Congressional Research Service

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

Ronald O'Rourke
Specialist in Naval Affairs

October 17, 2013

Congressional Research Service
7-5700
www.crs.gov
RL33745

CRS Report for Congress
Prepared for Members and Committees of Congress

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 MDA and Navy plans, the number of BMD-capable Navy Aegis ships is scheduled to grow from 24 at the end of FY2011 to 41 at the end of FY2018.

Under the Administration's European Phased Adaptive Approach (EPAA) for European BMD operations, BMD-capable Aegis ships are operating in European waters to defend Europe from potential ballistic missile attacks from countries such as Iran. On October 5, 2011, the United States, Spain, and NATO jointly announced that, as part of the EPAA, four BMD-capable Aegis ships are to be forward-homeported (i.e., based) at Rota, Spain, in FY2014 and FY2015. BMD-capable Aegis ships also 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. On March 15, 2013, the Department of Defense (DOD) announced that it is dropping the fourth and final phase of the EPAA and canceling the development program for the Aegis SM-3 Block IIB interceptor missile that was to be deployed under that phase.

The Aegis BMD program is funded mostly through MDA's budget. The Navy's budget provides additional funding for BMD-related efforts. MDA's proposed FY2014 budget requests a total of $2,087.2 million in procurement and research and development funding for Aegis BMD efforts, including funding for Aegis Ashore sites that are to be part of the EPAA. MDA's budget also includes operations and maintenance (O&M) and military construction (MilCon) funding for the Aegis BMD program.

Issues for Congress regarding the Aegis BMD program include the following:

- the impact on the Aegis BMD program of the March 1, 2013, sequester on FY2013 funding and unobligated prior-year funding for the program;
- the potential impact on the Aegis BMD program of a possible sequester later this year or early next year on FY2014 funding and unobligated prior-year funding for the program;
- U.S. vs. European naval contributions to European BMD;
- the lack of a target for simulating the endo-atmospheric (i.e., final) phase of flight of China's DF-21 anti-ship ballistic missile; and
- concurrency and technical risk in the Aegis BMD program.

Contents

Introduction 1
Background 1
Aegis Ships 1
Ticonderoga (CG-47) Class Aegis Cruisers 1
Arleigh Burke (DDG-51) Class Aegis Destroyers 2
Projected Aegis Ship Force Levels 2
Aegis Ships in Allied Navies 3
Aegis BMD System 3
Versions of Aegis BMD System 3
Aegis BMD Interceptor Missiles 3
European Phased Adaptive Approach (EPAA) for European BMD 6
Planned Numbers of BMD-Capable Aegis Ships and SM-3 Interceptors 8
Home Ports of BMD-Capable Aegis Ships 9
Pacific vs. Atlantic Fleet Homeporting 9
October 5, 2011, Announcement of Homeporting in Spain 9
Aegis BMD Flight Tests 10
Allied Participation and Interest in Aegis BMD Program 13
Japan 13
Other Countries 14
FY2014 Funding Request 14
Issues for Congress 15
Impact of March 1, 2013, Sequester on FY2013 Funding 15
Potential Impact of Possible Late 2013/Early 2014 Sequester on FY2014 Funding 15
U.S. vs. European Naval Contributions to European BMD 15
Target for Simulating Endo-Atmospheric Flight of DF-21 ASBM 16
Concurrency and Technical Risk in Aegis BMD Program 17
SM-3 Block IB Missile 17
SM-3 Block IIA Missile 21
SM-6 Missile 22
Aegis Ashore 23
Legislative Activity for FY2014 27
Summary of Action on FY2014 MDA Funding Request 27
FY2014 National Defense Authorization Act (H.R. 1960/S. 1197) 28
House 28
Senate 32
FY2014 DOD Appropriations Act (H.R. 2397/S. 1429) 44
House 44
Senate 44

Tables

Table 1. Versions of Aegis BMD System 6
Table 2. Numbers of BMD-Capable Aegis Ships and SM-3 Missiles 8
Table 3. MDA Funding for Aegis BMD Efforts, FY2013-FY2018 14

Table 4. Summary of Congressional Action on FY2014 Request for MDA Procurement and RDT&E Funding for Aegis BMD Program 27
Table A-1. Aegis BMD Flight Tests Since January 2002 46

Appendixes

Appendix A. Aegis BMD Flight Tests 45
Appendix B. Homeporting of U.S. Navy Aegis BMD Ships at Rota, Spain 64
Appendix C. Allied Participation and Interest in Aegis BMD Program 67
Appendix D. Earlier Oversight Issues Relating to SM-3 Block IIB Missile 75

Contacts

Author Contact Information 79

Introduction

This report provides background information and issues for Congress on the Aegis ballistic missile defense (BMD) program, which is carried out by the Missile Defense Agency (MDA) and the Navy, and gives Navy Aegis cruisers and destroyers a capability for conducting BMD operations. Congress's decisions on the Aegis BMD program could significantly affect U.S. BMD capabilities and funding requirements, and the BMD-related industrial base.

Background

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, 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 (CGs 47 through 51), which were built to an earlier technical standard in certain respects, were judged by the Navy to be too expensive to modernize and were removed from service in 2004-2005.

As a cost-saving measure, the Navy's FY2014 budget proposes retiring 7 of the remaining 22 Aegis cruisers in FY2015, years before the end of their 35-year expected service lives. The Navy's proposed FY2013 budget had made a similar proposal to retire 7 of the 22 cruisers in FY2013 and FY2014.[1] One of the seven cruisers proposed for early retirement under the FY2013 budget had been given a capability for BMD operations;[2] some or all of the other six were scheduled to be modified for BMD operations at some point. Congress, in acting on the Navy's proposed FY2013 budget, did not accept the proposed early retirements, and instead instructed the Navy to keep these seven cruisers in service. Section 8103 of the FY2013 DOD appropriations act (Division C of H.R. 933/P.L. 113-6 of March 26, 2013, the Consolidated and Further Continuing Appropriations Act, 2013) established a Ship Modernization, Operations and Sustainment Fund to fund the continued operation and support of these seven cruisers (and also two amphibious ships that were proposed for early retirements) in FY2013 and FY2014. The

[1] The seven ships were *Cowpens* (CG-63), *Anzio* (CG-68), *Vicksburg* (CG-69), and *Port Royal* (CG-73), which were proposed for retirement in FY2013, and *Gettysburg* (CG-64), *Chosin* (CG-65), and *Hue City* (CG-66), which were proposed for retirement in FY2014. These ships entered service between 1991 (*Cowpens*) and 1994 (*Port Royal*); their 35-year service lives would extend to between 2026 and 2029. *Port Royal* was the last of the 27 ships in the class (i.e., it is the youngest ship in the class). Of the 22 Aegis cruisers currently in service, the oldest is *Bunker Hill* (CG-52), which entered service in 1986.

[2] The ship that has already been given a capability for BMD operations is *Port Royal* (CG-73).

seven cruisers that the Navy's FY2014 budget proposes for early retirements in FY2015 are the same seven cruisers that were proposed for early retirements under the FY2013 budget.[3]

Arleigh Burke (DDG-51) Class Aegis Destroyers[4]

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 entered service in FY2012. 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 scheduled 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.

11 Flight IIA DDG-51s Procured or Programmed for FY2010-FY2016

Procurement of DDG-51s resumed in FY2010. One Flight IIA DDG-51 was procured in FY2010, two more were procured in FY2011, one more was procured in FY2012, and three more were procured in FY2013. Navy plans call for procuring four more Flight IIA DDG-51s in FY2014-FY2016. The ship procured in FY2010 is scheduled to enter service in FY2016.

Flight III DDG-51s Programmed Starting in FY2016

Navy plans call for shifting to procurement of a new version of the DDG-51, called the Flight III version, starting in FY2016.[5] 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.

Projected Aegis Ship Force Levels

The Navy's FY2014 30-year (FY2014-FY2043) shipbuilding plan projects that the total number of Aegis cruisers and destroyers will be between 80 and 90 for most of the 30-year period.[6]

---

[3] The seven cruisers proposed for early retirement in FY2015 under the FY2014 budget submission are identified in *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for FY2014*, May 2013, p. 21 (Table A1-1).

[4] For more on the DDG-51 program, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke.

[5] Of the two DDG-51s scheduled for procurement in FY2016, one is to be the final Flight IIA ship, and the other is to be the first Flight III ship.

[6] For a table showing the total number of cruisers and destroyers each year from FY2014 through FY2043, see CRS (continued...)

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.[7]

Aegis BMD System[8]

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

Currently fielded versions of the Aegis BMD system are called the 3.6.1 version and the newer and more capable 4.0.1 and 4.0.2 versions. MDA and Navy plans call for fielding increasingly capable versions in coming years; these planned versions are called 5.0, 5.0 CU (meaning capability upgrade), and 5.1. Improved versions feature improved processors and software, and are to be capable of using improved versions of the SM-3 interceptor missile (see **Table 1**).

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-2 Block IV is to be succeeded in coming years by a BMD version of the new SM-6 interceptor.

SM-3 Midcourse Interceptor

The SM-3 is designed to intercept ballistic missiles above the atmosphere (i.e., exo-atmospheric intercept), 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.

(...continued)

Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke. A similar table can be found in CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke. The totals shown in these two reports include the three Zumwalt (DDG-1000) class destroyers, which are to enter service in FY2014, FY2016, and FY2018; these non-Aegis ships would need to be subtracted out of the figures shown in the tables to get the figures for the total number of Aegis ships.

[7] 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.

[8] Unless stated otherwise, information in this section is taken from MDA briefings on the Aegis BMD program given to CRS and CBO analysts in March 2010, March 2011, March 2012, and April 2013.

MDA and Navy plans call for fielding increasingly capable versions of the SM-3 in coming years. The current version, called the SM-3 Block IA, is now being supplemented by the more capable SM-3 Block IB. These are to be followed by the even more capable 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 at the bottom but are 13.5 inches in diameter along the remainder of their lengths, the Block IIA version is to 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 greater than that of the Block IA and IB versions,[9] 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.[10]

Until recently, a more capable missile called the SM-3 Block IIB was also planned. Compared to the Block IIA, the Block IIB version was to include a lighter kill vehicle, flexible propulsion, and upgraded fire control software.[11] On March 15, 2013, however, the Department of Defense (DOD) announced that it was

- "restructuring" (i.e., canceling) the SM-3 Block IIB program;
- shifting funding from SM-3 Block IIB program to other BMD efforts (specifically, the Ground Based Interceptor (GBI) BMD program in Alaska and to earlier versions of the SM-3); and
- dropping Phase IV of the European Phased Adaptive Approach (or EPAA—see discussion below), which was to feature the deployment of the SM-3 Block IIB missile.[12]

---

[9] Some press reports and journal articles, most now a decade or more old, report unconfirmed figures on the burnout velocities of various SM-3 missile configurations (some of which were proposed but ultimately not pursued). See, for example, J. D. Marshall, *The Future Of Aegis Ballistic Missile Defense*, point paper dated October 15, 2004, accessed online at http://www.marshall.org/pdf/materials/259.pdf; "STANDARD Missile-3 Destroys a Ballistic Missile Target in Test of Sea-based Missile Defense System," Raytheon news release circa January 26, 2002; Gopal Ratnam, "U.S. Navy To Play Larger Role In Missile Defense, *Defense News*, January 21-27, 2002: 10; Hans Mark, "A White Paper on the Defense Against Ballistic Missiles," *The Bridge*, Summer 2001, pp. 17-26, accessed online at http://www.nae.edu/nae/bridgecom.nsf/weblinks/NAEW-63BM86/$FILE/BrSum01.pdf?OpenElement; Michael C. Sirak, "White House Decision May Move Sea-Based NMD Into Spotlight," *Inside Missile Defense*, September 6, 2000: 1; Henry F. Cooper and J.D. Williams, "The Earliest Deployment Option—Sea-Based Defenses," *Inside Missile Defense*, September 6, 2000 (guest perspective; including graphic on page 21); Robert Holzer, "DoD Weighs Navy Interceptor Options, *Defense News*, July 24, 2000: 1, 60 (graphic on page 1); and Robert Holzer, "U.S. Navy Gathers Strength, Allies in NMD Showdown," *Defense News*, March 15, 1999: 1, 42 (graphic on page 1).

[10] 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.

[11] Source: H.Rept. 111-491 of May 21, 2010 (the House Armed Services Committee report on H.R. 5136, the FY2011 defense authorization bill), p. 196.

[12] As part of a March 15, 2013, statement announcing changes in BMD programs, Secretary of Defense Chuck Hagel (continued...)

MDA states that that SM-3 Block IBs have an estimated unit procurement cost of about $12 million to $15 million, and that SM-3 Block IIAs have an estimated unit procurement cost of about $20 million to $24 million.

SM-2 and SM-6 Terminal Interceptors

The SM-2 Block IV is designed to intercept ballistic missiles inside the atmosphere (i.e., endo-atmospheric intercept), during the terminal phase of an enemy ballistic missile's flight. It is equipped with a blast fragmentation warhead.

The existing inventory of SM-2 Block IVs—72 as of February 2012—was created by modifying SM-2s that were originally built to intercept aircraft and ASCMs. A total of 75 SM-2 Block IVs were modified, and 3 have been used in BMD flight tests, leaving the current remaining inventory of 72.

MDA and Navy plans call for developing and procuring a more capable terminal-phase BMD interceptor based on the SM-6 air defense missile (the successor to the SM-2 air defense missile). The initial version of the SM-6 BMD interceptor, called Increment 1, is to enter service around 2015; a subsequent version, called Increment 2, is to enter service around 2018.

Table 1 summarizes the various versions of the Aegis BMD system and correlates them with the phases of the European Phased Adaptive Approach (or EPAA; see below) for European BMD operations.

(...continued)

stated that "we are restructuring the SM-3 IIB program. As many of you know, we had planned to deploy the SM-3 IIB as part of the European Phased Adaptive Approach. The purpose was to add to the protection of the U.S. homeland already provided by our current GBIs against missile threats from the Middle East. The timeline for deploying this program had been delayed to at least 2022 due to cuts in congressional funding. Meanwhile, the threat matures. By shifting resources from this lagging program to fund the additional GBIs as well as advanced kill vehicle technology that will improve the performance of the GBI and other versions of the SM-3 interceptor, we will be able to add protection against missiles from Iran sooner while also providing additional protection against the North Korean threat." (Missile Defense Announcement, As Delivered by Secretary of Defense Chuck Hagel, The Pentagon, Friday, March 15, 2013, accessed March 20, 2013, at http://www.defense.gov/speeches/speech.aspx?speechid=1759.) Following this announcement, Secretary Hagel and two other DOD officials—James Miller, the Under Secretary of Defense for Policy, and Admiral James Winnefeld, the Vice Chairman of the Joint Chiefs of Staff—took questions from the press. One questioner asked whether DOD was dropping Phase IV of the EPAA. Under Secretary Miller replied: "Yes, the—the prior plan had four phases. The third phase involved the deployment of interceptors in Poland. And we will continue with phases one through three. In the fourth phase, in the previous plan, we would have added some additional—an additional type of interceptors, the so-called SM-3 IIB would have been added to the mix in Poland. We no longer intend to—to add them to the mix, but we'll continue to have the same number of deployed interceptors in Poland that will provide coverage for all of NATO in Europe." (DOD news transcript, "DOD News Briefing on Missile Defense from the Pentagon," March 15, 2013, accessed March 20, 2013, at http://www.defense.gov/transcripts/transcript.aspx?transcriptid=5205.)

Table 1. Versions of Aegis BMD System

EPAA Phase	Phase I	Phase II		Phase III
Version of Aegis BMD system	**3.6.1**	**4.0.1**	**5.0/5.0 CU**	**5.1**
Certified for initial use	2006	2012	2015	2018
OTE assessment	2008	2014	2016	2020
SM-3 Block IA	X	X	X	X
SM-3 Block IB		X	X	X
SM-3 Block IIA				X
SM-2 Block IV	X			X
SM-6 Increment 1			X	
SM-6 Increment 2				X
SRBM	Yes	Yes	Yes	Yes
MRBM	Yes	Yes	Yes	Yes
IRBM	Limited	Yes	Yes	Enhanced
ICBM	No[a]	No[a]	No[a]	Limited
Launch on remote	Initial	Enhanced	Yes	Yes
Engage on remote	No	No	No	Yes

Source: MDA briefings to CRS and the Congressional Budget Office (CBO), April 2013.

Notes: OTE is operational test and evaluation. **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.

a. Cannot intercept ICBMs, but the system has a long-range search and track (LRS&T) capability—an ability to detect and track ballistic missiles at long ranges.

European Phased Adaptive Approach (EPAA) for European BMD

On September 17, 2009, the Obama Administration announced a new approach for regional BMD operations called the Phased Adaptive Approach (PAA). The first application of the approach is in Europe, and is called the European PAA (EPAA). EPAA calls for using BMD-capable Aegis ships, a land-based radar in Europe, and eventually two Aegis Ashore sites in Romania and Poland to defend Europe against ballistic missile threats from countries such as Iran. MDA stated in 2012 that

> The Department [of Defense] met its commitment for EPAA Phase 1 by deploying Aegis BMD ships and a land-based radar in Europe by the end of 2011. Deliveries in the next three EPAA phases include
>
> - Aegis Ashore in Romania with SM-3 IB interceptors in the 2015 timeframe (Phase 2),

- Aegis Ashore in Poland with SM-3 IIA interceptors in the 2018 timeframe (Phase 3), and
- SM-3 IIB interceptors and early intercept capability in the 2020 timeframe (Phase 4)

The United States will also pursue phased adaptive approaches in the Asia Pacific and the Middle East by building on current efforts.[13]

On March 15, 2013, DOD announced that it is

- "restructuring" (i.e., canceling) the SM-3 Block IIB program;
- shifting funding from SM-3 Block IIB program to other BMD efforts (specifically, the Ground Based Interceptor (GBI) BMD program in Alaska and to earlier versions of the SM-3); and
- dropping Phase IV of the EPAA, which was to feature the deployment of the SM-3 Block IIB missile.[14]

Each Aegis Ashore site in the EPAA is to include a structure housing an Aegis system similar to the deckhouse on an Aegis ship and 24 SM-3 missiles launched from a re-locatable Vertical Launch System (VLS) based on the VLS that is installed in Navy Aegis ships.

Although BMD-capable Aegis ships have deployed to European waters in the past, the first BMD-capable Aegis ship officially deployed to European waters as part of the EPAA departed its home port of Norfolk, VA, on March 7, 2011, for a deployment to the Mediterranean that lasted several months.[15]

---

[13] Department of Defense, *Department of Defense, Fiscal Year (FY) 2013 President's Budget Submission, Missile Defense Agency, Justification Book Volume 2a, Research, Development, Test & Evaluation, Defense-Wide*, February 2012, pp. xix-xx.

[14] As part of a March 15, 2013, statement announcing changes in BMD programs, Secretary of Defense Chuck Hagel stated that "we are restructuring the SM-3 IIB program. As many of you know, we had planned to deploy the SM-3 IIB as part of the European Phased Adaptive Approach. The purpose was to add to the protection of the U.S. homeland already provided by our current GBIs against missile threats from the Middle East. The timeline for deploying this program had been delayed to at least 2022 due to cuts in congressional funding. Meanwhile, the threat matures. By shifting resources from this lagging program to fund the additional GBIs as well as advanced kill vehicle technology that will improve the performance of the GBI and other versions of the SM-3 interceptor, we will be able to add protection against missiles from Iran sooner while also providing additional protection against the North Korean threat." (Missile Defense Announcement, As Delivered by Secretary of Defense Chuck Hagel, The Pentagon, Friday, March 15, 2013, accessed March 20, 2013, at http://www.defense.gov/speeches/speech.aspx?speechid=1759.) Following this announcement, Secretary Hagel and two other DOD officials—James Miller, the Under Secretary of Defense for Policy, and Admiral James Winnefeld, the Vice Chairman of the Joint Chiefs of Staff—took questions from the press. One questioner asked whether DOD was dropping Phase IV of the EPAA. Under Secretary Miller replied: "Yes, the—the prior plan had four phases. The third phase involved the deployment of interceptors in Poland. And we will continue with phases one through three. In the fourth phase, in the previous plan, we would have added some additional—an additional type of interceptors, the so-called SM-3 IIB would have been added to the mix in Poland. We no longer intend to—to add them to the mix, but we'll continue to have the same number of deployed interceptors in Poland that will provide coverage for all of NATO in Europe." (DOD news transcript, "DOD News Briefing on Missile Defense from the Pentagon," March 15, 2013, accessed March 20, 2013, at http://www.defense.gov/transcripts/transcript.aspx?transcriptid=5205.)

[15] Karen Parrish, "Milestone nears for European Missile Defense Plan," *American Forces Press Service*, March 2, 2011 (accessed online at http://www.defense.gov/news/newsarticle.aspx?id=62997); Untitled "Eye On The Fleet" news item, *Navy News Service*, March 7, 2011 (accessed online at http://www.navy.mil/view_single.asp?id=98184); "Warship With Radar Going To Mediterranean," *Washington Post*, March 2, 2011; Brock Vergakis, "US Warship Deploys to (continued...)

Planned Numbers of BMD-Capable Aegis Ships and SM-3 Interceptors

As shown in **Table 2**, under the proposed FY2014 budget, the number of BMD-capable Navy Aegis ships is scheduled to grow from 24 at the end of FY2011 to 41 at the end of FY2018.

Table 2. Numbers of BMD-Capable Aegis Ships and SM-3 Missiles

	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18
BMD-capable Aegis ships								
BMD conversions of existing Aegis cruisers and destroyers (cumulative totals)								
3.6.1 version	22	24	22	19	17	17	17	17
4.0.1 version	2	4	6	9	9	9	9	9
5.0/5.0 CU version	0	1	3	4	6	7	8	10
5.1 version	0	0	0	0	0	0	1	1
Subtotal	24	29	31	32	32	33	35	37
New Aegis destroyers procured in FY2010 and beyond, with BMD installed during construction (cumulative totals)								
5.0 version	0	0	0	0	0	3	3	4
TOTAL	**24**	**29**	**31**	**32**	**32**	**36**	**38**	**41**
SM-3 missile procurement (annual quantities)								
Block IA	23	14	0	0	0	0	0	0
Block IB	0	14	46	52	72	72	72	72
Block IIA	0	0	0	0	22	0	12	16
Total	23	28	46	52	94	72	84	88
SM-3 missile deliveries/inventory								
Block I/IA	102/82	113/93	113/90	141/118	150/118	150/101	150/83	150/58
Block IB	1/0	3/0	25/18	39/29	85/68	137/120	209/192	281/264
Block IIA	0/0	0/0	0/0	0/0	0/0	0/0	0/0	10/6
Total	**103/82**	**116/93**	**138/108**	**180/147**	**235/186**	**287/221**	**359/275**	**441/328**

Source: MDA data received by CRS on April 16, 2013.

Regarding the planned increase over time in the number of BMD-capable Aegis ships, Vice Admiral Thomas Copeman, Commander, Naval Surface Forces, stated in an interview published in March 2013 that

> The ballistic missile defense [BMD] ships—the cruisers, the DDGs [guided-missile destroyers] that are equipped to conduct ballistic missile defense—again, are a very high demand [item]. They are going on eight- to 10-month deployments, coming back for short periods of time, and having to go again just because of the demand signal in the

(...continued)

Mediterranean to Protect Europe Form Ballistic Missiles, *Canadian Press*, March 7, 2011.

