Navy Aegis Ballistic Missile Defense (BMD) Program: Background and Issues for Congress

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Summary

The Aegis ballistic missile defense (BMD) program, which is carried out by the Missile Defense Agency (MDA) and the Navy, gives Navy Aegis cruisers and destroyers a capability for conducting BMD operations. Under current MDA and Navy plans, the number of BMD-capable Navy Aegis ships is scheduled to grow from 20 at the end of FY2010 to 38 at the end of FY2015. MDA and Navy plans also call for an increasing portion of the Navy's BMD-capable Aegis ships to be equipped with newer and more capable versions of the Aegis BMD system.

BMD-capable Aegis ships operate in the Western Pacific and the Persian Gulf to provide regional defense against potential ballistic missile attacks from countries such as North Korea and Iran. The Administration's Phased Adaptive Approach (PAA) for BMD operations, announced in September 2009, calls for operating BMD-capable Aegis ships in European waters to defend Europe from potential ballistic missile attacks from countries such as Iran.

Some observers are concerned—particularly following the Administration's announcement of its intention to use Aegis-BMD ships to defend Europe against potential ballistic missile attacks—that demands from U.S. regional military commanders for BMD-capable Aegis ships are growing faster than the number of BMD-capable Aegis ships. They are also concerned that demands from U.S. regional military commanders for Aegis ships for conducting BMD operations could strain the Navy's ability to provide regional military commanders with Aegis ships for performing non-BMD missions. There is also some concern regarding the adequacy of planned numbers of SM-3 missiles—the interceptor missiles used by Aegis ships for conducting BMD operations.

The Aegis BMD program is funded mostly through MDA's budget. The Navy's budget provides additional funding for the program. MDA's proposed FY2011 budget requests a total of $2,161.6 million for the Aegis BMD program.

FY2011 issues for Congress include whether to approve, reject, or modify the FY2011 MDA and Navy funding requests for the Aegis BMD program, and whether to provide MDA or the Navy with additional direction concerning the program. FY2011 options for Congress regarding the Aegis BMD program include, among other things, the following: accelerating the modification of Aegis ships to BMD-capable configurations, increasing procurement of new Aegis destroyers, increasing procurement of SM-3 missiles, and providing funding for integrating the SM-2 Block IV BMD interceptor missile into the 4.0.1 version of the Aegis BMD system.

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Background

Navy Aegis Ships

The Navy's cruisers and destroyers are called Aegis ships because they are equipped with the Aegis ship combat system—an integrated collection of sensors, computers, software, displays,

[1] For a news article about BMD-capable Aegis ships providing ballistic missile defense in the Persian Gulf, see David E. Sanger and Eric Schmitt, "U.S. Speeding Up Missile Defenses In Persian Gulf," *New York Times*, January 31, 2010: 1.

weapon launchers, and weapons named for the mythological shield that defended Zeus. The Aegis system was originally developed in the 1970s for defending ships against aircraft, anti-ship cruise missiles (ASCMs), surface threats, and subsurface threats. The system was first deployed by the Navy in 1983, and it has been updated many times since. The Navy's Aegis ships include Ticonderoga (CG-47) class cruisers and Arleigh Burke (DDG-51) class destroyers.

Ticonderoga (CG-47) Class Aegis Cruisers

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 remaining 22 are scheduled to remain in service until age 35.

Arleigh Burke (DDG-51) Class Aegis Destroyers

62 Flight I/II and Flight IIA DDG-51s Procured in FY1985-FY2005

A total of 62 DDG-51s were procured for the Navy between FY1985 and FY2005; the first entered service in 1991 and the 62nd is scheduled to enter service in late 2011. The first 28 ships, known as Flight I/II DDG-51s, are scheduled to remain in service until age 35. The next 34 ships, known as Flight IIA DDG-51s, incorporate some design changes and are to remain in service until age 40.

No DDG-51s Procured in FY2006-FY2009

No DDG-51s were procured in FY2006-FY2009. The Navy during this period instead procured three Zumwalt (DDG-1000) class destroyers. The DDG-1000 design does not use the Aegis system and does not include a capability for conducting BMD operations. Navy plans do not call for modifying DDG-1000s to make them BMD-capable.

Nine More Flight IIA DDG-51s Programmed for Procurement in FY2010-FY2015

Procurement of DDG-51s resumed in FY2010. Navy plans call for procuring nine Flight IIA DDG-51s in FY2010-FY2015 in annual quantities of 1-2-1-2-1-2. The first of the nine ships is scheduled to enter service in late 2015; the ninth may enter service around 2020.

24 Flight III DDG-51s Envisioned for Procurement in FY2016-FY2031

Navy plans call for shifting in FY2016 to procurement of a new version of the DDG-51, called the Flight III version. The Flight III version is to be equipped with a new radar, called the Air and Missile Defense Radar (AMDR), that is more capable than the SPY-1 radar installed on all previous Aegis cruisers and destroyers. The Navy's 30-year (FY2011-FY2040) shipbuilding plan calls for procuring 24 Flight III DDG-51s between FY2016 and FY2031.[2] This plan, if

[2] Supplementary data on 30-year shipbuilding plan provided to CRS and CBO by the Navy on February 18, 2010. For more on the Navy's plans for procuring DDG-51s, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke.

implemented, would bring the Navy's total DDG-51 production run to 95 ships over 47 years (FY1985-FY2031).

Projected Aegis Ship Force Levels

The Navy's 30-year shipbuilding plan projects that the total number of Aegis cruisers and destroyers will grow from 84 at the end of FY2011 to a peak of 93 in FY2020 and FY2021, and then decline thereafter as CG-47s and older DDG-51s retire and are replaced by new DDG-51s on a less than one-for-one basis.[3]

Aegis Ships in Allied Navies

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, South Korea, Australia, Spain, and Norway.[4]

Aegis BMD System[5]

Aegis ships are given a capability for conducting BMD operations by incorporating changes to the Aegis system's computers and software, and by arming the ships with BMD interceptor missiles. In-service Aegis ships can be modified to become BMD-capable ships, and DDG-51s procured in FY2010 and subsequent years are to be built from the start with a BMD capability.

Versions of Aegis BMD System

The current version of the Aegis BMD system is called the 3.6.1 version. MDA and Navy plans call for fielding increasingly capable versions in coming years; the current 3.6.1 version is to be followed by a version called 4.0.1, and after that by versions called 5.0, 5.1, and 5.2. Later versions feature improved processors and software, and are to be capable of using improved versions of the SM-3 interceptor missile (see below).

MDA states that an in-service Aegis ship with no BMD capability can be given a 3.6.1 BMD capability for about $10 million to $15 million, or a 4.0.1 BMD capability for about $53 million to $55 million. MDA states that an in-service ship with a 3.6.1 BMD capability can be upgraded to a 4.0.1 BMD capability for about $45 million, and that an in-service ship with a 5.0 capability can be upgraded to a 5.1 capability for about $23 million.

[3] The Navy's cruiser-destroyer force during this period is also to include the three DDG-1000s procured in FY2006-FY2009.

[4] The Norwegian ships 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.

[5] Unless stated otherwise, information in this section is taken from an MDA briefing on the Aegis BMD program given to CRS and CBO analysts on March 18, 2010.

Aegis BMD Interceptor Missiles

The BMD interceptor missiles used by Aegis ships are the Standard Missile-3 (SM-3) and the Standard Missile-2 Block IV (SM-2 Block IV). The SM-3 is designed to intercept ballistic missiles above the atmosphere, in the midcourse phase of an enemy ballistic missile's flight. It is equipped with a "hit-to-kill" warhead, called a kinetic warhead, that is designed to destroy a ballistic missile's warhead by colliding with it. The SM-2 Block IV is designed to intercept ballistic missiles inside the atmosphere, during the terminal phase of an enemy ballistic missile's flight. It is equipped with a blast fragmentation warhead.

MDA and Navy plans call for fielding increasingly capable versions of the SM-3 in coming years. The version currently in use, the SM-3 Block IA, is to be followed by the SM-3 Block IB, and then the SM-3 Block IIA. Compared to the Block IA version, the Block IB version has an improved (two-color) target seeker, an advanced signal processor, and an improved divert/attitude control system for adjusting its course. In contrast to the Block IA and 1B versions, which have a 21-inch-diameter booster stage but are 13.5 inches in diameter along the remainder of their lengths, the Block IIA version would have a 21-inch diameter along its entire length. The increase in diameter to a uniform 21 inches provides more room for rocket fuel, permitting the Block IIA version to have 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 and IB versions,[6] as well as a larger-diameter kinetic warhead. The United States and Japan have cooperated in developing certain technologies for the Block IIA version, with Japan funding a significant share of the effort.[7]

MDA states that SM-3 Block IAs have a unit procurement cost of about $9 million to $10 million, SM-3 Block IBs have an estimated unit procurement cost of about $12 million to $15 million, and SM-3 Block IIAs have an estimated unit procurement cost of about $15 million.

The existing inventory of 75 SM-2 Block IVs (as of January 2010) was created by modifying SM-2s that were originally built to intercept aircraft and ASCMs. MDA and Navy plans do not call for acquiring any additional SM-2 Block IVs; they instead call for eventually replacing the current stock of SM-2 Block IVs with a new and more capable terminal-phase BMD interceptor.

Table 1 summarizes the various versions of the Aegis BMD system and correlates them with phases of the Administration's Phased Adaptive Approach (PAA) for BMD operations.

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[6] 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, available 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 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*, by Steven A. Hildreth et al.

[7] The cooperative research effort has been carried out under a U.S.-Japan memorandum of agreement signed in 1999. The effort 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. The Block IIA development effort includes the development of a missile, called the Block II, as a stepping stone to the Block IIA. As a result, the Block IIA development effort has sometimes been called the Block II/IIA development effort. The Block II missile is not planned as a fielded capability.

Table 1. Versions of Aegis BMD System

	PAA Phase I	PAA Phase II		PAA Phase III	
Version of Aegis BMD system	**3.6.1**	**4.0.1**	**5.0**	**5.1**	**5.2**
Certified for initial use	2006	2012	2014	2016	2018
OTE assessment	2008	2014	2016	2018	2020
Mid-course interceptor(s) used					
SM-3 Blk IA	X	X	X	X	X
SM-3 Blk IB		X	X	X	X
SM-3 Blk IIA				X	X
Terminal-phase interceptor used					
SM-2 Blk IV	X				
Eventual new missile					X
LRS&T capability	Yes	Yes	Yes	Yes	Yes
Types of ballistic missiles that can be engaged					
SRBM	Yes	Yes	Yes	Yes	Yes
MRBM	Yes	Yes	Yes	Yes	Yes
IRBM	Limited	Limited	Limited	Enhanced	Enhanced
ICBM	No	No	No	Limited	Limited
Launch on remote capability	Initial	Enhanced	Yes	Yes	Yes
Engage on remote capability	No	No	No	Yes	Yes

Source: MDA briefing to CRS and CBO, March 18, 2010.

Notes: OTE is operational test and evaluation. **LRS&T** is long-range search and track—the ability to detect and track ballistic missiles. **SRBM** is short-range ballistic missile; **MRBM** is medium-range ballistic missile; **IRBM** is intermediate-range ballistic missile; **ICBM** is intercontinental ballistic missile. **Launch on remote** is the ability to launch the interceptor using data from off-board sensors. **Engage on remote** is the ability to engage targets using data from off-board sensors.

Aegis Ashore Sites

The Administration's Phased Adaptive Approach for BMD operations calls for fielding two land-based Aegis BMD systems in Europe. Each of these Aegis Ashore sites, as they are called, would include, among other things, a land-based Aegis SPY-1 radar and 24 SM-3 missiles. The SM-3 missiles would be launched from a re-locatable Vertical Launch System (VLS) based on the VLS that is installed in Navy Aegis ships for launching missiles. Observers expect that the establishment of the two Aegis Ashore sites will permit a reduction in the number of BMD-capable Aegis ships needed for European BMD operations.

Planned Quantities of Ships, Ashore Sites, and Interceptor Missiles

MDA and the Navy plan to eventually equip at least 10 of the Navy's 22 Aegis cruisers, and every Aegis destroyer, for BMD operations. As of early 2010, MDA and the Navy were discussing whether to equip more than 10 of the CG-47s for BMD operations, and had not yet settled on a

schedule for providing BMD capability to the 34 Flight IIA DDG-51s procured between FY1994 and FY2005.

As shown in **Table 2**, under current MDA and Navy plans, the number of BMD-capable Navy Aegis ships is scheduled to grow from 20 at the end of FY2010 to 38 at the end of FY2015. As also shown in the plan, MDA and Navy plans call for an increasing portion of the Navy's BMD-capable Aegis ships to be equipped with newer and more capable versions of the Aegis BMD system.

Table 2. Aegis BMD Ships, Aegis Ashore Sites, and SM-3 Deliveries, FY2009-FY2018

	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18
Aegis cruisers modified to have:										
3.6.1 version	2	4	3	3	3	3	3	1	1	0
4.0.1 version	0	0	2	2	2	2	0	0	0	0
5.0/5.1/5.2 version	0	0	0	0	0	3	6	9	9	9
Total	2	4	5	5	5	8	9	10	10	9
Flight I/II Aegis destroyers procured in FY1985-FY1994 and later modified to have:										
3.6.1 version	16	16	18	20	20	16	13	10	9	6
4.0.1 version	0	0	0	2	4	7	7	7	6	6
5.0/5.1/5.2 version	0	0	0	1	3	5	8	11	13	16
Total	16	16	18	23	27	28	28	28	28	28
Flight IIA Aegis destroyers procured in FY1994-FY2005 and later modified to have:										
versions TBD	0	0	0	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Flight IIA destroyers procured FY2010-FY2015 and built from the start with:										
4.0.1 version	0	0	0	0	0	0	1	3	4	6
TOTAL AEGIS BMD SHIPS										
3.6.1 version	18	20	21	23	23	19	16	11	10	6
4.0.1 version	0	0	2	4	6	9	8	10	10	12
5.0/5.1/5.2 version	0	0	0	1	3	8	14	20	22	25
ALL VERSIONS	**18**	**20**	**23**	**28**	**32**	**36**	**38**	**41**	**42**	**43**
Aegis Ashore Sites	0	0	0	0	0	0	1	1	1	2
Cumulative SM-3 missile deliveries										
SM-3 Block IAs	n/a	80	106	112	112	112	112	112	112	112
SM-3 Block IBs	n/a	1	4	16	42	108	180	252	324	324
TOTAL IAs/IBs	**n/a**	**81**	**110**	**128**	**154**	**220**	**292**	**364**	**436**	**436**
SM-3 Block IIAs	n/a	n/a	n/a	n/a	n/a	n/a	3	n/a	n/a	n/a

Source: MDA briefing to CRS and CBO, March 18, 2010.

