16, 2001; Gopal Ratnam, "Raytheon Chief Asks DOD To Revive Navy Program," *Defense News*, January 14-20, 2002: 10.)

provided by the Block IVA missile. One aim of the modification strategy, DOD officials suggested, was to avoid the added costs to the BMD program of starting a replacement sea-based terminal defense program.[31]

MDA states that:

> There is currently no sea-based terminal ballistic missile defense capability. The Navy Area [Defense] Theater Ballistic Missile Defense (TBMD) Program, had been under development, but was terminated in December 2001. In ballistic missile defense, the modified Aegis Weapon System, with a modified SM-2 Block IV missile provides a near term, limited emergency capability against a very specific segment of the ballistic missile threat. The Navy and MDA consider it vital to develop a more robust capability for terminal ballistic missile defense of the joint sea base and friendly force embarkation points ashore.[32]

A modified Block SM-2 IV missile successfully intercepted a target ballistic missile inside the atmosphere, during the terminal phase of flight, in a test conducted on May 24, 2006.[33]

***DOD Inspector General Report.*** A March 2006 DOD Inspector General Report on system engineering for DOD's overall missile effort stated:

> Although the Aegis BMD element manager (the element manager) followed many of the systems engineering processes described in the Defense Acquisition Guidebook, she had not completed several systems engineering documents and processes that are important to transition the Aegis BMD Element (the element) capabilities for Block [20]04 to the Navy.[34]

***Government Accountability Office (GAO) Report.*** A March 2006 Government Accountability Office (GAO) report assessing the status of selected major weapon programs stated of the Aegis BMD program:

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[31] Zachary M. Peterson, "Navy To Field Terminal Pahse, Sea-Based Missile Defense Capability," *Inside the Navy*, June 5, 2006; Gopal Ratnam, "U.S. Studies New Solution To Naval Missile Defense," *Defense News*, May 13-19, 2002: 4; Randy Woods, "DOD Scraps Navy Area Requirements, Will Expand Midcourse System," *Inside the Navy*, May 6, 2002.

[32] Missile Defense Agency, "First at-Sea Demonstration of Sea-Based Terminal Capability Successfully Completed," May 24, 2006 (06-FYI-0079).

[33] See Missile Defense Agency, "First at-Sea Demonstration of Sea-Based Terminal Capability Successfully Completed," May 24, 2006 (06-FYI-0079); Gregg K. Kakesako, "Missile Defense System Makes History," *Honolulu Star-Bulletin*, May 25, 2006; Audrey McAvoy, "Ship Shoots Down Test Missile For The First Time," *NavyTimes.com*, May 25, 2006; "Navy, MDA Announce First Terminal Sea-Based Intercept," *Aerospace Daily & Defense Report*, May 26, 2006; Zachary M. Peterson, "Navy Conducts First Sea-Based Terminal Phase Missile Defense Test," *Inside the Navy*, May 29, 2006; and Jeremy Singer, "Sea-Based Terminal May Boost U.S. Missile Defense Capability," *Space News (www.space.com)*, June 12, 2006.

[34] Department of Defense, Office of Inspector General, *Acquisition: System Engineering Planning for the Ballistic Missile Defense System (D-2006-060)*, March 2, 2006 (redacted version), p. 9. The report elaborates on the situation in detail on pages 9-16.

According to program officials, the Block 2004 increment of SM-3 missiles being fielded during 2004-2005 has mature technologies and a stable design. However, the program deferred full functionality of the missile's Solid Divert and Altitude Control System, which maneuvers the missile's kinetic warhead to its target, to a future upgrade. Program officials noted that even with reduced capability, the first increment of missiles provide a credible defense against a large population of the threat. All drawings for the first increment of missiles have been released to manufacturing. The program is not collecting statistical data on its production process but is using other means to gauge production readiness....

*Technology Maturity*

Program officials estimate that all three technologies critical to the SM-3 missile are mature. These technologies — the missile's third stage rocket motor and the kinetic warhead's infrared seeker and Solid Divert and Attitude Control System (SDACS) — have been tested in flight. While the first two technologies were fully demonstrated in flight tests, the SDACS, which steers the kinetic warhead, was only partially demonstrated. The SDACS operation in "pulse mode," which increases the missile's divert capability, failed during a June 2003 flight test. According to program officials, the test failure was likely caused by a defective subcomponent within the SDACS, a problem that should be corrected through specific design modifications. To implement these corrective actions, the program is deferring full functionality of the missile's SDACS technology to the next upgrade of the hit-to-kill missile. Program officials note that only partial functionality of the SDACS is required for Block 2004, which has been successfully demonstrated in flight tests.

*Design Stability*

Program officials reported that the design for the first 11 SM-3 missiles being produced during Block 2004 is stable with 100 percent of its drawings released to manufacturing. The program plans to implement design changes in subsequent blocks (delivered during 2006-2007) to resolve the SDACS failure witnessed in the June 2003 flight test.

*Production Maturity*

We did not assess the production maturity of the SM-3 missiles being procured for Block 2004. Program officials stated that given the low quantity of missiles being produced, statistical process control data on the production process would have no significance. The Aegis BMD program is using other means to assess progress in production and manufacturing, such as integrated product team reviews, risk reviews, Engineering Manufacturing Readiness Levels, and missile metrics.

*Other Program Issues*

The Aegis BMD element builds upon the existing capabilities of Aegis-equipped Navy cruisers and destroyers. Planned hardware and software upgrades to these ships will enable them to carry out the ballistic missile defense mission. In particular, the program is working to upgrade Aegis destroyers for surveillance and tracking of intercontinental ballistic missiles. Because this function is new to the element, the program has faced a tight schedule to develop

> and test this added functionality during the Block 2004 time frame. Although the program aims to upgrade ten destroyers as part of its Block 2004 increment, this new functionality has been exercised in a limited number of flight tests and has never been validated in an end-to-end flight test with the GMD system, for which it is providing long range surveillance and tracking.[35]

### Program Funding.

*How much funding has the Aegis BMD program received in previous years? How much does the Administration plan to request for the program in future years?*

For FY2007, the Administration requested $1,031.9 million in research and development funding for the Aegis BMD program; Congress appropriated about $1,127.4 million — a $95.5-million increase over the requested amount.