> Mediterranean, in the Middle East, and having to keep them forward deployed in the Seventh Fleet [Western Pacific] area of operations.[16]

Home Ports of BMD-Capable Aegis Ships

Pacific vs. Atlantic Fleet Homeporting

As of March 2013, 15 of the Navy's 27 BMD-capable Aegis ships were homeported in the Pacific, including 5 at Yokosuka, Japan, 5 at Pearl Harbor, HI, and 5 at San Diego, CA. The other 12 BMD-capable Aegis ships were homeported in the Atlantic, with 10 at Norfolk, VA, and 2 at Mayport, FL.

October 5, 2011, Announcement of Homeporting in Spain

On October 5, 2011, the United States, Spain, and NATO jointly announced that, as part of the EPAA, four BMD-capable Aegis ships are to be forward-homeported (i.e., based) at the naval base at Rota, Spain.[17] The four ships are the destroyers *Ross* (DDG-71) and *Donald Cook* (DDG-75), which are to move to Rota in FY2014, and the destroyers *Carney* (DDG-64) and *Porter* (DDG-78), which are to move to Rota in FY2015. As of early 2012, *Carney* was homeported at Mayport, FL, and the other three ships were homeported at Norfolk.[18] The move is to involve an estimated 1,239 military billets (including 1,204 crew members for the four ships and 35 shore-based support personnel),[19] and about 2,100 family members.[20]

The Navy estimates the up-front costs of transferring the four ships at $92 million in FY2013, and the recurring costs of basing the four ships in Spain rather than in the United States at roughly $100 million per year.[21]

---

[16] "Navigating. Warfighting, Maintaining," *Sea Power*, March 2013: 31. Materials in brackets as in original, except for "[item]" and "[Western Pacific]," which were added here.

[17] "Announcement on missile defence cooperation by NATO Secretary General Anders Fogh Rasmussen, the Prime Minister of Spain, Jose Luis Rodriguez Zapatero and US Defense Secretary Leon Panetta," October 5, 2011, accessed October 6, 2011, at http://www.nato.int/cps/en/SID-107ADE55-FF83A6B8/natolive/opinions_78838.htm. See also "SECDEF Announces Stationing of Aegis Ships at Rota, Spain," accessed October 6, 2011, at http://www.navy.mil/search/display.asp?story_id=63109.

[18] See "Navy Names Forward Deployed Ships to Rota, Spain," *Navy News Service*, February 16, 2012, accessed online at http://www.navy.mil/search/display.asp?story_id=65393; Kate Wiltrout, "Three Norfolk-Based Navy Ships To Move To Spain," *Norfolk Virginian-Pilot*, February 17, 2012; "Bound for Spain, *Inside the Navy*, February 20, 2012.

[19] Source: Navy information paper dated March 8, 2012, provided by Navy Office of Legislative Affairs to CRS on March 9, 2012.

[20] Source: Navy briefing slides dated February 27, 2012, provided by the Navy to CRS on March 9, 2012.

[21] Source: Navy briefing slides dated February 27, 2012, provided by the Navy to CRS on March 9, 2012. The briefing slides state that the estimated up-front cost of $92 million includes $13.5 million for constructing a new weapon magazine, $0.8 million for constructing a pier laydown area, $3.4 million for constructing a warehouse, $5.0 million for repairing an existing facility that is to be used as an administrative/operations space, and $69.3 million for conducting maintenance work on the four ships in the United States prior to moving them to Rota. The briefing states that the estimated recurring cost of $100 million per year includes costs for base operating support, annual PCS (personnel change of station) costs, a pay and allowances delta, annual mobile training team costs, ship maintenance work, the operation of a Ship Support Activity, and higher fuel costs associated with a higher operating tempo that is maintained by ships that are homeported in foreign countries.

Rota is on the southwestern Atlantic coast of Spain, a few miles northwest of Cadiz, and about 65 miles northwest of the Strait of Gibraltar leading into the Mediterranean. U.S. Navy ships have been homeported at Rota at various points in the past, most recently in 1979.[22]

For additional background information on the Navy's plan to homeport four BMD-capable Aegis destroyers at Rota, Spain, see **Appendix B**.

Aegis BMD Flight Tests

DOD states that since January 2002, the Aegis BMD system has achieved 25 successful exo-atmospheric intercepts in 31 attempts using the SM-3 missile (including 3 successful intercepts in 4 attempts by Japanese Aegis ships), and 3 successful endo-atmospheric intercepts in 3 attempts using the SM-2 Block IV missile, making for a combined total of 28 successful intercepts in 34 attempts.

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.[23] Including this intercept in the count increases the totals to 26 successful exo-atmospheric intercepts in 32 attempts using the SM-3 missile, and 29 successful exo- and endo-atmospheric intercepts in 35 attempts using both SM-3 and SM-2 Block IV missiles.

The Aegis BMD development effort, including Aegis BMD flight tests, is often described as following a development philosophy long-held within the Aegis program office of "build a little, test a little, learn a lot," meaning that development is done in manageable steps, then tested and validated before moving on to the next step.[24]

---

[22] Source: Sam Fellman, "U.S. To Base Anti-Missile Ships in Spain," *Defense News*, October 10, 2011: 76.

[23] 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 the MDA discussion available online at http://www.mda.mil/system/aegis_one_time_mission.html, and also 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.)

[24] See, for example, "Aegis BMD: "Build a Little, Test a Little, Learn a Lot"," USNI blog, March 15, 2010, accessed September 11, 2013, at http://blog.usni.org/2010/03/15/aegis-bmd-build-a-little-test-a-little-learn-a-lot, and "Aegis Ballistic Missile Defense, Aegis Ballistic Missile Defense Overview for the George C. Marshall Institute, RADM Alan (continued...)

A December 2012 report on various DOD acquisition programs from DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual report for FY2012—stated, in the section on the Aegis BMD program, that

> **Assessment**
>
> • In FY12, Aegis BMD demonstrated the capability to perform end-to-end engagements against non-separating and simple separating short-range ballistic missiles with the Aegis BMD 4.0 system and SM-3 Block IB interceptors.
>
> • In response to the anomalous behavior observed during the SM-3 Block IA flyout in FTM-15 (April 2011), the program redesigned a component in the third stage rocket motor, which is common to both the Block IA and Block IB interceptors. The newly redesigned component was flown in FTM-18 and performed successfully.
>
> • The failed intercept in FTM-16 Event 2 (September 2011) is currently being addressed by the program. The program conducted three initial ground firing tests of the SM-3 third stage rocket motor to further understand the FTM-16 anomaly. Subsequently, the program conducted three ground firings of the third stage rocket motor to further verify that it functions properly using newly-adjusted firing parameters. Two more ground firings are planned before the end of the calendar year to close-out actions from the FTM-16 failure review board.
>
> • GT-04 series ground tests in early FY12, which addressed EPAA Phase 1, showed that improvements in interoperability are needed between the various elements and sensors that are part of the EPAA Phase 1 defense architecture, including the Aegis BMD 3.6.1 system that continues to take part in these tests after completion of its FOT&E.
>
> • The near-simultaneous engagement of an anti-air warfare target during FTI-01 verified ship self-defense capability while conducting a ballistic missile engagement even though the SM-3 Block IA interceptor missed its target. The MDA is investigating the cause of the missed intercept; however, their efforts will be hindered because Kill Weapon telemetry was lost during key portions of the engagement flyout.
>
> • No LRS&T events are planned for Aegis BMD 4.0 until FTG-08. Aegis BMD has tested that capability only once during a flight test (FTG-06a in December 2010) and in ground testing to date. Further live-target testing of this capability is needed to allow for an assessment.
>
> **Recommendations**
>
> • Status of Previous Recommendations. The program partially addressed the single recommendation from FY11 when it conducted FTM-18 testing with the redesigned component in the SM-3 third stage rocket motor (to address the FTM-15 anomaly). Flight testing to demonstrate the correction for the FTM-16 Event 2 failure has not yet taken place.
>
> • FY12 Recommendations. The program should:

(...continued)

B. Hicks, USN, Aegis BMD Program Director, August 3, 2009, slide 16 of 20, entitled "Some of our Philosophies In a Nutshell (1 of 2)," accessed September 11, 2011, at http://www.marshall.org/pdf/materials/743.pdf.

> 1. Conduct further live-target testing of the Aegis BMD 4.0.2 LRS&T capability using long-range targets to provide additional data on that capability for the Aegis BMD 4.0.2 system.
>
> 2. Engage a medium-range target before the Full-Rate Production Decision for the SM-3 Block IB interceptor to support an assessment of midcourse defense capability.[25]

An August 27, 2013, press report states:

> As the U.S. Navy tries to stick to its funding plans for Aegis combat system upgrades, and as successful live-fire tests for the latest software improvements to the system mount, the service is considering flying fewer tests to save money.
>
> "They're looking at ways to consolidate life-fire tests to save some bucks," says Jim Sheridan, director of the U.S. Navy's Aegis program for Lockheed Martin, the prime contractor for the combat system and proposed upgrades.
>
> The Navy could shave the number of tests to three from five, Sheridan says, adding that the company supports the measures. "We certainly understand the need," Sheridan says.
>
> Not too long ago, Sheridan had voiced concerns that sequestration and other funding issues would delay shipboard Aegis upgrades and improvements. "With the fielding profile, though," he says, "they are sticking to their guns."
>
> According to Sheridan, reducing the number of tests is more than a fair tradeoff for keeping that upgraded Aegis fielding schedule. However, fewer tests, he says, will create challenges for Lockheed Martin, which has prided itself on an Aegis program that develops a little and tests a lot.
>
> "It will make for more dynamic underways," Sheridan says. "It will be busier on the ships."
>
> A shortened test schedule also will reduce the time between exercises for Lockheed to address any problems it sees during those tests. It will be a challenge, Sheridan says, "to turn around fixes expeditiously."[26]

A September 17, 2013, press report states:

> While the U.S. Navy may be considering truncating some Aegis Combat System missile tests, the nation is still sticking to the planned testing schedule, according to officials for Lockheed Martin, the system's prime contractor.
>
> Navy officials—like everyone else at the Pentagon—have been looking for ways to shave costs to deal with the effects of sequestration and other budgetary concerns. Thanks to the recent round of successful Aegis tests, the service has begun to consider consolidating some Aegis tests to help save money, says Jim Sheridan, director of the U.S. Navy's Aegis program for Lockheed.
>
> For example, the Navy could shave the number of tests to three from five, Sheridan says, adding that the company supports the measures, if they are needed.

---

[25] Director, Operational Test and Evaluation, *FY 2012 Annual Report*, December 2012, p. 283.

[26] Michael Fabey, "U.S. Navy Mulls Cutting Aegis Flight Tests To Save Money," *Aerospace Daily & Defense Report*, August 27, 2013: 1.

> But sequestration thus far has had no effect on the Aegis testing schedule, Sheridan said Sept. 10 during a Lockheed update briefing on missile programs.
>
> "There has been no impact," Sheridan says. "Targets are being procured. We are continuing on a path laid out a couple of years ago."
>
> Keith Little, Lockheed spokesman, says, "All planned test events associated with the program of record, as of right now, are fully funded."
>
> But, Little reiterates, the successful Aegis testing thus far gives the Navy options. "Should there be budget challenges in the future, consolidation of some test events might be a cost-saving measure for consideration," he says.[27]

For further discussion of Aegis BMD flight tests—including a May 2010 magazine article and supplementary white paper in which two professors with scientific backgrounds criticize DOD claims of successes in Aegis (and other DOD) BMD flight tests—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.[28] In addition to cooperating with the United States on development of technologies for the SM-3 Block IIA missile, Japan is modifying all six of its Aegis destroyers with at least an approximate equivalent of the 3.6.1 version Aegis BMD system. As of December 2010, four of Japan's Aegis ships had received the 3.6.1-equivaent modification.[29] A July 7, 2013, press report states that the other two ships are being modified and are likely reenter service as BMD-capable ships by 2018. The same press report stated that Japan will likely procure two additional Aegis ships in FY2015 and FY2016, and that the ships would enter service by FY2020, increasing Japan's fleet of Aegis ships to eight.[30] An August 15, 2012, press report stated that the United States and Japan were discussing the option of equipping the fifth and sixth Japanese Aegis destroyers with an approximate equivalent of the 5.1 version of the Aegis BMD system, so that the ships could fire the SM-3 Block IIA missile.[31] Japanese BMD-capable Aegis ships have conducted four flight tests of the Aegis BMD system using the SM-3 interceptor, achieving three successful exo-atmospheric intercepts.

---

[27] Michael Fabey, "Aegis Missile Testing Still On Track, Lockheed Says," *Aerospace Daily & Defense Report*, September 17, 2013: 6.

[28] 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.

[29] John Liang, "Japan To Increase Aegis BMD Ship Fleet From Four To Six," *Inside the Navy*, December 27, 2010.

[30] Kyodo news service, "Japan Eyes Two New Aegis Destroyers To Counter N. Korea Missile Threat," *Japan Times*, July 7, 2013.

[31] Jim Wolf, "US, Japan Said Discussing Missile-Defense Ship Upgrades," *Reuters.com*, August 15, 2012.

Other Countries

Other countries that MDA views as potential naval BMD operators (using either the Aegis BMD system or some other system of their own design) 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.

For additional background information on allied participation and interest in the Aegis BMD program, see **Appendix C**.

FY2014 Funding Request

The Aegis BMD program is funded mostly through MDA's budget. The Navy's budget provides additional funding for BMD-related efforts. As shown in **Table 3**, MDA's proposed FY2014 budget requests a total of $2,087.2 million in procurement and research and development funding for Aegis BMD efforts, including funding for Aegis Ashore sites that are to be part of the EPAA, which is referred to in the table as funding for the land-based SM-3. MDA's budget also includes operations and maintenance (O&M) and military construction (MilCon) funding for the Aegis BMD program.

Table 3. MDA Funding for Aegis BMD Efforts, FY2013-FY2018

(In millions of dollars, rounded to nearest tenth; totals may not add due to rounding)

	FY13	FY14	FY15	FY16	FY17	FY18
Procurement (PE 0208866C)						
Aegis Ashore Phase III	0	131.4	256.3	38.6	63.9	71.6
Aegis BMD	523.6	580.8	746.7	745.3	1,018.2	1,094.0
Aegis Initial Spares	0	0	20.0	46.4	46.5	47.9
SUBTOTAL Procurement	**523.6**	**712.2**	**1,023.0**	**830.3**	**1,128.6**	**1,213.5**
Research, development, test & evaluation (RDT&E)						
Aegis BMD (PE 0603892C)	897.5	937.1	987.7	1,074.9	880.5	876.7
Aegis SM-3 IIB (PE 0603902C)	55.5	0	0	0	0	0
Land-based SM-3 (PE 0604880C)	249.9	129.4	124.5	51.9	55.8	32.9
Aegis SM-3 IIA (PE 0604881C)	425.6	308.5	230.5	128.7	41.0	0
SUBTOTAL RDT&E	**1,628.5**	**1,375.0**	**1,342.7**	**1,255.5**	**977.3**	**909.6**
TOTAL	**2,152.1**	**2,087.2**	**2,365.7**	**2,085.8**	**2,105.9**	**2,123.1**

Source: FY2014 MDA briefings materials and FY2014 MDA budget-justification books for MDA for Research, Development, Test & Evaluation, Defense-Wide (Volume 2a) and for Procurement, Defense-Wide (Volume 2b).

Note: Figures for FY2013 are MDA estimates of appropriated levels as reduced by the March 1, 2013, sequestration; FY2014 figures are requested; FY2015-FY2018 figures are programmed.

Issues for Congress

Impact of March 1, 2013, Sequester on FY2013 Funding

One issue for Congress concerns the impact on the Aegis BMD program of the March 1, 2013, sequester on FY2013 funding (and unobligated prior-year funding) for the program. For the Aegis BMD program, this could affect areas such as research and development work on new versions of the Aegis BMD system, procurement of SM-3 interceptors missiles, adding BMD capabilities to Aegis ships (or upgrading those capabilities), military construction funding for the Aegis BMD program, and operations and maintenance funding for the Aegis BMD program.[32]

Potential Impact of Possible Late 2013/Early 2014 Sequester on FY2014 Funding

Another potential issue for Congress concerns the potential impact on the Aegis BMD program of a possible sequester on FY2014 funding (and unobligated prior-year funding) for the program that might occur in late 2013 or early 2014 under the terms of the Budget Control Act of 2011 (S. 365/P.L. 112-25 of August 2, 2011).

U.S. vs. European Naval Contributions to European BMD

Another potential oversight issue for Congress concerns European naval contributions to European BMD capabilities and operations compared to U.S. naval contributions to European BMD capabilities and operations, particularly in light of worldwide operational demands for U.S. Navy Aegis ships. A May 30, 2013, press report states:

> As the missile threats from Iran and North Korea have advanced in recent years, the U.S. has become more invested in Navy cruisers and destroyers that carry the high-tech Aegis radar system and dozens of missile interceptors.
>
> As a result, the ballistic missile defense destroyers and cruisers are a growing capability that is in hot demand from military commanders across the Middle East, Europe and the Pacific....
>
> ... the increasing requirements for the ships also exact another toll on the already strained naval forces. Commanders are routinely forced to extend the ships' deployments, keeping sailors at sea for longer periods and shrinking their time at home.
>
> The USS Stout, which is pierside at the Norfolk Naval Station, returned from its deployment to the Persian Gulf region in June 2011, and its crew is now preparing to go back out this summer. While most Navy cruisers and destroyers deploy for about 6-1/2 months, and then spend more than three years at home, the missile defense warships are spending up to 7-1/2 months deployed and get a bit more than two years at home between tours.

[32] Source: Navy briefing dated February 28, 2013. The Navy states that the figure of $81 million in approximate and subject to refinement.

> "They are the most stressed, they have the highest operational tempo of all our forces," [Admiral Bill] Gortney [Commander of U.S. Fleet Forces Command] said. "What we're trying to do in the Navy is to meet that demand at an acceptable personnel tempo for our sailors and their families, as well as allow us to continue to do the maintenance so these ships go to their service life."[33]

Potential oversight issues for Congress include the following:

- How does the total value of European naval contributions to European BMD capabilities and operations compare to the total value of the U.S. contributions to European BMD capabilities and operations?
- Given anticipated reductions in planned levels of U.S. defense spending resulting from the Budget Control Act of 2011 (S. 365/P.L. 112-25 of August 2, 2011), as well as the potential for giving BMD capabilities to European navy ships (see "Allied Participation and Interest in Aegis BMD Program" in "Background") or for European countries to purchase Aegis ashore systems, should the United States seek increased investment by European countries in their regional BMD capabilities so as to reduce the need for assigning BMD-capable U.S. Navy Aegis ships to the EPAA? Why should European countries not pay a greater share of the cost of the EPAA, since the primary purpose of the EPAA is to defend Europe against theater-range missiles?

Target for Simulating Endo-Atmospheric Flight of DF-21 ASBM

Another potential oversight issue for Congress concerns the lack of a target for simulating the endo-atmospheric (i.e., final) phase of flight of China's DF-21 anti-ship ballistic missile. DOD's Director, Operational Test and Evaluation (DOT&E), in a December 2011 report (DOT&E's annual report for FY2011), stated:

> **Anti-Ship Ballistic Missile Target**
>
> A threat representative Anti-Ship Ballistic Missile (ASBM) target for operational open-air testing has become an immediate test resource need. China is fielding the DF-21D ASBM, which threatens U.S. and allied surface warships in the Western Pacific. While the Missile Defense Agency has exo-atmospheric targets in development, no program currently exists for an endo-atmospheric target. The endo-atmospheric ASBM target is the Navy's responsibility, but it is not currently budgeted. The Missile Defense Agency estimates the non-recurring expense to develop the exo-atmospheric target was $30 million with each target costing an additional $30 million; the endo-atmospheric target will be more expensive to produce according to missile defense analysts. Numerous Navy acquisition programs will require an ASBM surrogate in the coming years, although a limited number of targets (3-5) may be sufficient to validate analytical models.[34]

A February 28, 2012, press report stated:

> "Numerous programs will require" a test missile to stand in for the Chinese DF-21D, "including self-defense systems used on our carriers and larger amphibious ships to counter

[33] Lolita C. Baldor, "Navy Ships Form First Line Of Missile Defense," *Yahoo.com (Associated Press)*, May 30, 2013.

[34] Department of Defense, Director, Operational Test and Evaluation, *FY 2011 Annual Report*, December 2011, p. 294.

> anti-ship ballistic missiles," [Michael Gilmore, the Pentagon's director of operational test and evaluation] said in an e-mailed statement....
>
> "No Navy target program exists that adequately represents an anti-ship ballistic missile's trajectory," Gilmore said in the e-mail. The Navy "has not budgeted for any study, development, acquisition or production" of a DF-21D target, he said.
>
> Lieutenant Alana Garas, a Navy spokeswoman, said in an e-mail that the service "acknowledges this is a valid concern and is assessing options to address it. We are unable to provide additional details."...
>
> Gilmore, the testing chief, said his office first warned the Navy and Pentagon officials in 2008 about the lack of an adequate target. The warnings continued through this year, when the testing office for the first time singled out the DF-21D in its annual public report....
>
> The Navy "can test some, but not necessarily all, potential means of negating anti-ship ballistic missiles," without a test target, Gilmore said.[35]

The December 2012 report from DOT&E (i.e., DOT&E's annual report for FY2012) did not further discuss this issue; a January 21, 2013, press report stated that this is because the details of the issue are classified.[36]

Concurrency and Technical Risk in Aegis BMD Program

Another potential oversight issue for Congress is development-production concurrency and technical risk there is in the Aegis BMD program. Below are comments from GAO reports on concurrency and technical risk in certain parts of program.

SM-3 Block IB Missile

A July 2013 report to Congress by the Missile Defense Executive Board stated the following regarding concurrency in the SM-2 Block IB missile:

> MDA received an early decision from the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) for initial production of 14 Standard Missile (SM)-3 Block IB missiles. This procurement will provide for timely availability of missiles to support the EPAA Phase 2 Warfighter requirement. This procurement will also sustain suppliers, maintain qualified production lines and maintain SM-3 Block IB missile unit costs. Risk of concurrency is mitigated by the positive results of several SM-3 Block IB flight tests that informed the initial production decision. Subsequently, USD(AT&L) provided an early production decision to procure long lead material for the next lot of 29 SM-3 Block IB missiles and missile canisters. This decision will further enable production missiles to be delivered on a schedule to meet inventory requirements for EPAA Phase 2. The next planned production decisions to approve SM-3 Block IB "all-up-rounds" will also be informed by additional BMDS tests, an initial operational test and evaluation in accordance with title 10, U.S.C., and Knowledge Points (KPs)....

[35] Tony Capaccio, "Navy Lacks Targets To Test U.S. Defenses Against China Missile," *Bloomberg Government (bgov.com)*, February 28, 2012.

[36] Christopher J. Castelli, "DOD Testing Chief Drops Public Discussion Of ASBM Target Shortfall," *Inside the Navy*, January 21, 2013.