Notes: TBD means to be determined; n/a means data not available from briefing. Modification schedule for Flight IIA destroyers procured FY1994-FY2005 to be determined; modifications of any of these ships by FY2018 would add to the totals shown in the table. Figures for FY2009 and FY2010 do not include one cruiser, Lake Erie (CG-70), that is equipped with an Engineering Development Model (EDM) version of the 4.0.1 system. CG-70 is scheduled to convert to an operational BMD system in FY2011 and is counted as such in FY2011 and subsequent years. Each Aegis Ashore Site is equipped with 24 SM-3 missiles.

Home Ports of BMD-Capable Aegis Ships

As of January 2010, 16 of the Navy's 21 BMD-capable Aegis ships were homeported in the Pacific, including five at Yokosuka, Japan, six at Pearl Harbor, HI, and five at San Diego, CA. The remaining five BMD-capable Aegis ships were homeported in the Atlantic, with four at Norfolk, VA, and one at Mayport, FL. The figures of 21 BMD-capable ships, including six at Pearl harbor, include the Lake Erie (CG-70), which is equipped with an Engineering Development Model (EDM) version of the 4.0.1 system. This ship is not included in the totals shown for FY2009 and FY2010 in **Table 2**. Implementing the Administration's plan to use BMD-capable Aegis ships to defend Europe against potential ballistic missile attacks would likely lead to an increase over time in the number of BMD-capable Aegis ships homeported in the Atlantic.

Aegis BMD Flight Tests

Since January 2002, the Aegis BMD system has achieved 16 successful exo-atmospheric intercepts in 20 attempts using the SM-3 missile (including two successful intercepts in three attempts by Japanese Aegis ships), and three successful endo-atmospheric intercepts in three attempts using the SM-2 Block IV missile, making for a combined total of 19 successful intercepts in 23 attempts. For details on these flight tests, see **Appendix B**. In addition, on February 20, 2008, a BMD-capable Aegis cruiser operating northwest of Hawaii used a modified version of the Aegis BMD system to shoot down an inoperable U.S. surveillance satellite that was in a deteriorating orbit. Including this intercept in the count increases the total to 20 successful intercepts in 24 attempts.[8]

Administration's Phased Adaptive Approach (PAA) for BMD

On September 17, 2009, the Obama Administration announced a new approach for BMD operations, called the Phased Adaptive Approach (PAA), that calls for using BMD-capable Aegis ships and eventually Aegis Ashore sites to defend Europe against ballistic missile threats from

[8] The modifications to the ship's Aegis BMD midcourse system reportedly involved primarily making changes to software. DOD stated that the modifications were of a temporary, one-time nature. Three SM-3 missiles reportedly were modified for the operation. The first modified SM-3 fired by the cruiser successfully intercepted the satellite at an altitude of about 133 nautical miles (some sources provide differing altitudes). The other two modified SM-3s (one carried by the cruiser, another carried by an engage-capable Aegis destroyer) were not fired, and the Navy stated it would reverse the modifications to these two missiles. (For additional information, see Peter Spiegel, "Navy Missile Hits Falling Spy Satellite," *Los Angeles Times*, February 21, 2008; Marc Kaufman and Josh White, "Navy Missile Hits Satellite, Pentagon Says," *Washington Post*, February 21, 2008; Thom Shanker, "Missile Strikes A Spy Satellite Falling From Its Orbit," *New York Times*, February 21, 2008; Bryan Bender, "US Missile Hits Crippled Satellite," *Boston Globe*, February 21, 2008; Zachary M. Peterson, "Navy Hits Wayward Satellite On First Attempt," *NavyTimes.com*, February 21, 2008; Dan Nakaso, "Satellite Smasher Back At Pearl," *Honolulu Advertiser*, February 23, 2008; Zachary M. Peterson, "Lake Erie CO Describes Anti-Satellite Shot," *NavyTimes.com*, February 25, 2008; Anne Mulrine, "The Satellite Shootdown: Behind the Scenes," *U.S. News & World Report*, February 25, 2008; Nick Brown, "US Modified Aegis and SM-3 to Carry Out Satellite Interception Shot," *Jane's International Defence Review*, April 2008: 35.)

MDA states that the incremental cost of the shoot-down operation was $112.4 million when all costs are included. MDA states that this cost is to be paid by MDA and the Pacific Command (PACOM), and that if MDA is directed to absorb the entire cost, "some realignment or reprogramming from other MDA [program] Elements may be necessary to lessen significant adverse impact on [the] AEGIS [BMD program's] cost and schedule." (MDA information paper dated March 7, 2008, provided to CRS on June 6, 2008. See also Jason Sherman, "Total Cost for Shoot-Down of Failed NRO Satellite Climbs Higher," *InsideDefense.com*, May 12, 2008.)

countries such as Iran. The PAA is to be implemented in four phases between 2011 and 2020. The Administration has stated that the PAA can be used for structuring BMD operations in other regions, such as the Western Pacific and the Persian Gulf. For more on the PAA, see **Appendix A**.

Allied Participation and Interest in Aegis BMD Program

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-1 ballistic missile that flew over Japan before falling into the Pacific.[9] In addition to cooperating with the United States on development of technologies for the SM-3 Block IIA missile, Japan is modifying four of its six Aegis destroyers with an approximate equivalent of the 3.6.1 version Aegis BMD system. As of March 2010, three of Japan's Aegis ships had received the modification. As mentioned earlier (see "Aegis BMD Flight Tests"), Japanese BMD-capable Aegis ships have conducted three flight tests of the Aegis BMD system using the SM-3 interceptor, achieving two successful exo-atmospheric intercepts. A Japanese Aegis ship has also tracked a ballistic missile target in a U.S. Aegis BMD flight test.

Other Countries

Other countries that MDA views as potential naval BMD operators include the United Kingdom, the Netherlands, Spain, Germany, Denmark, South Korea, and Australia. As mentioned earlier, Spain, South Korea, and Australia 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. As of March 2010, none of these countries had committed to fielding a sea-based BMD capability.

MDA Funding For Aegis BMD Program in FY2011-FY2015

Table 3 shows requested and programmed MDA funding for the Aegis BMD program for FY2011-FY2015. The table does not include Navy funding for the Aegis BMD program, which includes, among other things, funding for modifying in-service Aegis ships to have a BMD capability. As can be seen in the table, MDA's proposed FY2011 budget requests a total of $2,161.6 million for the Aegis BMD program, including $281.4 million for the Aegis Ashore development project.

[9] 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*, coordinated by Emma Chanlett-Avery.

Table 3. MDA Funding for Aegis BMD Program, FY2011-FY2015

(Millions of dollars, rounded to nearest tenth)

	FY11	FY12	FY13	FY14	FY15
PE0603892C / Project MD09	1,412.6	972.0	1,063.4	1,030.0	886.0
PE0603892C / Project MD40	54.7	49.9	49.3	46.7	37.3
PE0604881C / Project MD09	318.8	405.5	416.3	337.3	227.5
PE0208866C / Project MD09	94.1	701.9	712.7	681.7	669.7
SM-3 quantities in above line	*8*	*66*	*72*	*72*	*72*
Subtotal above	**1,880.2**	**2,129.3**	**2,241.7**	**2,095.7**	**1,820.5**
PE0604880C / Project MD68	281.4	345.9	187.1	93.5	139.6
TOTAL	**2,161.6**	**2,475.2**	**2,428.8**	**2,189.2**	**1,960.1**

Source: Department of Defense, *Fiscal Year (FY) 2011 President's Budget, Missile Defense Agency, Research, Development, Test & Evaluation, Defense-Wide – 0400, Justification Book*, February 2010, Volume 2b and Volume 2c, and Missile Defense Agency, *Fiscal Year (FY) 2011 Budget Estimates Overview*, p. 25.

Notes: Table includes only MDA funding for Aegis BMD program; it does not include Navy funding for Aegis BMD program. PE is program element (i.e., a research and development account line item).

PE0603892C / Project MD09 is the Aegis BMD project within the BMD Aegis program element.

PE0603892C / Project MD40 is program-wide support within the BMD Aegis program element.

PE0604881C / Project MD09 is U.S. funding for the SM-2 Block IIA co-development project with Japan.

PE0208866C / Project MD09 is procurement of SM-3 missiles.

PE0604880C / Project MD68 is the Aegis Ashore development project within the land-based SM-3 program element.

In addition to the funding shown in the table, MDA's proposed FY2011 budget requests $40.8 million in FY2011 funding for research and development on high-performance interceptor components that DOD budget materials describe as technologies for the SM-3. MDA states: "We are requesting $41M in FY 2011 to develop components that increase the speed of our SM-3 family of interceptors with advanced divert capability, faster boosters, and lighter kill vehicles." (Missile Defense Agency, *Fiscal Year (FY) 2011 Budget Estimates Overview*, p. 15.)

Regarding the first two line items in **Table 3**, MDA states the following:

> *BMD Aegis (PE 0603892C):* For the FYDP, we are requesting $5.602B, including $1.467B in FY 2011. The request includes $165M to complete manufacturing of 30 SM-3 Block IB interceptors that are incrementally funded from the RDT&E appropriation. All additional SM-3 Block IB interceptors are fully funded from the Procurement appropriation after the Under Secretary of Defense for Acquisition, Technology and Logistics has approved initial production. The remainder of the request is primarily devoted to continuing the hardware and software developments as outlined below:
>
> - $143M for the continuing development and testing of the Aegis BMD 4.0.1 Combat System. The System expands the Aegis BMD Weapons System (AWS) effectiveness by allowing the use of both the SM-3 Block IA and the SM-3 Block IB interceptor. It improves engagement performance against an expanded threat set and surveillance and track performance against some IRBMs as well as the capability of using remote BMDS sensor information to launch an interceptor (termed "Launch-on-Remote").

- $99M to continue the upgrade of three additional Aegis BMD engagement ships (two Aegis BMD 3.6.1 destroyers and one 4.0.1 destroyer).

- $255M for continuing development and testing of the SM-3 Block IB interceptor. The SM-3 IB is the next upgrade entering the fleet. The seeker, signal processor, and propulsion system of the Block IB missile kinetic warheads are improved versions of the proven Block IA missile and will result in increased missile effectiveness against growing technical sophistication of ballistic missiles. This missile upgrade, in combination with the BMD signal processor, provides Aegis BMD and the BMDS with an improved capability to identify closely spaced objects and probability of kill against advanced threats; it also expands the number of possible simultaneous engagements.

- $110M for system-level testing, including two important flight tests: (1) exercise the PAA's Phase 1 capability with an Aegis BMD AWS 3.6.1 and SM-3 IA interceptor engagement of an MRBM target; and (2) test an Aegis BMD AWS 4.0.1 and SM-3 Block 1B missile engagement and intercept of an MRBM target.

- $228M for continuing development and testing of the Aegis BMD 5.0 capability. Aegis BMD 5.0 will integrate Aegis BMD 4.0.1 with the Open Architecture system developed by the Navy. This will allow the transition of Aegis BMD from older military standard computers to a commercial-off-the-shelf (COTS) computing system and will ensure the Aegis BMD system remains compatible with Navy assets as ship modernization plans are executed. A significant advantage of Aegis BMD 5.0 is that it will enable any Aegis ship to serve as a candidate for the BMD mission.

- $119M for development of Aegis BMD 5.1. Aegis BMD 5.1 integrates the SM-3 Block IIA missile with the 5.0 Open Architecture AWS and is capable of using remote BMDS sensor information to engage an incoming target (Engage-on-Remote).[10]

Issues for Congress

Demands for BMD-Capable Aegis Ships[11]

Some observers are concerned—particularly following the Administration's announcement of its intention to use Aegis-BMD ships to defend Europe against potential ballistic missile attacks—that demands from U.S. regional military commanders for BMD-capable Aegis ships are growing faster than the number of BMD-capable Aegis ships. Much of the concern focuses on the situation over the next few years, prior to the scheduled establishment of the two Aegis Ashore sites in Europe, which observers anticipate will permit a reduction in the number of BMD-capable Aegis ships needed for European BMD operations.

[10] Missile Defense Agency, *Fiscal Year (FY) 2011 Budget Estimates Overview*, pp. 11-12.

[11] The discussion in this section is adapted from Statement of Ronald O'Rourke, Specialist in Naval Affairs, Congressional Research Service, before the House Armed Services Committee Subcommittee on Seapower and Expeditionary Forces hearing on Navy Force Structure and Capabilities, January 20, 2010, pp. 15-16. For an additional and broadly similar discussion of the potential number of BMD-capable Aegis ships that will be needed for the next few years, see Statement of Eric J. Labs, Senior Analyst for Naval Forces and Weapons, [on] The Long-Term Outlook for the U.S. Navy's Fleet, before the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, U.S. House of Representatives, January 20, 2010, pp. 14-17.

The number of BMD-capable cruisers and destroyers that will be needed for European BMD operations over the next few years will depend on

- the number of BMD-capable ships that are to be kept on station in European waters,
- the way in which being on station is defined, and
- the Navy's approach for providing ships for those stations.

General James Cartwright, Vice Chairman of the Joint Chiefs of Staff, testified in 2009 that for "early-stage" European BMD operations, DOD is considering maintaining two BMD-capable ships at each of three European BMD stations, for a total of six ships on station.[12] Those figures could change; if they do, the discussion below could be adjusted accordingly.

If the Navy relied entirely on East Coast-homeported destroyers operating on seven-month deployments for supporting European BMD operations, then maintaining six ships continuously on station in European waters could require approximately 26 ships.[13] This figure might be taken as a high-end or worst-case analysis. The figure could be reduced by

- **increasing trans-Atlantic transit speeds**, which would marginally reduce stationkeeping multipliers by reducing transit times (but would also increase fuel consumption during transits);
- **using Sea Swap**—that is, extended-length (e.g., 18- or 24-month) deployments with crew rotation—which could substantially reduce stationkeeping multipliers by reducing the number of trans-Atlantic transits;
- **using multiple crewing**—that is, operating the ships with an average of more than one crew for each ship—which could substantially reduce stationkeeping multipliers by increasing the percentage of time that each ship is in deployed status;
- **homeporting the ships in Europe**, which could substantially reduce stationkeeping multipliers by eliminating most trans-Atlantic transits (some trans-Atlantic transits might still be needed for maintenance or training reasons);
- **taking advantage of transit presence**—that is, meeting some of the requirement with BMD-capable cruisers and destroyers that are passing through the Mediterranean on their way to or from the Indian Ocean/Persian Gulf region; and

[12] Emelie Rutherford, "Congress To Probe Possible Need For More Ships For Obama Missile-Defense Plan," *Defense Daily*, January 12, 2010: 1-2; Pat Host, "Lawmaker: Pacific Left Vulnerable Under New Missile Defense Plan," *Inside the Navy*, October 19, 2009; Dan Taylor, "O'Reilly: Pentagon To Send BMD Ships To Eastern Mediterranean," *Inside the Navy*, October 5, 2009; Dan Taylor, "Cartwright: Navy May Station Six Aegis BMD Ships Near Europe." *Inside the Navy*, September 28, 2009; Emelie Rutherford, "Navy Ship Role In New Missile-Defense Architecture Questioned," *Defense Daily*, September 25, 2009: 2-3.