**Table 3** shows actual or programmed funding for the Aegis BMD program from FY1995 through FY2011.

**Table 3. Aegis BMD Program Funding, FY1995-FY2011**
(in millions of dollars, rounded to the nearest tenth; figures for FY2008-FY2011 as shown in FY2007-FY2011 FYDP)

| | |
|---|---|
| FY95 | 75.0 |
| FY96 | 200.4 |
| FY97 | 304.2 |
| FY98 | 410.0 |
| FY99 | 338.4 |
| FY00 | 380.0 |
| FY01 | 462.7 |
| FY02 | 476.0 |
| FY03 | 464.0 |
| FY04 | 726.2 |
| FY05 | 1,159.8 |
| FY06 | 939.1 |
| FY07 | 1,127.4 |
| *FY08** | *951.6** |
| *FY09** | *980.5** |
| *FY10** | *973.2** |
| *FY11** | *799.2** |

**Source:** DOD Information Paper provided to CRS by Navy Office of Legislative Affairs, November 14, 2006.

[35] Government Accountability Office, *Defense Acquisitions: Assessments of Selected Major Weapon Programs,* GAO-06-391, March 2006, pp. 25-26.

* Figures for FY2008-FY2011 are those shown in FY2007-FY2011 Future Years Defense Plan (FYDP).

**Potential Allied Programs.** ***Japan.*** Japan's interest in BMD, and in cooperating with the United States on the issue, was heightened in August 1998, when North Korea test-fired a Taepo Dong-1ballistic missile that flew over Japan before falling into the Pacific.[36] In addition to cooperating with the United States on development of technologies for the SM-3 Block II/IIA missile, current plans call for Japan to modify four of its Aegis destroyers with the Block 2004 version of the Aegis BMD system between FY2007 and early FY2011, at a pace of about one ship per year. Under this plan, Japan would have an opportunity in FY2011 and subsequent years to upgrade the ships' BMD capability to a later Block standard, and to install the Aegis BMD capability on its two remaining Aegis destroyers. A Japanese Aegis ship participated as a tracking platform in FTM-10, the June 22, 2006, flight test of the Aegis BMD system. This was the first time that an allied military unit participated in a U.S. Aegis BMD intercept test.[37]

***Other Countries.*** Other countries that DOD views as potential naval BMD operators include South Korea, Australia, the UK, Germany, the Netherlands, Spain, and Italy. As mentioned earlier, South Korea, Australia, and Spain either operate, are building, or are planning to build Aegis ships. The other countries operate destroyers and frigates with different combat systems that may have potential for contributing to BMD operations.

The United States has conducted high-level discussions with Korea about equipping Korea's Aegis destroyers with a BMD capability. The United States signed a memorandum of understanding (MOU) on BMD with the UK in 2003, and another with Australia in 2004. A U.S.-UK study on a potential BMD capability for the UK's planned Type 45 destroyers was initiated in 2006. The United States has provided pricing data to the Netherlands, and is conducting initial discussions with the Dutch to assess the potential for installing a BMD capability on certain Dutch ships. An October 2006 press report states that the Dutch government has decided to upgrade one of its frigates with BMD capability, and that the ship will participate as a tracking platform in a U.S. test of the Aegis BMD system in late 2006. Germany has a liaison officer working with the Aegis BMD office to understand BMD-related issues.[38]

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[36] For a discussion, see CRS Report RL31337, *Japan-U.S. Cooperation on Ballistic Missile Defense: Issues and Prospects*, by Richard P. Cronin. This archived report was last updated on March 19, 2002. See also CRS Report RL33436, *Japan-U.S. Relations: Issues for Congress*, by Emma Chanlett-Avery, Mark E. Manyin, and William H. Cooper.

[37] Missile Defense Agency, "Missile Defense Test Results in Successful 'Hit To Kill' Intercept," June 22, 2006 (06-NEWS-0018).

[38] Primary source for this paragraph: Missile Defense Agency, Frequently Asked Questions, available online at [http://www.mda.mil/mdalink/html/faq.html]. The October 2006 press report about the Dutch frigate is: Jack Dorsey, "Navy On Front Line Of Missile Defense," *Norfolk Virginian-Pilot*, Oct. 21, 2006.

## Sea-Based X-Band Radar (SBX)

*What is the Sea-Based X-Band Radar (SBX)?*

**General.** The Sea-Based X-Band Radar (SBX) is DOD's other principal sea-based BMD element. It is a midcourse fire-control radar designed to support long-range BMD systems. Its principal functions are to detect and establish precise tracking information on ballistic missiles, discriminate missile warheads from decoys and debris, provide data for updating ground-based interceptors in flight, and assess the results of intercept attempts. SBX is intended to support more operationally realistic testing of the ground-based midcourse system and enhance overall BMD system operational capability.

SBX is a large, powerful, phased-array radar operating in the X band, a part of the radio frequency spectrum that is suitable for tracking missile warheads with high accuracy. The radar is mounted on a modified, self-propelled, semi-submersible oil platform that can transit at a speed of 8 knots and is designed to be stable in high winds and rough seas.[39]

SBX was completed in 2005 for the Missile Defense Test Bed. The semi-submersible platform was designed by a Norwegian firm and built in Russia. It was purchased for the SBX program, and modified and integrated with the SBX radar in Texas.[40] SBX underwent sea trials and high-power radiation testing in the Gulf of Mexico in 2005. It was then moved by a heavy transport vessel to Hawaii, arriving there in January 2006. From there, it is to transit to Adak, Alaska, in the Aleutian Islands, where it is to be homeported and put into operation.

**Technical Issues.** Technical issues relating to the SBX platform have delayed the SBX's planned departure for Alaska. A November 2006 press report stated that:

> the vessel carrying the radar has sprung leaks and blown out electrical circuits.
>
> Such mundane problems have kept this vital part of the nation's defense against missile attacks stuck in the wrong harbor. If all had gone according to

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[39] The platform is 238 feet wide and 398 feet long. It measures 282 from its submerged keel to the top of the radar dome. The SBX has a total displacement of almost 50,000 tons — about one-half the full load displacement of a Navy aircraft carrier. SBX is operated by a crew of about 75.

