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SUMMARY

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

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. BMD-capable Aegis ships operate in European waters to defend Europe from potential ballistic missile attacks from countries such as Iran, and in in the Western Pacific and the Persian Gulf to provide regional defense against potential ballistic missile attacks from countries such as North Korea and Iran. The number of BMD-capable Aegis ships has been growing over time. MDA's FY2025 budget submission states that "by the end of FY 2025, there will be 56 total BMD capable [Aegis] ships requiring maintenance support." MDA testified on December 7, 2023, that the number of BMD-capable ships on that date was 49, and that under MDA's FY2024 budget submission, the number is to grow to 56 by FY2025 and 69 by FY2030.

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 FY2024 budget requests a total of $1,329.9 million (i.e., about $1.3 billion) in procurement and research and development funding for Aegis BMD efforts, including funding for two Aegis Ashore sites in Poland and Romania. 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:

- whether to approve, reject, or modify MDA's annual procurement and research and development funding requests for the program;
- the adequacy of MDA's cost estimating and its reporting of costs;
- what role the Aegis BMD program should play in defending the U.S. homeland against attack from ICBMs;
- required versus available numbers of BMD-capable Aegis ships;
- the burden that BMD operations may be placing on the Navy's fleet of Aegis ships, and whether there are alternative ways to perform BMD missions now performed by U.S. Navy Aegis ships, such as establishing additional Aegis Ashore sites;
- allied burden sharing—how allied contributions to regional BMD capabilities and operations compare to U.S. naval contributions to overseas regional BMD capabilities and operations;
- whether to convert the Aegis test facility in Hawaii into an operational land-based Aegis BMD site;
- the potential for ship-based lasers to contribute in coming years to Navy terminal-phase BMD operations and the impact this might eventually have on required numbers of ship-based BMD interceptor missiles; and
- deliveries, testing, and technical risk in the Aegis BMD program.

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Introduction

This report provides background information and issues for Congress on the Aegis ballistic missile defense (BMD) program, a program carried out by the Missile Defense Agency (MDA) and the Navy that gives Navy Aegis cruisers and destroyers a capability for conducting BMD operations. The issue for Congress is whether to approve, reject, or modify Department of Defense (DOD) acquisition strategies and proposed funding levels for the Aegis BMD program. 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

All but three of 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 exceptions are the Navy's three Zumwalt [DDG-1000] class destroyers, which are discussed below.) 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 (CGs 47 through 73) were procured for the Navy between FY1978 and FY1988; the ships entered service between 1983 and 1994. The first five ships in the class (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, leaving 22 ships in operation (CGs 52 through 73). Retirements of these 22 ships began in FY2022. The Navy's FY2025 budget submission projects that 9 will remain in service at the end of FY2024, and proposes that these 9 ships be retired in FY2025 (four ships), FY2026 (three ships), and FY2027 (two ships).

Arleigh Burke (DDG-51) Class Aegis Destroyers

The Navy began procuring DDG-51s in FY1985, and a total of 94 have been procured through FY2024. The first DDG-51 entered service in 1991, and a total of 74 have been delivered as of August 2023. Under the Navy's FY2025 budget submission, retirements of older DDG-51s are to begin in FY2028.

The DDG-51 design has been updated multiple times over the years. The first 28 DDG-51s are known as Flight I/II DDG-51s. The next 34, known as Flight IIA DDG-51s, incorporate some significant design changes, including the addition of a helicopter hangar. The version currently being procured, called the Flight III DDG-51 design, incorporates another significant change—a new radar, called the SPY 6 radar (and prior to that, the Air and Missile Defense Radar, or AMDR), that is more capable than the SPY-1 radar installed on CG-47s and earlier DDG-51s.

No DDG-51s were procured in FY2006-FY2009. The Navy during this period instead procured the three above-mentioned 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 the three DDG-1000s to make them BMD-capable.[1]

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.[2] Japan's Aegis-equipped ships are BMD-capable. The Aegis-equipped ships operated by South Korea, Australia, Spain, and Norway are currently not BMD-capable.

Aegis BMD System[3]

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. Older Aegis ships can be modified to become BMD-capable ships, and DDG-51s procured in FY2010 and subsequent years have been built from the start with a BMD capability.