[13] This number is based on a stationkeeping multiplier of 4.4 for Norfolk-based DDG-51s deploying to the European Command's area of responsibility on seven-month deployments. The stationkeeping multiplier is the number of ships of a given type and a certain homeporting location that are needed to maintain one ship of such ship continuously on station in a certain overseas operating area. (Source for stationkeeping multiplier: Navy information paper on stationkeeping multipliers dated December 30, 2009, provided by the Navy to CRS on January 8, 2010.)

- **using an operational "tether"**—that is, defining "being on station" to mean being in the needed location and ready to conduct BMD operations within a certain number of hours or days of receiving an order. General Cartwright testified last year that DOD is considering using a tether of "a couple of days" for European BMD operations, as it does for BMD operations in the Sea of Japan.[14]

These measures are not mutually exclusive, and pursuing a combination could substantially reduce the number of cruisers and destroyers required to keep six on station. European homeporting, for example, might be combined with multiple crewing and taking advantage of transit presence. Such a strategy, combined with an operational tether, might represent something close to a low-end or best-case analysis.[15]

Demands for Aegis Ships in General

Some observers are concerned that demands from U.S. regional military commanders for Aegis ships for conducting BMD operations could strain the Navy's ability to provide regional military commanders with Aegis ships for performing non-BMD missions in various locations around the world.

The Navy's Aegis ships are multi-mission platforms that are used for performing a range of non-BMD missions, including forward deployed presence for regional deterrence, reassurance and stabilization; partnership-building activities; humanitarian assistance and disaster response (HADR) operations; maritime security operations (including anti-piracy operations in the Gulf of Aden); intelligence, surveillance, and reconnaissance (ISR) operations; counter-terrorism operations; and (if need be) conventional warfighting operations. In conventional warfighting operations, Aegis ships could be called upon to perform a variety of non-BMD functions, including anti-air warfare, anti-surface warfare, strike warfare and naval surface fire support, and antisubmarine warfare. Locations that are good for performing BMD operations might not be good for performing non-BMD operations, and vice versa.

The Navy's current cruiser-destroyer force-structure goal is to achieve and maintain a force of 88 cruisers and destroyers. The 88-ship goal is part of the Navy's overall 313-ship force structure plan, which was first presented to Congress in February 2006. A potential issue for Congress is whether the 88-ship goal is still appropriate, particularly in light of the Administration's September 2009 announcement of its plan to use BMD-capable Aegis ships to defend Europe against potential ballistic missile attacks. The Navy in recent years has deployed only limited

[14] Pat Host, "Lawmaker: Pacific Left Vulnerable Under New Missile Defense Plan," *Inside the Navy*, October 19, 2009; Dan Taylor, "O'Reilly: Pentagon To Send BMD Ships To Eastern Mediterranean," *Inside the Navy*, October 5, 2009.

[15] The aircraft carrier that is homeported in Japan is counted as being present as a forward-deployed ship in the Pacific even when it is at pier or in dry dock in Japan. As a result, the Navy treats the homeporting of a carrier in Japan as reducing to 1.0 the stationkeeping multiplier for keeping a carrier forward-deployed in the Pacific. This counting rule might not be suitable for BMD-capable ships homeported in Europe, since their mission would involve not simply being present, but being ready to conduct BMD operations. Consequently, homeporting the ships in Europe might not reduce to six the total number of ships required to keep six on station. But it could reduce the stationkeeping multiplier by significantly reducing time spent transiting between the home port and the operating station, and perhaps also by permitting the ships to adopt an operational cycle that is more like the operational cycle of the Japan-homeported carrier.

numbers of cruisers and destroyers to waters around Europe,[16] and has not announced a reduction in the combined number of cruisers and destroyers required for performing operations in other regions.

In December 2009, it was reported that the Navy was considering increasing the cruiser-destroyer force-level objective to 96 ships as part of its FY2011 budget submission.[17] The FY2011 budget submission, however, left the 313-ship plan, including the 88-ship cruiser-destroyer objective, unchanged, at least for the time being. The Navy's report on its 30-year (FY2011-FY2040) shipbuilding plan refers to a forthcoming force structure assessment (FSA) that could lead to a change in the 313-ship plan, possibly including a change in the cruiser-destroyer force-level objective. The report does not state when the FSA will be completed, or when a change to the 313-ship plan might be announced.[18]

The Navy's report on its 30-year shipbuilding plan projects that the cruiser-destroyer force will increase from 84 ships in FY2011 to 88 ships in FY2015, continue increasing to a peak of 96 ships in FY2020 and FY2021, decline to 67 ships in FY2034, and then increase to 76 ships by FY2039 and FY2040. (For FY2015 and later years, these figures include three non-Aegis DDG-1000 class destroyers.)

A January 4, 2010, news report stated:

> No sooner did the Aegis ballistic missile defense (BMD) system become operational in 2008 than U.S. combatant commanders started asking for BMD-equipped ships to begin patrolling their areas.
>
> Central Command needed a "shooter" in the northern Arabian Gulf. European Command wanted one in the eastern Mediter-ranean. Pacific Command already had Aegis ships with limited BMD capabilities on guard around Japan for a potential launch from North Korea.
>
> The demand for BMD ships is only expected to increase, driven in part by rising concerns about Iran's intentions and the U.S. decision in September to cancel an anti-missile system in Poland and the Czech Republic and rely instead on Aegis.
>
> But the Navy has a relatively small number of such ships, and those destroyers and cruisers are designed to carry out a wide range of war-fighting tasks.
>
> As a result, while Navy commanders are pleased with the expanding capabilities of their Aegis ships, they're also somewhat guarded about trumpeting the advances.
>
> "We can't constrain assets to one mission," a senior officer said last month. "They need to do a variety of other missions." Worries that valuable Aegis ships might be locked into the

[16] The Navy stated in 2009 that an average of about 1.7 cruisers and destroyers have been maintained on station in the Mediterranean on a daily basis during the preceding five years. This figure excludes cruisers and destroyers transiting the Mediterranean on their way to the Indian Ocean/Persian Gulf region or the Atlantic Ocean. It also excludes any cruisers and destroyers the Navy might have deployed to northern European waters for purposes such as making port calls or conducting exercises. (Source: Navy information paper dated October 8, 2009, and provided to CRS on October 9, 2009, by the Navy Office of Legislative Affairs.)

[17] Christopher J. Castelli, "Navy Raises 313-Ship Goal To 324, Boosts Focus on Missile Defense," *Inside the Navy*, December 7, 2009.

[18] For further discussion, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

BMD mission were discussed in December at a two-day seminar at the National Defense University (NDU) in Washington. Reporters were allowed to quote comments made at the seminar under the condition that no speaker be identified.

"Sea-based ballistic missile defense is a necessary component of any theater defense," said the senior officer. "We need to find ways to get folks to use the ships in ways consistent with their being a ship—to realize they are not a point-defense asset." One analyst added, "The demand signal is ahead of the pot of ships." U.S. Navy spokesman Lt. Tommy Buck said the service is working to manage the demand.

"Combatant commanders need to understand BMD-capable ships are multimission-capable. BMD is one available asset," Buck said Dec. 18.

The Navy is also working on how to respond, said Vice Adm. Samuel Locklear, director of the Navy Staff.

"We have a small Navy today—the smallest since 1916—yet we have a growing global demand for maritime forces, maritime security operations. And now we have a growing demand for maritime ballistic missile defense. Our ships and our crews and our systems are up to the challenge, but it's a capacity issue for us," Locklear said to a reporter during the NDU seminar.

"As the capacity grows faster than we can grow the number of ships we have—which is always difficult, particularly in the demanding fiscal environment we're in—we have to look at ways to deploy these ships so that we can get the job done and still have a reasonable expectation that we can take care of the ship and the crew," Locklear said. "So we're looking at a lot of different options as to how we'll do that as this demand grows. But we are limited in capacity." Locklear said that despite meeting demands from joint commanders, the Navy has "to some degree preserved the command and control. Navy component commanders still command and control these ships." But, he added, "What we've had to do is to spread these multimission platforms more thinly across a growing number of demands globally."

27 BMD Ships By 2013

Twenty-one cruisers and destroyers will have been upgraded with the Aegis BMD capability by early 2010, and six more destroyers are to receive the upgrade in 2012 and 2013. But at least one senior officer at the seminar noted "there will be no more new ships for missile defense." The demand has already affected deployments. Early in 2009, for example, The Sullivans, a Florida-based destroyer on deployment with a carrier group, moved to Japan for a few weeks to pick up the exercise schedule of a Japan-based BMD destroyer that was called on by Central Command to guard the northern Ara-bian Gulf.

This fall, a San Diego-based ship, the destroyer Higgins, deployed to the eastern Mediterranean to provide BMD defense for European Command and take part in exercises.

Both moves are unusual, as it's rare for an Atlantic Fleet ship to visit Japan or for a Pacific ship to patrol the Mediterranean. Such cross-deployments require more coordination by fleet planners.

"Effective global force management requires global visibility on requirements," Buck said. "U.S. Fleet Forces Command [headquartered in Norfolk, Va.] and Pacific Fleet [headquartered in Pearl Harbor, Hawaii] collaborate, coordinate and communicate to have more complete knowledge of location and status of fleet capabilities and work to best employ those capabilities to meet global combatant commander requirements to include BMD." The senior officer said one way to manage demand is to encourage combatant

> commanders to give "sufficient warning to have ships on station. We need to remind [combatant commanders] that these are multimission ships." The BMD cruisers and destroyers are also equipped to handle anti-submarine, land-attack, air-defense and other tasks.[19]

Numbers of SM-3 Interceptors

Some observers have expressed concern in recent years regarding the adequacy of planned numbers of SM-3 missiles. These concerns may have been reinforced by the Administration's September 2009 announcement of its plan to use BMD-capable Aegis ships to defend Europe against potential ballistic missile attacks. MDA in recent years has been increasing planned numbers of SM-3s, and states that its FY2011 plan—which would procure a cumulative total of 436 SM-3 Block IA and IB missiles by FY2015 and deliver a cumulative total of 436 by FY2017 (see **Table 2**)—represents an increase of 107 missiles over the number in its FY2010 plan.[20]

SM-2 Block IV Capability for 4.0.1 and Higher Versions

Another potential issue for Congress concerns MDA's plan to not include a capability for using the SM-2 Block IV missile in the 4.0.1, 5.0, and 5.1 versions of the Aegis BMD system (see **Table 1**). Being able to use the SM-2 Block IV gives a BMD-capable Aegis ship a second layer of defense against ballistic missiles, permitting the ship to attempt to intercept missiles that are not intercepted by SM-3s. MDA states that the absence of an ability to use the SM-2 Bock IV missile from the 4.0.1 version of the Aegis BMD system is an affordability measure. A potential question for Congress is how much additional funding would be needed to add a capability for using the SM-2 Block IV missile to the 4.0.1, 5.0, and 5.1 versions of the Aegis system, and how adding such a capability would affect the ability of ships equipped with the 4.0.1, 5.0, and 5.1 versions to intercept ballistic missiles under various scenarios. Another potential question is whether the current fixed inventory of 75 SM-2 Block IVs (as of January 2010) would be adequate to provide missiles to ships equipped with the 4.0.1, 5.0, and 5.1 versions.

Additional Issues Concerning European Aegis BMD Operations

The Administration's plan to use BMD-capable Aegis ships to defend Europe against potential ballistic missile attacks raises a number of additional potential oversight issues for Congress, including the following:

- What will be the command and control procedures governing use of sea-based SM-3s for purposes of intercepting ballistic missiles fired toward Europe from Iran (or some other country in the Middle East or Southwest Asia)? Would authority to fire the missile rest with the ship's commanding officer, or would approval from a higher authority be required?
- What modifications are needed to make the SM-3 suitable for use as a land-based missile, and what are the technical risks associated with these modifications?

[19] Christopher P. Cavas, "U.S. Navy Juggles Ships To Fill BMD Demands," *Defense News*, January 4, 2010. Material in brackets as in original.

[20] Missile Defense Agency, *Fiscal Year (FY) 2011 Budget Estimates Overview*, p. 11.

- What additional system-integration challenges would the Administration's plan pose for the Aegis BMD system? How significant are the technical risks associated with these challenges?
- What implications, if any, does Japanese involvement in the development of the SM-3 Block IIA missile have for implementing the Administration's plan?
- If allied European navies in the future acquire BMD capabilities using the Aegis/SM-3 combination or other systems, does the Administration envisage having those navies participate in European BMD operations, so as to reduce the burden on U.S. BMD systems?