[40] The platform was designed by Moss Maritime, a Norwegian firm, and built for Moss in 2001-2002 by Vyborg shipbuilding, which is located in Vyborg, Russia (a city north of St. Petersburg, on the Gulf of Finland, that is near the Finnish border). Vyborg Shipbuilding's products include semi-submersible oil platforms. Moss sold the platform to Boeing. Boeing and a subcontractor, Vertex RSI (a part of General Dynamics), modified the platform at the Keppel AMFELS shipyard in Brownsville, TX. The platform was then moved to Kiewit Offshore Services of Corpus Christi, TX, where the radar was added by a combined team of Boeing, Raytheon, Vertex RSI, and Kiewit. ("MDA Completes Integration of X-Band Radar On Sea-Going Platform," *Defense Daily*, Apr. 5, 2005; and "Sea-Based X-band Radar," *GlobalSecurity.org*.)

plan, the $950 million radar rig, known as SBX, would be operating now off the Aleutian Islands in Alaska and ready to defend against threats from North Korea. Instead, after a three-year odyssey from Norway to Texas and around South America, the 28-story-high converted oil platform is in Hawaii, 2,000 miles and months away from its final destination....

By late 2005, it looked as if SBX might come close to meeting its [end-of-2005] target for arriving in Alaska. After trials in the Gulf of Mexico, it was hauled 15,000 miles around South America — the rig is too big for the Panama Canal — and it arrived in Hawaii in January of this year [2006]. The trip to Alaska seemed around the corner, but in March, alarms went off in SBX's engine room. A leaky valve caused water to flood into SBX's pontoon. The rig had to return to Pearl Harbor for repairs to the flaw, which an independent panel later called a 'major casualty.'

Then in June [2006], an electrical fault tripped circuit breakers, forcing SBX back into port for two more weeks of repairs. Such problems are typical during the initial 'shakedown' phase of a new class of ship, says Tom Alexiou, Boeing's SBX program manager. Most important, adds Paul Smith, a Boeing radar manager, there haven't been major issues in the 'far more complex' task of integrating the radar with other ship systems....

Col. John Fellows, the Pentagon's manager for SBX, says staying near Hawaii makes it easier to iron out kinks and join the tests, although officials are eager for the radar's permanent deployment. 'We're pressured on both sides,' he says.

In any case, further issues must be sorted out before the trip to Alaska. The independent panel hired by the Pentagon concluded in June that while SBX 'is an inherently rugged and suitable platform,' the vessel needs 47 modifications before it goes into service. Among them: a better plan for operating in harsh winters and steps to ensure the rig is protected against being rammed by boats. Senior program officials call the modifications minor and say they have agreed to almost all of them.

The panel also noted that maintaining morale poses a challenge. SBX's crew is composed mostly of defense-industry employees and merchant mariners hired by Boeing subcontractors. Only a handful of shipmates are servicemen. Civilian mariners rotate only every 56 days, much longer than work cycles for comparable oil-industry jobs. Leisure consists of a gym, a basketball hoop on the deck and movies under the stars, though plasma TVs and more DVDs are on the way.

Funding for SBX's mooring in the Aleutians, previously cut in another headache for project managers, has been restored, but construction won't be finished until next August, says Col. Fellows. The latest projection for the trip to Alaska is sometime next year [2007].[41]

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[41] Jonathan Karp, "A Radar Unit's Journey Reflects Hopes, Snafus In Missile Defense," *Wall Street Journal*, Nov. 28, 2006: 1. See also Kirsten Scharnberg, "Radar Staying Longer Than Planned," *Chicago Tribune*, Sept. 3, 2006. The article was also published in the *Honolulu Advertiser*.

The independent assessment referred to in the above-quoted article was completed in June 2006. The report concluded that SBX:

> is an inherently rugged and suitable platform for the intended mission[,] however, the [assessment] panel found that at the current time:
>
> 1. Crew Readiness and Materiel Readiness issues indicate that SBX-1 needs additional underway shakedown time and inport time to address crew and material issues in the Hawaiian area, and
>
> 2. Operational Considerations identifies issues for which operational commanders and developing commands need a full understanding of associated implications, and which require resolution prior to departure from Hawaii and operations at the Adak winter MODLOC [modified location] in the Bering Sea.[42]

According to a November 2006 press report, the top U.S. military officer in Alaska believes the SBX will arrive in Adak in January 2007.[43]

**Potential Other Uses.** A March 2006 press report states:

> Boeing missile defense officials refuse to answer questions about whether they are developing techniques to produce high-energy weapon effects from the SBX sea-based radar. However, since large distributed-array devices [like the SBX] can be focused to deliver large spikes of energy, powerful enough to disable electronic equipment, the potential is known to exist and is being fielded on a range of U.S., British and Australian aircraft.[44]

# Potential Issues for Congress

## Sea-Based Systems in Eventual BMD Architecture

*What should be the role of sea-based systems in the eventual national BMD architecture?*

A key potential issue for Congress concerns the role of sea-based systems in the eventual U.S. BMD architecture. The eventual architecture is to be defined by U.S. Strategic Command (USSTRATCOM) — the U.S. military command responsible for

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[42] *SBX-1 Operational Suitability and Viability Assessment, An Independent Assessment*. Arlington (VA), SYColeman, 2006, pp. i-ii. (Final Report, June 2, 2006, Submitted to: Director, Mission Readiness Task Force, Missile Defense Agency, Submitted by: Independent Assessment Team, Prepared by: SYColeman, A Wholly Owned Subsidiary of L-3 Communications). The report is available online at [http://www.pogo.org/m/dp/dp-SBXOVA-06022006.pdf]

[43] Associated Press, "Floating Missile Detector May Reach Alaska in January," *ArmyTimes.com*, Nov. 16, 2006.

[44] "Radar Weapons," *Aerospace Daily & Defense Report*, Mar. 20, 2006.