Versions and Capabilities of Aegis BMD System

Overview

The Aegis BMD system exists in multiple variants whose ascending numerical designations indicate ascending levels of capability. As part of MDA's FY2022 budget submission, the designations of Aegis BMD system variants were changed and consolidated to 4.X, 5.X, and 6.X, with the X indicating multiple subvariants. (The 4.X variant, for example, includes the 4.1 and 4.2 subvariants.[4])

BMD system variants correlate with certain versions (i.e., baselines, or BLs) of the overall Aegis system, which have their own numbering system. The more recent BMD variants, in addition to being able to address more challenging BMD scenarios, give BMD-equipped ships a capability to simultaneously perform both BMD operations against ballistic missiles and anti-air warfare (AAW) operations (aka air-defense operations) against aircraft and anti-ship cruise missiles. **Figure 1** provides a 2019 Government Accountability Office (GAO) summary of the capabilities of the more recent BMD variants and their correlation to Aegis system baselines as of 2019. Because **Figure 1** was prepared in 2019, it uses the older designations for Aegis BMD system variants, rather than the new designations that were introduced as part of the MDA's FY2022 budget submission.

The Aegis BMD system was originally designed primarily to intercept theater-range ballistic missiles, meaning short-, medium-, and intermediate-range ballistic missiles (SRBMs, MRBMs, and IRBMs, respectively). In addition to its capability for intercepting theater-range ballistic

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

[2] 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.

[3] Unless stated otherwise, information in this section is taken from MDA briefings on the Aegis BMD program given to CRS and CBO analysts on the MDA's FY2023 and prior-year budget submissions.

[4] The 4.X variant is the new designation for the variants previously designated 3.6.X, 4.0.X, 4.1, and 4.2. The 5.X variant is the new designation for the variants previously designated 5.0CU (with the CU standing for Capability Upgrade) and 5.1. The 6.X variant is the new designation for the variant previously designated 6.0.

missiles, detection and tracking data collected by the Aegis BMD system's radar might be passed to other U.S. BMD systems that are designed to intercept intercontinental ballistic missiles (ICBMs), which might support intercepts of ICBMs that are conducted by those other U.S. BMD systems.

Figure 1. GAO Summary of Capabilities of Aegis BMD System Variants

Table 5: Aegis Ballistic Missile Defense (BMD) spirals with associated Aegis Weapons System Baselines and capabilities.

Aegis BMD spirals	Associated integrated Aegis Weapon System Baselines (BL)	Key Ballistic Missile Defense Capabilities	Delivery date
BMD 5.0 Capability Upgrade (CU)	BL 9.C1	• Addition of Standard Missile-3 (SM-3) Block IB Threat Upgrade interceptor • Launch on Remote[a] • Improved discrimination using infrared and radio wave data • Capability against more advanced threats • Ship battle group defense capability using Standard Missile (SM-6) Dual I[b]	2015
	BL 9.B1	• BMD 5.0 CU capabilities for Aegis Ashore in Romania without Standard Missile (SM-6) Dual I	2015
BMD 5.1	BL 9.C2	• Addition of SM-3 Block IIA • Engage on Remote[c] • Ship battle group defense capability using Standard Missile (SM-6) Dual II[b] •	2019
	BL 9.B2	• BMD 5.1 capabilities for Aegis Ashore in Romania and Poland	2019
BMD 4.1	BL 5.4	• Similar capabilities to BMD 5.0 CU capabilities, installed on legacy hardware	2020
BMD 4.2	BL 5.X	• Aegis SPY-1 radar refurbishment for improved tracking capability	2023
BMD 6.0	BL 10.0	• New SPY-6 radar with increased radar capacity and discrimination • Performance against additional threats and larger raids • Improved missile communications	2023

Source: GAO analysis of MDA data | GAO-19-387

[a]Launch on Remote allows Aegis BMD to launch its interceptor on tracks provided by off board sensor before its own radar acquires the threat, but the intercept itself is executed based on onboard the Aegis SPY-1 radar.