A September 30, 2009, press report stated:

> The Navy's new mission of protecting Europe from ballistic-missile attacks has widespread implications for the surface fleet, potentially affecting everything from deployment schedules to crewing arrangements to command-and-control procedures for cruisers and destroyers.
>
> Ballistic-missile defense warships have become the keystone in a new national strategy to shield European allies from potential attacks by Iran. Rather than field sensors and missiles on the ground in Poland and the Czech Republic, the U.S. will first maintain a presence of at least two or three Aegis BMD ships in the waters around Europe, starting in 2011.
>
> That announcement—which defined a new mission for the surface force: continent defense—immediately raised many questions that Navy planners must answer over the next two years:
>
> Which ships will take the patrol mission? What will the deployments look like—will ships participate in exercises, make port visits or be confined to a narrow patrol box? How long will ships be assigned picket duty? Will BMD patrol ships sail with the crews they would have taken on normal deployments, or will they have fewer sailors to account for the narrower mission?
>
> Navy officials had few answers in the week after Defense Secretary Robert Gates announced the new BMD mission. Spokesmen at the Pentagon and for 3rd Fleet, which is responsible for Navy Air and Missile Defense Command, said officials were working out the details.
>
> Some hints could come from the deployment this summer of the BMD destroyer Stout, which spent six months in the Mediterranean and Black seas, training with Turkish, Romanian, Georgian and other sailors. When the mission was finished, Stout returned to Norfolk, Va., in early September.
>
> But that traditional model might not be best for the new BMD patrols, said retired Rear Adm. Ben Wachendorf. He said top commanders might consider reviving crew-swaps—flying replacement sailors to a forward port to relieve a ship's company when its time at sea is over, keeping the ship at sea for extended periods of time.
>
> Wachendorf, who worked on the Navy's original crew-swap experiments in the early 2000s, said it would be expensive, but crew swaps would enable commanders to keep BMD ships in place in European ports and save long transits home. Most of the Navy's BMD fleet is based in the Pacific, meaning ships would need a month at sea just to get to Europe and then another month for the trip home.
>
> One reason the fleet might reconsider crew swaps is that BMD-patrol ships could sail with fewer people. If a cruiser or destroyer is loaded only with Standard Missile-3 interceptors

> and will be tasked only with picket duty, it may not need some elements of a normal crew, making it easier to fly fewer people to a forward port.
>
> Then again, that concept could backfire.
>
> "You might be able to cut back on some things. Do you need a towed array? Are you ever going to stream it out? Do you need a [helicopter] detachment?" Wachendorf asked. "I could say no, but Big Navy worries, 'If we have a helo-capable ship that never operates helos, they're not going to be ready to do that.' Same thing with [anti-submarine warfare]."
>
> Who pushes the button?
>
> There were broader questions beyond crewing and deployments: For the first time, the commanding officer of a surface warship will have strategic responsibilities—the ship could be the only thing standing between a nuclear attacker and its victim. What discretion will commanders have in responding to attacks?
>
> "You've put these commanders on a par with [ballistic-missile submarine] commanders," said Steven Cimbala, an expert on ballistic-missile issues.
>
> "But unlike an SSBN commander, who is unlikely to be under immediate tactical threat, an Aegis cruiser or a [destroyer] could very easily be attacked by surface or subsurface craft, or aircraft, as part of a first strike," Cimbala said.
>
> According to new intelligence described by Gates, the stakes for an engagement are very high: Rather than one or two rogue launches, Gates described the threat from Iran as involving volleys of many missiles fired simultaneously.
>
> That also means a BMD captain could be responsible for a big, complex, dangerous battle in the space over Europe, needing to fire dozens of missiles to try to destroy dozens of attackers.[21]

An October 8, 2009, press report stated:

> As Navy planners figure out how the fleet will take on its new job of providing ballistic-missile defense protection for Europe, they don't have to look far for an example of what it could look like.
>
> The Norfolk, Va.-based destroyer Stout returned in early September from European Command's first dedicated BMD deployment, in what could be an early model for the missions of tomorrow.
>
> "I would think they would look kind of similar to what we did," Cmdr. Mark Oberley, the Stout's commanding officer, told Navy Times.
>
> Stout deployed to the 6th Fleet area of operations, made regular stops in the Mediterranean and Black seas, trained with partner navies and overall showed the U.S. flag. But everywhere it went, BMD was part of its daily life.

[21] Philip Ewing, "BMD Fleet Plans Europe Defense Mission," *NavyTimes.com*, September 30, 2009. Material in brackets as in original.

> "The BMD just kind of goes in parallel with our normal routine wherever we go in the world; that didn't really change the exercises we did and the way we prepared," Oberley said.
>
> The U.S. is committing at least two BMD ships—and as many as six, a top defense official said Sept. 24—for a standing patrol off Europe by 2011. The ships will be there to safeguard against ballistic-missile attacks launched from Iran.
>
> It isn't clear yet just what that duty will look like: Still to be determined is where ships will patrol, how they'll be outfitted and what it all means for their crews and schedules.
>
> In Stout's case, the crew was tied to patrol areas for which the ship had to provide BMD protection, within which it had some latitude about where it could stray.
>
> "[Aegis] can reach far, but you also have a tether to be in a certain area in a certain time, just like a lot of the other missions that we do, and basically, as long as we're in that tether, then you're good," he said.
>
> And although the Navy's BMD tests in the Pacific typically involve two or three ships, Oberley said Stout or any other BMD ship probably could see and hit a ballistic missile flying from the Middle East toward Europe.
>
> "It depends on where it's launched from and where it's going to, so all those things are variable. If the situation required us to link with another ship or another system, we could do that," he said.
>
> Missile numbers
>
> Aegis warships are suitable for ballistic-missile defense because they can carry so many SM-3 interceptors. Cruisers have 122 vertical launch system missile tubes and destroyers have 90 or 96, depending on their flight. But there aren't even that many missiles in the whole U.S. arsenal—yet. The Pentagon has "more than 40" SM-3s today, according to Missile Defense Agency spokesman Chris Taylor. It requested funds for 147 missiles in fiscal 2009 and planned to request funding for 218 missiles in fiscal 2010.[22]

A November 6, 2009, press report stated:

> Citing the resource-constrained U.S. Army budget, the general overseeing the Army's Space and Missile Defense Command says he would prefer the U.S. Navy to assume oversight and execution of the mission to land-base SM-3 Block IB ballistic missile killers in Europe for protection against an Iranian attack.
>
> "Today, we have a number of priorities that we have trouble meeting outside of missile defense," Campbell said during a Nov. 3 interview with *Aviation Week*.
>
> These include providing weapons and manpower for the wars in Afghanistan and Iraq.
>
> "In my view this is an opportunity to have another service, in this case the Navy, to be the lead service…From a resource perspective, it would be one less competing priority that we have to put in the mix."

[22] Philip Ewing, "Stout Deployment May Be BMD Mission Blueprint," *NavyTimes.com*, October 8, 2009.

> The Pentagon plans to field land-based SM-3 Block IB interceptors, originally designed for launch from Aegis ships, in Europe by 2015. Eventually, the SM-3 Block IIA, built on a 21-inch booster (the IA and IB use 13.5-inch boosters), will likely be based on European soil. It is unclear what type of fire control and sensor architecture will be used. Candidates include those used for the Navy's Aegis ship system or the Army's Terminal High-Altitude Area Defense (Thaad) system now being fielded.
>
> It would seem a natural mission for the Army to fund and field the land-based SM-3 mission as the lead service. Campbell notes that the Army has 10 years of experience in operating missile defense architectures abroad through the Patriot, PAC-3 and now Thaad. "We've only started to scratch on the surface on how would it work in the theater with the new Terminal High-Altitude Air Defense, Thaad, and then how would it work with an Aegis ship introduced into the same region … and Patriot could be part of that architecture," Campbell said.
>
> However, he says the service is facing too many financial troubles to take on the mission.
>
> Inputs from both the Army and Navy have been sent to the Pentagon for consideration. A final decision is expected on the matter soon.[23]

An October 25, 2009, press report stated:

> U.S. Defense Secretary Robert Gates asked Japan last week to export a new type of ship-based missile interceptor [the SM-3 Block IIA] under joint development by Tokyo and Washington to third countries, presumably European, sources close to Japan-U.S. relations said.
>
> Gates' request could lead to a further relaxation of Japan's decades-long arms embargo and spark a chorus of opposition from pacifist elements in the ruling Democratic Party of Japan and one of its coalition partners, the Social Democratic Party.
>
> Gates made the request concerning Standard Missile-3 Block 2A missiles during talks with Defense Minister Toshimi Kitazawa on Wednesday, the sources said....
>
> Japan has a policy of not exporting weapons or arms technology, except to the United States, with which it has a bilateral security pact.
>
> Gates' request followed President Barack Obama's announcement in September that the United States is abandoning plans for a missile defense shield in Eastern Europe and adopting a new approach to antimissile defense.
>
> During his talks with Kitazawa, Gates called for a relaxation of Japan's arms embargo and prodded Tokyo to pave the way for exports of the new interceptors to third countries, particularly European, the sources said.
>
> Kitazawa refrained from answering directly, telling Gates the government would study the request as it is an internal matter for Japan, the sources said.
>
> The United States plans to begin deploying SM-3 Block 2A missiles in 2018. The Foreign and Defense ministries believe it will be difficult to reject Gates' request, the sources said.

[23] Amy Butler, "Army Three-Star Pushes For Navy To Be Ashore SM-3 Lead," *Aerospace Daily & Defense Report*, November 6, 2009: 1-2. Ellipses as in original.

> In December 2004, Japan and the United States signed an agreement for bilateral cooperation on a ballistic missile defense system. At the time, Japan exempted U.S.-bound exports of missile interceptors to be developed by the two countries from its arms embargo rules.
>
> Following an agreement on joint development of a new missile interceptor, Japan and the U.S. exchanged diplomatic documents on banning its transfer to third parties or its use for purposes other than originally intended without Japan's advance agreement.
>
> The sources said Japan would probably be forced to exempt the export of the interceptors to third countries or give its nod in advance as stated in the documents.
>
> The United States is hoping to get an answer to Gates' request by the end of 2010, and envisages Japan exporting the new interceptors to European countries, including Germany, the sources said....
>
> In fiscal 2006, Japan and the United States began to jointly develop the SM-3 Block 2A, an advanced and more accurate version [of the SM-3 interceptor]....
>
> Japan is developing the core part of the interceptor, which protects an infrared ray sensor from heat generated by air friction, while the United States is in charge of developing the warhead, called the Kinetic projectile, which would hit and destroy a ballistic missile.
>
> Japan's arms embargo dates back to 1967, when then Prime Minister Eisaku Sato declared a ban on weapons exports to communist states, countries to which the United Nations bans such exports and parties to international conflicts.
>
> The policy was tightened in 1976 when then Prime Minister Takeo Miki imposed an almost blanket ban on the export of weapons. But in 1983, Japan exempted exports of weapons technology to the United States from the embargo.[24]

Technical Risk in Aegis BMD Program

Another potential oversight issue for Congress is how much technical risk there is in the Aegis BMD program. A March 2010 Government Accountability Office (GAO) report assessing the technical risks of selected weapon programs stated the following regarding the Aegis BMD program:

> **Technology Maturity**
>
> The Aegis BMD program is putting the SM-3 Block IB at risk for cost growth and schedule delays by planning to begin manufacturing in 2010 before its critical technologies have been demonstrated in a realistic environment. This risk has been deemed acceptable by the MDA. While Aegis program officials consider two technologies to be fully mature and three to be nearing maturity, we assessed four of those five technologies as immature. Prototypes of these four critical technologies—the throttleable divert and attitude control system, all reflective optics, two-color seeker, and kinetic warhead advanced signal processor—have not completed developmental testing in a relevant environment. Aegis program officials told us that the integrated ground test would not be completed until late 2010. In addition, the first target intercept flight test will not occur until the second quarter of fiscal year 2011.

[24] Kyodo News, "U.S. Urges Japan To Export SM-3s," *Japan Times*, October 25, 2009.

Design Maturity

Program officials reported that 100 percent of SM-3 Block IB drawings were released to manufacturing. However, since most of the critical technologies have not completed developmental testing, additional design changes and costly rework could be necessary if problems are discovered.

Production Maturity

The Aegis program intends to proceed with production of 18 operationally configured Block IB rounds for testing or fielding in the second quarter of 2010 before flight testing a fully integrated prototype in an operational environment. This increases the risk of design changes and costly rework while production is underway. The first target intercept flight test will help demonstrate that the system will work as intended and in a reliable manner, but it has been delayed until the second quarter of fiscal year 2011. Program officials consider moving forward with SM-3 Block IB production before a fully integrated prototype is tested to be an acceptable risk because of the SM-3 Block IB's success in developmental testing and the program office's confidence in the throttleable divert and attitude control system design. In addition, in order to avoid a break in the combined SM-3 IA/IB missile production, long lead items must be ordered about 30 months before delivery. We could not assess the maturity of the SM-3 Block IB's production processes because the program has not started to collect production data. The program has identified 26 critical manufacturing processes—an important first step for assessing maturity—and intends to conduct a detailed analysis of process control data before the manufacturing readiness review in December 2010.

Other Program Issues

The Aegis program is developing an SM-3 Block IIA missile under a cooperative agreement with the government of Japan. The Block IIA missile is intended to be faster and have an advanced discrimination seeker. The Aegis program completed the system design review for the Block IIA in fiscal year 2009 after a delay of over 5 months. The first operational test of the Block IIA is planned for the third quarter of fiscal year 2014.

Program Office Comments

In commenting on a draft of this assessment, Aegis BMD program officials disagreed with GAO's assertion that the SM-3 Block IB missile is at risk of cost growth and schedule delays by beginning production in 2010. Program officials stated that the SM-3 Block IB full rate production decision is scheduled for 2012—after several flight tests. The procurement that is mentioned in this report is for test rounds to conduct developmental and operational flight testing. These rounds may also be deployed if a security situation demands, and any remaining rounds will support fleet proficiency firings.

GAO Response

The program office acknowledges that the initial 18 SM-3 Block IBs could be deployed if needed, indicating that they may be used as operational fleet assets. Furthermore, according to MDA's September 2009 SM-3 Block IB utilization plan, 2 missiles are to be used for flight tests, 10 are to be used for fleet deployment and 6 are to be used for either fleet proficiency or deployment. The program office acknowledged that the technologies will not

be fully mature until after the decision to produce these 18 SM-3s, which puts the program at risk for costly design changes and retrofits if testing reveals issues.[25]

Options For Congress

FY2011 options for Congress regarding the Aegis BMD program include, among other things, the following:

- accelerating the modification of Aegis ships to BMD-capable configurations,
- increasing procurement of new Aegis destroyers,
- increasing procurement of SM-3 missiles, and
- providing funding for integrating the SM-2 Block IV missile into the 4.0.1 version of the Aegis BMD system.

Legislative Activity for FY2011

FY2011 Funding Request

The Aegis BMD program is funded mostly through MDA's budget. The Navy's budget provides additional funding for the program. MDA's proposed FY2011 budget requests a total of $2,161.6 million for the Aegis BMD program.

[25] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-10-388SP, March 2010, p. 38.

Appendix A. Phased Adaptive Approach (PAA) for BMD Operations

This appendix presents additional background information on the Phased Adaptive Approach (PAA) for BMD operations announced by the Administration on September 17, 2009.