"synchronized DoD effects to combat adversary weapons of mass destruction worldwide," including integrated missile defense[45] — in consultation with MDA.

Under the evolutionary acquisition approach adopted for the overall U.S. BMD program, it likely will be a number of years before USSTRATCOM and MDA define the eventual BMD architecture.[46] Until then, the absence of an objective architecture might complicate the task of assessing whether the types and numbers of sea-based BMD systems being acquired are correct. If the role of sea-based systems in the eventual U.S. BMD architecture turns out to be greater than what DOD has assumed deciding to equip 18 Aegis ships with BMD capabilities, then additional funding might be needed to expand the scope of the program to include more than 18 ships.

The issue could also affect the required total number of Navy cruisers and destroyers. As discussed in another CRS report,[47] the Navy faces a long-term challenge in being able to maintain its planned force of 88 cruisers and destroyers. If the role of sea-based systems in the eventual U.S. BMD architecture turns out to be greater than what the Navy has assumed in calculating its 88-ship cruiser-destroyer requirement, then the requirement might need to be increased to something more than 88 ships, which could exacerbate the potential long-term shortfall in cruisers and destroyers. Potential oversight questions for Congress include the following:

- In the absence of a defined U.S. BMD architecture, what was the basis for deciding that 18 Aegis ships should be equipped for BMD operations? What is the likelihood that 18 BMD-equipped Aegis ships will turn out to be too many or not enough?

- What kinds of BMD operations were factored into the Navy requirement for maintaining a force of at least 88 cruisers and destroyers? If BMD operations by Navy ships turn out to be more significant than what the Navy assumed in calculating the 88-ship figure, will the figure need to be increased, and if so, by how much?

## Replacement for Navy Area Defense (NAD) Program

*Should a new program be initiated to fully replace the canceled Navy Area Defense (NAD) program?*

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[45] For more on USSTRATCOM, see CRS Report RL33408, *Nuclear Command and Control: Current Programs and Issues*, by Robert D. Critchlow. See also USSTRATCOM's website at [http://www.stratcom.mil/], from which the quoted passage is taken.

[46] For more on evolutionary acquisition in general, see CRS Report RS21195, *Evolutionary Acquisition and Spiral Development in DOD Programs: Policy Issues for Congress*, by Gary J. Pagliano and Ronald O'Rourke. As ballistic missile threats change over time, it is possible that the U.S. BMD architecture may never be fully defined.

[47] CRS Report RL32109, *Navy DDG-1000 (DD(X)) and CG(X) Ship Acquisition Programs: Oversight Issues and Options for Congress*, by Ronald O'Rourke.

As discussed in the background section, DOD in 2002 decided against initiating a new program to fully replace the canceled NAD program, opting instead for a two-part strategy to (1) modify the SM-3 missile to intercept ballistic missiles at lower altitude, and (2) modify the SM-2 Block IV air defense missile to cover some of the remaining portion of the sea-based terminal defense requirement. As discussed earlier, this effort is aimed at replacing most (but not all) of the capability that was to have been provided by the NAD system.

The potential issue for Congress is whether to continue with this two-part strategy or pursue a new strategy, such as initiating a new program to fully replace the capability that was to have been provided by the NAD system. Reported options for a new NAD-replacement program include a system using a modified version of the Army's Patriot Advanced Capability-3 (PAC-3) interceptor or a system using a modified version of the SM-6 Extended Range Active Missile (SM-6 ERAM) air defense missile being developed by the Navy.[48]

In October 2002, it was reported that 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.[49]

The above-quoted Admiral Mullen became the Chief of Naval Operations (CNO) on July 22, 2005.

In July 2004 it was reported that:

> The Navy's senior leadership is rebuilding the case for a sea-based terminal missile defense requirement that would protect U.S. forces flowing through foreign ports and Navy ships from short-range missiles, according to Vice Adm. John Nathman, the Navy's top requirements advocate.
>
> The new requirement, Nathman said, would fill the gap left when the Pentagon terminated the Navy Area missile defense program in December 2001. ... However, he emphasized the Navy is not looking to reinstate the old [NAD] system. "That's exactly what we are not talking about," he said March 24....

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[48] See, for example, Jason Ma and Christopher J. Castelli, "Adaptation Of PAC-3 For Sea-Based Terminal Missile Defense Examined," *Inside the Navy*, July 19, 2004; Malina Brown, "Navy Rebuilding Case For Terminal Missile Defense Requirement," *Inside the Navy*, Apr. 19, 2004.

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

> The need to bring back a terminal missile defense program was made clear after reviewing the "analytic case" for the requirement, he said. Though Nathman could only talk in general terms about the analysis, due to its classified nature, he said its primary focus was "pacing the threat" issues. Such issues involve threats that are not a concern today, but could be in the future, he said. Part of the purpose of the study was to look at the potential time line for those threats and the regions where they could emerge.[50]

Supporters of staying with the current two-part strategy could argue that it replaces enough of the planned NAD capability to provide Navy ships with a sufficient degree of terminal defense capability. They could also argue that initiating a full NAD-replacement program could increase development risks, delay the fielding of a useful terminal defense capability, or require reducing funding for other BMD programs or other DOD priorities, increasing operational risks in other areas.

Supporters of initiating a new replacement program could note that the Navy and MDA state that they "consider it vital to develop a more robust capability for terminal ballistic missile defense of the joint sea base and friendly force embarkation points ashore." Supporters of a new replacement program could argue that a full capability for intercepting missiles in the terminal phase could prove useful, if not critical, for intercepting missiles — such as SRBMs or ballistic missiles fired along depressed trajectories — that do not fly high enough to exit the atmosphere and consequently cannot be intercepted by the SM-3. They could also argue a full NAD replacement program would provide a more robust ability to counter potential Chinese TBMs equipped with maneuverable reentry vehicles (MaRVs) capable of hitting moving ships at sea.[51]

## Aegis Radar Upgrades

*Are current plans for upgrading the BMD capabilities of the SPY-1 radars on Navy Aegis ships appropriate for meeting requirements for sea-based BMD?*

As discussed in the background section, current plans for upgrading the radar capabilities of the Navy's Aegis cruisers and destroyers include the Aegis BSP, which forms part of the planned Block 06 version of the Navy's Aegis BMD capability. One potential issue for Congress is whether current plans for developing and installing the Aegis BSP are adequate and sufficiently funded for meeting requirements for sea-based BMD. A second potential issue is whether there are other

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[50] Malina Brown, "Navy Rebuilding Case For Terminal Missile Defense Requirement," *Inside the Navy*, Apr. 19, 2004.