[b]SM-6 Dual I and SM-6 Dual II allow ship to defend itself and other nearby ships in a battle group. SM-6 Dual I and II baselines are not included in the Ballistic Missile Defense Accountability Report and thus fall outside the scope of this review.

[c]Engage on Remote increases the area defended by the BMDS, by allowing Aegis BMD to intercept a threat before it is visible to its own radar, based entirely on tracks from a forward-based sensor.

Source: Government Accountability Office, *Missile Defense[:] Delivery Delays Provide Opportunity for Increased Testing to Better Understand Capability*, GAO-19-387, June 2019, Table 5 on p. 31.

Aegis BMD Interceptor Missiles

The BMD interceptor missiles used by Aegis ships are the Standard[5] Missile-3 (SM-3) and the SM-6.

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 vehicle, that is designed to destroy a ballistic missile's warhead

[5] The Standard Missile is so named because it was originally developed, decades ago, as a surface-to-air (i.e., air defense) missile to serve as the common (i.e., standard) successor to the Navy's then-existing collection of Talos, Terrier, and Tartar air defense missiles, which were sometimes referred to collectively as the 3-T missiles.

by colliding with it. The current versions of the SM-3 missile include the SM-3 Block IA, the SM-3 Block IB, and the SM-3 Block IIA.[6]

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. Compared 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 has 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, as well as a larger-diameter kinetic warhead. The United States and Japan cooperated in developing certain technologies for the Block IIA version, with Japan funding a significant share of the effort.[7]

An April 15, 2024, press report stated

> For the first time in combat, guided-missile destroyers fired missiles developed to intercept ballistic missiles during the U.S. response to the Iranian attack on Israel, USNI News has learned.
>
> USS Arleigh Burke (DDG-51) and USS Carney (DDG-64), in the Eastern Mediterranean, fired four to seven Standard Missile 3s to intercept Iranian ballistic missiles headed toward Israeli targets over the weekend, two defense officials confirmed to USNI News on Monday [April 15]….
>
> Both the destroyers were placed off the coast of Israel as part of the defensive measures against a Iranian strike in retaliation for an Israeli attack on an Iranian embassy in Syria.[8]

On April 16, 2024, Secretary of the Navy Carlos Del Toro similarly testified to Defense subcommittee of the Senate Appropriations Committee that over the previous weekend (i.e., the weekend of April 13-14), U.S. Navy BMD-capable Aegis ships used SM-3s to counter ballistic missiles fired from Iran.[9] Prior to April 2024, it had been reported that Navy ships operating in the Red Sea had countered anti-ship ballistic missiles (ASBMs) fired by Houthi forces, but the weapons used by the Navy ships to counter these ASBMs were not specified.[10]

---

[6] MDA and Navy plans at one point called for the SM-3 Block IIA to be succeeded by a still-more-capable interceptor called the SM-3 Block IIB. The effort to develop that missile, however, was ended years ago, and MDA at the time was reportedly not pursuing any follow-on capabilities to the SM-3 Block IIA. (See, for example, Justin Doubleday, "Missile Defense Agency Not Pursuing Follow-On to SM-3 Block IIA Interceptor," *Inside the Navy*, October 24, 2016.)

[7] The cooperative research effort was carried out under a U.S.-Japan memorandum of agreement signed in 1999. The effort 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.

[8] Sam LaGrone, "SM-3 Ballistic Missile Interceptor Used for First Time in Combat, Officials Confirm," *USNI News*, April 15, 2024.

[9] For press articles about Secretary Del Toro's testimony, see, for example, Jake Epstein, "US Navy Warships Shot Down Iranian Missiles with a Weapon They've Never Used in Combat Before," *Business Insider*, April 16, 2024; Connor O'Brien, "Nearly $1B in Missiles Used in Middle East, Navy Secretary Says," *Politico Pro*, April 16, 2024. See also Jake Epstein, "A U.S. Navy Missile That Just Scored Its First Kill This Year Got Another Workout Against Iranian Weapons," *Business Insider*, October 3, 2024; Mallory Shelbourne and Sam LaGrone, "U.S. Destroyers Successfully Down Iranian Missiles with SM-3s, Carrier USS Harry. S. Truman Now in U.S. 6th Fleet," *USNI News*, October 2, 2024.