A September 17, 2009, White House fact sheet on the PAA stated:

> President Obama has approved the recommendation of Secretary of Defense Gates and the Joint Chiefs of Staff for a phased, adaptive approach for missile defense in Europe. This approach is based on an assessment of the Iranian missile threat, and a commitment to deploy technology that is proven, cost-effective, and adaptable to an evolving security environment.
>
> Starting around 2011, this missile defense architecture will feature deployments of increasingly-capable sea- and land-based missile interceptors, primarily upgraded versions of the Standard Missile-3 (SM-3), and a range of sensors in Europe to defend against the growing ballistic missile threat from Iran. This phased approach develops the capability to augment our current protection of the U.S. homeland against long-range ballistic missile threats, and to offer more effective defenses against more near-term ballistic missile threats. The plan provides for the defense of U.S. deployed forces, their families, and our Allies in Europe sooner and more comprehensively than the previous program, and involves more flexible and survivable systems.
>
> The Secretary of Defense and the Joint Chiefs of Staff recommended to the President that he revise the previous Administration's 2007 plan for missile defense in Europe as part of an ongoing comprehensive review of our missile defenses mandated by Congress. Two major developments led to this unanimous recommended change:
>
> - New Threat Assessment: The intelligence community now assesses that the threat from Iran's short- and medium-range ballistic missiles is developing more rapidly than previously projected, while the threat of potential Iranian intercontinental ballistic missile (ICBM) capabilities has been slower to develop than previously estimated. In the near-term, the greatest missile threats from Iran will be to U.S. Allies and partners, as well as to U.S. deployed personnel—military and civilian –and their accompanying families in the Middle East and in Europe.
>
> - Advances in Capabilities and Technologies: Over the past several years, U.S. missile defense capabilities and technologies have advanced significantly. We expect this trend to continue. Improved interceptor capabilities, such as advanced versions of the SM-3, offer a more flexible, capable, and cost-effective architecture. Improved sensor technologies offer a variety of options to detect and track enemy missiles.
>
> These changes in the threat as well as our capabilities and technologies underscore the need for an adaptable architecture. This architecture is responsive to the current threat, but could also incorporate relevant technologies quickly and cost-effectively to respond to evolving threats. Accordingly, the Department of Defense has developed a four-phased, adaptive approach for missile defense in Europe. While further advances of technology or future changes in the threat could modify the details or timing of later phases, current plans call for the following:

- Phase One (in the 2011 timeframe)—Deploy current and proven missile defense systems available in the next two years, including the sea-based Aegis Weapon System, the SM-3 interceptor (Block IA), and sensors such as the forward-based Army Navy/Transportable Radar Surveillance system (AN/TPY-2), to address regional ballistic missile threats to Europe and our deployed personnel and their families;

- Phase Two (in the 2015 timeframe)—After appropriate testing, deploy a more capable version of the SM-3 interceptor (Block IB) in both sea- and land-based configurations, and more advanced sensors, to expand the defended area against short- and medium-range missile threats;

- Phase Three (in the 2018 timeframe)—After development and testing are complete, deploy the more advanced SM-3 Block IIA variant currently under development, to counter short-, medium-, and intermediate-range missile threats; and

- Phase Four (in the 2020 timeframe)—After development and testing are complete, deploy the SM-3 Block IIB to help better cope with medium- and intermediate-range missiles and the potential future ICBM threat to the United States.

Throughout all four phases, the United States also will be testing and updating a range of approaches for improving our sensors for missile defense. The new distributed interceptor and sensor architecture also does not require a single, large, fixed European radar that was to be located in the Czech Republic; this approach also uses different interceptor technology than the previous program, removing the need for a single field of 10 ground-based interceptors in Poland. Therefore, the Secretary of Defense recommended that the United States no longer plan to move forward with that architecture.

The Czech Republic and Poland, as close, strategic and steadfast Allies of the United States, will be central to our continued consultations with NATO Allies on our defense against the growing ballistic missile threat.

The phased, adaptive approach for missile defense in Europe:

- *Sustains U.S. homeland defense* against long-range ballistic missile threats. The deployment of an advanced version of the SM-3 interceptor in Phase Four of the approach would augment existing ground-based interceptors located in Alaska and California, which provide for the defense of the homeland against a potential ICBM threat.

- *Speeds protection of U.S. deployed forces, civilian personnel, and their accompanying families* against the near-term missile threat from Iran. We would deploy current and proven technology by roughly 2011—about six or seven years earlier than the previous plan—to help defend the regions in Europe most vulnerable to the Iranian short- and medium-range ballistic missile threat.

- *Ensures and enhances the protection of the territory and populations of all NATO Allies*, in concert with their missile defense capabilities, against the current and growing ballistic missile threat. Starting in 2011, the phased, adaptive approach would systematically increase the defended area as the threat is expected to grow. In the 2018 timeframe, all of Europe could be protected by our collective missile defense architecture.

- *Deploys proven capabilities and technologies* to meet current threats. SM-3 (Block 1A) interceptors are deployed on Aegis ships today, and more advanced versions are in

> various stages of development. Over the past four years, we have conducted a number of tests of the SM-3 IA, and it was the interceptor used in the successful engagement of a decaying satellite in February 2008. Testing in 2008 showed that sensors we plan to field bring significant capabilities to the architecture, and additional, planned research and development over the next few years offers the potential for more diverse and more capable sensors.
>
> - *Provides flexibility to upgrade and adjust the architecture*, and to do so in a cost-effective manner, as the threat evolves. Because of the lower per-interceptor costs and mobility of key elements of the architecture, we will be better postured to adapt this set of defenses to any changes in threat.
>
> We will work with our Allies to integrate this architecture with NATO members' missile defense capabilities, as well as with the emerging NATO command and control network that is under development. One benefit of the phased, adaptive approach is that there is a high degree of flexibility—in addition to sea-based assets, there are many potential locations for the architecture's land-based elements, some of which will be re-locatable. We plan to deploy elements in northern and southern Europe and will be consulting closely at NATO with Allies on the specific deployment options.
>
> We also welcome Russian cooperation to bring its missile defense capabilities into a broader defense of our common strategic interests. We have repeatedly made clear to Russia that missile defense in Europe poses no threat to its strategic deterrent. Rather, the purpose is to strengthen defenses against the growing Iranian missile threat. There is no substitute for Iran complying with its international obligations regarding its nuclear program. But ballistic missile defenses will address the threat from Iran's ballistic missile programs, and diminish the coercive influence that Iran hopes to gain by continuing to develop these destabilizing capabilities.
>
> Through the ongoing Department of Defense ballistic missile defense review, the Secretary of Defense and the Joint Chiefs of Staff will continue to provide recommendations to the President that address other aspects of our ballistic missile defense capabilities and posture around the world.[26]

At a September 17, 2009, DOD news briefing on the PAA, General James Cartwright, the Vice Chairman of the Joint Chiefs of Staff, stated the following:

- The SM-3 "has had eight successful flight tests since 2007. These tests have amply demonstrated the SM-3's capability and have given us greater confidence in the system and its future."
- Regarding the second phase of the proposal, "Consultations have begun with allies, starting with Poland and the Czech Republic, about hosting a land-based version of the SM-3 and other components of the system. Basing some interceptors on land will provide additional coverage and save costs compared to a purely sea-based approach."
- The SM-3 Block 1A "has proven itself in the testing and which we are now fielding in larger numbers. It is a more capable area-defense weapon. It is more

[26] White House news release, September 17, 2009, entitled "Fact Sheet on U.S. Missile Defense Policy A 'Phased, Adaptive Approach' for Missile Defense in Europe," available online at http://www.whitehouse.gov/the_press_office/FACT-SHEET-US-Missile-Defense-Policy-A-Phased-Adaptive-Approach-for-Missile-Defense-in-Europe/.

aligned with trying to take care of a general area like the area from Philadelphia down to Washington, D.C., for an analogy."

- The SM-3 Block 1B "along with better sensors—and the beginning deployment of these airborne sensors, should they manifest themselves in the way we think they will—will allow us to move from a relatively small area—and I talked about Philadelphia to Washington, D.C.—this would be at least three times larger, based on the ability of the missile and the sensor packages to address the threats that are out there."
- The SM-3 Block IIA "will allow us, in probably no more than three locations, to be able to cover the entire land mass of Europe, okay, against intermediate- and short-range ballistic missiles. "
- The SM-3 Block IIB "is an even more energetic capability that will have a substantial capability to intercept intercontinental ballistic missile type capabilities emanating from Iran."
- "What you can do with an SM-3 in affordability and in deployment and dispersal is substantially greater for larger numbers of missiles than we what we have with a ground-based interceptor. A single Aegis can carry a hundred-plus or minus a few, depending on their mission configuration, of the SM-3. So this is a substantial addressal of the proliferation of the threat that we're seeing emerge. If it doesn't emerge, we don't have to build them all, but if it does, we're ready to basically go after it. And so we've put in place an architecture here that allows us to be adaptable. It is a global architecture."
- Regarding the number of Aegis ships that would be maintained on station near Europe for BMD purposes, "on a day-in, day-out basis, we're looking probably for what we would call a 2.0 presence, maybe a 3.0 presence [i.e., two or three ships on station 12 months out of the year], so [two or] three ships at any given time in and around the Mediterranean and the North Sea, et cetera, to protect areas of interest, and then we would surge additional ships. And part of what's in the budget is to get us a sufficient number of ships to allow us to have a global deployment of this capability on a constant basis, with a surge capacity to any one theater at a time."
- Regarding where in Europe land-based SM-3s might be based, "Initially—and it's the [SM-3 Block] IB that we would start with, the land-based system, so about the 2015 time frame. And it's actually relatively agnostic to the where. And so the Czech Republic, Poland, are both candidates. It's certainly something that they have to have a say in, though, as to whether we go there. There are other candidates in that region, and then obviously deeper into Europe, that would be good sites for the SM-3."[27]

Secretary of Defense Robert Gates, who was at the DOD news briefing along with Cartwright, also addressed the issue of where land-based SM-3s might be based, stating:

[27] Transcript of the September 17, 2009, DOD news briefing with Secretary of Defense Robert Gates and Vice Chairman of the Joint Chiefs of Staff General James Cartwright, available online at http://www.defenselink.mil/transcripts/transcript.aspx?transcriptid=4479.

> We still want to partner with Poland. We still want Poland to go forward with the ratification of the agreements that we have with them, including the SOFA. We would prefer to put the SM-3s in Poland, in place of the GBI—the ground-based interceptors. That will still involve a presence of the U.S. They may be there earlier than they would have been with the ground-based interceptors, because, as I said, they would not become operational until probably 2017, 2018. We're talking about 2015 now. So I think that there are—all of the same opportunities for partnership between the United States and Poland that existed under the previous program continue to exist under this program.[28]

At an October 1, 2009, hearing before the House Armed Services Committee, General James E. Cartwright, the Vice Chairman of the Joint Chiefs of Staff, and Michèle A. Flournoy, the Under Secretary of Defense for Policy, stated:

> Thank you, Chairman Skelton, Congressman McKeon, and members of the Committee. We appreciate the opportunity to discuss the Administration's new approach to missile defense in Europe, and to set the record straight that the Obama Administration is committed to deploying timely, cost-effective, and responsive missile defenses to protect the United States, our deployed forces, as well as our friends and allies against ballistic missiles of all ranges.
>
> We are confident that our new approach represents a dramatic improvement over the program of record. Under the old plan, we were not going to be able to deploy a European missile defense system capable of protecting against Iranian missiles until at least 2017. Under our new plan, we'll be able to protect vulnerable parts of Europe and the tens of thousands of US troops stationed there by the end of 2011. We'll also be creating a far more flexible missile defense system, one that can be adapted to provide better protection against emerging threats. And finally, we'll be able to enhance protections for the U.S. homeland against possible future threats from long-range ICBMs.
>
> Before going into details, I would like to place this decision about European missile defense in context. As you know, we are in the midst of several major defense reviews, one of which is a congressionally-mandated review of our approach to ballistic missile defense. DOD is leading that review, with active participation from the intelligence community and a number of other agencies. That review is comprehensive and ongoing; it examines our strategic and operational approach to missile defense not just in Europe but around the world.
>
> The review is moving forward based on four key principles:
>
> 1) We must ensure that US missile defenses are responsive to the threats we face today and are likely to face in the future, that the technologies we use are proven and effective, and that our defenses are cost effective;
>
> 2) We must maintain and improve defenses for the US and our allies against potential missile attacks from countries such as Iran and North Korea;
>
> 3) We must renew our emphasis on protecting US deployed forces and their dependents in theater, as well as US Allies and partners against regional threats; and
>
> 4) We must continue to make missile defense an important feature of our international cooperation efforts.

[28] Transcript of the September 17, 2009, DOD news briefing with Secretary of Defense Robert Gates and Vice Chairman of the Joint Chiefs of Staff General James Cartwright, available online at http://www.defenselink.mil/transcripts/transcript.aspx?transcriptid=4479.

The results of the Ballistic Missile Defense Review are not due back to Congress until January, but as we began our in-depth analysis, it became clear very early that circumstances had changed fundamentally with regard to missile defense in Europe, so that we would need to make some significant adjustments to the previous administration's plans.

Let me start by discussing what has changed since early 2007, when the previous administration decided to seek deployment of ground-based interceptors in Poland, a European Mid-Course radar (EMR) in the Czech Republic, and an AN/TPY-2 radar elsewhere in the region. The decision to move forward with that particular configuration was made nearly three years ago, based on the threat information and the technologies available at that time.

Circumstances have changed significantly since early 2007, however.

First, we now have a rather different intelligence picture than we had three years ago, particularly with regard to Iranian capabilities. And second, we have made major strides in missile defense technologies and capabilities in just the last few years. We are now in a position to put an effective missile defense system in place far more rapidly than we were a few years ago, one that will be far more flexible, adaptable, and capable.

The intelligence community now assesses that the threat from Iran's short- and medium-range ballistic missiles is developing more rapidly than previously projected, while the threat of potential Iranian intercontinental ballistic missile (ICBM) capabilities has been slower to develop than previously estimated. Iran already possesses hundreds of ballistic missile capable of reaching neighbors in the Middle East, Turkey and the Caucasus, and is actively developing and testing missiles that can reach further into Europe. Our intelligence assessments indicate that the continued production and deployment of these more capable medium-range missiles has become one of Iran's highest missile priorities.

In the near-to mid-term, what this means is that the primary threat posed by Iranian missiles will be to US allies, our 80,000 deployed forces in the Middle East and Europe, and our civilian personnel and the many accompanying families. And needless to say, this concern is all the more urgent in light of Iran's continued uranium enrichment program. Iran continues to defy international obligations, and there continues to be reason to fear that Iran is seeking a nuclear weapons option.

We hope that won't come to pass. But obviously it increases the urgency of developing a truly effective missile defense system in Europe for the protection of NATO territory and population and the US homeland. Missile defense is not a substitute for the critically important diplomatic efforts the U.S. and the international community are already engaged in with Iran, but strong missile defense can complement diplomatic efforts by providing an effective deterrent.