[51] As discussed in another CRS report, China may now be developing TBMs equipped with maneuverable reentry vehicles (MaRVs). Observers have expressed strong concern about this potential development, because such missiles, in combination with a broad-area maritime surveillance and targeting system, would permit China to attack moving U.S. Navy ships at sea. The U.S. Navy has not previously faced a threat from highly accurate ballistic missiles capable of hitting moving ships at sea. Due to their ability to change course, MaRVs would be more difficult to intercept than non-maneuvering ballistic missile reentry vehicles. See CRS Report RL33153, *China Naval Modernization: Implications for U.S. Navy Capabilities — Background and Issues for Congress*, by Ronald O'Rourke.

opportunities for improving the radar capabilities of the Navy's Aegis cruisers and destroyers that are not currently being pursued or are funded at limited levels, and if so, whether funding for these efforts should be increased, so as to better meet requirements for sea-based BMD.

## SM-3 Block II/IIA Missile

*If feasible, should the effort to develop the Block II/Block IIA version of the Standard Missile 3 (SM-3) interceptor missile be accelerated?*

Another potential question is whether, if feasible, the effort to develop the Block II/Block IIA missile should be accelerated, and if so, whether this should be done even if this requires the United States to assume a greater share of the combined U.S.-Japan development cost. Views on this issue could be affected by estimates of when other countries might deploy ballistic missiles of various kinds.

## Kinetic Energy Interceptor (KEI)

*If the Kinetic Energy Interceptor (KEI) is developed for land-based BMD operations, should it also be based at sea? If so, what kind of sea-based platform should be used?*

Another potential issue for Congress concerns the Kinetic Energy Interceptor (KEI) — a new ballistic missile interceptor that, if developed, could be used as a ground-based interceptor and perhaps subsequently as a sea-based interceptor. Compared to the SM-3, the KEI would be much larger (perhaps 40 inches in diameter and 36 feet in length) and would have a much higher burnout velocity. Because of its much higher burnout velocity, it might be possible to use a KEI based on a forward-deployed ship to attempt to intercept ballistic missiles during the boost and early ascent phases of their flights. Development funding for the KEI has been reduced by Congress in recent budgets, slowing the missile's development schedule. DOD, however, plans to increase the budget for KEI significantly over the next several years. Under current plans, the missile could become available for Navy use in 2014-2015.[52]

The issue is whether the KEI, if developed, should be based at sea, and if so, what kind of sea-based platform should be used. Basing the KEI on a ship would require the ship to have missile-launch tubes that are bigger than those currently installed on Navy cruisers, destroyers, and attack submarines. Potential sea-based platforms for the KEI include, but are not necessarily limited to, the following:

- ballistic missile submarines (which have launch tubes large enough to accommodate the KEI);

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[52] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Major Weapon Programs*, GAO-05-301, March 2005, pp. 89-90. See also Thomas Duffy, "Northrop, MDA Working On KEI Changes Spurred By $800 Million Cut," *Inside Missile Defense*, Mar. 30, 2005: p. 1.

- surface combatants equipped with newly developed missile-launch tubes large enough for the KEI; and
- a non-combat DOD ship (perhaps based on a commercial hull) or floating platform.

Supporters of deploying the KEI at sea could argue that it would be more capable than the SM-3 Block II/IIA for intercepting ICBMs and that it could enable navy ships to attempt to intercept certain missiles during the boost phase of flight. Skeptics could argue that in light of other planned BMD capabilities, the need for basing the KEI at sea is not clear.

Among supporters of basing the KEI at sea, supporters of basing it on ballistic missile submarines could argue that submarines can operate close to enemy coasts, in positions suitable for attempting to intercept missiles during their boost phase of flight, while remaining undetected and less vulnerable to attack than surface platforms. Skeptics of basing the KEI on ballistic missile submarines could argue that communication links to submarines are not sufficiently fast to support boost-phase intercept operations, and that launching the KEI could give away the submarine's location, making it potentially vulnerable to attack.

Supporters of basing the KEI on surface combatants equipped with missile-launch tubes large enough for the KEI could argue that surface ships have faster communication links than submarines and more capability to defend themselves than non-combat ships or floating platforms. Skeptics could argue that surface combatants might not be able to get close enough to enemy coasts to permit boost-phase intercepts, and that the defensive capabilities of a surface combatant are excessive to what would be needed for a KEI platform operating in the middle of the ocean, far from potential threats, for the purpose of using the KEI for midcourse intercepts.

Supporters of a non-combat ship or floating platform could argue that a non-combat ship or floating platform would be suitable for basing the KEI in mid-ocean locations, far from potential threats, for the purpose of using the KEI for midcourse intercepts. Skeptics could argue that using such a platform could not be used close to an enemy coast, for the purpose of attempting a boost-phase intercept, unless it were protected by other forces.

According to one report, MDA has been studying possibilities for basing the KEI at sea and was to have selected a preferred sea-based platform in May 2006.[53]

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[53] Marc Selinger, "MDA To Pick Platform For Sea-Based KEI in May," *Aerospace Daily & Defense Report*," Aug. 19, 2005: 2.