The SM-3 Block IB program office also uses a series of BMDS KPs to identify information to make key decisions about acquisition life-cycle phase transition, funding, technology selections, capability demonstrations, program continuation, selecting an alternative course of action, and managing program risk. MDA KPs are critical to managing development risk at an acceptable level and informing decisions to incorporate technological advances sought by the Warfighter to counter the rapidly advancing threat. This knowledge-based approach measures progress and guides development and production to support an acceptable balance between schedule and risk. Using knowledge-based acquisition decisions in addition to a manageable balance of parallel development and production directly supports BMDS EPAA Phase 2 Warfighter requirements.

In June 2010, through the MDA acquisition oversight process, the alread ongoing SM-3 Block IB (with Aegis Ballistic Missile Defense version 4.0.1) was established in the product development phrase and initial acquisition baselines were set. Development concurrency was mitigated early in the program by leveraging the capability in the SM-3 Block IA missile before acquiring any SM-3 Block IB missiles. SM-3 Block IB missiles use many of the same components as the SM-3 Block IA, including the entire booster stack. The SM-3 Block IB offers more capability against a greater threat set because of improvements in the kinetic warhead (KW). These improvements include a two-color seeker, all reflective optics, an advanced signal processor, and a throttleable control system.

To support SM-3 Block IB development, ground tests were conducted to reduce risk and validate test conditions that are often difficult to duplicate in flight tests. The ground tests mitigated development risk before starting SM-3 Block IB flight tests in 3rd Quarter FY 2011. As a result of problems discovered during flight tests FTM-15 and FTM-16 E2, MDA received congressional approval to convert procurement appropriation funding to research, development, test, and evaluation (RDT&E) funding to resolve those problems before resuming flight tests. Analysis of the flight test results drove additional development to one legacy component as well as an update to the Aegis Weapon System (AWS) version 4.0.2 before the SM-3 Block IB began production. The program office is currently taking delivery of RDT&E missile placed on contract during FY2011. Based on the long lead-time for production, some material had to be procured before flight testing. These RDT&E missiles are supporting final development and testing of the SM-3 Block IB missile.

By direction of the Office of Management and Budget, in 3rd Quarter FY 2012 the program office received a decision from USD(AT&L) to start initial production with the authorization to acquire the first 14 SM-3 Block IB missiles using procurement appropriations. This decision was based on positive results from several SM-3 Block IB flight tests (FTM-16E2a and initial results from FTM-18). This overlap between final aspects of product development and initial production is necessary to sustain suppliers and maintain bioth qualified production lines and SM-3 Block IB missile unit costs.

In addition to the successful flight tests FTM-16E2a and FTM-18 already flown, a number of ground tests and final verification and qualification tests on critical SM-3 Block IB components were conducted prior to the USD(AT&L) decision to authorize long lead material procurement for the next 29 missiles. These steps mitigated potential concurrency between final product development and early material procurement necessary for the next lot of production SM-3 Block IB missiles. Additionally, potential concurrency and concurrency mitigation were reviewed by the MDA Director at the SM-3 Block IB Developmental Baseline Review in 2nd Quarter FY 2013 and progress towards mitigating concurrency is reviewed quarterly by the MDA Director during the SM-3 Block IB BER [Baseline Execution Review]. Finally, the SM-3 Block IB program office plans to participate in a number of additional flight tests tests [sic] including an initial operational test and evaluation in accordance with title 10, U.S.C. (i.e.;, FTM-19, FTM-21, and FTM-22) and complete BMDS KPs to inform the USD(AT&L) decision to approve production of SM-3 Block IB

> missiles through FY 2017. These sequential production decisions, informed by tailored component qualification tests, other ground tests, and flight tests, minimize concurrency, validate progression from one acquisition phase to the next, and will maintain the schedule necessary to satisfy BMDS EPAA Phase 2 Warfighter requirements.[37]

An April 2013 GAO report stated the following regarding the SM-3 Block IB missile:

> In 2012, the Aegis BMD SM-3 Block IB was able to partially overcome the production and testing issues exacerbated by its concurrent development and production strategy. MDA prematurely began purchasing SM-3 Block IB missiles beyond the number needed for developmental testing in 2010. In 2011, developmental issues arose when the program experienced a failure in its first developmental flight test and an anomaly in a separate SM-3 Block IA flight test, in a component common with the SM-3 Block IB. As a result, production was disrupted when MDA slowed production of the SM-3 Block IB interceptors and reduced planned quantities from 46 to 14. In 2012, the program was able to successfully conduct two flight tests which allowed the program to address some of the production issues by demonstrating a fix made to address one of the 2011 flight test issues. However, development issues continue to delay the program's fiscal year 2012 schedule and production. For example, MDA experienced further difficulties completing testing of a new maneuvering component—contributing to delays for a third flight test needed to validate the SM-3 Block IB capability and also subsequently delaying a production decision for certain components from December 2012 to February 2013.
>
> In order to avoid further disruptions to the production line, the program plans to award the next production contract for some missile components needed for the next order of 29 SM-3 Block IB missiles in February 2013—before the third flight test can verify the most recent software modifications. The program then plans to award the contract to complete this order upon conducting a successful flight test planned for the third quarter of fiscal year 2013.The program is at risk for costly retrofits, additional delays and further production disruptions if issues are discovered during this flight test.[38]

The April 2013 GAO report includes an appendix with additional in-depth discussion of concurrency and technical risk in the SM-3 Block IB program.[39]

A March 2013 GAO report stated:

> **Technology and Design Maturity**
>
> According to the program, all five of its critical technologies—the third-stage rocket motor, throttleable divert attitude control system (TDACS), reflective optics, two-color warhead seeker, and kinetic warhead advanced signal processor—are mature. However, while the program completed TDACS qualification in February 2013, after many delays and additional cost, its flight test program continues to experience disruptions. In 2011, the program observed two anomalies with the third-stage rocket motor during flight tests, including the

[37] *Missile Defense Executive Board Report to Congress on Concurrency in Development of Ballistic Missile Defense System Capability*, July 2013, pp. 3 and 7-9. Posted online at InsideDefense.com (subscription required), September 27, 2013. The report was directed by page 82 of the House Armed Services Committee's report (H.Rept. 112-479 of May 11, 2012) on H.R. 4310, the FY2013 National Defense Authorization Act.

[38] Government Accountability Office, *Missile Defense[:] Opportunity to Refocus on Strengthening Acquisition Management*, GAO-13-432, April 2013, pp. 22-23.

[39] Government Accountability Office, *Missile Defense[:] Opportunity to Refocus on Strengthening Acquisition Management*, GAO-13-432, April 2013, Appendix II on pp. 52-59.

failure of the first flight test, which led to a reassessment of the program's cost and schedule and failure investigations. Since then, the program has concluded the investigations, determining that it needed to redesign a component of the rocket motor and institute a software change in the Aegis weapon system. Both changes have been implemented, but only one successfully fight tested. The flight test of the Aegis software change was delayed because of challenges with the qualification of the TDACS. Initial assessments of the software change indicate minimal effect on the operational performance. A full resolution of the issue would require a redesign of the third-stage rocket motor—which is currently unfunded. The cost of the investigations and subsequent modifications caused by last year's failures is estimated at $149 million. Production Maturity

Following anomalies with the third-stage rocket motor, the program delayed SM-3 IB procurement decisions by about a year and slowed acceptance of both SM-3 IA and SM-3 IB missiles already in production until failure investigations were completed and a redesign introduced. Additionally, the program reduced SM-3 IB procurement quantities in fiscal year 2012 in order to free up funding to investigate the failures, develop solutions, and confirm those solutions in ground and flight tests. As a result, rather than the planned 46 missiles, the program bought only 14 SM-3 IB missiles in fiscal year 2012, adjusting its production quantities for the third time in three years. The program also purchased additional 14 SM-3 IA missiles, again delaying plans to cancel production of that variant. The program conducted the SM-3 IB manufacturing readiness review in May 2012, which resulted in a conditional pass, largely due to issues with the qualification of the TDACS. Continued challenges with the qualification of that component delayed a key test until the third quarter of fiscal year 2013. In order to avoid further disruptions to the production line, the program seeks permission to award the next production contract for some components of the next order of up to 29 additional missiles in February 2013—before a flight test can verify the recent software modifications. The program currently plans to begin operational missile production in fiscal year 2013 if four more intercept tests are completed successfully.

Other Program Issues

The program is developing an improved SM-3 IB missile, designed to intercept additional complex threats. The software upgrade will be available in 2014, and cost an additional $86.6 million over the course of five years.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS [Electronic Subcontracting Reporting System]. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that neither of the subcontracting reports for SM-3 IB's two contracts had been accepted.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.[40]

[40] Government Accountability Office: *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-13-294SP, March 2013, p. 50.

SM-3 Block IIA Missile

A July 2013 report to Congress by the Missile Defense Executive Board stated the following regarding concurrency in the SM-2 Block IIA missile:

> In 2010, MDA began an acquisition oversight process to establish SM-3 Block IIA and ABMD [Aegis BMD] 5.1 in the technology development phase and set initial technology acquisition baselines.
>
> The program office will complete development and initial testing of the SM-3 Block IIA using a structured systems engineering approach that aligns with MDA acquisition policy and processes. In February 2010, the SCD [SM-3 Block IIA Cooperative Development] Executive Steering Committee approved the SCD KP [Knowledge Point] plan. The 33 identified KPs define the critical knowledge required during development to ensure successful design and initial testing. The structured systems engineering and knowledge-based approach eliminates development concurrency for required capability delivery within planned cost and schedule. Additionally, the program office's progress towards mitigating concurrency is reviewed quarterly by the MDA Director during the SM-3 Block IIA BER [Baseline Execution Review].
>
> The program office has begun a robust development and test process using hardware; major test events and KPs precede major acquisition milestones. For example, the program office successfully demonstrated subsystem functional performance and completed subsystem preliminary design reviews (PDRs) for all critical SM-3 Block IIA subsystems (e.g., third stage rocket motor (TSRM), second stage rocket motor (SSRM), booster, nosecone, divert attitude control system (DACS), and the KW [kinetic warhead]) well in advance of the March 2012 system PDR. The subsystem reviews used data from computer in the loop (CIL) tests and data fro hardware testing from two full-duration DACS valve hot-fire tests, three Japanese rocket motor firings, and Japanese nosecone separation testing.
>
> SM-3 Block IIA will continue this rigorous engineering review process focused on hardware performance to prepare and inform the move from the technology development phase to product development. The SCD critical design review (CDR) of the interface with the Aegis BMD 5.1 weapon system for organic operation will be complete before the full SM-3 Block IIA production development decision in the 2nd Quarter FY 2014. The SCD CDR will use data from both hardware in the loop (HIL) and CIL tests, and data from hardware tests like a restrained firing of the MK-72 booster, a propulsion test vehicle test, and hot-fire test events on the DACS, SSRN, and TSRM. The full system CRS (planned for 1st Quarter FY 2015) will incorporate results from the missile system CDRs, VLS CDRs, canister CDR, KPs, and testing, using organic ABMD 5.1 weapon and missile system interface.
>
> The rigorous engineering process will continue to inform decisions as SM-3 Block IIA moves from product development to the production phase. Performance data from HIL and CIL tests will be augmented with flight test data to support knowledge-based decisions. Initial flight tests will focus on validating propulsion system performance in flight using CTVs [control test vehicles]. Subsequent flight tests will demonstrate missile functionality and intercept capability, and prior to a full production decision, will culminate in an initial operational test and evaluation in accordance with title 10, U.S.C. Flight tests will be spaced from 1 year to 6 months so that lessons learned are incorporated into the design before the next test.[41]

[41] *Missile Defense Executive Board Report to Congress on Concurrency in Development of Ballistic Missile Defense System Capability*, July 2013, pp. 9-10. Posted online at InsideDefense.com (subscription required), September 27, (continued...)

An April 2013 GAO report stated the following regarding the SM-3 Block IIA missile:

> MDA has taken steps to reduce acquisition risk by decreasing the overlap between technology development and product development for two of its programs—the Aegis BMD SM-3 Block IIA and the [now-terminated] SM-3 Block IIB programs. Reconciling gaps between requirements and available resources before product development begins makes it more likely that a program will meet cost, schedule, and performance targets.
>
> • The Aegis BMD SM-3 Block IIA program added time and money to the program to extend development. Following significant technology development problems with four components, MDA delayed the system preliminary design review—during which a program demonstrates that the technologies and resources available are aligned with requirements—for more than 1 year, thereby reducing its acquisition risk. As a result, in March 2012, following additional development of the four components, the program was able to successfully complete the review.[42]

The April 2013 GAO report includes an appendix with additional in-depth discussion of concurrency and technical risk in the SM-3 Block IIA program.[43]

SM-6 Missile

A March 2013 GAO stated the following regarding the SM-6 missile:

> **Technology, Design, and Production Maturity**
>
> According to the program office, all SM-6 critical technologies are mature and its design is stable; however, the program remains at risk of further design changes pending testing to verify correction of failures. The program obtained approval at development start to conduct limited developmental testing because the risk of integrating the legacy AMRAAM missile seeker with the Standard Missile was perceived to be low. However, over half of the SM-6's at-sea developmental flight tests experienced anomalies or resulted in failure with multiple issues that have been attributed to these legacy components. The program proceeded with operational testing in June 2011 and the missile failed 5 of 12 tests. According to the program office, the Navy's operational test organization concluded that the missile is effective, but a determination of suitability and reliability is pending the completing of supplemental testing.
>
> The SM-6 program has proven out its production processes, but has not yet demonstrated that its critical processes are in control or that the missiles produced perform reliably. According to the program, the sample size needed for measuring processes control will not be achieved until 2014.
>
> **Other Program Issues**

(...continued)

2013. The report was directed by page 82 of the House Armed Services Committee's report (H.Rept. 112-479 of May 11, 2012) on H.R. 4310, the FY2013 National Defense Authorization Act.

[42] Government Accountability Office, *Missile Defense[:] Opportunity to Refocus on Strengthening Acquisition Management*, GAO-13-432, April 2013, p. 21.

[43] Government Accountability Office, *Missile Defense[:] Opportunity to Refocus on Strengthening Acquisition Management*, GAO-13-432, April 2013, Appendix IV on pp. 70-72.

> The SM-6's highly concurrent testing and production strategy has resulted in design changes and schedule delays. In 2009, the Under Secretary of Defense for Acquisition, Technology, and Logistics approved low-rate production of up to 19 missiles before completing developmental testing and required the program to complete developmental testing prior to awarding additional contracts. The Under Secretary subsequently approved the award of two additional low-rate production contracts before this testing was complete. After numerous developmental test failures, the program proceeded into operational testing where the high failure rate continued. In February 2012, the Under Secretary of Defense approved an acquisition strategy update which extended low-rate production through fiscal year 2012 and delayed the full-rate production decision until fiscal year 2013 to allow for supplemental testing. In addition, multiple SM-6 capabilities will not be fully tested until full-rate production is well underway. According to officials, the program plans to have 387 of 1,200 missiles under contract by the end of fiscal year 2014, prior to the fielding the Naval Integrated Fire Control- Counter Air From the Sea capability, which enables its over-the-horizon capabilities.
>
> As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS [Electronic Subcontracting Reporting System]. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report for SM-6's contract has not been accepted.
>
> **Program Office Comments**
>
> In commenting on a draft of this assessment, the Navy disagreed with our assertion that the missile has not been demonstrated to perform reliably. According to officials, supplemental testing was successfully completed in November 2012 and the program expects the missile to be assessed as reliable. The program office also provided technical comments, which were incorporated where deemed appropriate.
>
> **GAO Response**
>
> While program officials expect the SM-6 to be assessed as reliable, the Director, Operational Test and Evaluation reported in January 2013 that data from supplemental testing are insufficient to verify correction of problems found in operational testing and concluded that the missile does not meet the flight reliability criteria established by the Under Secretary of Defense. Our reviews of DOD weapons systems confirm that production costs are minimized when a fully integrated, capable prototype is demonstrated to show that the system will work as intended in a reliable manner.[44]

Aegis Ashore

A July 2013 report to Congress by the Missile Defense Executive Board stated the following regarding concurrency in the SM-2 Block IB missile:

> The Aegis Ashore element is leveraging and reusing the development and design from several United States Navy programs with similar components. For example, the Aegis Ashore vertical launch system (VLS) is the same system previously procured for the cruiser and destroyer programs. The deckhouse design is similar to the destroyer configuration for

[44] Government Accountability Office: *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-13-294SP, March 2013, p. 124.

> the Aegis SPY radar arrays. The Aegis Ashore program office will also use a number of BMDS KPs [Knowledge Points] and flight tests, including an operational test at the Pacific Missile Range Facility, from other MDA elements to mitigate risk and inform major program decisions....
>
> In June 2010, through the MDA acquisition oversight process, Aegis Ashore was established in the product development phase and initial acquisition baselines were set. The current Aegis Ashore acquisition strategy has balanced development concurrency with flight tests, military construction and component procurement decisions. It has an appropriately aligned strategy with the necessary levels of testing, monitored by knowledge-based decision points. Aegis Ashore uses ongoing development from United State navy ASW [Aegis Weapon System] program. The AWS supporting Aegis Ashore is the same system supporting all Aegis shipbuilding programs (past and present). Before the first Aegis Ashore flight test, the SM-3 Block IB missile will have been tested several times with the AWS.
>
> Significant activities during the Aegis Ashore product development phase include integrating the MK41 VLS launcher. The VLS housing is a stell modular structure because there is no ship structure to surround the launcher. This structure design is new, but replicates what was field-tested with other variant of the [S]tandard [M]issile at the White Sands Missile Range, New Mexico. The program office does not expect Aegis Ashore flight-testing to affect the technical design of the MK 41 VLS or the VLS housing.
>
> The deckhouse contains the AWS and hosts the operators who execute the Aegis Ashore mission. This structure is new, not based on an existing design, yet replicates the height and spacing of the Aegis SPY radar arrays similar to a destroyer configuration. Flight-testing is not expected to affect the technical design of the deckhouse.
>
> Aegis Ashore testing includes both weapon system testing to verify performance as the deckhouse is built up, and flight tests to verify communication and controlled fly out of the SM-3 from the MK 41 LVS launcher and will conclude with an operational test at the Pacific Missile Range Facility. This test approach is the same process used in Navy ship construction shake-down trials and combat systems qualifications.
>
> Planning continues for the production of the next and final Aegis Ashore system (based on current requirements and funding). This last system will support EPAA Phase 3. MDA notified USD(AT&L) of their intent to use procurement appropriation funding for Navy program offices to acquire material for this system. The Aegis Ashore program office expects to procure long lead material in 1st Quarter FY 2014. Although the previous Aegis Ashore system will not be completely developed and constructed before the final system begins construction, the last Aegis Ashore system is also based on existing Navy programs and incorporate[s] updates from the previous developmental system. Ground and flight tests from the previous developmental system and other SM-3 flight tests are not expected to impact the design of the final Aegis Ashore system. Progress in maintaining mitigation of potential concurrency risks is reviewed quarterly by the MDA Director during the Aegis Ashore BER [Baseline Execution Review].[45]

An April 2013 GAO report stated the following regarding the Aegis Ashore program:

[45] *Missile Defense Executive Board Report to Congress on Concurrency in Development of Ballistic Missile Defense System Capability*, July 2013, pp. 3 and 10-11. Posted online at InsideDefense.com (subscription required), September 27, 2013. The report was directed by page 82 of the House Armed Services Committee's report (H.Rept. 112-479 of May 11, 2012) on H.R. 4310, the FY2013 National Defense Authorization Act.

> The Aegis Ashore program, as we reported in April 2012, initiated product development and established cost, schedule, and performance baselines prior to completing the preliminary design review. Further, we reported that this sequencing increased technical risks and the possibility of cost growth by committing to product development with less technical knowledge than recommended by acquisition best practices and without ensuring that requirements were defined, feasible, and achievable within cost and schedule constraints. In addition, the program committed to buy components necessary for manufacturing prior to conducting flight tests to confirm the system worked as intended. As a result, any design modifications identified through testing would need to be retrofitted to produced items at additional cost. However, the MDA Director stated in March 2012 that the Aegis Ashore development is low risk because of its similarity to the sea-based Aegis BMD.41 Nonetheless, this concurrent acquisition plan means that knowledge gained from flight tests cannot be used to guide the construction of Aegis Ashore installations or the procurement of components for operational use.[46]

The April 2013 GAO report also stated:

> As we reported in April 2012, the instability of content in the Aegis Ashore program's resource baseline obscures our assessment of the program's progress. MDA prematurely set the baseline before program requirements were understood and before the acquisition strategy was firm. The program established its baseline for product development for the Romania and Hawaii facilities in June 2010 with a total cost estimate of $813 million. However 3 days later, when the program submitted this baseline to Congress in the 2010 BAR [BMDS (ballistic missile defense system) Accountability Report], it increased the total cost estimate by 19 percent, to $966 million. Since that time, the program has added a significant amount of content to the resource baseline to respond to acquisition strategy changes and requirements that were added after the baseline was set. Because of these adjustments, from the time the total estimated cost for Aegis Ashore in Romania and Hawaii was first approved in June 2010 at $813 million, it has nearly doubled to its estimate of $1.6 billion reported in the February 2012 BAR. These major adjustments in program content made it impossible to understand annual or longer-term program progress.
>
> These adjustments also affected the schedule baseline for Aegis Ashore. For example, many new activities were added to the baseline in 2012. In addition, comparing the estimated dates for scheduled activities listed in the 2012 BAR to the dates baselined in the 2010 BAR is impossible in some cases because activities from the 2010 BAR were split into multiple events, renamed, or eliminated all together in the 2012 BAR. MDA also redistributed planned activities from the Aegis Ashore schedule baselines into several other Aegis BMD schedule baselines. For example, activities related to software for Aegis Ashore were moved from the Aegis Ashore baseline and were split up and added to two other baselines for the second generation and modernized Aegis weapon systems software. Rearranging content made tracking the progress of these activities against the prior year and original baseline very difficult and in some cases impossible. As a result, appendix III contains a limited schedule assessment of near-term and long-term progress based on activities we were able to track in the BAR.[47]

The April 2013 GAO report also stated:

---

[46] Government Accountability Office, *Missile Defense[:] Opportunity to Refocus on Strengthening Acquisition Management*, GAO-13-432, April 2013, pp. 24-25.

[47] Government Accountability Office, *Missile Defense[:] Opportunity to Refocus on Strengthening Acquisition Management*, GAO-13-432, April 2013, pp. 33-34.

Developing and deploying new missile defense systems in Europe to aid in defense of Europe and the United States is a highly complex effort. We reported last year that several of the individual systems that comprise the current U.S. approach to missile defense in Europe—called the European Phased Adaptive Approach—have schedules that are highly concurrent. Concurrency entails proceeding into product development before technologies are mature or into production before a significant amount of independent testing has confirmed that the product works as intended. Such schedules can lead to premature purchases of systems that impair operational readiness and may result in problems that require extensive retrofits, redesigns, and cost increases. A key challenge, therefore, facing DOD is managing individual system acquisitions to keep them synchronized with the planned time frames of the overall U.S. missile defense capability planned in Europe. MDA still needs to deliver some of the capability planned for the first phase of the U.S. missile defense in Europe and is grappling with delays to some systems and/or capabilities planned in each of the next three major deployments. MDA also is challenged by the need to develop the tools, the models and simulations, to understand the capabilities and limitations of the individual systems before they are deployed. Because of technical limitations in the current approach to modeling missile defense performance, MDA recently chose to undertake a major new effort that it expects will overcome these limitations. However, MDA and the warfighters will not benefit from this new approach until at least half of the four planned phases have deployed....