As the Secretary of Defense has noted, we understand that intelligence projections can be wrong, which makes it all the more important for us to have a flexible and adaptable missile defense system that can evolve with the threat. Iran may change its priorities and capabilities and ways we can't entirely predict. So we remain very concerned about Iran's potential to develop ICBMs in the future, and part of our approach is to maintain and improve robust homeland defense capabilities to ensure that we can effectively counter any future ICBM threats, whether they come from Iran or North Korea or any other adversary.

But I'll come back to that in a moment. I've described the changed intelligence assessments that lead us to consider short and medium-range missiles the greatest near-term threat. As I mentioned, however, the threat assessment is not the only thing that has changed since the

program of record was planned nearly three years ago. The second thing that has changed is the technologies and capabilities available to us.

Technological developments over the past several years have led to new capabilities, demonstrated in multiple tests. Improved interceptor capabilities now offer us more flexible and capable missile defense architecture, and we have also significantly improved our sensor technologies. That means we now have a variety of better options to detect and track enemy missiles and guide the interceptor in-flight to enable a successful engagement. As a result, we now have new and proven missile defense options that were not available even a few years ago.

The previous plan, approved in early 2007, relied on two large, fixed missile-defense sites, with 10 ground-based interceptors in Poland and the EMR in the Czech Republic. It was designed to identify and destroy up to about five to ten long-range missiles, and as noted, the radar and interceptors called for under the old plan would not have been in place until at least 2017.

Our new approach, which the President adopted on the unanimous recommendation of the Secretary of Defense and the Joint Chiefs of Staff, will rely on a distributed network of sensors and SM-3 interceptors. The SM-3 IA has had eight successful tests since 2007, and it is more than capable of dealing with current threats from even multiple short and medium-range missiles. It and future variants also have many advantages over a Ground Based Interceptor (GBI). The SM-3 is much smaller, weighing only about 1 ton compared to the GBI's 20 tons. Because it is smaller and fits inside a vertical launch canister, it can be fired both from Aegis capable ships and, starting with the SM-3IB, from land.

The capability of having a missile defense system that can integrate sensors and interceptor sites located both at sea and on land offers us geographic flexibility that was unavailable under the previous plan. Furthermore, the resulting distributed network is more survivable in the case of an attack than the single large radar and single missile field of the previous plan. The SM-3 IA and IB, at around $10 million per interceptor, are also much cheaper than a GBI, which costs around $70 million per interceptor. This means that we can deploy scores of SM-3 interceptors, again enhancing our defensive capabilities. Since Iran already possesses hundreds of short and medium range ballistic missiles, this improved defensive capability is critical.

Our new plan for European missile defense involves a phased, adaptive approach. As our capabilities and technologies continue to improve, the architecture will evolve and become ever more capable. Specifically, we are phasing in SM-3 upgrades over time. Each SM-3 upgrade will provide more capability for countering Iranian threats, meaning each upgrade will be able to defend an increasingly larger area.

Phase 1 of our approach to missile defense in Europe is already underway; the SM-3 Block IA is already deployed in the fleet. In this first phase of our plan, we can provide SM-3 Block IA capable warships when necessary for the protection of parts of southern Europe. To enhance protection in Phase 1, we will also rely on a forward based sensor, probably a TPY-2 radar. We expect that full Phase I missile defense capability will be possible in 2011.

By including a forward based sensor in Phase 1, we are retaining one of the most significant contributions to the defense of the United States from the previously proposed architecture. The forward based sensor will not only help protect the region, but will also contribute to the defense of the United States homeland by providing early and precise track data to our Ground-Based Interceptors in Alaska and California.

In Phase 2, to be completed by 2015, we intend to use a more advanced version of the SM-3 interceptor, the SM-3 Block IB, which is already under development. We will deploy this at sea and on land. By adding the land-based sites, we will significantly increase coverage of NATO against ballistic missiles from Iran without having to increase the number of Aegis BMD ships—a much more cost effective approach.

In Phase 3, we will introduce a new, more capable version of the SM-3, the Block IIA. The SM-3 Block IIA will provide full coverage of NATO against short, medium, and intermediate range ballistic missiles. We expect to deploy the SM-3 Block IIA by 2018.

In the final phase, Phase 4, we expect to field an even more-improved SM-3 missile that has anti-ICBM capabilities. This ascent-phase intercept capability will further augment the defense of the US homeland from potential Iranian ICBM threats. This phase is planned for 2020.

It is important to note that the SM-3-based defense against any Iranian ICBMs will be in addition to the GBI-based defense we already have deployed in the United States, at Fort Greely and Vandenberg AFB. As noted previously, these U.S.-based defenses will be made more effective by the forward-basing of a TPY-2 radar—which we plan by 2011.

We currently have the ability to defend the United States (including the East Coast) against any Iranian ICBM, and with the TPY-2 deployment planned in Phase I and continued improvement of the GBIs, this defense will grow even stronger in the next several years.

While we expect the SM-3-based approach to ICBM defense to be effective on its own, we also will continue to improve our existing GBI-based system here in the United States and conduct tests of the 2-stage GBI in the near-term. The SM-3s ascent-phased intercept capability in Phase 4 would mean that, unlike the previous administration's GBI-based system, Iranian missiles would have to defeat not one, but two very different kinds of missile defenses. This is something I want to underline, since it has at times been misunderstood: we are already capable of countering all current Iranian missile threats to the US homeland, and this will not change. Our defenses of the US homeland will only grow stronger as we proceed with our new approach.

But back to Europe: Over time, we plan on one land-based site in southern Europe and one somewhere in northern Europe. Given the flexibility of the architecture, there are a number of options for land-based sites that would provide the same capability, including in Poland. The mix of sea-and land-based systems makes our new approach far more capable and adaptable than the program of record, because we can move sensors and interceptors from region to region as needed. This approach also allows us to scale up our defenses, if necessary, by deploying additional SM-3 interceptors much faster and at lower costs than by adding the program of record's much heavier Ground Based Interceptors and their associated silos.

In times of crisis, the system can "flex" by surging Aegis capable ships to the area for more protection and to serve as a visible deterrent. This approach also allows us to deal with a wider range of potential missile tactics, such as salvo launches. The previous GBI architecture could intercept about five to ten missiles at most; the new plan's distributed network will be able to cope far more effectively should an adversary fire many missiles simultaneously.

Similarly, replacing the fixed radar site with a mix of sensors that are airborne, seaborne and ground-based will allow us to gather much more accurate data, and will offer better early warning and tracking options combined with a stronger networking capacity. Finally, because it relies on a distributed network of sensors and interceptors, the new approach is

more survivable—less vulnerable to destruction or disruption—than the previous plan, which relied on a single large radar and a single interceptor field.

It should be crystal clear that those who say we are "scrapping" missile defense in Europe are, as Secretary Gates has said, "either misinformed or misrepresenting the reality of what we are doing." In fact, we are replacing the previous plan with a phased approach that delivers more effective and more robust capability sooner.

To sum up: the new Phased Adaptive Approach offers many advantages over the previous plan for European missile defense. We will now be able to defend the most vulnerable parts of Europe 6-7 years earlier than the previous plan. Our new approach will be also able to cover all NATO territory and populations, rather than leaving some allies exposed to short- and medium-range threats. And we will move toward a new additive approach to defending the United States against any future Iranian ICBM—while continuing to enhance our existing GBI-based defenses. Overall, our new approach allows us to better respond to existing threats now—and to better prepare for future threats as they emerge.

Those who assert that the new plan doesn't uphold U.S. security commitments to friends and allies, particularly Poland and the Czech Republic, are far off the mark. This is a better defense for Europe as well as for the United States. All of our missile defense efforts will be complementary of and interoperable with those being developed by NATO, and the new architecture we are creating provides many opportunities for alliance-building and burden-sharing between the United States and our NATO partners. NATO Secretary General Rasmussen has hailed our decision as "a positive step"; Polish Prime Minister Donald Tusk said it offers a real "chance to strengthen Europe's security."

We remain firmly committed to strong bilateral relationships with both Poland and the Czech Republic and have already begun discussions with both nations about their potential roles in the new missile defense architecture. In the coming weeks, we will have numerous strategic discussions with the Poles on missile defense and our security arrangements. It is prudent that we continue to seek Polish ratification of the missile defense basing agreement and supplemental Status of Forces Agreement.

We are also in discussions with the Czech Republic to ensure that they continue to play a leadership role on missile defense within the Alliance. We have several joint projects already underway with our Czech partners, and are discussing several more.

Two weeks ago, in addition to visiting Warsaw and Prague to discuss the Phased, Adaptive Approach, I briefed the North Atlantic Council on our new approach and emphasized that we will pursue missile defense in a NATO context. The response was very positive, as evidenced by the NATO Secretary General's comments last week that "It is my clear impression that the American plan on missile defense will involve NATO…to a higher degree in the future…This is a positive step in the direction of an inclusive and transparent process, which I also think is in the interest of…the NATO alliance."

This phased adaptive approach better meets our security needs, and our security commitments to our European allies and partners. Russia's positive response to date is a useful collateral benefit, though we are not sure whether and how it will affect their perspective on missile defenses. We welcome Russian interest in our new approach as well as potential cooperation in sharing data from their radars. But this is not about Russia, and regardless of Russian reactions, we will continue to do whatever it takes to ensure our security and that of our European partners and allies.

> In closing, it is important to note that the strategic thinking behind our new approach to European missile defense will also be valuable as we continue to address missile defense issues in other regions.
>
> Because the type of system we are planning in Europe can be easily adapted to different geographic constraints, it can be applied in various regions around the globe, if necessary. In fact, a scaled-down version of this approach is already being used for the defense of Japan against North Korean missile threats, and for the defense of Israel against an Iranian missile attack. Because the assets of this system are either mobile or transportable, the new approach provides future flexibility to reposition interceptors and sensors if the geopolitical environment changes. And because the systems will be upgraded over time, the new approach provides a natural evolution to match the threat.
>
> As the President said, "our new missile defense architecture in Europe will provide a stronger, smarter, and swifter defense of American forces, and America's allies. It is more comprehensive than our previous program. It deploys capabilities that are proven (SM-3 IA) and cost-effective. And it sustains and builds upon our commitment to protect the U.S. homeland against long-range ballistic missile threats. And it ensures and enhances the protection of all of our NATO allies."
>
> Thank you for your time. We will continue to work with you as we move forward on the Ballistic Missile Defense Review, and I look forward to your questions. [29]

At the same hearing, Lieutenant General Patrick J. O'Reilly, the Director of MDA, stated:

> Good morning, Mr. Chairman, Mr. McKeon, distinguished Members of the Committee. I appreciate the opportunity to testify before you today on the technical and programmatic details of the President's decision to use a Phased Adaptive Approach to enhance missile defense protection for the United States and Europe for our friends, Allies, our forward deployed forces, civilian personnel, and their families there. This new proposal would provide a more powerful missile defense capability for NATO, enhance U.S. homeland defense, would be applicable in other theaters around the world to counter a growing ballistic missile threat, and would be more adaptable to respond to threat uncertainties and developments. With the Phased Adaptive Approach, we are not scrapping or diminishing missile defense—rather we are strengthening it and delivering more capability sooner.
>
> In 2006 the Defense Department proposed a long-range missile defense of Europe that consisted of four components: a command and control system; 10 Ground Based Interceptors (or GBIs) in Poland; an X- band discrimination radar in the Czech Republic; and an X-band precision tracking radar forward based in Southern Europe. Assuming a shot doctrine of two interceptors against each threat missile, the 2006 proposed missile defense architecture provided an upper-tier missile defense to intercept five Intermediate Range Ballistic Missiles (IRBMs) aimed at Europe, or it could intercept five Intercontinental Ballistic Missiles (ICBMs) aimed at the Continental United States from the Middle East. The most important component of the 2006 proposed architecture to the defense of the U.S. homeland was the forward based X-band radar in Southern Europe, which provided early and precise tracking of threat missiles from the Middle East, increasing the accuracy of the fire control instructions to our GBIs based at Fort Greely, Alaska and Vandenberg Air Force Base, California. We remain concerned about a future Iranian ICBM threat; therefore, we are

[29] Opening Statement of VCJCS [General James E. Cartwright, USMC, Vice Chairman, Joint Chiefs of Staff] and USDP [Honorable Michèle A. Flournoy, Under Secretary of Defense for Policy, Department of Defense] [at] HASC hearing on European Missile Defense, October 1, 2009, 8 pp.

retaining the forward-based X-band radar of the 2006 proposed European missile defense architecture in our new Phased Adaptive Approach proposal. We will also continue to improve our domestic GBI-based system and conduct research and development for the two-stage GBI in the near term.

Under the Phased, Adaptive Approach, we propose defending Europe in phases starting with the area most vulnerable to today's Iranian missile threat: southern Europe. Phase 1 would consist of Aegis ships with Standard Missile (SM)-3 Block IA missiles deployed in the Mediterranean Sea and a forward-based sensor in southern Europe. This will provide protection across much of the southern tier of Europe against Iranian medium-range ballistic missiles.

We propose by 2015 the deployment of the SM-3 Block IB missile, which will have a greater capacity to use a network of sensors and greater ability to discriminate threat objects. Once this technology is proven in our test program these interceptors would be deployed at land- and sea-based locations and extend protection against medium-range ballistic missiles launched from the Middle East.

By 2018, the deployment of the SM-3 Block IIA missile, an interceptor with greater range currently being developed, could defend all of Europe from land- and sea-based locations. By 2020, our goal is to leverage the lightweight kill vehicle technology developed in the now terminated Multiple Kill Vehicle program to develop a higher velocity SM-3 Block IIB missile that would destroy ballistic missiles early in flight, during the ascent phase, from many hundreds of kilometers from the threat launch location. This missile would still fit on today's Aegis launch system. With that capability, two land-based SM-3 Block IIB sites could protect all of Europe. The timelines I have presented allow for missile defense technologies to be tested and proven prior to deployment decisions.

A significant limitation of the previous European architecture was that the GBIs were used in both ICBM and IRBM defense roles. Although we have only tested the GBIs against IRBMs (ranges less than 5,000 km), it is currently our only interceptor designed against ICBMs. The earliest operational date of the 2006 proposed architecture is 2017 and more likely 2018 considering the host nation approvals that would have been required to construct the facilities. When deployed in 2017 the European based GBIs could be consumed by an attack of 5 IRBMs aimed at NATO countries, leaving no two-stage GBIs to contribute to U.S. ICBM defense. Therefore, the previously proposed European Defense architecture is insufficient to counter large raid sizes. Under the Phased, Adaptive Approach, the SM-3 Block IIB would be able to accommodate a large IRBM and ICBM missile threat and diversify the technology that we are using to counter Iranian ICBMs, providing a layered defense.