## CG(X) Cruiser

*Should procurement of the planned CG(X) cruiser be accelerated?*

As a replacement for its 22 remaining Aegis cruisers, the Navy plans to procure 18 or 19 new CG(X) cruisers. The radar capabilities of the CG(X) are to be greater than that of the Navy's Aegis ships, and the CG(X) has been justified primarily in connection with future air defense and BMD operations. Under Navy plans, the first CG(X) is to be procured in FY2011, and the final ship in FY2023. The Navy had earlier planned to begin CG(X) procurement in FY2018, but accelerated the planned start of procurement to FY2011 as part of its FY2006 budget submission. If procured as planned, the first CG(X) might enter service in 2017, and the final ship might enter service in 2029. It is possible that limitations on Navy budgets combined with desires to fund other Navy programs may limit CG(X) procurement to no more than one ship per year, which would delay the completion of an 18- or 19-ship CG(X) program by several years.[54]

If improvements to Aegis radar capabilities are not sufficient to achieve the desired level of sea-based radar capability for BMD operations, CG(X) radar capabilities could become important to achieving this desired capability. If so, then a potential additional issue is whether the planned CG(X) procurement profile would be sufficient to achieve this desired capability in a timely manner. CG(X) radar technologies could be introduced into the fleet more quickly by accelerating planned procurement of CG(X)s or by designing a less expensive ship that preserves CG(X) radar capabilities while reducing other capabilities less critical to BMD operations, and then procuring this ship more rapidly than the CG(X) could afford to be procured. The option of a reduced-cost ship that preserves CG(X) radar capabilities while reducing other capabilities is discussed in more detail in another CRS report.[55]

## Development and Testing of Aegis BMD System

*Are there lessons from development and testing of the Aegis BMD system that can be applied to programs for developing and testing land-based systems?*

With seven successful intercepts in eight flight tests, the Aegis BMD program has achieved a higher rate of successful intercepts than has the ground-based midcourse system. At least some part of the Aegis BMD program's higher success rate may be due to two factors:

- The configuration of the Aegis BMD system that has been tested to date is intended to shoot down shorter-range ballistic missiles. In general, shorter-range missiles fly at lower speeds than longer-ranged missiles, and interceptors intended to shoot down shorter-ranged

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[54] For more on the CG(X) program, see CRS Report RL32109, *Navy DDG-1000 (DD(X)) and CG(X) Ship Acquisition Programs: Oversight Issues and Options for Congress*, by Ronald O'Rourke.

[55] See the "Options For Congress" section of CRS Report RL32109, op. cit.

ballistic missiles don't need to be as fast as interceptors intended to shoot down longer-ranged ballistic missiles. Consequently, the closing speeds[56] involved in intercepts of shorter-ranged ballistic missiles are generally lower than those for intercepts of longer-ranged ballistic missiles. Intercepts involving lower closing speeds can be less difficult to attempt than intercepts involving higher closing speeds. In BMD tests over more than 20 years, tests of shorter-range kinetic-energy BMD systems has generally been more successful than tests of longer-range BMD systems.[57]

- The Aegis BMD system is being developed as an extension of the existing Aegis air defense system, and can thus benefit from the proven radar, software, and interceptor technology of that system, whereas the ground-based midcourse system is being developed essentially as a relatively new weapon system.

The potential question is whether these two factors account completely for the difference in success rates for testing of the Aegis BMD program and the ground-based midcourse program. If they do not, then one potential issue is whether there is something about the approach adopted for developing and testing the Aegis BMD capability, compared to that of the ground-based midcourse program that accounts for part of the difference.

As mentioned earlier, the Aegis BMD program says it has focused since its inception on the philosophy of "test a little, learn a lot." It can also be noted that the Navy has a long history of air-defense missile development programs, and has established a record of technical discipline, rigorousness, and excellence in areas such as nuclear propulsion and submarine-launched ballistic missiles. Potential questions for Congress include the following:

- How do the Aegis BMD and ground-based midcourse programs compare in terms of their approaches for system development and testing?

- Are there features of the Aegis BMD program's approach that, if applied to the ground-based midcourse program or other U.S. BMD programs, could improve the development and test efforts for these programs?

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[56] Closing speed is the relative speed at which the missile warhead and the interceptor kinetic kill vehicle approach one another.

[57] For a discussion, see CRS Report RL33240, *Kinetic Energy Kill for Ballistic Missile Defense: A Status Overview*, by Steven A. Hildreth.

## Potential Allied Programs

*Should current efforts to explore the potential for establishing BMD capabilities in allied navies be reduced, accelerated, or maintained at current levels?*

A final potential issue for Congress concerns the potential for establishing BMD capabilities in allied navies. Should these efforts be reduced, accelerated, or maintained at current levels? Potential oversight questions for Congress include the following:

- What are the potential military and political advantages and disadvantages of establishing BMD capabilities in allied navies?
- To what degree, if any, would these capabilities be integrated into the overall U.S. BMD architecture? How, in terms of technology, command and control, doctrine, and training, would such an integration be accomplished? If these capabilities are not integrated into the U.S. architecture, what kind of coordination mechanisms might be needed to maximize the collective utility of U.S. and allied sea-based BMD capabilities or to ensure that they do not work at cross-purposes?
- How might the establishment of BMD capabilities in allied navies affect U.S. requirements for sea-based BMD systems? To what degree, if any, could allied BMD ships perform BMD operations now envisaged for U.S. Aegis ships?
- What are the potential implications for regional security of missile proliferation and proliferation of BMD systems?

# Legislative Activity for FY2007

For FY2007, the Administration requested $1,031.9 million in research and development funding for the Aegis BMD program; Congress appropriated about $1,127.4 million — a $95.5-million increase over the requested amount.