[10] See, for example, Jake Epstein, "US Warships Are Shooting Down Weapons No One's Ever Faced in Combat Before, and a Navy Commander Says it's a 'Great Opportunity,'" *Business Insider*, February 17, 2024. See also Tom Sharpe, "History Has Been Made as Ballistic Missiles Finally Used against Warships for Real," *Telegraph (UK)*, February 16, 2024.

A March 31, 2020, press report stated

> Raytheon and the Missile Defense Agency are exploring options to extend the range of the Standard Missile-3 Block IB—pushing the ballistic missile interceptor to dramatically expand a defended area by allowing the weapon to communicate with off-board radars—a move that would require enhancing one of the Aegis ballistic missile defense system's newest features: Engage-on-Remote….
>
> MDA Director Vice Adm. Jon Hill told Congress earlier this month that the new Engage-on-Remote capability provides "a seven-fold increase in missile defense coverage when compared to an autonomous Aegis platform."[11]

SM-6 Terminal Interceptor (Overview)

The SM-2 Block IV was MDA's and the Navy's initial sea-based terminal-phase (SBT) BMD interceptor. It was 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 was equipped with a blast fragmentation warhead. A limited number of these missiles were produced years ago.[12] The SM-2 Block IV has now been replaced by the SM-6.

The SM-6 is MDA's and the Navy's more capable next-generation SBT BMD interceptor. It is based on the SM-6 air defense missile (the Navy's successor to the SM-2 air defense missile). The SM-6 is a dual-capability missile that can be used for either air defense (i.e., countering aircraft and ASCMs) or ballistic missile defense. A July 23, 2018, press report states the following:

> The Defense Department has launched a prototype project that aims to dramatically increase the speed and range of the Navy's Standard Missile-6 by adding a larger rocket motor to the ship-launched weapon, a move that aims to improve both the offensive and defensive reach of the Raytheon-built system.
>
> On Jan. 17 [2018], the Navy approved plans to develop a Dual Thrust Rocket Motor with a 21-inch diameter for the SM-6, which is currently fielded with a 13.5-inch propulsion package. The new rocket motor would sit atop the current 21-inch booster, producing a new variant of the missile: the SM-6 Block IB.[13]

SM-6 Terminal Interceptor (Hypersonic Threat Intercept Capability)

MDA and the Navy are developing a capability for the SM-6 to intercept hypersonic missiles. MDA testified in December 2023 that

> Today, the SM-6, which uses a blast fragmentation kill mechanism, is the only interceptor available for a limited defense against hypersonic missile threats….
>
> MDA is working closely with the Navy to develop, field, and upgrade SBT defenses to counter more advanced maneuvering and hypersonic threats. SBT Inc 2 is deployed. MDA is analyzing the evasion maneuvers that hypersonic weapons may perform and addressing them in Aegis SBT Inc 3. SBT Inc 3 upgrade and delivery are in 2025 and include terminal

[11] Jason Sherman, "After MDA Demonstrates 7x Increase in Defended Area, Raytheon Pitching EOR for Older SM-3s," *Inside Defense*, March 31, 2020.

[12] The inventory of SM-2 Block IVs 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 at least 3 were used in BMD flight tests through February 2012.

[13] Jason Sherman, "Navy Looking to Increase Range, Speed of SM-6 with Larger Rocket Motor," *Inside the Navy*, July 23, 2018.