We have made significant advances in missile defense technologies that enable the Phased Adaptive Approach. First, the interceptors we are developing are smaller, faster and have greater on-board discrimination capability. The sea-based Aegis BMD SM-3 interceptor would provide a very capable weapon for this particular mission due to its high acceleration, burn out velocity, proven track record (for the SM-3 IA), and our ability to rapidly increase the number of interceptors at any launch site. Since we began testing the operationally configured SM-3 Block 1A missile in June 2006, we successfully intercepted the target in 8 out of 9 attempts. We are also taking a deliberate approach to the development and testing of the next generation kill vehicle for the SM-3 interceptor, the SM-3 1B, which has a more advanced seeker and a fire control system that uses external sensors as well as its ship's radar. We have already demonstrated the higher risk components of the new kill vehicle: the solid propellant Divert and Attitude Control System, new seeker, and fire control system with good results. The first test of the SM-3 1B is scheduled for the winter of 2011.

The area of greatest opportunity for increased missile defense capability involves our achievements in developing faster and more accurate Command Control, Battle Management, and Communication capabilities, which combine data from a network of many different sensors (especially sensors that track missiles in the early phases of their flight), rather than using single large radars. Key to our successful intercept of the ailing satellite in February 2008 was our ability to combine data from sensors around the world and provide a highly accurate track of the satellite to an Aegis ballistic missile defense ship and launch the modified SM-3 1A prior to the ship's radar seeing the satellite. We have had many other demonstrations of these capabilities to date, to include the most recent intercept test of the Ground-based Midcourse Defense system last December, when we combined the tracks of satellites, early warning radars, Sea Based X-band radar and forward-based radars on land and at sea to provide the GBIs with a very accurate targeting track. Additionally, we have also demonstrated the capability of Unmanned Aerial Vehicles as highly accurate forward-based missile defense sensors in the Navy's "Stellar Daggers" series of intercept tests last spring. Last week, we launched a pair of demonstration Space Tracking and Surveillance System (STSS) satellites that will detect and track ballistic missiles over their entire flight. Over the next few years we will conduct several tests using the tracking capabilities of these STSS demonstration satellites, including the launching of an interceptor from an Aegis ship, to intercept ballistic missile targets. Finally, at our External Sensors Laboratory at Schriever Air Force Base, Colorado, we continue to develop new algorithms and combine new sensor data to achieve even more accurate tracks than any individual sensor could produce.

A more advanced variant of the SM-3 has been under development since FY 2006. This interceptor will have the range to defend all of NATO from only a few small sites. This SM-3 is also more affordable than GBIs (you can buy four to seven production variants of the SM-3s (IA or IB) for the cost of one GBI). But the key attribute is that we can launch SM-3s from sea or sites on land, which gives us great flexibility in locating the interceptor launch point between the origin of the threat launch and the area we are trying to protect—a key enabler to intercepting threat missiles early in flight. One advantage of land-based SM-3s over the previous GBI missile field proposal is that they can be relocated if the direction of the threat changes rather than waiting the more than five years needed to construct a new GBI missile field.

I would note that the new Phased Adaptive Approach offers greater opportunities for our close allies, including Poland and the Czech Republic, to collaborate on the missile defense architecture—by hosting sites or providing funding or capabilities that could be linked to provide a network of missile defenses. Likewise, the radars at Armavir and Gabala could augment the proposed sensor network and that type of cooperation could perhaps be a catalyst for Russia to join countries participating in our cooperative development of missile defense technologies.

An additional advantage of the Phased Adaptive Approach is that efforts over the next several years to develop, test, and procure the sensor, command and control, and interceptor upgrades for deployment of this architecture have application in the United States and theaters other than Europe.

We are committed to fully funding this program as we prepare for the next budget submission to Congress. However, it is important that we have relief from rescissions and the flexibility to spend the unused FY 2009 RDT&E and some MILCON dollars associated with the previous European Site proposal. With relief from some of the constraints placed on our FY 2009 budget and some redirection of FY 2010 funds, we believe we can pursue this new architecture within our FY 2010 budget request.

I would note that both House and Senate authorizing committees very presciently included provisions in this year's National Defense Authorization bill that permit the Department to

use FY 2009 and FY 2010 funding for an alternative architecture once the Secretary of Defense certifies that this architecture is as cost-effective, technically reliable, and operationally available as the previous program. I believe the President's new plan meets these criteria and would strongly reinforce NATO's overall approach to missile defense.

My assessment is that executing this approach is challenging, but no more challenging than the development of other missile defense technologies. It is more adaptable, survivable, affordable, and responsive than the previous proposal, and it enhances the resulting defense of the U.S. homeland and our European Allies. There will be setbacks, but the engineering is executable and development risks are manageable.

I look forward to discussing the specifics of the Phased, Adaptive Approach with Members and staff in this and other forums.

Thank you and I look forward to your questions. [30]

[30] Unclassified Statement of Lieutenant General Patrick J. O'Reilly, USA, Director, Missile Defense Agency, Before the House Armed Services Committee Regarding Missile Defense in Europe, Thursday, October 1, 2009, 9 pp.

Appendix B. Aegis BMD Flight Tests

Table B-1 summarizes Aegis BMD exo-atmospheric and endo-atmospheric flight tests since January 2002.

Table B-1. Aegis BMD Flight Tests Since January 2002

Date	Country	Name of Flight Test	Successful?	Cumulative Successes	Cumulative Attempts
Exo-atmospheric (using SM-3 missile)					
1/25/02	US	FM-2	Yes	1	1
6/13/02	US	FM-3	Yes	2	2
11/21/02	US	FM-4	Yes	3	3
6/17/03	US	FM-5	**No**	3	4
12/11/03	US	FM-6	Yes	4	5
2/24/05	US	FTM 04-1 (FM-7)	Yes	5	6
11/17/05	US	FTM 04-2 (FM-8)	Yes	6	7
6/22/06	US	FTM 10	Yes	7	8
12/7/06	US	FTM 11	**No**	7	9
4/26/07	US	FTM 11 Event 4	Yes	8	10
6/22/07	US	FTM 12	Yes	9	11
8/31/07	US	n/a	Yes	10	12
11/6/07	US	FTM 13	Yes	11	13
			Yes	12	14
12/17/07	Japan	JFTM 1	Yes	13	15
11/1/08	US	PACBLITZ 08	Yes	14	16
			No	14	17
11/19/08	Japan	JFTM 2	**No**	14	18
7/30/09	US	FTM 17	Yes	15	19
10/28/09	Japan	JFTM 3	Yes	16	20
Endo-atmospheric (using SM-2 missile)					
5/24/06	US	n/a	Yes	1	1
6/5/08	US	FTM 14	Yes	2	2
3/26/09	US	Stellar Daggers	Yes	3	3
Combined total for exo- and endo-atmospheric tests					
n/a	US and Japan		n/a	19	23

Source: Prepared by CRS based on MDA briefing to CRS and CBO on March 18, 2010, and DOD data.

Details On Selected Exo-Atmospheric (SM-3) Flight Tests

June 22, 2006, Test. This was the first test to use the 3.6 version of the Aegis BMD system.[31]

December 7, 2006, Test. This was the first unsuccessful flight test since June 2003. MDA stated that the ninth test

> 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 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.[32]

A news article about the ninth 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.

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

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

> 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.[33]

A subsequent news article stated:

> the test abort of the Aegis Ballistic Missile Defense system Dec. 7 resulted from human error, [MDA Director USAF Lt. Gen. Henry] Obering says.... Both the ballistic missile and aircraft targets launched as planned, but the first interceptor failed to fire because an operator had selected an incorrect setting for the test. Officials then aborted before the second could boost.
>
> Aegis missile defense system tests are at a standstill until officials are able to identify an appropriate ballistic missile target. The one used Dec. 7 was the last of its kind, Obering says, leaving them empty handed in the near future.[34]

Another article stated:

> 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."[35]

April 26, 2007, Test. MDA states that this test:

> involved the simultaneous engagements of a ballistic missile "unitary" target (meaning that the target warhead and booster remain attached) and a surrogate hostile air target....
>
> The test demonstrated the [Aegis ship's] ability to engage a ballistic missile threat and defend itself from attack at the same time. The test also demonstrated the effectiveness of engineering, manufacturing, and mission assurance changes in the solid divert and attitude control system (SDACS) in the kinetic kill weapon. This was the first flight test of all the SM-3 Block IA's upgrades, previously demonstrated in ground tests.[36]

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[33] David Briscoe, "Test Interceptor Missile Fails To Launch," *NavyTimes.com*, December 8, 2006.

[34] Amy Butler, "GMD Trial Delayed Until Spring; Aegis Failure Human Error," *Aerospace Daily & Defense Report*, December 19, 2006.

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

[36] Missile Defense Agency, "Successful Sea-Based Missile Defense 'Hit to Kill' Intercept," April 26, 2007 (07-NEWS-0032).

A press report on the test stated that the hostile air target was an anti-ship cruise missile. The article stated that the scenario for the test

> called for the [Aegis ship] to come under attack from a cruise missile fired by an enemy plane.... A Navy plane fired the cruise missile target used in the test.[37]

June 22, 2007, Test. MDA states that this test

> was the third intercept involving a separating target and the first time an Aegis BMD-equipped destroyer was used to launch the interceptor missile. The USS Decatur (DDG 73), using the operationally-certified Aegis Ballistic Missile Defense Weapon System (BMD 3.6) and the Standard Missile-3 (SM-3) Block IA missile successfully intercepted the target during its midcourse phase of flight....
>
> An Aegis cruiser, USS Port Royal (CG 73), a Spanish frigate, MÉNDEZ NÚÑEZ (F-104), and MDA's Terminal High Altitude Area Defense (THAAD) mobile ground-based radar also participated in the flight test. USS Port Royal used the flight test to support development of the new Aegis BMD SPY-1B radar signal processor, collecting performance data on its increased target detection and discrimination capabilities. MÉNDEZ NÚÑEZ, stationed off Kauai, performed long-range surveillance and track operations as a training event to assess the future capabilities of the F-100 Class. The THAAD radar tracked the target and exchanged tracking data with the Aegis BMD cruiser.
>
> This event marked the third time that an allied military unit participated in a U.S. Aegis BMD test, with warships from Japan and the Netherlands participating in earlier tests.[38]

August 31, 2007, Test. MDA has publicly noted the occurrence of this test and the fact that it resulted in a successful intercept,[39] but states that the details about the test are classified.[40] MDA does not appear to have issued a news release about this flight test following the completion of the test, as it has for other Aegis BMD flight tests.[41]

November 6, 2007, Test. MDA states that this test involved:

> a multiple simultaneous engagement involving two ballistic missile targets.... For the first time, the operationally realistic test involved two unitary "non-separating" targets, meaning that the target's warheads did not separate from their booster rockets....

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[37] Audrey McAvoy, "Aegis Missile Test Successful," *NavyTimes.com*, April 27, 2007.

[38] Missile Defense Agency, "Sea-Based Missile Defense 'Hit to Kill' Intercept Achieved," June 22, 2007 (07-NEWS-0037).

[39] See for example, slide 8 in the 20-slide briefing entitled "Ballistic Missile Defense Program Overview For The Congressional Breakfast Seminar Series," dated June 20, 2008, presented by Lieutenant General Trey Obering, USAF, Director, Missile Defense Agency. Source for briefing: *InsideDefense.com* (subscription required). Each slide in the briefing includes a note indicating that it was approved by MDA for public release on June 13, 2008. Slide 8 lists Aegis BMD midcourse flight tests conducted since September 2005, including a test on August 31, 2007. The slide indicates with a check mark that the flight test was successful. A success in this test is also needed to for the total number of successful intercepts to match the reported figure.

[40] An email from MDA to CRS dated June 30, 2008, states that the flight test "was a hit to kill intercept test but details about the test are classified."

[41] MDA's website, when accessed on June 30, 2008, did not show a news release issued on of soon after August 31, 2007, that discusses this test.

> At approximately 6:12 p.m. Hawaii Standard Time (11:12 p.m. EST), a target was launched from the Pacific Missile Range Facility (PMRF), Barking Sands, Kauai, Hawaii. Moments later, a second, identical target was launched from the PMRF. The USS Lake Erie's Aegis BMD Weapon System detected and tracked the targets and developed fire control solutions.
>
> Approximately two minutes later, the USS Lake Erie's crew fired two SM-3 missiles, and two minutes later they successfully intercepted the targets outside the earth's atmosphere more than 100 miles above the Pacific Ocean and 250 miles northwest of Kauai....
>
> A Japanese destroyer also participated in the flight test. Stationed off Kauai and equipped with the certified 3.6 Aegis BMD weapon system, the guided missile destroyer JS Kongo performed long-range surveillance and tracking exercises. The Kongo used the test as a training exercise in preparation for the first ballistic missile intercept test by a Japanese ship planned for later this year. This event marked the fourth time an allied military unit participated in a U.S. Aegis BMDS test.[42]

December 17, 2007, Test. In this flight test, a BMD-capable Japanese Aegis destroyer used an SM-3 Block IA missile to successfully intercept a ballistic missile target in a flight test off the coast of Hawaii. It was the first time that a non-U.S. ship had intercepted a ballistic missile using the Aegis BMD system.[43]

November 1, 2008, Test. This flight test was reportedly the first U.S. Navy Aegis BMD flight test conducted by the Navy, without oversight by MDA. The test involved two Aegis ships, each attempting to intercept a ballistic missile. The SM-3 fired by the first Aegis ship successfully intercepted its target, but the SM-3 fired by the second Aegis ship did not intercept its target. A press release from the U.S. Third Fleet (the Navy's fleet for the Eastern Pacific) states that:

> Vice Adm. Samuel J. Locklear, Commander, U.S. Third Fleet announced today the successful Navy intercept of a ballistic missile target over the Pacific Ocean during Fleet Exercise Pacific Blitz. This was the first Fleet operational firing to employ the Standard Missile-3 (SM-3) against a ballistic missile target. Command and control of this mission resided with Commander, U.S. Third Fleet, based in San Diego, Calif.
>
> Pearl Harbor-based Aegis destroyers, USS Paul Hamilton (DDG 60) and USS Hopper (DDG 70), which have been upgraded to engage ballistic missiles, fired SM-3 missiles at separate targets. During this event, a short-range ballistic missile target was launched from the Pacific Missile Range Facility (PMRF), Barking Sands, Kauai, Hawaii. Upon detecting and tracking the target, USS Paul Hamilton, launched a SM-3 missile, resulting in a direct-hit intercept. Following USS Paul Hamilton's engagement, PMRF launched another target. USS Hopper successfully detected, tracked and engaged the target. The SM-3 followed a nominal trajectory, however intercept was not achieved. Extensive analysis of the flight mission will be used to improve the deployed Aegis BMD system.[44]

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[42] Missile Defense Agency, "Sea-Based Missile Defense "Hit to Kill" Intercept Achieved," November 6, 2007 (07-NEWS-0051).