As we reported in December 2010, the U.S. missile defense approach in Europe commits MDA to delivering systems and associated capabilities on a schedule that requires concurrency among technology, design, testing, and other development activities. We reported in April 2012 that deployment dates were a key factor in the elevated levels of schedule concurrency for several programs. We also reported at that time that concurrent acquisition strategies can affect the operational readiness of our forces and risk delays and cost increases.

DOD declared Phase 1 operational in December 2011, but the systems delivered do not yet provide the full capability planned for the phase. MDA deployed, and the warfighter accepted, Phase 1 with the delivery of an AN/TPY-2 radar, an Aegis BMD ship with SM-3 Block IA missiles, an upgrade to C2BMC, and the existing space-based sensors. Given the limited time between the September 2009 announcement of the U.S. missile defense in Europe and the planned deployment of the first phase in 2011, that first phase was largely defined by existing systems that could be quickly deployed. MDA planned to deploy the first phase in two stages—the systems described above by December 2011 and upgrades to those systems in 2014. Although the agency originally planned to deliver the remaining capabilities of the first phase in 2014, an MDA official told us that MDA now considers these capabilities to be part of the second phase and these capabilities may not be available until 2015.

In addition, independent organizations determined that some of the capabilities that were delivered did not work as intended. For example, the Director, Operational Test and Evaluation reported that there were some interoperability and command and control deficiencies. This organization also reported that MDA is currently investigating these deficiencies.

According to MDA documentation, systems and associated capabilities for the next phases are facing delays, either in development or in integration and testing.

• For Phase 2, some capabilities, such as an Aegis weapon system software upgrade, may not be available. MDA officials stated they are working to resolve this issue.

• For Phase 3, some battle management and Aegis capabilities are currently projected to be delayed and the initial launch of a planned satellite sensor system—PTSS—is delayed.

• For [the now-terminated] Phase 4, deployment of the SM-3 Block IIB missile [was] delayed from 2020 to 2022, and full operational capability of PTSS [was] delayed to no sooner than 2023.[48]

The April 2013 GAO report includes an appendix with additional in-depth discussion of concurrency and technical risk in the Aegis Ashore program.[49]

Legislative Activity for FY2014

Summary of Action on FY2014 MDA Funding Request

Table 4 summarizes congressional action on the FY2014 request for MDA procurement and research and development funding for the Aegis BMD program.

Table 4. Summary of Congressional Action on FY2014 Request for MDA Procurement and RDT&E Funding for Aegis BMD Program

(In millions of dollars, rounded to nearest tenth; totals may not add due to rounding)

		Authorization			Appropriation		
	Request	**HASC**	**SASC**	**Conf.**	**HAC**	**SAC**	**Conf.**
Procurement (PE 0208866C)							
Aegis Ashore Phase III	131.4	131.4	131.4		131.4	131.4	
Aegis BMD	580.8	580.8	580.8		580.8	580.8	
Subtotal Procurement	**712.2**	**712.2**	**712.2**		**712.2**	**712.2**	
Research, development, test and evaluation (RDT&E)							
Aegis BMD (PE 0603892C)	937.1	937.1	937.1		937.1	910.1	
Land-based SM-3 (PE0604880C)	129.4	129.4	129.4		129.4	129.4	
Aegis SM-3 IIA (PE0604881C)	308.5	308.5	308.5		308.5	308.5	
Subtotal RDT&E	**1,375.0**	**1,375.0**	**1,375.0**		**1,375.0**	**1,348.0**	
TOTAL	**2,087.2**	**2,087.2**	**2,087.2**		**2,087.2**	**2,060.2**	

Source: For request: FY2014 MDA briefing materials and FY2014 budget-justification books for MDA for Research, Development, Test & Evaluation, Defense-Wide (Volume 2a) and for Procurement, Defense-Wide (Volume 2b). **For HASC:** H.Rept. 113-102, pp. 407, 445, 446. **For SASC:** S.Rept. 113-44, pp. 315, 353, 354. **For HAC:** H.Rept. 113-113, pp. 203, 256, 257. **For SAC:** S.Rept. 113-85, pp. 134, 174, 178.

Notes: HASC is House Armed Services Committee; **SASC** is Senate Armed Services Committee; **HAC** is House Appropriations Committee; **SAC** is Senate Appropriations Committee; **Conf.** is conference.

[48] Government Accountability Office, *Missile Defense[:] Opportunity to Refocus on Strengthening Acquisition Management*, GAO-13-432, April 2013, pp. 35 and 37-38.

[49] Government Accountability Office, *Missile Defense[:] Opportunity to Refocus on Strengthening Acquisition Management*, GAO-13-432, April 2013, Appendix III on pp. 60-69.

FY2014 National Defense Authorization Act (H.R. 1960/S. 1197)

House

The House Armed Services Committee, in its report (H.Rept. 113-102 of June 7, 2013) on H.R. 1960, recommended the funding levels shown in **Table 4**.

Section 238 of H.R. 1960 as reported states:

> SEC. 238. NATO AND THE PHASED, ADAPTIVE APPROACH TO MISSILE DEFENSE IN EUROPE.
>
> (a) NATO Funding-
>
> (1) PHASE I OF EPAA- Not later than 60 days after the date of the enactment of this Act, the President shall consult with the North Atlantic Council and the Secretary General of the North Atlantic Treaty Organization (in this section referred to as `NATO') on—
>
> (A) the funding of the phased, adaptive approach to missile defense in Europe; and
>
> (B) establishing a plan for NATO to provide at least 50 percent of the infrastructure and operations and maintenance costs of phase I of the phased, adaptive approach to missile defense in Europe.
>
> (2) PHASES II AND III OF EPAA- The President shall use the NATO Military Common-Funded Resources process to seek to fund at least 50 percent of the costs for phases II and III of the phased, adaptive approach to missile defense in Europe.
>
> (3) REPORTS- Not later than 180 days after the date of the enactment of this Act, and each 180-day period thereafter, the President shall submit to the congressional defense committees, the Committee on Foreign Affairs of the House of Representatives, and the Committee on Foreign Relations of the Senate a report on the funding provided by NATO pursuant to paragraphs (1) and (2).
>
> (b) Interceptors- If the Secretary of Defense determines that it is useful to the interests of the United States, the Secretary shall seek to engage with members of NATO to establish a NATO common pool of Aegis standard missile-3 block IA, standard missile-3 block IB, and standard missile-3 block IIA interceptors to defend NATO members through the phased, adaptive approach to missile defense in Europe.

Regarding Section 238, H.Rept. 113-102 states:

> Section 238—NATO and the Phased, Adaptive Approach to Missile Defense in Europe
>
> This section would require, not later than 60 days after the date of enactment of this Act, that the President shall consult with the North Atlantic Council and the Secretary General of the North Atlantic Treaty Organization (NATO) on the funding of the Phased, Adaptive Approach to missile defense in Europe to establish a plan for NATO to provide at least 50 percent of the costs of operations and maintenance, and infrastructure, of Phase I of that system.
>
> This section would further require the President to use the NATO Military Common-Funded Resources process to seek at least 50 percent funding support of the costs for Phases II and

III of that missile defense system. This section would also require the Secretary of Defense, if he determines it useful, to seek establishment by NATO of a common pool of Aegis Standard Missile 3 missile interceptors. (Page 109)

H.Rept. 113-102 also states:

Aegis Ballistic Missile Defense System

The budget request contained $937.5 million in PE 63892C for the Aegis Ballistic Missile Defense System (BMDS).

The Aegis BMDS is the world's most proven naval missile defense system and the sea-based element of the U.S. Ballistic Missile Defense System. Aegis BMD plays an active role in protecting the United States and U.S. deployed forces from enemy ballistic missile attack. The Aegis BMD system has been included in the Administration's Phased Adaptive Approach to European Defense and has undergone an extensive and successful testing regime. The budget request included funding to meet significant capability and test milestones related to the evolution of the Aegis Weapons System and the test and deployment of new missile defense capabilities, including Launch on Remote technology.

The committee recommends $937.5 million, the full amount of the request, in PE 63892C for Aegis Ballistic Missile Defense.

Request for multi-year procurement authority for Standard Missile–3 Block IB beginning in FY15

The committee notes the successful FTM–19 flight test on May 16, 2013, which again demonstrated the robust design and performance of the Standard Missile–3 Block IB missile. With over $4.0 billion programmed for this missile across the FYDP, the committee strongly encourages the Department to request multi-year procurement authority for SM–3 Block IB beginning in fiscal year 2015.

The committee notes there could be savings in a multi-year procurement, such a contractual arrangement for SM–3 Block IB could yield savings equivalent to an entire additional year of production at current planned rates. The Department is directed to report to the congressional defense committees by December 31, 2013, with a recommendation on whether SM–3 Block IB could use multi-year or advanced procurement authority beginning in fiscal year 2015. If such authorities are requested, an estimate of what cost savings would accrue shall be required.

Service Life Extension Program for Standard Missile–3 Block IA missile interceptor

The committee is aware that the United States has completed procurement of additional Standard Missile–3 block IA interceptors and is planning to begin procurement of the block IB interceptor, which has a more capable seeker than the IA interceptor.

The committee is also aware that the United States has acquired a substantial inventory of block IA interceptors, many of which will soon begin to reach the end-of-design-life. The committee is aware that the Missile Defense Agency (MDA) is currently studying whether and how to conduct a service life extension program (SLEP) of the block IA interceptor and such a program could extend the lifetime of this substantial inventory of block IA missiles by approximately fifty percent.

> The committee believes such a SLEP should therefore be carefully studied and, if the results are promising, such a program should be promptly carried out. The committee believes that by carrying out this SLEP, MDA could come closer to meeting the requirements of the combatant commanders for missile interceptor inventory.
>
> *Standard Missile–3 Block IB ballistic missile interceptor*
>
> The committee is aware that the Standard Missile–3 (SM–3) block IB program will be transitioning from development to production in the next calendar year, after several delays. The committee is eager that the combatant commanders receive the block IB missile, which will be more capable than the IA missile that is presently the mainstay of the Aegis ballistic missile defense system fleet. Combatant commanders continue to state their demand for additional assets in theater to support ballistic missile defense mission requirements.
>
> According to the Missile Defense Agency, it will procure 52 of these improved missile interceptors in fiscal year 2014, and 72 missiles per year each year through the fiscal year 2014 Future Years Defense Program. The committee supports this procurement.
>
> The committee is aware of the challenges moving to procurement and the challenges of significantly increasing delivery quantities. The committee expects to be informed of any challenges meeting the increased production rate. The committee also expects to be informed of the progress of the FTM–19, 21, and 22 tests, which are required to get the IB missile certified for full rate production. The committee is eager to see full rate production when these maritime flight test events are successfully completed. (Pages 72-73)

The report also states:

> *Solid Divert and Attitude Control System*
>
> The budget request contained $309.2 million in PE 63175C for Ballistic Missile Defense Technology. Of this amount, $24.0 million was requested for the continued development, post SM–3 IIB termination, of an enhanced Solid Divert and Attitude Control System (SDACS).
>
> In the committee report (H. Rept. 112–479) accompanying the National Defense Authorization Act for Fiscal Year 2013, the committee expressed its concerns about the possibility of relying on a single provider of SDACS technology. The committee is pleased that, with the termination of the SM–3 IIB, the Missile Defense Agency is taking steps to ensure there is an additional opportunity for diversity in the industrial base for this critical technology.
>
> The committee recommends $24.0 million, the full amount requested, in PE 63175C for development of Solid Divert and Attitude Control System technology. (Page 75)

The report also states:

> *Common Kill Vehicle for missile defense*
>
> The budget request contained $309.2 million in PE 63175C for Ballistic Missile Defense Technology. Of this amount, $70.0 million was requested for the Common Kill Vehicle Technology (CKVT) program.

> The committee is aware that approximately $20.0 million of the funds appropriated for the Standard Missile 3 block IIB program in fiscal year 2013 are to be redirected to the CKVT program by the Missile Defense Agency (MDA).
>
> The committee understands that MDA's intention for the CKVT program is to: enable the consolidation of the development of kill vehicles; develop a modular, open kill vehicle architecture; transition a more capable kill vehicle to the Ground-based Interceptor and the Standard Missile 3; and evolve to a multiple kill vehicle payload. The committee supports these developmental goals.
>
> The committee is also aware that, pursuant to section 225 of the National Defense Authorization Act for Fiscal Year 2013 (Public Law 112–239), the Missile Defense Agency is developing a plan for a next generation exo-atmospheric kill vehicle. Section 225 also requires the Director, Missile Defense Agency to submit to the congressional defense committees a report on the plan.
>
> The committee finds that the budget justification material regarding the CKVT program was insufficient, lacked necessary details, and should be further revised to include a date for initial operating capability, as well as a plan to transition to a development program based on full and open competition in time to support current and future interceptor procurement. The committee directs the Missile Defense Agency to provide a briefing to the congressional defense committees on such information by July 31, 2013, as well as for it to be included in the report required by section 225 of Public Law 112–239.
>
> In addition, the committee directs the Director, Missile Defense Agency to determine an alternate program element (PE) in the fiscal year 2015 budget submission to fund the Common Kill Vehicle Technology and Capability Development program. It should balance the Ground-based Midcourse Defense system equities in a potential Common Kill Vehicle Technology and Capability Development program, as well as those possessed by the Aegis ballistic missile defense program. In addition, the committee recommends a new PE for fiscal year 2014.
>
> The committee recommends no funds, a decrease of $70.0 million, in PE 63175C for the Common Kill Vehicle Technology program. Further, the committee recommends $70.0 million, an increase of $70.0 million, in a new PE for the Common Kill Vehicle Technology and Capability Development program. (Pages 75-76)

The report also states:

> *Electro Magnetic Rail Gun for Missile Defense*
>
> The committee notes that the U.S. Navy has been conducting long-term research into electromagnetic railgun technology to support naval surface fire support missions. The committee is aware that pursuant to section 243 of the National Defense Authorization Act for Fiscal Year 2012 (Public Law 112–81), the Secretary of the Navy provided an unclassified and classified report on the development, future deployment, and operational challenges of this technology. The committee is also aware that the Assistant Secretary of the Navy for Research, Development, and Acquisition wrote in response to this reporting requirement that, ''[p]reliminary analysis shows that a tactical railgun ... has the potential to provide lethal effectiveness ... for antiship ballistic missile defense.'' The committee acknowledges significant challenges ahead in developing, integrating, and deploying such technology, as with many technology development programs.
>
> Additionally, the committee is aware that the Department has established a new effort within the Strategic Capabilities Office in the Office of the Secretary of Defense to leverage the

> Navy's program to explore the development a land-based railgun. As noted in the committee report (H. Rept. 112–479) for the National Defense Authorization Act of Fiscal Year 2013, the committee is interested in the potential utility in accelerating some electromagnetic railgun efforts for land-based area defense.
>
> The committee finds these developments encouraging, and urges the Director, Missile Defense Agency to examine these activities in order to determine their potential application, if they can provide additional capability, to broader ballistic missile defense missions of the Missile Defense Agency. (Pages 79-80)

The report also states:

> *Next generation Aegis missile—Standard Missile 3 block IIB*
>
> The committee is aware that on March 15, 2013, the Secretary of Defense announced that the Administration would propose to restructure the Standard Missile (SM) 3 block IIB program in the budget request for fiscal year 2014. The Missile Defense Agency has made it clear that this decision was driven by congressional reductions in technology development in fiscal years 2012–13, as well as technical challenges related to the projected capability of the missile and related to sea-basing the prospective missile interceptor.
>
> The committee is also aware that the Government and its industry partners both made significant investments in the development of the SM–3 IIB missile. The committee believes that it would be imprudent and short-sighted to walk away from these investments and to leave no program of record for the continued improvement of the SM–3 system. The committee encourages the Missile Defense Agency to use these investments as much as possible to improve and inform the development of the Aegis ballistic missile defense system SM–3 IIA interceptor, planned to be fielded in fiscal year 2018, as well as a follow-on system. Therefore, the committee directs the Director, Missile Defense Agency to provide a briefing to the congressional defense committees by November 15, 2013, on the potential for a concept development program for leveraging the investments made in the SM–3 IIB program by the United States and industry to continue to improve the SM–3 IIA missile through an evolved or iterative variant, for example an SM–3 IIA+. (Page 92)

Senate

The Senate Armed Services Committee, in its report (S.Rept. 113-44 of June 20, 2013) on S. 1197, recommended the funding levels shown in **Table 4**.

Section 231 of S. 1197 as reported states:

> SEC. 231. HOMELAND BALLISTIC MISSILE DEFENSE.
>
> (a) Findings- Congress makes the following findings:
>
> (1) The Ballistic Missile Defense Review of February 2010 stated as its first policy priority that `the United States will continue to defend the homeland against the threat of limited ballistic missile attack' and that `an essential element of the United States' homeland ballistic missile defense strategy is to hedge against future uncertainties, including both the uncertainty of future threat capabilities and the technical risks inherent to our own development plans'.

(2) The United States currently has an operational Ground-based Midcourse Defense (GMD) system with 30 Ground-Based Interceptors (GBIs) deployed in Alaska and California, protecting all of the United States, including the East Coast, against the threat of limited ballistic missile attack from both North Korea and Iran. During 2013, senior military and civilian defense leaders have stated repeatedly that they have confidence in the ability of the current Ground-based Midcourse Defense system to protect the United States from limited ballistic missile attack from North Korea and Iran.

(3) On March 15, 2013, Secretary of Defense Chuck Hagel announced a series of planned steps to enhance United States homeland ballistic missile defense, to stay ahead of the future missile threat from North Korea and Iran. These steps include the deployment of 14 additional Ground-Based Interceptors at Fort Greely, Alaska, by 2017, a nearly 50 percent increase in the number of such interceptors deployed by the United States.

(4) In response to provocative behavior and public threats by North Korea to launch missiles at the United States, the Department of Defense took a number of actions to enhance United States homeland missile defense capabilities, including deployment of the Sea-Based X-band radar into the Pacific Ocean.

(5) Before the March 15, 2013, announcement by Secretary of Defense Hagel, General Robert Kehler, Commander of the United States Strategic Command, testified that `I am confident that we can defend against a limited attack from Iran, although we are not in the most optimum posture to do that today ... it doesn't provide total defense today'. Shortly after the announcement by Secretary Hagel, General Charles Jacoby, Commander of the United States Northern Command, testified that `we have the capability of limited defense right now. And I think it's not optimum and I think that we've made some important steps forward in what was rolled out. And I think we need to continue to assess the threat and make sure we stay ahead of it'.

(6) As its highest near-term priority, the Missile Defense Agency is designing a correction to the problem that caused a December 2010 flight test failure of the Ground-based Midcourse Defense system using the Capability Enhancement-II (CE-II) model of exo-atmospheric kill vehicle, and plans to demonstrate the correction through flight testing, including an intercept test, before resuming production, assembly, or refurbishment of additional Capability Enhancement-II kill vehicles.

(7) The Department of Defense has a program to improve the performance and reliability of the Ground-based Midcourse Defense system. According to Department officials, the goal of the Ground-Based Interceptor reliability program is to double the number of threat Intercontinental Ballistic Missiles (ICBMs) that the current United States inventory of Ground-Based Interceptors could defeat, thereby effectively doubling the capability of the current Ground-based Midcourse Defense system.

(8) The Missile Defense Agency, working with the Director of Operational Test and Evaluation and with United States Strategic Command, has developed a comprehensive Integrated Master Test Plan (IMTP) for missile defense, with flight tests for the Ground-based Midcourse Defense system planned through fiscal year 2023, including salvo testing, multiple simultaneous engagement testing, and operational testing. The current test plan includes an additional intercept flight test using the Capability Enhancement-I kill vehicle, scheduled for mid-2013, to demonstrate the reliability enhancements to Ground-Based Interceptors quipped with that kill vehicle. The Director of Operational Test and Evaluation reviewed and approved the Ground-based Midcourse Defense system test plan and pace, including the plan to demonstrate the correction of the Capability Enhancement-II kill vehicle.

(9) In May, 2013, Vice Admiral James Syring, the Director of the Missile Defense Agency, testified to Congress that he is seeking to improve the performance and reliability of the Ground-Based Interceptors, and to make the Ground-based Midcourse Defense system `more operationally effective and cost-effective', including by improving its sensors, discrimination, kill assessment, and battle management. He testified that these improvements are `absolutely needed' and are `equally important to interceptors' in terms of staying ahead of the threat.

(10) As part of its United States homeland defense hedging strategy, the Department of Defense has already decided upon or implemented a number of actions to improve the missile defense posture of the United States to stay ahead of the evolving threat of Intercontinental Ballistic Missiles from North Korea and Iran. These include the following actions:

(A) As announced by Secretary of Defense Hagel, the Department plans to deploy 14 additional Ground-Based Interceptors at Fort Greely, Alaska, by 2017, to deploy a second AN/TPY-2 radar in Japan, and to pursue an advanced kill vehicle technology development program.

(B) The Missile Defense Agency has completed construction of Missile Field-2 at Fort Greely, Alaska, with eight extra silos available to deploy the additional operational Ground-Based Interceptors announced by Secretary of Defense Hagel.

(C) The Department plans to refurbish the 6 prototype silos in Missile Field-1 at Fort Greely, Alaska, to deploy the additional Ground-Based Interceptors announced by Secretary of Defense Hagel.

(D) The Missile Defense Agency plans to deploy an in-flight interceptor communication system data terminal at Fort Drum, New York, to enhance the performance of Ground-Based Interceptors defending the eastern United States against possible future missile threats from Iran.

(E) The Missile Defense Agency is continuing the development and testing of the two-stage Ground-Based Interceptor for possible deployment in the future, if needed.

(F) The Missile Defense Agency plans to upgrade the early warning radars in Clear, Alaska, and Cape Cod, Massachusetts, to enhance the ability to defend the United States homeland against potential future Intercontinental Ballistic Missile threats from North Korea and Iran.

(G) The Missile Defense Agency is evaluating sites for a possible future United States homeland ballistic missile defense interceptor site in the United States, in compliance with section 227 of the National Defense Authorization Act for Fiscal Year 2013 (P.L. 112-239), and will complete an Environmental Impact Statement for the best suited sites by early 2016, in case the President decides to proceed with the deployment of such a site.

(11) As part of its United States homeland missile defense hedging strategy, the Department of Defense is considering additional options to enhance the future United States posture and capability to defend the homeland, including the feasibility, advisability, and affordability of deploying additional Ground-Based Interceptors beyond the 14 Ground-Based Interceptors announced by Secretary of Defense Hagel, including possibly at a missile defense site on the East Coast of the United States.

(12) In discussing the possible benefits of a potential additional missile defense interceptor site in the United States, General Jacoby testified that `exploring a third site is an important next step. What a third site gives me, whether it's on the East Coast or an alternate location,

would be increased battle space. That means increased opportunity for me to engage threats from either Iran or North Korea'.