## FY2007 Defense Authorization Act (H.R. 5122/P.L. 109-364)

**House.** The House Armed Services Committee, in its report (H.Rept. 109-452 of May 5, 2006) on H.R. 5122, stated the following with regard to the FY2007 request for research and development funding for the Aegis BMD program:

> The budget request contained $1.0 billion in PE [program element] 63892C for Aegis ballistic missile defense (BMD).
>
> The committee is encouraged by the Aegis BMD program performance and overall cost/schedule performance. The committee understands that budget

> constraints have reduced planned SM-3 interceptor procurement, thereby delaying SM-3 interceptor deployment to Aegis BMD platforms.
>
> The committee recommends $1.1 billion in PE 63892C for Aegis BMD, an increase of $40.0 million, to include: $10.0 million for continued S-band advanced radar algorithm work for missile defense applications, $10.0 million for Aegis open architecture program acceleration, and $20.0 million to increase the SM-3 production rate from two per month to four per month. (Page 242)

The report also stated:

> The budget request contained $473.1 million in PE 63890C for ballistic missile defense systems (BMDS) core.
>
> The committee is concerned with the results of a March 2006 Department of Defense Inspector General report finding weaknesses in the Missile Defense Agency's systems engineering plans and processes. The committee is particularly concerned with the report's finding that the Aegis missile defense system, an element of the BMDS that has achieved success in actual intercept tests and that is being fielded and deployed now, lacks an approved systems engineering plan. The committee directs the Secretary of Defense to submit a report to the congressional defense committees by February 1, 2007, stating the specific deficiencies in the Aegis systems engineering plan and the required corrective action.
>
> The committee recommends $483.1 million in PE 63890C, an increase of $10.0 million for additional support for the Aegis missile defense system information assurance and systems engineering integration efforts. (Page 243)

The report also stated:

> The budget request contained $75.3 million for AEGIS support equipment, but included no funds for modernizing AEGIS land-based test sites.
>
> The committee understands that the AEGIS land-based test sites are essential to the operational effectiveness of the AEGIS weapons system, including the development of an integrated missile defense system capable of providing a layered defense against ballistic and cruise missiles. The committee is aware that in order to maintain the highest possible level of effectiveness, the land-based test sites require state-of-the-art upgrades to peripheral emulators and switching systems used to collect and analyze combat system performance data. Modernization of the emulators and switches will ensure timely testing, certification and delivery of updated AEGIS baselines to the fleet.
>
> The committee recommends $80.3 million for AEGIS Support Equipment, an increase of $5.0 million to be used for modernizing AEGIS land-based test sites. (Page 82)

**Senate.** Section 232 of S. 2766, the Senate-passed version of the FY2007 defense authorization bill, stated:

SEC. 232. POLICY OF THE UNITED STATES ON PRIORITIES IN THE DEVELOPMENT, TESTING, AND FIELDING OF MISSILE DEFENSE CAPABILITIES.

(a) FINDINGS- Congress makes the following findings:

(1) In response to the threat posed by ballistic missiles, President George W. Bush in December 2002 directed the Secretary of Defense to proceed with the fielding of an initial set of missile defense capabilities in 2004 and 2005.

(2) According to assessments by the intelligence community of the United States, North Korea tested in 2005 a new solid propellant short-range ballistic missile and is likely developing intermediate-range and intercontinental ballistic missile capabilities that could someday reach as far as the United States with a nuclear payload.

(3) According to assessments by the intelligence community of the United States, Iran continued in 2005 to test its medium range ballistic missile, and the danger that Iran will acquire a nuclear weapon and integrate it with a ballistic missile Iran already possesses is a reason for immediate concern.

(b) POLICY- It is the policy of the United States that the Department of Defense accord a priority within the missile defense program to the development, testing, fielding, and improvement of effective near-term missile defense capabilities, including the ground-based midcourse defense system, the Aegis ballistic missile defense system, the Patriot PAC-3 system, the Terminal High Altitude Area Defense system, and the sensors necessary to support such systems.

The Senate Armed Services Committee, in its report (S.Rept. 109-254 of May 9, 2006) on S. 2766, stated:

The budget request included $1.0 billion in PE 63892C, for the sea-based Aegis Ballistic Missile Defense (BMD) system. The Aegis BMD is intended to provide protection against short- and medium-range ballistic missiles. The committee recommends an increase of $100.0 million in PE 63892C to restore the delivery of SM-3 interceptors to 120 by the end of fiscal year 2011, and to increase the overall effectiveness of the Aegis BMD system capability against longer-range threats. Of the increased amount, the committee directs $70.0 million be applied toward procuring 24 additional SM-3 block 1B missiles over fiscal years 2008 to 2011, and $30.0 million be used to accelerate SM-3 and Aegis weapon system integration to take full advantage of missile and weapons systems capabilities, including the BMD signal processor and two-color seeker. MDA is expected to budget for the completion of these tasks over fiscal years 2008 to 2011. (Page 126)

**Conference.** Section 223 of the conference report (H.Rept. 109-702 of September 29, 2006) on H.R. 5122 (P.L. 109-364 of October 17, 2006) stated:

SEC. 223. POLICY OF THE UNITED STATES ON PRIORITIES IN THE DEVELOPMENT, TESTING, AND FIELDING OF MISSILE DEFENSE CAPABILITIES.

(a) FINDINGS.—Congress makes the following findings:

(1) In response to the threat posed by ballistic missiles, President George W. Bush in December 2002 directed the Secretary of Defense to proceed with the fielding of an initial set of missile defense capabilities in 2004 and 2005.

(2) According to assessments by the intelligence community of the United States, North Korea tested in 2005 a new solid propellant short-range ballistic missile, conducted a launch of a Taepodong-2 ballistic missile/space launch vehicle in 2006, and is likely developing intermediate-range and intercontinental ballistic missile capabilities that could someday reach as far as the United States with a nuclear payload.

(3) According to assessments by the intelligence community of the United States, Iran continued in 2005 to test its medium-range ballistic missile, and the danger that Iran will acquire a nuclear weapon and integrate it with a ballistic missile Iran already possesses is a reason for immediate concern.

(b) POLICY.—It is the policy of the United States that the Department of Defense accord a priority within the missile defense program to the development, testing, fielding, and improvement of effective near-term missile defense capabilities, including the ground-based midcourse defense system, the Aegis ballistic missile defense system, the Patriot PAC-3 system, the Terminal High Altitude Area Defense system, and the sensors necessary to support such systems.

The report discusses this provision on pages 639-640. With regard to the FY2007 funding request for the Aegis BMD program, the report stated:

The budget request included $1.0 billion in PE 63892C for the sea-based Aegis Ballistic Missile Defense system.

The House bill would authorize an increase of $40.0 million in PE 63892C.

The Senate amendment would authorize an increase of $100.0 million in PE 63892C.