[43] John Liang, "Japanese Destroyer Shoots Down Ballistic Missile Test Target," *Inside Missile Defense*, December 19, 2007; "Japanese Aegis Destroyer Wins Test By Killing Target Missile With SM-3 Interceptor," *Defense Daily*, December 18, 2007; Reuters, "Japanese Ship Downs Missile In Pacific Test," *New York Times*, December 18, 2007: 8; Audrey McAvoy, "Japan Intercepts Missile In Test Off Hawaii," NavyTimes.com, December 17, 2007.

[44] Commander, U.S. Third Fleet, Public Affairs Office, press release 23-08, dated November 1, 2008, entitled "Navy Intercepts Ballistic Missile Target in Fleet Exercise Pacific Blitz." See also Dave Ahearn, "One of Two Missiles Hit In Aegis Test; Navy For First Time Runs Test Instead of MDA," *Defense Daily*, November 4, 2008: 1-2.

November 19, 2008, Test. This was the second Japanese flight test, and involved a single ballistic missile target. The test did not result in a successful intercept. MDA states that:

> Rear Admiral Tomohisa Takei, Director General of Operations and Plans, for the Japanese Maritime Staff Office (MSO), Japan Maritime Self Defense Force (JMSDF), and Lt. General Henry "Trey" Obering, United States Missile Defense Agency director, announced the completion today of a cooperative sea-based Aegis Ballistic Missile Defense intercept flight test off the coast of Kauai in Hawaii. The event, designated Japan Flight Test Mission 2 (JFTM-2), marked the second attempt by an Allied naval ship to intercept a ballistic missile target with the sea-based midcourse engagement capability provided by Aegis Ballistic Missile Defense. Target performance, interceptor missile launch and flyout, and operation of the Aegis Weapon System by the crew were successful, but an intercept was not achieved.
>
> The JFTM-2 was a test of the newest engagement capability of the Aegis Ballistic Missile Defense configuration of the recently upgraded Japanese destroyer, JS CHOKAI (DDG-176). At approximately 4:21 pm (HST), 11:21 am (Tokyo time) a ballistic missile target was launched from the Pacific Missile Range Facility, Barking Sands, Kauai, Hawaii. JS CHOKAI crew members detected and tracked the target using an advanced on-board radar. The Aegis Weapon System then developed a fire control solution, and at approximately 4:24 pm (HST), 11:24 am (Tokyo time) on Nov 20, a single Standard Missile -3 (SM-3) Block IA was launched. Approximately two minutes later, the SM-3 failed to intercept the target. There is no immediate explanation for the failed intercept attempt. More information will be available after a thorough investigation. The JS CHOKAI crew performance was excellent in executing the mission. JFTM-2 was the second time that a Japanese ship was designated to launch the interceptor missile, a major milestone in the growing cooperation between Japan and the U.S.[45]

A November 21, 2008, press report states that:

> An Aegis ballistic missile defense (BMD) test by the Japanese destroyer Chokai (DDG-176) ended in failure when the Standard Missile-3 Block 1A interceptor lost track of the target missile in the final seconds before a planned hit-to-kill.
>
> The Chokai and its crew performed well throughout the test, and the SM-3 also performed flawlessly through its first three stages, according to Rear Adm. Brad Hicks, the U.S. Navy Aegis ballistic missile defense program director. He spoke with several reporters in a teleconference around midnight ET Wednesday-Thursday, after the test in the area of the Pacific Missile Range Facility, Barking Sands, Kauai, Hawaii.
>
> This was the second Aegis BMD test failure in less than a month.
>
> These latest two failures come as some Democrats in Congress are poised to cut spending on missile defense programs when they convene next year to consider the Missile Defense Agency budget for the fiscal year ending Sept. 30, 2010....
>
> Still, in the coming money debates next year, missile defense advocates will be able to point out that even including the Hopper and Chokai failures, the record for the Aegis tests is an overwhelming 16 successful hits demolishing target missiles out of 20 attempts.

[45] Missile Defense Agency press release 08-News-0087, dated November 19, 2008, entitled "Japan/U.S. Missile Defense Flight Test Completed."

> Those successes included the first Japanese attempt. The Japanese destroyer Kongo (DDG-173) successfully used its SM-3 interceptor to kill a target missile. The difference in tests is that the Kongo crew was advised beforehand when the target missile would be launched, while the Chokai crew wasn't....
>
> [Hicks] said a board will be convened to examine why the latest test failed. Hicks declined to speculate on why the SM-3 interceptor missed the target. "I'm confident we'll find out the root cause" of the Chokai interceptor failure to score a hit, he said.
>
> However, he was asked by *Space & Missile Defense Report* whether the prior SM-3 successes make it unlikely the Chokai failure stems from some basic design flaw in all SM-3s, and whether it is more likely that the Chokai SM-3 failed because of some flaw or glitch in just that one interceptor.
>
> Hicks said that is likely.
>
> "Obviously, we believe this is hopefully related to this one interceptor," and doesn't reflect any basic design flaw in the SM-3 interceptors, he said.
>
> The Chokai test failure cost Japan a $55 million loss, he said, adding, "It wasn't cheap."...
>
> In the Chokai test, the target missile was launched from Barking Sands, and about three minutes later the Chokai crew had spotted the target, the Aegis system had developed a tracking and hit solution, and the SM-3 interceptor was launched.
>
> The first, second and third stages of the interceptor performed nominally, without problems, but then came the fourth stage. The nosecone components opened to expose the kill vehicle area, and somehow the program to track the target missile failed.
>
> "It lost track," Hicks said, only seconds before the hit would have been achieved.
>
> If the kill had occurred, it would have been about 100 nautical miles (roughly 115 statute miles) above Earth, and some 250 miles away from Barking Sands, Hicks said.
>
> It took the interceptor about two minutes flight time to reach the near miss with the target missile.
>
> Meanwhile, the Hamilton was nearby watching the test. The Hamilton Aegis system successfully spotted and tracked the target, and developed a simulated solution and simulated interceptor launch that, if it had been real, would have resulted in a successful hit on the target, Hicks said. The Hamilton didn't cue the Chokai, however. "It was strictly Chokai's engagement," Hicks said.[46]

July 30, 2009, Test. MDA states that:

> In conjunction with the Missile Defense Agency (MDA), U.S. Pacific Fleet ships and crews successfully conducted the latest Aegis Ballistic Missile Defense (BMD) at-sea firing event on July 30. During this event, entitled Stellar Avenger, the Aegis BMD-equipped ship, USS Hopper (DDG 70), detected, tracked, fired and guided a Standard Missile -3 (SM-3) Block (Blk) IA to intercept a sub-scale short range ballistic missile. The target was launched from

[46] Dave Ahearn, "Japanese Aegis Missile Defense Test Fails, But Aegis Record Is 16 Hits In 20 Tries," Defense Daily, November 21, 2008: 5-6.

> the Kauai Test Facility, co-located on the Pacific Missile Range Facility (PMRF), Barking Sands, Kauai. It was the 19th successful intercept in 23 at-sea firings, for the Aegis BMD Program, including the February 2008 destruction of the malfunctioning satellite above the earth's atmosphere. Stellar Avenger was part of the continual evaluation of the certified and fielded Aegis BMD system at-sea today.
>
> At approximately 5:40 pm (HST), 11:40 pm (EDT), a target was launched from PMRF. Three U.S. Navy Aegis BMD-equipped ships, the cruiser, USS Lake Erie (CG 70) and destroyers USS Hopper (DDG 70) and USS O'Kane (DDG 77) detected and tracked the target with their SPY radars. Each developed fire control solutions. At 5:42 pm (HST), 11:42 pm (EDT) the crew of USS Hopper fired one SM-3 Blk IA missile. The USS Hopper's Aegis BMD Weapon System successfully guided the SM-3 to a direct body to body hit, approximately two minutes after leaving the ship. The intercept occurred about 100 miles above the Pacific Ocean. USS O'Kane conducted a simulated engagement of the target. USS Lake Erie, with its recently installed upgraded Aegis BMD 4.0.1 Weapons System, detected and tracked the same target.[47]

A July 31, 2009, press report states:

> The test was the first Aegis BMD exercise to feature two versions of the software in a single event, according to Lisa Callahan, Lockheed's vice president for ballistic missile defense programs.
>
> A goal of the exercises was to test the Aegis system's ability to discern all the different parts and pieces of a ballistic missile, Nick Bucci, Lockheed's director for Aegis BMD development programs, told reporters July 29 during a pre-exercise conference call.
>
> Three more flight tests this fall will further test the system's discrimination capabilities, Bucci added, with each test becoming more complex. The last test will "be against a pretty darn complex target," he said.
>
> The July 30 tests also validated fixes put in place after a BMD test last November involving a missile launched from the Aegis BMD Japanese destroyer Chokai failed to intercept its target, according to MDA spokesman Chris Taylor. The improvements—which were successful in the most recent test—involved fixes to the Solid Divert Attitude Control System.
>
> The Chokai is the second of four Japanese Aegis ships being upgraded with BMD capability. A third ship, the Myoko, is scheduled to carry out a BMD test this fall.[48]

An August 3, 2009, press report states:

> This test was added to the schedule to evaluate changes made after last year's failed attempt to intercept a target with an SM-3 Block IA launched by a Japanese Aegis-equipped ship .... After the Nov. 19 test, MDA officials said, "Target performance, interceptor missile launch and flyout, and operation of the Aegis Weapon System by the crew were successful, but an intercept was not achieved."

[47] Missile Defense Agency press release 09-News-0015, dated July 31, 2009, entitled "Aegis Ballistic Missile Defense Test Successful."

[48] Christopher P. Cavas, "Aegis BMD Test Successful," *DefenseNews.com*, July 31, 2009.

> A root cause has not been identified, and an MDA spokesman did not say whether fixes have been made to hardware or operational procedures resulting from the failure review. It is also unclear why a subscale target was used in the July 30 trial.[49]

An August 4, 2009, press report states:

> [Rear Admiral Alan "Brad" Hicks, Aegis/SM-3 program manager for MDA], said that a November [2008] failure of an SM-3 Block IA... during a flight-test was attributable to poor adherence to processes on Raytheon's assembly line in Tucson, Ariz.
>
> This was isolated to that missile, and it was the result of perturbations to the build process encountered when shifting from development to production operations.
>
> During the November test, a Japanese Aegis-equipped ship fired the interceptor and it flew "perfectly," Hicks said. In the endgame, a failure of the divert and attitude control system on the unitary kill vehicle led to a miss.
>
> The July 30 demonstration using a U.S. ship "restored confidence" for the Japanese that the miss last fall was an isolated incident, he says. [50]

October 28, 2009, Test. This was the third Japanese flight test, and it involved a single ballistic missile target. MDA states that:

> The Japan Maritime Self-Defense Force (JMSDF) and the United States Missile Defense Agency (MDA) announced the successful completion of an Aegis Ballistic Missile Defense (BMD) intercept flight test, in cooperation with the U.S. Navy, off the coast of Kauai in Hawaii. The event, designated Japan Flight Test Mission 3 (JFTM-3), marked the third time that a JMSDF ship has successfully engaged a ballistic missile target, including two successful intercepts, with the sea-based midcourse engagement capability provided by Aegis BMD.
>
> The JFTM-3 test event verified the newest engagement capability of the Japan Aegis BMD configuration of the recently upgraded Japanese destroyer, JS MYOKO (DDG-175). At approximately 6:00pm (HST), 1:00 pm Tokyo time on Oct 28, a separating, medium-range ballistic missile target was launched from the Pacific Missile Range Facility, Barking Sands, Kauai, Hawaii. JS MYOKO crew members detected and tracked the target. The Aegis Weapon System then developed a fire control solution and, at approximately 6:04pm (HST), 1:04 pm Tokyo time a Standard Missile-3 (SM-3) Block IA interceptor missile was launched. Approximately 3 minutes later, the SM-3 successfully intercepted the target approximately 100 miles above the Pacific Ocean. JFTM-3 is a significant milestone in the growing cooperation between Japan and the U.S. in the area of missile defense.
>
> Also participating in the test, were the Pearl Harbor-based USS Lake Erie (CG 70) and USS Paul Hamilton (DDG 60) which detected and tracked the target and conducted a simulated engagement.[51]

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[49] Amy Butler, "SM-3 Scores Hit After Fixes Implemented," *Aerospace Daily & Defense Report*, August 3, 2009: 5.

[50] Amy Butler, "SM-3 Upgrade Program Cost Increases," *Aerospace Daily & Defense Report*, August 4, 2009: 1-2. For more news reports on this test, see Dan Taylor, "Navy Conducts Aegis BMD Test, New Baseline System Participates," *Inside the Navy*, August 3, 2009; Daniel Wasserbly, "US Aegis BMD System Achieves Trial Success," *Jane's Defence Weekly*, August 5, 2009: 8.

[51] Missile Defense Agency press release 09-News-0021, dated October 28, 2009, entitled "Japan/U.S. Missile Defense Flight Test Successful." Some defense trade press reports state that the test occurred on October 27 rather than October (continued...)

Endo-Atmospheric (SM-2 Block IV) Flight Tests

The Aegis BMD system using the SM-2 BLock IV interceptor has achieved three successful endo-atmospheric intercepts in three at-sea attempts, the first occurring on May 24, 2006,[52] the second on June 5, 2008,[53] and the third between March 24 and March 26, 2009.[54]

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28. See, for example, Christopher P. Cavas, "Japanese Destroyer Conducts Successful BMD Test," *NavyTimes.com*, October 28, 2009; and Amy Butler and Michael Bruno, "SM-3 Scores Hit In Japanese Test," *Aerospace Daily & Defense Report*," October 29, 2009: 3.

[52] 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.

[53] See Missile Defense Agency, "Successful Sea-Based Missile Defense Intercept," June 5, 2008 (08-NEWS-0068); Dave Ahearn, "Aegis, SM-2 Interceptors Kill Target Missile In Terminal-Phase Success," *Defense Daily*, June 6, 2008.

[54] "Navy Completes Air and Ballistic Missile Exercise," *Navy News Service*, March 26, 2009.