(b) Sense of Congress- It is the sense of Congress that—

(1) it is a national priority to defend the United States homeland against the threat of limited ballistic missile attack from North Korea and Iran;

(2) the currently deployed Ground-based Midcourse Defense system, with 30 Ground-Based Interceptors deployed in Alaska and California, provides protection of the entire United States homeland, including the East Coast, against the threat of limited ballistic missile attack from North Korea and Iran, although this capability can and should be improved;;

(3) it is essential for the Ground-based Midcourse Defense system to achieve the levels of reliability, availability, sustainability, and operational performance that will allow it to continue providing protection of the United States homeland against limited ballistic missile attack and to stay ahead of the threat as it develops;

(4) the Missile Defense Agency should, as its highest priority, correct the problem that caused the December 2010 Ground-based Midcourse Defense system flight test failure and demonstrate the correction through flight testing, including a successful intercept test, before resuming production of the Capability Enhancement-II kill vehicle, in order to provide confidence that the system will work as intended;

(5) the Department of Defense should continue to enhance the performance and reliability of the Ground-based Midcourse Defense system, and enhance the capability of the Ballistic Missile Defense System (including through improved sensors, discrimination, kill assessment, exo-atmospheric kill vehicles, and battle management) to provide improved capability to defend the United States homeland against the evolving missile threats from North Korea and Iran;

(6) the Missile Defense Agency should continue its robust, rigorous, and realistic testing of the Ground-based Midcourse Defense system, as described in the Integrated Master Test Plan, including salvo testing, multiple simultaneous engagement testing, and operational testing;

(7) the Department of Defense has taken a number of prudent, affordable, cost-effective, and operationally significant steps to hedge against the possibility of future growth in the ballistic missile threat to the United States homeland from North Korea and Iran, including the planned deployment of 14 additional Ground-Based Interceptors; and

(8) the Department of Defense should continue to evaluate the evolving long-range missile threat from North Korea and Iran and consider further possibilities for prudent, affordable, cost-effective, and operationally significant steps to improve the posture of the United States to defend the United States homeland against possible future growth in the threat from North Korea and Iran.

(c) Report on Potential Future Homeland Ballistic Missile Defense Options-

(1) REPORT REQUIRED- Not later than 180 days after the enactment of this Act, the Secretary of Defense shall submit to the congressional defense committees a report on potential future options for enhancing United States homeland ballistic missile defense.

(2) ELEMENTS- The report required by paragraph (1) shall include the following:

(A) A description of the current assessment of the threat to the United States from long-range ballistic missiles of North Korea and Iran, and an assessment of the projected future threat through 2022, including a discussion of confidence levels and uncertainties in such threat assessment.

(B) A description of the current United States homeland ballistic missile defense capability to defend against the current threat of limited ballistic missile attack from North Korea and Iran.

(C) A description of planned improvements to the current United States homeland ballistic missile defense system, and the capability enhancements that would result from such planned improvements, including—

(i) deployment of 14 additional Ground-Based Interceptors at Fort Greely, Alaska;

(ii) missile defense upgrades of early warning radars at Clear, Alaska, and Cape Cod, Massachusetts;

(iii) deployment of an In-Flight Interceptor Communications System Data Terminal at Fort Drum, New York; and

(iv) improvements to the effectiveness and reliability of the Ground-Based Interceptors and the overall Ground-based Midcourse defense system.

(D) A description of potential additional future United States homeland ballistic missile defense options, in addition to those described in subparagraph (C), if future ballistic missile threats warrant deployment of such options to increase United States homeland ballistic missile defense capabilities, including—

(i) deployment of a missile defense interceptor site on the East Coast;

(ii) deployment of a missile defense interceptor site in another location in the United States, other than on the East Coast;

(iii) expansion of Missile Field-1 at Fort Greely, Alaska, to an operationally available 20-silo configuration, to permit further interceptor deployments;

(iv) deployment of additional Ground-Based Interceptors for the Ground-based Midcourse Defense system at Fort Greely, Alaska, Vandenberg Air Force Base, California, or both;

(v) deployment of additional missile defense sensors, including possibly an X-band radar on the East Coast or elsewhere, to enhance system tracking and discrimination;

(vi) enhancements to the operational effectiveness, cost effectiveness, and overall performance of the Ground-based Midcourse Defense system through improvements to system reliability, discrimination, battle management, exo-atmospheric kill vehicle capability, and related functions;

(vii) the potential for future enhancement and deployment of the Standard Missile-3 Block IIA interceptor to augment United States homeland ballistic missile defense;

(viii) missile defense options to defend the United States homeland against ballistic missiles that could be launched from vessels on the seas around the United States, including the Gulf

of Mexico, or other ballistic missile threats that could approach the United States from the south, should such a threat arise in the future; and

(ix) any other options the Secretary considers appropriate.

(3) EVALUATION OF POTENTIAL OPTIONS- For each option described under paragraph (2)(D), the Secretary shall provide an evaluation of the advantages and disadvantages of such option. The evaluation of each such option shall include consideration of the following:

(A) Technical feasibility.

(B) Operational effectiveness and utility against the projected future threat.

(C) Cost, cost effectiveness, and affordability.

(D) Schedule considerations.

(E) Agility to respond to changes in future threat evolution.

(4) CONCLUSIONS AND RECOMMENDATIONS- Based on the evaluation required by paragraph (3), the Secretary shall include in the report required by paragraph (1) such findings, conclusions, and recommendations as the Secretary considers appropriate for potential future options for United States homeland ballistic missile defense.

(5) FORM- The report required by paragraph (1) shall be submitted in unclassified form, but may include a classified annex.

Regarding Section 231, S.Rept. 113-44 states:

Homeland ballistic missile defense (sec. 231)

The committee recommends a provision that would express the sense of Congress concerning homeland ballistic missile defense, and require the Secretary of Defense to evaluate the advantages and disadvantages of a range of potential future options for enhancing homeland ballistic missile defense, including the possible deployment of a missile defense interceptor site on the East Coast, and the possible deployment of an additional sensor on the East Coast. The provision would require the Secretary to submit a report on the evaluation, including such findings, conclusions, and recommendations as the Secretary considers appropriate, for potential future options for homeland ballistic missile defense.

The United States currently has an operational homeland ballistic missile defense system, the Ground-based Midcourse Defense (GMD) system, with 30 Ground-based Interceptors (GBIs) deployed in Alaska and California. In appearances before the committee during 2013, numerous senior military leaders testified that they are confident in the ability of the current GMD system to protect the entire United States, including the East Coast, from limited ballistic missile attacks from North Korea and Iran. The committee agrees with the Department of Defense that this homeland missile defense capability can and should be improved.

The committee notes that, on March 15, Secretary of Defense Chuck Hagel announced a series of steps planned to enhance homeland ballistic missile defense, as part of the homeland missile defense hedge strategy, to stay ahead of the evolving long-range missile threat from North Korea and Iran. These steps include: the deployment of an additional 14 GBIs at Fort Greely, Alaska—a nearly 50 percent increase—by 2017; the deployment of a

second AN/TPY–2 missile defense radar in Japan; the evaluation of potential sites in the United States for possible future deployment of a missile defense interceptor site; and the establishment of a new common kill vehicle technology development program.

One element of the decision announced by Secretary Hagel was the cancelation of the previous plan to develop the Standard Missile–3 (SM–3) Block IIB interceptor missile for Phase 4 of the European Phased Adaptive Approach to missile defense. Twenty-four SM–3 IIB missiles had originally been intended for deployment at an Aegis Ashore interceptor site in Poland in 2020, to augment the GMD system in defending the United States from possible future long-range Iranian missiles. However, congressional funding reductions and technical challenges had delayed the program beyond 2022, with significant uncertainties about its ability to accomplish the intended mission. Secretary Hagel made clear that the U.S. commitment to North Atlantic Treaty Organization (NATO) missile defense ''remains ironclad,'' including the planned Aegis Ashore interceptor site deployments in Romania in 2015 and Poland in 2018. According to Secretary Hagel, these deployments "will still be able to provide coverage of all European NATO territory as planned by 2018."

As Secretary Hagel and other Department of Defense officials explained, deploying the additional 14 GBIs in Alaska would provide additional homeland defense at least 5 years sooner against both North Korea and Iran, and at far less cost than the SM–3 IIB program. Funds from the canceled SM–3 IIB program were redirected for the deployment of the additional 14 GBIs and for the new common kill vehicle technology development program. They also explained that, before the 14 additional GBIs are deployed, the GMD system would have to be tested and demonstrated successfully in an intercept test, to provide confidence that the system would work as intended.

This "fly before you buy" commitment is needed to demonstrate the successful correction of the problem that caused a GMD flight test failure in December 2010 with the Capability Enhancement-II (CE–II) kill vehicle. The Government Accountability Office estimates that correcting this problem and demonstrating its success in flight tests will cost more than $1.2 billion and has caused program delays of several years. The Missile Defense Agency (MDA) has halted all assembly, integration, manufacture, and refurbishment of GBIs with CE–II kill vehicles until the CE–II correction is successfully demonstrated in flight testing, including an intercept flight test planned for early 2014. The committee commends MDA for this "fly before you buy" approach, and notes that further procurement of GBIs, planned to replace the 14 GBIs that will be deployed by 2017, would also depend upon successful demonstration that the CE–II kill vehicle will work as intended. The committee expects the GBI industry team to show the same level of commitment to demonstrating success in correcting the CE–II problems.

In testimony before the committee, Vice Admiral James Syring, the Director of MDA, explained that improvements to the GMD "kill chain," particularly in sensors, discrimination, and kill assessment, would provide an "absolutely needed benefit" that would be "equally important to interceptors" in staying ahead of the evolving threat from North Korea and Iran. The committee strongly supports Admiral Syring's priority to improving the overall performance and effectiveness of the GMD system, and notes that these enhancements are intended to be cost-effective, timely, and affordable. Consequently, the committee directs the Director of MDA to provide a report to the congressional defense committees, not later than March 1, 2014, explaining the specific GMD kill chain enhancements that would be most beneficial to overall GMD effectiveness, including any improvements in GBI reliability and performance, and how and when MDA proposes to achieve those enhancements. (Pages 38-40)

Section 232 of H.R. 1960 as reported states:

SEC. 232. REGIONAL BALLISTIC MISSILE DEFENSE.

(a) Findings- Congress makes the following findings:

(1) In the introduction to the Ballistic Missile Defense Review of February 2010, Secretary of Defense Robert Gates wrote that `I have made defending against near-term regional threats a top priority of our missile defense plans, programs and capabilities'.

(2) In describing the threat of regional ballistic missiles, the report of the Ballistic Missile Defense Review stated that `there is no uncertainty about the existence of regional threats. They are clear and present. The threat from short-range, medium-range, and intermediate-range ballistic missiles (SRBMs, MRBMs, and IRBMs) in regions where the United States deploys forces and maintains security relationships is growing at a particularly rapid pace'.

(3) North Korea has hundreds of regional ballistic missiles, including short-range Scud missiles and medium-range Nodong missiles. North Korea also has publicly displayed, but not flight-tested, intermediate-range Musudan missiles. These regional missiles can reach United States forces and allies in South Korea and Japan, and perhaps Guam. In the spring of 2013, North Korea made public threats to use nuclear weapons and ballistic missiles against South Korea, Japan, and Guam.

(4) In response to these threats from North Korea, the United States deployed Aegis Ballistic Missile Defense ships, armed with Standard Missile-3 interceptors, to the waters near the Korean Peninsula, and a Terminal High Altitude Area Defense (THAAD) battery to Guam. It also deployed the Sea-Based X-band missile defense radar into the Pacific Ocean to enhance United States missile defense capabilities. On March 15, 2013, Secretary of Defense Hagel announced a series of planned steps to enhance missile defense, including the deployment of a second AN/TPY-2 missile defense radar in Japan to improve regional and homeland defense against North Korean missiles. As part of their response to the provocations of North Korea, South Korea deployed vessels equipped with Aegis missile defense radars, and Japan deployed its Aegis Ballistic Missile Defense ships, equipped with Standard Missile-3 interceptors.

(5) Iran has the largest inventory of regional ballistic missiles in the Middle East, with hundreds of missiles that can reach as far as southeastern Europe and all of the Middle East, including Israel. Iran is improving its existing missiles and developing new and longer-range regional missiles.

(6) In September 2009, President Barack Obama announced that he had accepted the unanimous recommendation of the Secretary of Defense and the Joint Chiefs of Staff to establish a European Phased Adaptive Approach (EPAA) to missile defense, designed to protect deployed United States forces, allies, and partners in Europe against the large and growing threat of ballistic missiles from Iran.

(7) In November 2010, at the Lisbon Summit, the North Atlantic Treaty Organization (NATO) decided to adopt the core mission of missile defense of its population, territory, and forces. The North Atlantic Treaty Organization agreed to enhance its missile defense command and control system, the Active Layered Theater Ballistic Missile Defense, to provide a North Atlantic Treaty Organization command and control capability. This is in addition to voluntary contributions of missile defense capabilities from individual nations.

(8) During 2011, the United States successfully implemented Phase 1 of the European Phased Adaptive Approach, including deployment of an AN/TPY-2 radar in Turkey, deployment of an Aegis Ballistic Missile Defense ship in the eastern Mediterranean Sea with

Standard Missile-3 Block IA interceptors, and the establishment of a missile defense command and control system in Germany.

(9) Phase 2 of the European Phased Adaptive Approach is planned for deployment around 2015, and is planned to include the deployment of Standard Missile-3 Block IB interceptors on Aegis Ballistic Missile Defense ships and at an Aegis Ashore site in Romania.

(10) Phase 3 of the European Phased Adaptive Approach is planned for deployment around 2018, and is planned to include the deployment of Standard Missile-3 Block IIA interceptors on Aegis Ballistic Missile Defense ships and at an Aegis Ashore site in Poland.

(11) At the North Atlantic Treaty Organization Summit in Chicago in May 2012, the North Atlantic Treaty Organization announced it had achieved an `interim capability' for the North Atlantic Treaty Organization missile defense system, including initial capability of its Active Layered Theater Ballistic Missile Defense system at a command and control facility in Germany.

(12) The United States has a robust program of missile defense cooperation with Israel, including joint development of the Arrow Weapon System and the new Arrow-3 interceptor, designed to defend Israel against ballistic missiles from Iran. These jointly developed missile defense systems are designed to be interoperable with United States ballistic missile defenses, and these interoperable systems are tested in large joint military exercises, such as `Austere Challenge' in 2012. The United States has also deployed an AN/TPY-2 radar in Israel to enhance missile defense against missiles from Iran.

(13) The United States is working with the nations of the Gulf Cooperation Council on enhanced national and regional missile defense capabilities against the growing missile threat from Iran. As part of this effort, the United Arab Emirates plans to purchase two Terminal High Altitude Area Defense batteries, as well as other equipment. During 2012, the United States deployed an AN/TPY-2 radar in the United States Central Command area of responsibility to enhance missile defense capability of forward-deployed United States forces, allies, and partners against missiles from Iran.

(14) The United States has a strong program of missile defense cooperation with Japan, including the co-development of the Standard Missile-3 Block IIA interceptor for the Aegis Ballistic Missile Defense system, intended to be deployed in Phase 3 of the European Phased Adaptive Approach, the Japanese fleet of Aegis Ballistic Missile Defense ships using Standard Missile-3 Block IA interceptors, and the United States deployment of two AN/TPY-2 radars in Japan.

(b) Sense of Congress- It is the sense of Congress that—

(1) the threat from regional ballistic missiles, particularly from North Korea and Iran, is serious and growing, and puts at risk forward-deployed United States forces, allies, and partners in the Asia-Pacific region, Europe, and the Middle East;

(2) the Department of Defense has an obligation to provide force protection of forward-deployed United States forces and facilities from regional ballistic missile attack;

(3) the United States has an obligation to meet its security commitments to its allies, including ballistic missile defense commitments;

(4) the Department of Defense has a balanced program of investment and capabilities to provide for both homeland defense and regional defense against ballistic missiles, consistent

with the Ballistic Missile Defense Review and with the prioritized and integrated needs of the commanders of the combatant commands;

(5) elements of United States regional missile defenses enhance and enable the homeland defense capabilities of the United States, including forward-deployed radars and defense of critical forward-deployed missile defense systems;

(6) the European Phased Adaptive Approach to missile defense is an appropriate and prudent response to the existing and growing ballistic missile threat from Iran to forward-deployed United States forces, allies, and partners in Europe;

(7) the Department of Defense should, as a high priority, continue to develop, test, and plan to deploy Phases 2 and 3 of the European Phased Adaptive Approach, including the planned Aegis Ashore sites in Romania and Poland;

(8) the Department of Defense should also continue with its other phased and adaptive regional missile defense efforts tailored to the Middle East and the Asia-Pacific region;

(9) European members of the North Atlantic Treaty Organization are making valuable contributions to missile defense in Europe, by hosting elements of United States missile defense systems on their territories, through individual national contributions to missile defense capability, and by collective funding and development of the Active Layered Theater Ballistic Missile Defense system;

(10) the actions taken by the Department of Defense to improve its regional missile defense posture in response to the provocative actions and threats of North Korea were prudent and appropriate and demonstrated the flexible and adaptive nature of its regional missile defense capabilities, which allows for surge deployments to meet regional contingencies in a timely manner; and

(11) Japan and South Korea are making notable progress in enhancing their missile defense capabilities, in partnership with the United States, to protect against regional missiles from North Korea.

(c) Report-

(1) REPORT REQUIRED- Not later than 180 days after the date of the enactment of this Act, the Secretary of Defense shall submit to the congressional defense committees a report on the status and progress of regional missile defense programs and efforts.

(2) ELEMENTS- The report required by paragraph (1) shall include the following:

(A) A description of the overall risk assessment from the most recent Global Ballistic Defense Assessment of regional missile defense capabilities relative to meeting the operational needs of the commanders of the geographic combatant commands, including the need for force protection of United States forward-deployed forces and capabilities and for defense of allies and partners.

(B) An assessment whether the currently planned European Phased Adaptive Approach and other planned regional missile defense approaches and capabilities of the United States meet the integrated priorities of the commanders of the geographic combatant commands in an affordable and balanced manner.

(C) A description of the progress made in the development and testing of elements of systems intended for deployment in Phases 2 and 3 of the European Phased Adaptive

Approach, including the Standard Missile-3 Block IB and IIA interceptors and the Aegis Ashore system.

(D) A description of the manner in which elements of regional missile defense architectures, such as forward-based X-band radars in Japan, Israel, Turkey, and the area of responsibility of the United States Central Command, contribute to the enhancement of the homeland defense of the United States.

(E) A description of the manner in which enhanced integration of offensive military capabilities and defensive missile defense capabilities will fit into regional missile defense planning and force structure assessments.

(3) FORM- The report required by paragraph (1) shall be submitted in unclassified form, but may include a classified annex.

Regarding Section 232, S.Rept. 113-44 states:

Regional ballistic missile defense (sec. 232)

The committee recommends a provision that would express the sense of Congress concerning the importance of regional ballistic missile defense and would require the Secretary of Defense to prepare a report on the status and progress of efforts to enhance regional ballistic missile defense capabilities.

The committee notes that regional ballistic missile defenses provide a critical force protection capability for forward deployed U.S. forces, as well as for allies and partners, against missile threats from countries such as North Korea and Iran. North Korea's public threats in the spring of 2013 to use ballistic missiles against South Korea, Japan, and Guam served as a stark reminder of the importance of regional missile defenses and the need to expand and improve U.S. regional missile defense capabilities.

Regional missile defenses are a high priority for geographic combatant commanders. Lieutenant General Richard P. Formica, USA, Commander of U.S. Army Space and Missile Defense Command, and Commander of the Joint Functional Component Command for Integrated Missile Defense, under U.S. Strategic Command, testified in May 2013 that the Global Ballistic Missile Defense Assessment for 2012 concluded that the operational risk for regional missile defenses is higher than the homeland missile defense risk. The Department of Defense is pursuing increased regional missile defense capabilities, such as the European Phased Adaptive Approach and similar approaches tailored to other regions, including cooperation with allies and partners.

The committee supports the continued development, testing, and deployment of regional missile defense capabilities such as the Aegis Ballistic Missile Defense system and its associated Standard Missile-3 interceptors, and the Terminal High Altitude Area Defense systems. The committee notes that missile defense tests over the last year have demonstrated increasing capability for these systems, including the capability to launch on remote sensor data. (Page 40)

S.Rept. 113-44 also states:

Common kill vehicle technology program

On March 15, 2013, Secretary of Defense Chuck Hagel announced a series of steps planned to enhance homeland ballistic missile defense, to stay ahead of the evolving long-range

missile threat from North Korea and Iran. One of the steps announced is the creation of a new program proposed in the President's budget request to develop advanced and common kill vehicle technologies for the Ground-Based Interceptor (GBI) and future variants of the Standard Missile–3 (SM–3) interceptor for the Navy's Aegis Ballistic Missile Defense program.

The objectives of the program are to develop common technologies, subsystems, or components that could be used in either kill vehicle, and to advance the state-of-the-art kill vehicle capability, including propulsion, electronics, navigation, seeker optics, discrimination, and communications. Advances in these kill vehicle technologies could provide significant improvements in the effectiveness of the Ground-based Midcourse Defense (GMD) and Aegis Ballistic Missile Defense systems, and the overall Ballistic Missile Defense System, which are high priority objectives for the Missile Defense Agency (MDA) and the combatant commands that rely on these systems.

Given that the program was first announced in mid-March, the committee understands it is still at the beginning stage of program concept development, and does not yet have a well-defined long-term plan in place. This is understandable for a new research and development program, but the committee expects MDA to provide more definition and clarity on the long-term plan for the Common Kill Vehicle Technology Development program.

Section 225 of the National Defense Authorization Act for Fiscal Year 2013 (Public Law 112–239) requires the Director of MDA to develop a long-term plan to modify and upgrade the current GBI Exo-atmospheric Kill Vehicle, and the competitive development of a next-generation kill vehicle for the GBI. The provision also requires the Director to report to Congress on the plan by July 2013. The committee expects that the new Common Kill Vehicle Technology Development program will be compatible and consistent with the intent of Section 225.

One key element of any future kill vehicle program will be advanced propulsion for the Divert and Attitude Control System (DACS) that steer the kill vehicle into the target warhead, including solid-fueled DACS that are currently used on all SM–3 variants. The committee notes that MDA plans to rely on the industrial base for innovation and competition for this Common Kill Vehicle Technology Development program. However, with the termination of the SM–3 IIB program, one of the two industry contractors with solid DACS expertise is at risk of ending their work and their ability to contribute to this program.

With these concerns in mind, the committee directs MDA to provide a report to the congressional defense committees, not later than March 1, 2014, setting forth the long-term plan and objectives for the Common Kill Vehicle Technology Development program, including an explanation of how it intends to maintain a competitive industrial base to implement the program.

The committee supports the efforts of MDA to develop technology for a next generation high performance, high reliability, and highly producible kill vehicle, which MDA says could be ready before the end of the decade. A next generation kill vehicle would have enhanced discrimination capabilities and the potential for volume kill capability. The committee encourages the MDA to move the program as expeditiously as possible from research and development into product development, based on demonstrated technical progress and consistent with sound acquisition practices, and to transfer this effort from the Ballistic Missile Defense Technology Development program element into a new program element dedicated to the development of a next generation kill vehicle for the Ground-Based Interceptor and future variants of the Standard Missile-3 interceptor. The committee expects MDA to fully incorporate the lessons learned from the previously terminated Multiple Kill Vehicle program to avoid the problems encountered in that program. (Pages 60-61)

FY2014 DOD Appropriations Act (H.R. 2397/S. 1429)

House

The House Appropriations Committee, in its report (H.Rept. 113-113 of June 17, 2013) on H.R. 2397, recommended the funding levels shown in **Table 4**.