The conferees agree to authorize $1.1 billion in PE 63892C, an increase of $100.0 million. The increase is directed as follows: $10.0 million for continued S-band advanced radar algorithm work; $20.0 million for Aegis BMD signal processor, 2-color seeker development, and acceleration of the open architecture program; and $70.0 million to support the procurement of 24 additional SM-3 block 1B missiles over fiscal years 2008 to 2011. MDA is expected to budget for the completion of these tasks over fiscal years 2008 to 2011.

The conferees are aware that the MDA and the Department of the Navy are exploring the feasibility of modifying 100 SM-2 Block IV missiles to obtain a near-term sea-based terminal ballistic missile defense capability starting in fiscal year 2007 with conversion of all missiles completed by the end of fiscal year 2009. According to briefings by the MDA and Department of the Navy, such a capability could afford protection for ships and other critical assets against short-range ballistic missiles in the Scud A/B class. This proposed development would cost approximately $130.0 million over fiscal years 2007 to 2009, with the Navy share estimated at approximately $20.0 million in fiscal year 2007. The conferees, while supportive of efforts to provide near-term missile defense capability, require further information before authorizing this development effort to proceed. Therefore, the conferees encourage the Department of Defense to submit to Congress a reprogramming request in fiscal year 2007 to pursue a sea-based terminal missile defense capability, should such a step be consistent with Department requirements and resource constraints. If submitted, the reprogramming request should be accompanied by documentation that: (1) explains the need for such a capability; (2) indicates Department of the Navy

> endorsement of this program; and (3) includes a Navy-MDA cost-share agreement through completion of the effort. (Page 629)

## FY2007 Defense Appropriations Act (H.R. 5631/P.L. 109-289)

**House.** The House Appropriations Committee, in its report (H.Rept. 109-504 of June 16, 2006), recommended a $25-million increase to the amount requested for research and development funding for the Aegis BMD program, of which $20 million is for "Aegis BMD Spiral Processor and Migration of Aegis BMD into OA [open architecture]" and $5 million is for "Asymmetric Missile Defense" (page 285). The report stated:

> The Committee commends the Missile Defense Agency (MDA) for showing progress and promise for continued success in its Aegis Ballistic Missile Defense System. The Committee strongly urges that MDA refrain from transferring funds out of the Aegis program to other missile defense programs during the year of execution and in the Future Years Defense Program (FYDP) and expects MDA shall fully fund and execute the Aegis program as Congress intends. (Page 290)

The report also recommended a $4-million increase to the $75.3 million requested in FY2007 for Aegis support equipment (page 144).

**Senate.** The Senate Appropriations Committee, in its report (S.Rept. 109-292 of July 25, 2006) on H.R. 5631, recommended a $108.2-million increase to the amount requested for research and development funding for the Aegis BMD program, of which $20 million is for "Aegis BMD Signal Processor and Migration of Aegis BMD into OA [open architecture]," $80 million is for Aegis SM-3 development and procurement, and $8.2 million is for upgrades to the Pacific Missile Range Facility (PMRF) in Hawaii (page 213). The report stated:

> The Committee recognizes MDA's concern over expanding and evolving threats. However, the Committee is concerned that MDA is investing too much funding in future systems and technology in advance of adequate testing and fielding of currently available technology. Therefore, the Committee's budget recommendations reflect a continuing emphasis on improving, testing and fielding the current missile defense components, in particular: Ground Based Midcourse Defense, AEGIS Ballistic Missile Defense, Theater High Altitude Area Defense and Airborne Laser.
>
> The Committee commends MDA for successful testing of both the Theater High-Altitude Area Defense and AEGIS systems over the fiscal year 2006 period. In addition, the Committee was encouraged by MDA's ability to quickly transition between development and test to provide immediate operational capability during the recent North Korean missile launches. The Committee understands that periods of immediate operational need will continue to arise in parallel with the development efforts; and therefore supports MDA's efforts to expand concurrent test and operations. To address these issues, the Committee provides an increase of $225,000,000 for additional test infrastructure enhancements, operational support, and interceptors. (Pages 216-217)

**Conference.** The conference report (H.Rept. 109-676 of September 25, 2006) on H.R. 5631 (P.L. 109-289 of September 29, 2006) recommended a total of $1,127.4 million in research and development funding for the Aegis BMD program — a $95.5-million increase over the requested amount, of which of which $20 million is for "Aegis BMD Signal Processor and Migration of Aegis BMD into OA [open architecture]," $4 million is for "Asymmetric Missile Defense," $65 million is for "Aegis Improvements," and $6.56 million is for upgrades to the Pacific Missile Range Facility (PMRF) in Hawaii (page 337). The report stated:

> The conferees have provided $65,000,000 for AEGIS Improvements. Of that amount $15,000,000 is available for the Sea-Based Terminal Capability, and $50,000,000 is available for development and procurement of SM-3 Interceptors.
>
> The conferees are aware that there is an additional requirement of $20,000,000 in fiscal year 2007 for Sea-Based Terminal Defense, and direct the Missile Defense Agency to submit a prior approval reprogramming to fully fund this requirement. (Page 343)

The report also stated:

> The conferees remain concerned that the Missile Defense Agency is moving funds between various elements and programs and/or moving contract scope across elements and programs in order to avoid reductions made by the congressional defense committees. This practice is unacceptable and MDA is directed to use prior approval reprogramming procedures specified in the report accompanying the House version of the fiscal year 2007 Department of Defense Appropriations bill (H.R. 109-504) for any movement of funds or contract scope beyond the $10,000,000 threshold in research, development, test and evaluation. The MDA shall follow the limitation that prior approval reprogramming is set at either the specified dollar threshold or 20% of the line, whichever is less. The conferees agree that: Ballistic Missile Defense AEGIS, PE 0603892C; Ballistic Missile Defense Terminal Defense Segment, PE 0603881C; Ballistic Missile Defense Midcourse Defense Segment, PE 0603882C; and Multiple Kill Vehicle, PE 0603894C are designated as congressional special interest items subject to prior approval reprogramming procedures. (Page 342)

The report also recommended a $1.8-million increase to the $75.3 million requested in FY2007 for Aegis support equipment for Aegis computer center upgrades (page 190).