Senate

The Senate Appropriations Committee, in its report (S.Rept. 113-85 of August 1, 2013) on S. 1429, recommended the funding levels shown in **Table 4**. The report states that the $27 million reduction in research and development funding recommended for Aegis BMD (PE 0603892C) is for "Restoring acquisition accountability: Aegis BMD 5.1 development cost growth." (Page 178, line 88) The report states:

> *Acquisition Accountability in Development Programs.*—The fiscal year 2014 budget request includes $937,056,000 to continue the development of multiple spirals of Aegis ballistic missile defense [BMD] capabilities. While the Committee notes the repeated success of the Aegis weapons system, the budget request includes roughly $500,000,000 for the concurrent development of Aegis BMD 4.0, Aegis BMD 5.0, and Aegis BMD 5.1. Since 2007, MDA has obligated over $450,000,000 for development of Aegis BMD 5.1, and the budget request for Aegis BMD 5.1 in fiscal year 2014 is $239,000,000. Despite the significant investment made to date in Aegis BMD 5.1 and the funding increase requested in fiscal year 2014, MDA has not completed an acquisition program baseline for Aegis BMD 5.1. Further, the Government Accountability Office in its April 2013 report identified unstable baselines as well as cost growth in the Aegis program. Therefore, the Committee does not fully support the increase sought for Aegis BMD 5.1, and recommends a reduction of $27,000,000. (Pages 180-181; material in brackets as in original.)

Appendix A. Aegis BMD Flight Tests

Summary of Test Flights

Table A-1 presents a DOD summary of Aegis BMD flight tests since January 2002. As shown in the table, DOD states that since January 2002, the Aegis BMD system has achieved 25 successful exo-atmospheric intercepts in 31 attempts using the SM-3 missile (including 3 successful intercepts in 4 attempts by Japanese Aegis ships), and 3 successful endo-atmospheric intercepts in 3 attempts using the SM-2 Block IV missile, making for a combined total of 28 successful intercepts in 34 attempts.

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—an operation called Burnt Frost. Including this intercept in the count increases the totals to 26 successful exo-atmospheric intercepts in 32 attempts using the SM-3 missile, and 29 successful exo- and endo-atmospheric intercepts in 35 attempts using both SM-3 and SM-2 Block IV missiles.

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

Date	Country	Name of flight test	Target	Successful?	Cumulative successes	Cumulative attempts
Exo-atmospheric (using SM-3 missile)						
1/25/02	US	FM-2	Unitary TTV short-range target	Yes	1	1
6/13/02	US	FM-3	Unitary TTV short-range target	Yes	2	2
11/21/02	US	FM-4	Unitary TTV short-range target	Yes	3	3
6/18/03	US	FM-5	Unitary TTV short-range target	**No**	3	4
12/11/03	US	FM-6	Unitary TTV medium-range target	Yes	4	5
2/24/05	US	FTM 04-1 (FM-7)	Unitary TTV short-range target	Yes	5	6
11/17/05	US	FTM 04-2 (FM-8)	Separating medium-range target	Yes	6	7
6/22/06	US	FTM 10	Separating medium-range target	Yes	7	8
12/7/06	US	FTM 11	Unitary TTV short-range target	**No**	7	9
4/26/07	US	FTM 11 Event 4	Unitary ARAV-A short-range target	Yes	8	10
6/22/07	US	FTM 12	Separating medium-range target	Yes	9	11
8/31/07	US	FTM-11a	Classified	Yes	10	12
11/6/07	US	FTM 13	Unitary ARAV-A short-range target	Yes	11	13
			Unitary ARAV-A short-range target	Yes	12	14
12/17/07	Japan	JFTM-1	Separating medium-range target	Yes	13	15
11/1/08	US	Pacific Blitz	Short-range target	Yes	14	16
			Short-range target	**No**	14	17
11/19/08	Japan	JFTM-2	Separating medium-range target	**No**	14	18
7/30/09	US	FTM-17	Unitary ARAV-A short-range target	Yes	15	19
10/27/09	Japan	JFTM-3	Separating medium-range target	Yes	16	20
10/28/10	Japan	JFTM-4	Separating medium-range target	Yes	17	21
4/14/11	US	FTM-15	LV-2 intermediate range target	Yes	18	22
9/1/11	US	FTM-16	Short-range target	**No**	18	23
5/9/12	US	FTM-16 E2a	Unitary ARAV-A short-range target	Yes	19	24
6/26/12	US	FTM-18	Separating medium-range target	Yes	20	25
10/25/12	US	FTI-01	Short-range target	**No**	20	26
2/12/13	US	FTM-20	Unitary medium-range target	Yes	21	27
5/15/13	US	FTM-19	Separating short-range target	Yes	22	28
9/10/13	US	FTO-01	Medium-range target	Yes	23	29
9/18/13	US	FTM-21	Complex separating short-range target	Yes	24	30
10/3/13	US	FTM-22	Medium-range target	Yes	25	31
Endo-atmospheric (using SM-2 missile)						
5/24/06	US	Pacific Pheonix	Unitary short-range target	Yes	1	1
6/5/08	US	FTM-14	Unitary short-range target	Yes	2	2
3/26/09	US	Stellar Daggers	Short-range target	Yes	3	3
Combined total for exo- and endo-atmospheric above tests					28	34

Source: Table adapted from table presented in MDA fact sheet, "Aegis Ballistic Missile Defense Testing," accessed on May 17, 2013, at http://www.mda.mil/global/documents/pdf/aegis_tests.pdf.

Notes: TTV is target test vehicle; **ARAV** is Aegis Readiness Assessment Vehicle. In addition to the flight tests shown above, there was a successful use of an SM-3 on February 20, 2008, to intercept an inoperative U.S. satellite—an operation called Burnt Frost. Including this intercept in the count increases the totals to 26 successful exo-atmospheric intercepts in 32 attempts using the SM-3 missile, and 29 successful exo- and endo-atmospheric intercepts in 35 attempts using both SM-3 and SM-2 Block IV missiles.

May 2010 Criticism of Claimed Successes in Flight Tests

In a May 2010 magazine article and supplementary white paper, two professors with scientific backgrounds—George Lewis and Theodore Postol—criticized DOD claims of successes in Aegis (and other DOD) BMD flight tests, arguing that

> the Defense Department's own test data show that, in combat, the vast majority of "successful" SM-3 experiments would have failed to destroy attacking warheads. The data also show potential adversaries how to defeat both the SM-3 and the GMD [ground-based missile defense] systems, which share the same serious flaws that can be readily exploited by adversaries.[50]

The criticisms made by Lewis and Postol were reported in a May 18, 2010, *New York Times* article.[51] In response to the criticisms and the *New York Times* article, MDA issued a press release and other information defending the flight tests and arguing that the criticisms are based on inaccurate or incomplete information.[52]

Details on Selected Exo-Atmospheric (SM-3) Flight Tests Since June 2006

June 22, 2006, Test. This was the first test to use the 3.6 version of the Aegis BMD system.[53]

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

[50] George N. Lewis and Theodore A. Postol, "A Flawed and Dangerous U.S. Missile Defense Plan," *Arms Control Today*, May 2010: 24-32. The quoted passage appears on p. 26. The associated white paper is George N. Lewis and Theodore A. Postol, *A Technically Detailed Description of Flaws in the SM-3 and GMD Missile Defense Systems Revealed by the Defense Department's Ballistic Missile Test Data*, May 3, 2010, 13 pp.

[51] William J. Broad and David E. Sanger, "Review Cites Flaws In U.S. Antimissile Program," *New York Times*, May 18, 2010: 1.

[52] Missile Defense Agency news release entitled "Missile Defense Agency Responds to New York Times Article," 10-News-0005, May 18, 2010; Missile Defense Agency, *Missile Defense Agency Response to Request for Information, Standard Missile – 3 Interceptor Testing*, May 18, 2010, 2 pp.; Missile Defense Agency, *Missile Defense Agency Response to Request for Information, Response to New York Times May 18, 2010, Article Regarding SM-3 Testing*, May 18, 2010, 3 pp.; Richard Lehner, "Missile Defense Agerncy Responds to New York Times Article*," DOD Live* (http://www.dodlive.mil), May 18, 2010; Transcript of Department of Defense Bloggers Roundtable With Richard Lehner, Spokesman, Missile Defense Agency (MDA), Subject: Standard Missile 3 Test Program, May 18, 2010.

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

> 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.[54]

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.
>
> 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.[55]

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.[56]

---

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

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

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."[57]

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.[58]

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.[59]

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

(...continued)

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

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

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

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

> 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.[60]

August 31, 2007, Test. MDA has publicly noted the occurrence of this test and the fact that it resulted in a successful intercept,[61] but states that the details about the test are classified.[62] 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.[63]

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....
>
> 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.[64]

---

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

[61] 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.

[62] An e-mail 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."

[63] 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.

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

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.[65]

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.[66]

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.

---

[65] 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.

[66] 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.

> 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.[67]

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.
>
> 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.

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

> 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.[68]

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 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.[69]

---

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

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

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.[70]

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."
>
> 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.[71]

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.[72]

---

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

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

October 27, 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.[73]

October 28, 2010, Test. This was the fourth 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 marked the fourth time that a JMSDF ship has engaged a ballistic missile target, including three successful intercepts, with the sea-based midcourse engagement capability provided by Aegis BMD.
>
> The JFTM-4 test event verified the newest engagement capability of the Japan Aegis BMD configuration of the recently upgraded Japanese destroyer, JS KIRISHIMA. At approximately 5:06 p.m. (HST), 12:06 p.m. Tokyo time on Oct. 29, 2010, a separating 1,000 km class ballistic missile target was launched from the Pacific Missile Range Facility at Barking Sands, Kauai, Hawaii.

(...continued)

[72] Amy Butler, "SM-3 Upgrade Program Cost Increases," *Aerospace Daily & Defense Report*, August 4, 2009: 1-2. See also 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.

[73] Missile Defense Agency press release 09-News-0021, dated October 28, 2009, entitled "Japan/U.S. Missile Defense Flight Test Successful." See also 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.

> JS KIRISHIMA crew members detected and tracked the target. The Aegis Weapon System then developed a fire control solution and launched a Standard Missile -3 (SM-3) Block IA missile. Approximately three minutes later, the SM-3 successfully intercepted the target approximately 100 miles above the Pacific Ocean. JFTM-4 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 was USS LAKE ERIE and USS RUSSELL, Aegis ships which cooperated to detect, track and conduct a simulated intercept engagement against the same target.[74]

April 15, 2011, Test. MDA states that this flight test "was the most challenging test to date, as it was the first Aegis BMD version 3.6.1 intercept against an intermediate-range target (range 1,864 to 3,418 [statute] miles) and the first Aegis BMD 3.6.1 engagement relying on remote tracking data." MDA states that

> The Missile Defense Agency (MDA), U.S. Navy sailors aboard the Aegis destroyer USS O'KANE (DDG 77), and Soldiers from the 94th Army Air and Missile Defense Command operating from the 613th Air and Space Operations Center at Hickam Air Force Base, Hawaii, successfully conducted a flight test of the Aegis Ballistic Missile Defense (BMD) element of the nation's Ballistic Missile Defense System, resulting in the intercept of a separating ballistic missile target over the Pacific Ocean. This successful test demonstrated the capability of the first phase of the European Phased Adaptive Approach (EPAA) announced by the President in September, 2009.
>
> At 2:52 a.m. EDT (6:52 p.m. April 15 Marshall Island Time), an intermediate-range ballistic missile target was launched from the Reagan Test Site, located on Kwajalein Atoll in the Republic of the Marshall Islands, approximately 2,300 miles southwest of Hawaii. The target flew in a northeasterly direction towards a broad ocean area in the Pacific Ocean. Following target launch, a forward-based AN/TPY-2 X-band transportable radar, located on Wake Island, detected and tracked the threat missile. The radar sent trajectory information to the Command, Control, Battle Management, and Communications (C2BMC) system, which processed and transmitted remote target data to the USS O'KANE. The destroyer, located to the west of Hawaii, used the data to develop a fire control solution and launch the SM-3 Block IA missile approximately 11 minutes after the target was launched.
>
> As the IRBM target continued along its trajectory, the firing ship's AN/SPY-1 radar detected and acquired the ballistic missile target. The firing ship's Aegis BMD weapon system uplinked target track information to the SM-3 Block IA missile. The SM-3 maneuvered to a point in space as designated by the fire control solution and released its kinetic warhead. The kinetic warhead acquired the target, diverted into its path, and, using only force of a direct impact, destroyed the threat in a "hit-to-kill" intercept.
>
> During the test the C2BMC system, operated by Soldiers from the 94th Army Air and Missile Defense Command, received data from all assets and provided situational awareness of the engagement to U.S. Pacific Command, U.S. Northern Command and U.S. Strategic Command.

[74] Missile Defense Agency press release 10-News-0016, dated October 29, 2010, entitled "Joint Japan-U.S. Missile Defense Flight Test Successful." See also Marina Malenic, "Japanese Aegis Destroyer Successfully Completes Missile-Intercept Test," *Defense Daily*, November 1, 2010: 6.

> The two demonstration Space Tracking and Surveillance Satellites (STSS), launched by MDA in 2009, successfully acquired the target missile, providing stereo "birth to death" tracking of the target.
>
> Today's event, designated Flight Test Standard Missile-15 (FTM-15), was the most challenging test to date, as it was the first Aegis BMD version 3.6.1 intercept against an intermediate-range target (range 1,864 to 3,418 [statute] miles) and the first Aegis BMD 3.6.1 engagement relying on remote tracking data. The ability to use remote radar data to engage a threat ballistic missile greatly increases the battle space and defended area of the SM-3 missile.
>
> Initial indications are that all components performed as designed. Program officials will spend the next several months conducting an extensive assessment and evaluation of system performance based upon telemetry and other data obtained during the test.[75]

September 1, 2011, Test. This flight test, which did not result in an intercept, was the first flight test of the SM-3 Block IB interceptor. MDA states that it

> was unable to achieve the planned intercept of a ballistic missile target during a test over the Pacific Ocean exercising the sea-based element of the Ballistic Missile Defense System (BMDS).
>
> At approximately 3:53 a.m. Hawaii Standard Time (9:53 a.m. EDT) a short-range ballistic missile target was launched from the U.S. Navy's Pacific Missile Range Facility on Kauai, Hawaii. Approximately 90 seconds later, a Standard Missile 3 (SM-3) Block 1B interceptor missile was launched from the cruiser USS LAKE ERIE (CG-70) but an intercept of the target was not achieved.
>
> This was the first flight test of the advanced SM-3 Block 1B interceptor missile. Program officials will conduct an extensive investigation to determine the cause of the failure to intercept.[76]

May 9, 2012, Test. MDA states that this flight test "was the first successful live fire intercept test of the SM-3 Block IB interceptor and the second-generation Aegis BMD 4.0.1 weapon system." MDA states that

> The Missile Defense Agency (MDA) and U.S. Navy sailors aboard the USS LAKE ERIE (CG 70) successfully conducted a flight test of the Aegis Ballistic Missile Defense (BMD) system, resulting in the first intercept of a short-range ballistic missile target over the Pacific Ocean by the Navy's newest Missile Defense interceptor, the Standard Missile – 3 (SM-3) Block IB.
>
> At 8:18 p.m. Hawaiian Standard Time (2:18 a.m. EDT May 10) the target missile was launched from the Pacific Missile Range Facility, located on Kauai, Hawaii. The target flew on a northwesterly trajectory towards a broad ocean area of the Pacific Ocean. Following target launch, the USS LAKE ERIE detected and tracked the missile with its onboard

[75] Missile Defense Agency press release 11-News-0007, dated April 15, 2011, entitled "Sea-based Missile Defense Flight Test Results in Successful Intercept."

[76] Missile Defense Agency press release 11-News-0016, dated September 1, 2011, entitled "Sea-Based Missile Defense Test Conducted." See also Amy Butler, "Upgraded Ballistic Missile Killer Fizzles In First Flight Test," *Aerospace Daily & Defense Report*, September 2, 2011: 3; and Mike McCarthy, "Sea-Based Missile Defense Test Fails," *Defense Daily*, September 2, 2011: 2-3.

> AN/SPY-1 radar. The ship, equipped with the second-generation Aegis BMD 4.0.1 weapon system, developed a fire control solution and launched the Standard Missile-3 (SM-3) Block IB interceptor.
>
> The USS LAKE ERIE continued to track the target and sent trajectory information to the SM-3 Block IB interceptor in-flight. The SM-3 maneuvered to a point in space, as designated by the fire control solution, and released its kinetic warhead. The kinetic warhead acquired the target, diverted into its path, and, using only the force of a direct impact, engaged and destroyed the threat in a hit-to-kill intercept.
>
> Today's event, designated Flight Test Standard Missile-16 (FTM-16) Event 2a, was the first successful live fire intercept test of the SM-3 Block IB interceptor and the second-generation Aegis BMD 4.0.1 weapon system. Previous successful intercepts were conducted with the Aegis BMD 3.6.1 weapon system and the SM-3 Block IA interceptor, which are currently operational on U.S. Navy ships deployed across the globe....
>
> Initial indications are that all components performed as designed. Program officials will conduct an extensive assessment and evaluation of system performance based upon telemetry and other data obtained during the test.[77]

June 26, 2012, Test. MDA states that this flight test "was the second consecutive successful intercept test of the SM-3 Block IB missile and the second-generation Aegis BMD 4.0.1 weapon system." MDA states that

> The Missile Defense Agency (MDA) and U.S. Navy sailors in the USS LAKE ERIE (CG 70) successfully conducted a flight test of the Aegis Ballistic Missile Defense (BMD) system, resulting in the intercept of a separating ballistic missile target over the Pacific Ocean by the Navy's newest missile defense interceptor missile, the Standard Missile-3 (SM-3) Block IB.
>
> At 11:15 pm Hawaii Standard Time, June 26 (5:15 am EDT June 27), the target missile was launched from the Pacific Missile Range Facility, located on Kauai, Hawaii. The target flew on a northwesterly trajectory towards a broad ocean area of the Pacific Ocean. Following target launch, the USS LAKE ERIE detected and tracked the missile with its onboard AN/SPY-1 radar. The ship, equipped with the second-generation Aegis BMD 4.0.1 weapon system, developed a fire control solution and launched the SM-3 Block IB missile.
>
> The USS LAKE ERIE continued to track the target and sent trajectory information to the SM-3 Block IB missile in-flight. The SM-3 maneuvered to a point in space, as designated by the fire control solution, and released its kinetic warhead. The kinetic warhead acquired the target, diverted into its path, and, using only the force of a direct impact, engaged and destroyed the threat in a hit-to-kill intercept.
>
> Today's test event was the second consecutive successful intercept test of the SM-3 Block IB missile and the second-generation Aegis BMD 4.0.1 weapon system. The first successful SM-3 Block IB intercept occurred on May 9, 2012. Today's intercept is a critical accomplishment for the second phase of the President's European Phased Adaptive Approach consisting of the SM-3 Block IB interceptor employed in an Aegis Ashore system in Romania in 2015.

[77] Missile Defense Agency press release 12-News-0007, dated May 9, 2012, entitled "Second-Generation Aegis Ballistic Missile Defense System Completes Successful Intercept Flight Test."

> Initial indications are that all components performed as designed resulting in a very accurate intercept.[78]

October 25, 2012, Test. MDA states that in this flight test,

> The Missile Defense Agency (MDA), U.S. Army soldiers from the 94th and 32nd Army Air and Missile Defense Command (AAMDC); U.S. Navy sailors aboard the USS FITZGERALD (DDG 62); and airmen from the 613th Air and Space Operations Center successfully conducted the largest, most complex missile defense flight test ever attempted resulting in the simultaneous engagement of five ballistic missile and cruise missile targets. An integrated air and ballistic missile defense architecture used multiple sensors and missile defense systems to engage multiple targets at the same time....
>
> The USS FITZGERALD successfully engaged a low flying cruise missile over water. The Aegis system also tracked and launched an SM-3 Block 1A interceptor against a Short-Range Ballistic Missile. However, despite indication of a nominal flight of the SM-3 Block 1A interceptor, there was no indication of an intercept of the SRBM.[79]

February 12, 2013, Test. MDA states that in this flight test,

> The Missile Defense Agency (MDA) and U.S. Navy sailors aboard the USS LAKE ERIE (CG 70) successfully conducted a flight test of the Aegis Ballistic Missile Defense (BMD) system, resulting in the intercept of a medium-range ballistic missile target over the Pacific Ocean by a Standard Missile-3 (SM-3) Block IA guided missile.
>
> At 11:10 p.m. HST (4:10 a.m. EST) a unitary medium-range ballistic missile target was launched from the Pacific Missile Range Facility, on Kauai, Hawaii. The target flew northwest towards a broad ocean area of the Pacific Ocean.
>
> The in-orbit Space Tracking and Surveillance System-Demonstrators (STSS-D) detected and tracked the target, and forwarded track data to the USS LAKE ERIE. The ship, equipped with the second-generation Aegis BMD weapon system, used Launch on Remote doctrine to engage the target.
>
> The ship developed a fire control solution from the STSS-D track and launched the SM-3 Block IA guided missile approximately five minutes after target launch. The SM-3 maneuvered to a point in space and released its kinetic warhead. The kinetic warhead acquired the target reentry vehicle, diverted into its path, and, using only the force of a direct impact, engaged and destroyed the target.
>
> Initial indications are that all components performed as designed. Program officials will assess and evaluate system performance based upon telemetry and other data obtained during the test.
>
> Today's event, designated Flight Test Standard Missile-20 (FTM-20), was a demonstration of the ability of space-based assets to provide mid-course fire control quality data to an

[78] Missile Defense Agency press release 12-News-0008, dated June 27, 2012, entitled "Second-Generation Aegis Ballistic Missile Defense System Completes Second Successful Intercept Flight Test."

[79] Missile Defense Agency press release 12-News-0011, dated October 25, 2012, entitled "Ballistic Missile Defense System Engages Five Targets Simultaneously During Largest Missile Defense Flight Test in History."

> Aegis BMD ship, extending the battlespace, providing the ability for longer range intercepts and defense of larger areas.[80]

May 16, 2013, Test. MDA states that in this flight test,

> The Missile Defense Agency (MDA) and U.S. Navy sailors aboard the USS LAKE ERIE (CG-70) successfully conducted a flight test today of the Aegis Ballistic Missile Defense (BMD) system, resulting in the intercept of a separating ballistic missile target over the Pacific Ocean by the Aegis BMD 4.0 Weapon System and a Standard Missile-3 (SM-3) Block IB missile.
>
> At 5:25 p.m. (Hawaii Time, 11:25 p.m. EDT), May 15, a separating short-range ballistic missile target was launched from the Pacific Missile Range Facility, on Kauai, Hawaii. The target flew northwest towards a broad ocean area of the Pacific Ocean. Following target launch, the USS LAKE ERIE (CG-70) detected and tracked the missile with its onboard AN/SPY-1 radar. The ship, equipped with the second-generation Aegis BMD weapon system, developed a fire control solution and launched the SM-3 Block IB missile. The SM-3 maneuvered to a point in space based on guidance from Aegis BMD Weapons Systems and released its kinetic warhead. The kinetic warhead acquired the target reentry vehicle, diverted into its path, and, using only the force of a direct impact, engaged and destroyed the target.
>
> Initial indications are that all components performed as designed. Program officials will assess and evaluate system performance based upon telemetry and other data obtained during the test.
>
> This test exercised the latest version of the second-generation Aegis BMD Weapon System and Standard Missile, providing capability for engagement of longer-range and more sophisticated ballistic missiles.
>
> Last night's event, designated Flight Test Standard Missile-19 (FTM-19), was the third consecutive successful intercept test of the Aegis BMD 4.0 Weapon System and the SM-3 Block IB guided missile. Previous successful ABMD 4.0 SM-3 Block IB intercepts occurred on May 9, 2012 and June 26, 2012. Other Aegis BMD intercepts have employed the ABMD 3.6 and 4.0 with the SM-3 Block IA missile, which is currently operational on U.S. Navy ships deployed across the globe.[81]

September 10, 2013, Test. MDA states that in this flight test,

> The Missile Defense Agency (MDA), Ballistic Missile Defense System (BMDS) Operational Test Agency, Joint Functional Component Command for Integrated Missile Defense, and U.S. Pacific Command, in conjunction with U.S. Army soldiers from the Alpha Battery, 2nd Air Defense Artillery Regiment, U.S. Navy sailors aboard the guided missile destroyer USS Decatur (DDG-73), and U.S. Air Force airmen from the 613th Air and Operations Center

[80] Missile Defense Agency press release 13-News-0002, dated February 13, 2013, entitled "Aegis Ballistic Missile Defense Intercepts Target Using Space Tracking and Surveillance System-Demonstrators (STSS-D) Data." See also Troy Clarke, "Space-Based Sensors Star in "Stellar Eyes" Missile Defense Test," *Navy News Service*, February 13, 2013.

[81] Missile Defense Agency press release 13-News-0005, dated May 16, 2013, entitled "Aegis Ballistic Missile Defense System Completes Successful Intercept Flight Test." See also Mike McCarthy, "Aegis Missile Intercept Successful," *Defense Daily*, May 17, 2013: 7-8; and Amy Butler, "MDA Conducts Two Successful Flight Tests," *Aerospace Daily & Defense Report*, May 17, 2013: 3.

> successfully conducted a complex missile defense flight test, resulting in the intercept of two medium-range ballistic missile targets. The flight test was planned more than a year ago, and is not in any way connected to events in the Middle East.
>
> The test was conducted in the vicinity of the U.S. Army Kwajalein Atoll/Reagan Test Site and surrounding areas in the western Pacific. The test stressed the ability of the Aegis Ballistic Missile Defense (BMD) and Terminal High Altitude Area Defense (THAAD) weapon systems to function in a layered defense architecture and defeat a raid of two near-simultaneous ballistic missile targets.
>
> The two medium-range ballistic missile targets were launched on operationally realistic trajectories towards a defended area near Kwajalein. Along with overhead space assets providing launch alerts, an Army-Navy/Transportable Radar Surveillance and Control (AN/TPY-2) radar in Forward Based Mode detected the targets and relayed track information to the Command, Control, Battle Management, and Communications (C2BMC) system for further transmission to defending BMDS assets.
>
> The USS Decatur with its Aegis Weapon System detected and tracked the first target with its onboard AN/SPY-1 radar. The Aegis BMD weapon system developed a fire control solution, launched a Standard Missile-3 (SM-3) Block IA missile, and successfully intercepted the target.
>
> In a demonstration of BMDS layered defense capabilities, a second AN/TPY-2 radar in Terminal Mode, located with the THAAD weapon system, acquired and tracked the target missiles. THAAD developed a fire control solution, launched a THAAD interceptor missile, and successfully intercepted the second medium-range ballistic missile target. THAAD was operated by soldiers from the Alpha Battery, 2nd Air Defense Artillery Regiment. As a planned demonstration of THAAD's layered defense capabilities, a second THAAD interceptor was launched at the target destroyed by Aegis as a contingency in the event the SM-3 did not achieve an intercept.
>
> Initial indications are that all components performed as designed. MDA officials will extensively assess and evaluate system performance based upon telemetry and other data obtained during the test.
>
> The event, a designated Flight Test Operational-01 (FTO-01), demonstrated integrated, layered, regional missile defense capabilities to defeat a raid of two threat-representative medium-range ballistic missiles in a combined live-fire operational test. Soldiers, sailors, and airmen from multiple combatant commands operated the systems, and were provided a unique opportunity to refine operational doctrine and tactics while increasing confidence in the execution of integrated air and missile defense plans.[82]

September 18, 2013, Test. MDA states that in this flight test,

> The Missile Defense Agency (MDA), U.S. Pacific Command, and U.S. Navy sailors aboard the USS Lake Erie (CG 70) successfully conducted a flight test today of the Aegis Ballistic Missile Defense (BMD) system, resulting in the intercept of a complex separating short-

[82] Missile Defense Agency press release 13-News-0007, dated September 10, 2013, entitled "Successful Missile Defense Test Against Multiple Targets." See also Megan Eckstein, "Aegis BMDS, THAAD Successful In Complex MDA Flight Test," *Defense Daily*, September 11, 2013: 1; and Amy Butler, "MDA Goes Two For Two In Operational Test," *Aerospace Daily & Defense Report*, September 11, 2013: 4.

range ballistic missile target over the Pacific Ocean by the Aegis BMD 4.0 Weapon System and a Standard Missile-3 (SM-3) Block IB guided missile.

At approximately 2:30 p.m. Hawaii Standard Time (8:30 p.m. EDT), a complex separating short-range ballistic missile target was launched from the Pacific Missile Range Facility on Kauai, Hawaii. The target flew northwest towards a broad ocean area of the Pacific Ocean. Following target launch, the USS Lake Erie detected and tracked the missile with its onboard AN/SPY-1 radar. The ship, equipped with the second-generation Aegis BMD weapon system, developed a fire control solution and launched two SM-3 Block IB guided missiles to engage the target. The first SM-3 that was launched successfully intercepted the target warhead. This was the first salvo mission of two SM-3 Block IB guided missiles launched against a single separating target.

Program officials will assess and evaluate system performance based upon telemetry and other data obtained during the test.

This test exercised the latest version of the second-generation Aegis BMD Weapon System, capable of engaging longer range and more sophisticated ballistic missiles. This was an operationally realistic test, in which the target's launch time and bearing are not known in advance, and the target complex was the most difficult target engaged to date.[83]

October 3, 2013, Test. MDA states that in this flight test,

The Missile Defense Agency (MDA), U.S. Pacific Command, and U.S. Navy sailors aboard the USS Lake Erie (CG 70) successfully conducted an operational flight test of the Aegis Ballistic Missile Defense (BMD) system, resulting in the intercept of a medium-range ballistic missile target over the Pacific Ocean by the Aegis BMD 4.0 Weapon System and a Standard Missile-3 (SM-3) Block IB guided missile.

At approximately 7:33 p.m. Hawaii Standard Time, Oct. 3 (1:33 a.m. EDT, Oct.4), a medium-range ballistic missile target was launched from the Pacific Missile Range Facility on Kauai, Hawaii. The target flew northwest towards a broad ocean area of the Pacific Ocean. Following target launch, the USS Lake Erie detected and tracked the missile with its onboard AN/SPY-1 radar. The ship, equipped with the second-generation Aegis BMD weapon system, developed a fire control solution and launched the SM-3 Block IB guided missile to engage the target. The SM-3 maneuvered to a point in space and released its kinetic warhead. The kinetic warhead acquired the target reentry vehicle, diverted into its path, and, using only the force of a direct impact, engaged and destroyed the target.

Program officials will assess and evaluate system performance based upon telemetry and other data obtained during the test.

This test exercised the latest version of the second-generation Aegis BMD Weapon System, capable of engaging longer range and more sophisticated ballistic missiles.[84]

---

[83] Missile Defense Agency press release 13-News-0008, dated September 18, 2013, entitled "Aegis Ballistic Missile Defense System Completes Successful Intercept Flight Test." See also Mike McCarthy, "Pentagon Succeeds At Sea-Based Missile Defense Test," *Defense Daily*, September 20, 2013: 1; Amy Butler, "Aegis Intercepts In First-Ever Salvo Test," *Aerospace Daily & Defense Report*, September 20, 2013: 3; and Jason Sherman and John Liang, "Missile Defense Agency's SM-3 Block IB Intercepts Target In Salvo Fire," *Inside the Navy*, September 23, 2013.

[84] Missile Defense Agency press release 13-News-0009, dated October 4, 2013, entitled "Aegis Ballistic Missile Defense System Completes Successful Intercept Flight Test." See also Michael Fabey, "Aegis Completes Another Intercept Test," *Aerospace Daily & Defense Report*, October 7, 2013: 2; Jason Sherman, "SM-3 Block IB Completes (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,[85] the second on June 5, 2008,[86] and the third on March 26, 2009.[87]

(...continued)

IOT&E With A Bang, Full-Rate Production Review," *Inside the Navy*, October 7, 2013.

[85] 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.

[86] 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.

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

Appendix B. Homeporting of U.S. Navy Aegis BMD Ships at Rota, Spain

This appendix presents additional background information on the Navy's plan to homeport four BMD-capable Aegis destroyers at Rota, Spain.

As part of the October 5, 2011, U.S.-Spain joint announcement of the plan, the Prime Minister of Spain, Jose Luis Rodriguez Zapatero, stated in part:

> This meeting marks a step forward on the path that we set for ourselves less than a year ago at the Lisbon Summit, aiming to make NATO an Alliance that is "more effective, engaged and efficient than ever before", in the words of [NATO] Secretary-General Rasmussen.
>
> At that historic Summit, decisions of enormous importance for the future of the Alliance were taken, such as the New Strategic Concept to face the new challenges of the 21st century, and the establishment of a new command structure that is leaner and more flexible, and improved.
>
> Besides these two important innovations, and as a consequence of them, the allies decided to develop an Anti-Missile Defence System.…
>
> As you will recall, as a consequence of this new structure launched in Lisbon, Spain obtained an installation of great importance within NATO's Command and Control Structure: the Combined Air Operations Centre (CAOC) in Torrejón de Ardoz, Spain.
>
> This Centre, together with the Centre in Uedem, Germany, will form part of the air command and control system which is to include the anti-missile defence that the Alliance is going to implement.
>
> Together with this land-based component of the new air defence system, I can inform you that Spain is also going to support, starting in 2013, an important part of the system's naval element.
>
> In recent months, the different options have been studied, and finally, it was decided that Spain should be the site for this component of the system, due to its geostrategic location and its position as gateway to the Mediterranean.
>
> Specifically, the United States is going to deploy, as its contribution to NATO's Anti-Missile Defence System, a total of four vessels equipped with the AEGIS system, to be based in Rota.
>
> This means that Rota is going to become a support centre for vessel deployment, enabling them to join multinational forces or carry out NATO missions in international waters, particularly in the Mediterranean.…
>
> Moreover, this initiative will have a positive impact, in socio-economic terms, on our country, and most especially on the Bay of Cadiz.
>
> Permanently basing four vessels in Rota will require investing in the Base's infrastructure, and contracts with service providers, thus generating approximately a thousand new jobs, both directly and indirectly.

> For the shipyards, and for Spain's defence industry, the foreseeable impact will also be highly positive, as the USA is considering conducting the vessels' maintenance and upkeep at the nearby San Fernando shipyards, in the province of Cadiz. In addition, there will be significant transfer of state-of-the-art technology, from which Spain can benefit.[88]

As part of the same joint announcement, Secretary of Defense Leon Panetta stated in part:

> With four Aegis ships at Rota, the alliance is significantly boosting combined naval capabilities in the Mediterranean, and enhancing our ability to ensure the security of this vital region. This relocation of assets takes place as part of the United States' ongoing effort to better position forces and defensive capabilities in coordination with our European allies and partners.
>
> This announcement should send a very strong signal that the United States is continuing to invest in this alliance, and that we are committed to our defense relationship with Europe even as we face growing budget constraints at home.…
>
> Alongside important agreements that were recently concluded with Romania, Poland, and Turkey, Spain's decision represents a critical step in implementing the European Phased Adaptive Approach, as our leaders agreed to in Lisbon.…
>
> Beyond missile defense, the Aegis destroyers will perform a variety of other important missions, including participating in the Standing NATO Maritime Groups, as well as joining in naval exercises, port visits, and maritime security cooperation activities….
>
> The agreement also enables the United States to provide rapid and responsive support to the U.S. Africa and U.S. Central Commands, as needed.[89]

An October 5, 2011, press report stated:

> A senior U.S. defense official said making the [ships'] base at Rota, on Spain's southwestern Atlantic coast near Cadiz, would reduce the numbers of [BMD-capable Aegis] ships needed for the [EPAA] system.
>
> "You [would] probably need 10 of these ships if they were based in the eastern U.S. to be able to ... transit across the ocean back and forth to [keep the same number on] patrol in the Med," he said.
>
> The U.S. official said the United States was committed to having at least one ship on station at all times in the eastern Mediterranean, where their anti-missile missiles would be most effective. Having them based in Rota would enable more than one to be in the eastern Mediterranean as needed.

---

[88] "Announcement on missile defence cooperation by NATO Secretary General Anders Fogh Rasmussen, the Prime Minister of Spain, Jose Luis Rodriguez Zapatero and US Defense Secretary Leon Panetta," October 5, 2011, accessed October 6, 2011, at http://www.nato.int/cps/en/SID-107ADE55-FF83A6B8/natolive/opinions_78838.htm.

[89] "Announcement on missile defence cooperation by NATO Secretary General Anders Fogh Rasmussen, the Prime Minister of Spain, Jose Luis Rodriguez Zapatero and US Defense Secretary Leon Panetta," October 5, 2011, accessed October 6, 2011, at http://www.nato.int/cps/en/SID-107ADE55-FF83A6B8/natolive/opinions_78838.htm. See also "SECDEF Announces Stationing of Aegis Ships at Rota, Spain," accessed October 6, 2011, at http://www.navy.mil/search/display.asp?story_id=63109.

> The ships also would be part of the pool of vessels available to participate in standing NATO maritime groups, which are used to counter piracy and for other missions, he said.[90]

An October 10, 2011, press report stated:

> "Our plan is to have the first couple [of ships] there in 2014 and the next two in about 2015," said Cmdr. Marc Boyd, spokesman for [U.S. Navy] 6th Fleet. Boyd added: "It's really early in the process and we haven't selected any of the ships yet." Boyd said the shift will bring an estimated 1,300 sailors and Navy civilians and 2,100 dependents to Naval Station Rota, which would double the base's ranks. Naval Station Rota spokesman Lt. j.g. Jason Fischer said the base now has 1,067 sailors….
>
> The three piers at the base primarily support Navy ships passing through on port calls.
>
> Boyd said 6th Fleet is considering plans to add base infrastructure and maintenance facilities to support the ships, as well as additional housing for crews, "but the base is pretty suited as it is now."[91]

[90] David Brunnstrom and David Alexander, "Spain To Host U.S. Missile Defense Ships," *Reuters*, October 5, 2011. Ellipsis as in original.

[91] Sam Fellman, "U.S. To Base Anti-Missile Ships in Spain," *Defense News*, October 10, 2011: 76.

Appendix C. Allied Participation and Interest in Aegis BMD Program

This appendix presents additional background information on allied participation and interest in the Aegis BMD program.

A September 16, 2013, press report states:

> One of the UK Royal Navy's new Type 45 destroyers is conducting tests to establish whether the warships could provide British forces with theater ballistic-missile defense (TBMD) capabilities for the first time, according to the head of the Royal Navy.
>
> First Sea Lord Adm. Sir George Zambellas said during a speech to industry executives and military personnel on the opening day of the DSEi defense exhibition that the "type is on trials in the Pacific to explore the ballistic-missile defense capabilities that are ready to be exploited, bringing strategic opportunities to the vessel."
>
> The Type 45 destroyer Daring, one of six Type 45s built by BAE Systems for the Royal Navy, has been in the Pacific for several weeks, having departed its Portsmouth base this summer for a wide-ranging nine-month deploy-ment, which the Royal Navy said in May would include science and technology trials. The work is being done as part of a US Missile Defense Agency (MDA) research and development test....
>
> In May, the UK Defence Ministry confirmed it was talking to Aster 30 partners France and Italy about developing an extended-range version of a missile already used by the French and Italian armies to intercept incoming missiles While there is no program to adapt the Type 45 to include TBMD capability, the trials support the possibility of such a move once a decision whether to go down that route is made by the British government.[92]

A March 18, 2013, press report states:

> Raytheon has discussed a possible pooling arrangement with three navies in northern Europe to make its SM-3 ballistic missile inter-ceptor more affordable, according to a senior company executive.
>
> Speaking after a successful test of a new data link enabling the SM-3 to communicate with X-band radars operated by Dutch, Danish and Ger-man warships, George Mavko, director of European missile defense at Raytheon Missile Systems, said the idea of a pooling arrangement had been raised by the company, even though none of the countries are pursuing procurement at this point....
>
> While all three European navies have expressed an interest in the capability of the SM-3 to engage ballistic missiles at ranges outside the atmosphere, none appear close to actually procuring the missiles....
>
> Instead, led by the Dutch, the initial moves appear focused on updating naval X-band radars and other systems so they can provide target data to SM-3 missiles even if they can't prosecute their own attack....

[92] Andrew Chuter, "UK Royal Navy Examines BMD Capabilities," *Defense News*, September 16, 2013: 38.

> Aside from the pooling idea, Raytheon also recently opened discussions with the U.S. Missile Defense Agency over co-production of SM-3 systems in Europe to sweeten any future deal, Mavko said....
>
> Small bits of the missile are already produced in Europe, although it was "too early to imply the U.S. is willing to release any major subsystems to other countries for co-production," Mavko said....
>
> Raytheon has been cooperating with the Dutch Navy for several years, exploring the potential of the SM-3 to talk to X-band radars. The Dutch have co-funded a study with the U.S. government on the feasibil-ity of a dual-band data link; the study is due to be extended into a second phase. The German government has agreed to participate this time.[93]

A March 11, 2013, press report states:

> The Eurosam SAMP/T surface-to-air missile system has destroyed a representative theater ballistic missile during a test in France.
>
> The March 6 test saw a joint Italian and French team engage an aircraft-launched target using an Aster 30 missile fired from the Biscarosse missile test center on the Bay of Biscay coast.
>
> According to French government defense procurement agency the DGA, the operational evaluation firing was jointly carried out by the Italian 4th Artillery Regiment of Mantova with the French military airborne test center (CEAM) of Mont-de-Marsan. In a change from previous interceptions, the SAMP/T used Link 16 data links to provide target information. The test also was the first to use what Eurosam calls a NATO environment in terms of command and control of the weapon, rather than simply using French sensors.
>
> The company says the firing was as "close to what would be an operational use for an anti-theater ballistic missile mission under the aegis of the alliance Active Layered Theater Ballistic Missile Defense program."
>
> The company adds, "The NATO Ballistic Missile Defense Operations Cell, located in Ramstein, Germany, was in the loop via Link 16 network."[94]

Another March 11, 2013, press report states:

> Joint US and European testing of command, control, communications and radar systems are underway to demonstrate the feasibility of integration of European radars and command and control systems into a future missile defense systems based on the planned European Phased Adaptive Approach (EPAA) utilizing the several AEGIS destroyers or cruisers to be based in Spain, land-based SM-3 interceptors to be stationed in Romania and Poland, along with SPY-2 radars sites. These assets are to be complemented by a number of European deployed radar sites.
>
> In recent weeks tests were carried out to evaluate such integration. Last week Raytheon reported about a recent trial that showed that a radar used by Dutch, German and Danish navies could provide target information to the interceptor. The current radar installed on the Dutch frigates is incompatible with the AEGIS/SM-3 link operating over S-band. The

[93] Andrew Chuter, "Raytheon Pushes European SM-3 Missile Pool," *Defense News*, March 18, 2013: 4.

[94] Tony Osborne, "European SAMP/T Destroys Ballistic Missile In Test," *Aerospace Daily & Defense Report*, March 11, 2013: 3.

> demonstration which took place at the Den Helder military test range validated a datalink that allows the missile to receive information from the Thales sensor while retaining the ability to communicate with Aegis combat ships used by the U.S. Navy. Generally, The Dutch, German and Danish navies datalinks are operating on X bands, while Norway, Spain and the U.S. operate AEGIS frigates communicating with their interceptors over the S band. To avoid unique configurations of missiles, Raytheon has developed a dual-band datalink which enables the same missile to communicate in both bands. This dual-band datalink was first tested in 2011.[95]

A March 8, 2013, press report states:

> The British Royal Navy is exploring the possibility of outfitting its newest class of destroyers with a ballistic missile defense capability.
>
> The Defence Ministry said this week it wants to examine the potential for the Type 45 destroyers to play a role in defending the United Kingdom and allies from the threat of ballistic missiles. The ministry said it will build on its relationship with the Pentagon's Missile Defense Agency to look at the option....
>
> The joint Defence Ministry and industry-run U.K. Missile Defence Center (MDC) plans to take part in a trial that for the first time will use a Type 45 in a research and development program with their American counterparts.
>
> That will involve testing the Sampson radar, which is part of the Sea Viper missile system, in detecting and tracking ballistic missiles, the ministry said.
>
> The is no program to deploy ballistic missile defense on Type 45s but the MDC has in recent years been exploring the option for the destroyers.
>
> "It will be a step change to be able to work so closely with such a ship in an emerging area of defense," MDC head Simon Pavitt said in a statement. "Working with an operational platform will make a significant difference to our level of understanding and could contribute both financially and technically towards any future program."[96]

An October 2012 article stated:

> The Royal Netherlands Navy's (RNLN's) four De Zeven Provincien-class LCF air defence and command frigates are to receive a substantially upgraded and rearchitectured SMART-L D-band volume search radar that will give the ships a ballistic missile defence (BMD) early warning capability.
>
> Thales Nederland received a EUR116 million (USD145 million) contract from the Netherlands' Defence Materiel Organisation (DMO) in June 2012 for the new extended-range sensor known as 'SMART-L EWC'. This new variant of SMART-L, which builds oni the results of a previous Extended Long Range (ELR) capability demonstration, will push

---

[95] Tamir Eshel, "Integrating European Radars with AEGIS/SM-3 Missile Defenses," *Defense Update (*http://defense-update.com*)*, March 11, 2013, accessed March 20, 2013 at http://defense-update.com/20130311_integrating-european-radars-with-aegissm-3-missile-defenses.html.

[96] Mike McCarthy, "U.K. Examining Sea-Based Missile Defense," *Defense Daily*, March 8, 2013: 10. See also "British Destroyer to Participate in U.S. Missile Defense Trials," *Defense Update (*http://defense-update.com*)*, March 7, 2013, accessed March 27, 2013, at http://defense-update.com/20130307_british-destroyer-to-participate-in-u-s-missile-defense-trials.html.

> instrumented range out to 2,000 km; improve elevation coverage; introduce new wave forms and processing optimised for the detection and tracking of very-high-velocity ballistic missile targets at altitude; and enable estimation of trajectories, launch sites and points of impact. At the same time, all SMART-L volume air search functionality will be retained.[97]

A journal article published in the summer of 2012 states:

> Today the steady growth of Aegis-capable ships in the U.S. Navy—as well as an increasing number of world navies fielding such ships—presents new opportunities and challenges....
>
> ... the Aegis BMD capabilities present in the navies of U.S. allies and friends can now provide the Global Maritime Partnership with a means to address the "high end" of the kill chain with combined, coordinated, ballistic-missile defense: the Aegis BMD Global Enterprise.
>
> This potential is already manifest in the Asia-Pacific region in the close working relationship between the United States and Japan. Korea and Australia could well join this Aegis network soon, giving the four governments the means to address not only territorial BMD but also coordinated BMD of fleet units operating together. In Europe, plans are well along to provide robust territorial defense of European nations with ALTBMD [active layered theater BMD] and the EPAA. Together, these systems provide a nascent BMD capability today and promise an even more robust capability as the EPAA evolves over the next decade and a half.
>
> But as demonstrated in Iraq, Afghanistan, and now Libya, NATO and the nations of Europe have equities often well beyond the territorial boundaries of the European continent. Also, a European military deployed beyond Europe's borders will always have a naval component. This is therefore a propitious time to begin to link European allies more completely into an Aegis BMD Global Enterprise in much the same way the U.S. Navy is linked to its Asia-Pacific partners—Japan today, Korea soon, and thereafter Australia in the near future—in a high-end Aegis BMD Global Maritime Partnership....
>
> The diffusion of Aegis BMD capability abroad is occurring quietly. Governments that have made naval force-structure investment decisions based primarily on inwardly focused national interests have discovered that their investments also enable them to combine their resources in collective defense....
>
> This effort to create a broad BMD enterprise builds on the current participation of allied navies in the Aegis program. This global effort started with a foreign military sales relationship with Japan, subsequently expanded to relationships with Australia and Korea, and now includes a commercial connection with Spain as well as an enterprise between Norway and Spain.22 Several other states have expressed interest in acquiring the Aegis weapon system and Aegis BMD. Importantly, Australia and other countries that are acquiring the Aegis system are stipulating that the systems they buy must have the capability of adding BMD in the future....
>
> In Europe, the decision as to whether and how to connect the European NATO allies' short- and medium-range theater missile-defense systems to the U.S. long-range missile defense system will be critical to the coherence of alliance-wide BMD. A high level of commitment to international partnership on the parts of both the United States and its allies—already

[97] Kate Tringham, "Warning Signs: Netherlands Evolves SMART-L Radar For Ballistic Missile Defence Mission," *Jane's International Defence Review*, October 2012: 28-29.

> evinced by ALTBMD and C2BMC shared situational-awareness tests—will encourage interoperability initiatives. This interoperability will, in turn, help ensure the success of the U.S. Phased Adaptive Approach....
>
> Close cooperation in the area of Aegis BMD between the United States and Japan, possibly Korea, and potentially Australia does not in itself qualify as an "Aegis BMD Global Enterprise." But to include European nations in an Aegis-afloat enterprise of capabilities approaching those planned for the ALTBMD/EPAA system would....
>
> European navies are now deployed worldwide fulfilling the vision of a Global Maritime Partnership: supporting operations in Iraq and Afghanistan, fighting in Libya, conducting antipiracy patrols in the Horn of Africa and elsewhere, and supporting humanitarian assistance operations around the world. There could be no more propitious time to begin to link more completely European allies in an Aegis BMD Global Enterprise, in much the same way the U.S. Navy is now linked to its Asia-Pacific partners in a high-end Aegis BMD Global Maritime Partnership....
>
> But it is unlikely that such a venture would succeed without ongoing U.S. leadership, the same sort of leadership that is supporting sea-based Aegis BMD for territorial and fleet ballistic-missile defense today in the northeast Pacific as well as sea-based and land-based ballistic territorial missile defense in Europe. Clearly, U.S. leadership could be what accelerates the morphing of a now-nascent Aegis BMD Global Enterprise in Europe into a global Aegis BMD afloat capability....
>
> There is a growing worldwide commitment to Aegis ballistic-missile defense, a commitment with broad potential to field an international global enterprise capable of defending against the most imminent, and growing, threat to nations and navies, on land and at sea alike—the threat of ballistic missiles, particularly those armed with weapons of mass destruction.[98]

A May 7, 2012, press report states:

> The German Navy's fleet of frigates could be upgraded to deploy Raytheon's [RTN] Standard Missile-3 to participate in NATO's ballistic missile defense program if the modifications were approved by the government, Germany's top naval officer recently said.
>
> Vice Admiral Axel Schimpf, the counterpart to the U.S. Navy's chief of naval operations, said in a recently published article that the F124 frigates are capable of being upgraded to play a vital role in ballistic missile defense (BMD).
>
> "The German Navy, with the F124 Frigates in their current configuration, has a weapon system at their disposal which forms the basis for capability enhancements for (German) armed forces' participation in various roles," according to a translation of an article he penned in Marine Forum, a publication of the German Maritime Institute.
>
> One option, Schimpf said, would be to upgrade the F124s' SMART-L and Active Phased Array Radar (APAR) combat management system, along with the Mk-41 vertical launch system to accommodate the SM-3....

[98] Brad Hicks, George Galdorisi, and Scott C. Truver, "The Aegis BMD Global Enterprise," *Naval War College Review*, Summer 2012: 65-80.

> The enhancements would be one way for Germany to participate in the Obama administration's European Phased Adaptive Approach (EPAA) embraced by NATO, and could be done in cooperation with Denmark or the Netherlands, Schimpf said....
>
> The German government has not made on decisions on whether to adapt its frigates for ballistic missile defense, and Germany's role in EPAA is the source of ongoing political discussions in Berlin ahead of NATO's May 20-21 summit in Chicago....
>
> Only a handful of NATO allies deploy the Aegis combat system on ships, and Germany is not one of them. Germany's combat system does not operate on an S-band frequency used on Aegis. Raytheon, however, says it has developed a duel band data link that would allow the combat system on allied ships to talk to the SM-3 and guide it to targets.[99]

An October 3, 2011, press report stated that

> The Netherlands, which has had a longtime interest in a missile shield, is pressing ahead to build up its own capabilities. The Dutch defense ministry plans to expand the capabilities of the Thales Smart-L radar on Dutch frigates to take on BMD roles. The program's value is estimated at €100-250 million, including logistics support and spares.
>
> Other European navies using the sensor may follow the Dutch lead.
>
> Dutch Defense Minister Hans Hillen notes that the Smart-L effort would help address the BMD sensor shortage within the NATO alliance. Citing NATO's decision last year to take a more expansive approach to BMD, Hillen says Smart-L could give the ALTBMD [Active Layered Theater BMD] command-and control backbone the required long-range target-detection analysis to help identify where a threat originates.
>
> The Netherlands has already carried out a sensor trial for the expanded role in cooperation with the U.S. Navy. The move does not include the purchase of Raytheon Standard Missile SM-3 interceptors.
>
> Both hardware and software modifications to the combat management system are needed. All four [of the Dutch navy's] De Zeven Provincien-class frigates would be modified to ensure that two can be deployed, even as one is in maintenance and the fourth is being readied for operations.
>
> Thales is due to complete a series of studies to prepare for the acquisition of the upgrade in the third quarter of 2012. The goal is to have the first frigates ready for operations by 2017. All four should be upgraded by the end of that year.
>
> Although the Netherlands is leading the program, other Smart-L users, including the German navy and Denmark, have been monitoring the effort. France also has shown interest in the system, Hillen said in a letter to legislators.
>
> France also wants to upgrade its Aster 30 interceptor to give it a basic BMD capability, although a formal contract has not been awarded….
>
> Raytheon, meanwhile, is still fighting to win a foothold for its Standard Missile 3 (SM-3) in Europe. The company continues its push to persuade continental navies to embrace the SM-3

[99] Mike McCarthy, "Raytheon's SM-3 An Option For German Role In Missile Defense, Admiral Says," *Defense Daily*, May 7, 2012: 9.

> Block 1B for missile defense roles, and says it has largely validated the dual-mode data link that would be key to the concept.
>
> The data link would feature both S- and X-band capability—the former to support the Aegis radar system used by the U.S. and others, and the latter for the Smart-L/APAR (active phased array radar) combination used, for instance, by the Dutch navy.[100]

A September 2011 press report states:

> The gulf in sea-based ballistic missile defence (BMD) capability between the navies of NATO's European member states and the US Navy (USN) was brought into stark relief by the recent deployment of the Ticonderoga-class cruiser USS Monterey to the Mediterranean and Black Sea region, as the first element of the United States' European Phased Adaptive Approach (EPAA) for missile defence....
>
> However, this situation is about to change as European NATO nations are committing their naval assets to BMD in response to evolving alliance policy towards developing a BMD architecture to protect the continent from perceived threats emanating from the Middle East.
>
> NATO embarked on an Active Layered Theatre Ballistic Missile Defence System (ALTBMDS) programme in September 2005, following a two-year feasibility study. Its initial focus was the protection of deployed alliance forces and high-value assets against short- and medium-range threats. At the November 2010 Lisbon Summit, political leaders from NATO states committed to expanding that remit to include the defence of the alliance's European territory.
>
> ALTBMD is providing a C2 framework on which to build a scalable and adaptable BMD 'system of systems' architecture, integrating new national systems as they are committed to the alliance and enabling a complete lower- and upper-layer capability covering Europe to be fielded. The first of these, Capability 1, with initial operational capability planned for the 2012 timeframe, integrates C2 infrastructure, sensors and ground-based Patriot interceptors. The expansion to provide upper-layer defence is due to achieve full operational capability between 2015 and 2016.
>
> The US contribution to this architecture is the EPAA set out by the Obama administration in September 2009....
>
> There is evidence that the EPAA has acted as a spur for some European nations to make a more coherent contribution to the NATO BMD construct, particularly in the maritime domain, as they seek to maintain sovereignty in the development and integration of indigenous BMD systems and defence of their territories.
>
> A number of classes of the latest generation of anti-air warfare (AAW) combatants with the potential to acquire a BMD capability are either operational or entering service in the navies of Denmark, France, Germany, Italy, the Netherlands, Norway, Spain and the UK. These offer the attributes of flexibility in deployment, mobility and sustainability inherent in naval

[100] Robert Wall, Amy Svitak, and Amy Butler, "Supporting Role," *Aviation Week & Space Technology*, October 3, 2011: 28-29. A shorter version of the story was published as Robert Wall, "Dutch Press Forward On Ship-Based Missile Defense Effort," *Aerospace Daily & Defense Report*, September 27, 2011: 4. See also Menno Steketee, "Dutch Frigates to Gain BMD Capability," *Jane's Navy International (Janes.com)*, September 28, 2011. (The print version of the report appeared under the same article title in the November 2011 issue of *Jane's Navy International*, page 8.

platforms and could operate as effective sensor nodes even without an organic intercept capability.

They would be able to forward deploy close to the origin of the threat and act as force multipliers in this role by providing early warning of launches and cueing of off-board interceptor systems with the provision of timely and accurate impact point prediction and missile tracks, together with launch point prediction for counter-targeting.[101]

[101] Charles Hollosi, "European Fleets Respond to Ballistic Missile Threats," *Jane's Navy International*, September 2011: 23-24, 26-30.

Appendix D. Earlier Oversight Issues Relating to SM-3 Block IIB Missile

On March 15, 2013, DOD announced that it is

- "restructuring" the SM-3 Block IIB program;
- shifting funding from SM-3 Block IIB program to other BMD efforts (specifically, the Ground Based Interceptor (GBI) BMD program in Alaska and to earlier versions of the SM-3); and
- dropping Phase IV of the EPAA, which was to feature the deployment of the SM-3 Block IIB missile.[102]

Prior to this announcement, potential oversight issues for Congress related to the SM-3 Block IIB interceptor included the prospective capability of the Block IIB missile for conducting certain kinds of intercepts called "early intercepts" as part of the EPAA, and concurrency and technical risk in the Block IIB development effort. This appendix presents information on those two issues as it existed prior to DOD's March 15, 2013, announcement.

Capability of Block IIB Interceptor

A June 13, 2011, press report stated:

> When asked what the Pentagon's plan is for countermeasures if early intercept does not materialize with the [SM-3 Block] IIB in 2020, Missile Defense Agency (MDA) officials simply state: "We fully expect to have a viable early-intercept capability with the SM-3 Block IIB in the 2020 time period."...

[102] As part of a March 15, 2013, statement announcing changes in BMD programs, Secretary of Defense Chuck Hagel stated that "we are restructuring the SM-3 IIB program. As many of you know, we had planned to deploy the SM-3 IIB as part of the European Phased Adaptive Approach. The purpose was to add to the protection of the U.S. homeland already provided by our current GBIs against missile threats from the Middle East. The timeline for deploying this program had been delayed to at least 2022 due to cuts in congressional funding. Meanwhile, the threat matures. By shifting resources from this lagging program to fund the additional GBIs as well as advanced kill vehicle technology that will improve the performance of the GBI and other versions of the SM-3 interceptor, we will be able to add protection against missiles from Iran sooner while also providing additional protection against the North Korean threat." (Missile Defense Announcement, As Delivered by Secretary of Defense Chuck Hagel, The Pentagon, Friday, March 15, 2013, accessed March 20, 2013, at http://www.defense.gov/speeches/speech.aspx?speechid=1759.) Following this announcement, Secretary Hagel and two other DOD officials—James Miller, the Undersecretary of Defense for Policy, and Admiral James Winnefeld, the Vice Chairman of the Joint Chiefs of Staff—took questions from the press. One questioner asked whether DOD was dropping Phase IV of the EPAA. Under Secretary Miller replied: "Yes, the—the prior plan had four phases. The third phase involved the deployment of interceptors in Poland. And we will continue with phases one through three. In the fourth phase, in the previous plan, we would have added some additional—an additional type of interceptors, the so-called SM-3 IIB would have been added to the mix in Poland. We no longer intend to—to add them to the mix, but we'll continue to have the same number of deployed interceptors in Poland that will provide coverage for all of NATO in Europe." (DOD news transcript, "DOD News Briefing on Missile Defense from the Pentagon," March 15, 2013, accessed March 20, 2013, at http://www.defense.gov/transcripts/transcript.aspx?transcriptid=5205.)

> At issue today is whether the architecture as envisioned is achievable; and the piece most critics question is the plan to achieve early intercept and protect the Eastern U.S. from an Iranian ICBM attack.
>
> USAF Gen. (ret.) Lester Lyles, who led the MDA when it was called the Ballistic Missile Defense Organization, is co-chairing a Defense Science Board task force review of the early-intercept strategy with Adm. (ret.) William Fallon, who headed U.S. Pacific Command. The report is being written and will likely be briefed to Pentagon leaders in the fall.
>
> Lyles declines to discuss his findings until they are briefed to the Pentagon. Industry and government sources familiar with the study have different views on what the findings will be. Some say the task force questions the ability to achieve early intercept with the time and money available. Others say the report will outline what can be achieved with the current strategy.
>
> Whatever the outcome, the results are likely to influence the SM-3 IIB program, whether it moves forward and, if it does, what the missile will look like. The IIB is the notional long-range missile killer that will be fielded in Phase IV by 2020 for early intercept to fulfill the promise of protecting the Eastern U.S. and most of Europe from an Iranian ICBM attack....
>
> GMD advocates point to the option of placing interceptors at Fort Drum, N.Y., to provide a deeper magazine and coverage for the Eastern U.S.....
>
> The question of whether a IIB missile can achieve early intercept, and how to do it, is likely be to sorted out this summer. The Defense Science Board will report its findings, and the MDA is likely to request funding for the IIB strategy in the fiscal 2013 budget proposal that is due to Congress next February.[103]

A June 17, 2011, press report states:

> A Defense Science Board (DSB) report on early missile intercept is already prompting discussion on Capitol Hill over how U.S. strategic forces are funded.
>
> The Obama administration is pursuing the European Phased Adaptive Approach to missile defense, which by 2020 would develop the SM-3 Block IIB interceptor to protect the U.S. and Europe against long-range missiles from North Korea and Iran. In April, Boeing, Lockheed Martin and Raytheon each won concept definition and program planning awards worth at least $41 million.
>
> But the DSB study, led by retired Air Force Gen. Lester Lyles and retired Navy Adm. William Fallon, casts doubt on a central capability of that interceptor—primarily the ability to hit an incoming missile before it deploys countermeasures, according to Senate Republican aides. The study's unclassified version also finds that the goal of early interception may lead to a less-capable system overall and rather than investing in the interceptor, improvements to radars, satellites and communications are also important, an aide says.
>
> With that information, already a critical question is emerging on Capitol Hill: During a deficit crisis, should the government be spending $1.7 billion over the next five years to develop the SM-3 Block IIB if its ultimate goal is in doubt?

[103] Amy Butler, "End Game," *Aviation Week & Space Technology*," June 13, 2011: 40.

> At least the rationale for pursuing the interceptor—replacing a missile defense site based in Poland and the Czech Republic—is in line for scrutiny.
>
> "If the administration continues to sell early interceptors as a way of going after countermeasures, that's not going to work," one aide says.
>
> So in that case, does it make sense to continue working on the IIB missile for other reasons? And if not, what are the alternatives?
>
> One camp could emerge in support of upgrades to the current Ground-based Midcourse Defense system or the creation of a site in the eastern United States. Another group may want to improve on the capabilities of the Raytheon-led SM-3 Block IIA.[104]

A July 6, 2011, letter to the editor from the two co-chairmen of the DSB task force in question and the chairman of the full DSB stated:

> The Defense Science Board (DSB) is now completing a review on Science and Technology Issues of Early Intercept (EI) Ballistic Missile Defense Feasibility as a concept to enhance missile defense....
>
> In previous work, the DSB found the EI concept helpful in national missile defense against long-range ballistic missiles. In the current review, EI, as defined by the study's terms of reference, was judged less helpful in regional missile defense against shorter range regional ballistic missiles....
>
> The DSB concluded that the Missile Defense Agency is on the right track in developing European Phased Adapted Approach (EPAA) options, including continued evolution of the SM-3 family of missiles, which will expand the battle space and provide more engagement opportunities in the regional defense provided by the EPAA. The DSB also examined the potential in the EPAA context for EI in regional defense against short-range missiles before threat payloads could be deployed, and concluded that this was not a viable option because of technical constraints - primarily related to the very short payload deployment times and the present absence of adequate sensors/Ballistic Missile C3 to overcome this.
>
> The fact that this form of EI is not viable in shorter-range regional applications does not imply that either SM-3 family interceptors or the EPAA concept are flawed. In general, EI, including intercepts of longer- range missiles before the threat missile reaches apogee, can provide for multiple engagement opportunities and more effective defenses.
>
> MDA is on the right track in pursuing this capability for national missile defense, and examining the potential application in regional defense as a function of the range of threat missiles.
>
> The DSB did not conclude that EI is flawed. Nor did they conclude that the EPAA approach or the SM-3 family were flawed. The DSB did conclude that EI would have a very limited role in regional defense against shorter range missile threats.[105]

---

[104] Jen DiMascio, "DSB Report Raises Questions About SM-3 Block IIB Costs," *Aerospace Daily & Defense Report*, June 17, 2011: 4.

[105] Letter to the editor from Admiral William J. Fallon, U.S. Navy, retired, task force co-chairman; General Lester Lyles, U.S. Air Force, retired, task force co-chairman and DSB vice chairman; and Paul G. Kaminski, DSB chairman, published under the title "'Early Intercept' Not Flawed," *Washington Times*, July 6, 2011: B2.

Concurrency and Technical Risk in Block IIB Development Effort

A March 2012 GAO report stated the following regarding the SM-3 Block IIB missile:

> **Current Status**
>
> The SM-3 Block IIB program entered technology development in July 2011 and awarded three contracts to conduct trade studies, define missile configurations, and produce development plans. One contractor will be selected for system development in 2013. The SM-3 Block IIB program is developing advance seeker and other technologies that cut across the SM-3's variants through a technology risk-reduction program.
>
> According to a tentative schedule, the SM-3 Block IIB program plans to enter system development prior to holding a preliminary design review, raising the possibility of cost and schedule growth. The program is conducting a series of reviews to receive engineering insight into each contractor's design. While these reviews will provide important knowledge, we have reported that before starting system development, programs should hold key engineering reviews, culminating in the preliminary design review, to ensure that the proposed design can meet defined, feasible requirements within cost, schedule, and other system constraints. Beyond the crosscutting technologies the program is developing, it is taking steps to develop technology maturation plans that will include demonstrating technologies in a relevant environment using a representative model or prototype before the SM-3 Block IIB enters system development. The three contractors' plans are expected to outline the level of investment required to demonstrate this degree of technology maturity by 2014. Program officials have not yet defined the specific critical technologies for the SM-3 Block IIB, which could hamper these efforts. Unlike most major defense acquisition programs, MDA programs are not required to demonstrate technologies in a relevant environment prior to system development, so decision makers will have to hold the program accountable for ensuring the technologies mature as intended....
>
> **Program Office Comments**: In commenting on a draft of this assessment, MDA noted the SM-3 Block IIB's primary mission is early intercept of long-range ballistic missiles. One system development contract will be competitively awarded in fiscal year 2014. MDA has identified key missile technologies and made investments to reduce development risks. Prior to system development, there will be a government-only system requirements review. MDA also provided technical comments, which were incorporated as appropriate.[106]

An April 2012 GAO report stated the following:

> The program has high levels of concurrency because it plans to commit to product development prior to holding a PDR [preliminary design review]....
>
> The need to meet the 2020 time frame announced by the President to field the SM-3 Block IIB for European PAA Phase IV is a key driver for the high levels of concurrency. The program is following some sound acquisition practices by awarding competitive contracts to multiple contractors to develop options for missile configurations and mature key technologies as well as planning to compete the product development contract. However, while the program is holding a series of reviews that will provide engineering insight into the SM-3 Block IIB design, we have previously reported that before starting development, programs should hold key system engineering events, culminating in the PDR, to ensure that

[106] Government Accountability Office: *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-12-400SP, March 2012, p. 140.

> requirements are defined and feasible and that the proposed design can meet those requirements within cost, schedule, and other system constraints. In addition, based on the initial schedule developed by the program and prior history of SM-3 interceptor development, the SM-3 Block IIB program will need to commit to building the first flight test vehicle prior to holding the PDR in order to remain on the planned test schedule. According to MDA, this approach is a low risk development if the program is funded at requested levels. The agency stated that the achievement of an initial operating capability will be based on technical progress and execution of a "fly before buy" approach. [107]

The April 2012 GAO report recommended that the Secretary of Defense direct MDA to "ensure that the SM-3 Block IIB requirements are defined and feasible and that the proposed design can meet those requirements within cost, schedule, and other system constraints by delaying the commitment to product development until the program completes a successful preliminary design review."[108]

Author Contact Information

Ronald O'Rourke
Specialist in Naval Affairs
rorourke@crs.loc.gov, 7-7610

[107] Government Accountability Office, *Missile Defense[:]Opportunity Exists to Strengthen Acquisitions by Reducing Concurrency*, GAO-12-486, April 2012, pp. 22-23; see also Appendix VI (pp. 58-64).

[108] Government Accountability Office, *Missile Defense[:]Opportunity Exists to Strengthen Acquisitions by Reducing Concurrency*, GAO-12-486, April 2012, pp. 28.