> defense capability against hypersonic threats. MDA will conduct flight tests against advanced threat-representative targets in FY 2024 and FY 2025….
>
> Additionally, MDA is working closely with the Navy to develop, field, and upgrade SBT defenses to counter more advanced maneuvering and hypersonic threats. We anticipate delivering these SBT Inc 3 capabilities in 2025. We are also engaged in a competitive development effort to significantly enhance hypersonic missile defense capabilities. MDA is developing a layered defense capability against regional hypersonic threats and have initiated a development program for Glide Phase Intercept (GPI) to defend the sea-base and regional forces ashore, leveraging existing systems where possible, including proven engage-on-remote and launch-on-remote capabilities. Layered defenses provide more opportunities to engage and potentially neutralize hypersonic threats in-flight. We are focusing on the proven Aegis Weapon System to provide the depth-of-fire needed for a layered defense against hypersonic threats. Today, MDA is funding technology maturation of two GPI concepts on the path to preliminary design.
>
> The Aegis Sea-Based GPI, planned for delivery in 2034, includes the ability to plan, detect, track, and defeat threats, and support integrated layered multiple engagement opportunities. GPI is developing a missile and updates to the existing Aegis Weapon System to counter hypersonic threats. The GPI interceptor will be hypersonic, multistage, and compatible with the Navy's MK-41 Vertical Launch System. MDA also is pursuing a Cooperative Development of the GPI Interceptor with the Japan Ministry of Defense. This project will focus on interceptor updates, and the United States will be responsible for the overall missile system design and integration. Japan will fund and develop all Japan workshare elements (to include rocket motor assemblies and control systems).[14]

In September 2024, it was reported that MDA had selected Northrop Grumman to design the GPI.[15]

Patriot (PAC-3 MSE) Interceptor (Hypersonic Threat Intercept Capability)

An October 25, 2024, press report states:

> Fearing China will deploy hypersonic weapons to sink ships in the Pacific, the U.S. Navy is moving forward with a plan to arm some of its vessels with Patriot interceptor missiles, two senior defense officials said.
>
> One industry official said putting the highly agile Patriot Advanced Capability-3 Missile Segment Enhancement (PAC-3 MSE) interceptors, used primarily in the U.S. by the Army, aboard Navy ships anticipates advances in Chinese missile technology, including the use of highly maneuverable hypersonic weapons.
>
> Integrating the Lockheed Martin-made… missiles with ships' air defenses comes amid simmering tension in the Indo-Pacific region as China rapidly modernizes its military, and in the wake of successful missile defense efforts in Ukraine and the Middle East….
>
> The PAC-3 is shorter-ranged than the Navy's SM-6 missiles and cannot reach into space.
>
> But steering rockets near the nose make it more agile, and destruction of the threat is more likely because of its "hit to kill" concept, in which the interceptor strikes the target rather than explode near it, said a missile defense program director with direct knowledge of the Aegis system.

[14] [Statement of] Rear Admiral Douglas L. Williams, USN, Director (Acting), Missile Defense Agency, Before the House Armed Services Committee, Strategic Forces Subcommittee, December 7, 2023, [hearing on] Demand for Theater Missile Defense Assets, pp. 4, 6, 7-8. See also Rich Abott, "MDA Still Trying To Quicken Hypersonic Defense, SM-6 Increment Three To Increase Hypersonic Targeting," *Defense Daily*, August 12, 2024.

[15] Jen Judson, "Pentagon Makes Early Pick for Hypersonic Interceptor Developer," *Defense News*, September 26, 2024.

> Facing advanced Chinese weapons, including hypersonic glide vehicle warheads, those qualities "supplement the existing missiles on a U.S. ship very well" by being able to more easily hit high-speed, maneuvering ballistic missiles and destroy them, said the program director….
>
> A PAC-3 interceptor from a Patriot missile system, primarily used by the U.S. Army and allied nations for land-based air defense, was tested in May on a "virtual Aegis ship" using a Mk. 70 vertical launcher, but has not been deployed on naval vessels.
>
> In the last year, however, it has intercepted numerous ballistic threats and aircraft in the Middle East and Ukraine, including Russia's advanced Khinzal missiles, making it an attractive addition to Navy magazines, the defense officials and people familiar with the matter said.
>
> The PAC-3 round is also much smaller than an SM-6 or SM-3, weighing about 300 kg (660 lbs), compared with 1,500 kg for the SM-6, and is about 9 cm (3.5 inches) smaller in diameter.
>
> Cost per missile varies by the customer and the deal, but both are roughly $4 million each, according to estimates.[16]

Numbers of BMD-Capable Aegis Ships

The number of BMD-capable Aegis ships has been growing over time. MDA's FY2025 budget submission states that "by the end of FY 2025, there will be 56 total BMD capable [Aegis] ships requiring maintenance support."[17] MDA testified on December 7, 2023, that the number of BMD-capable ships on that date was 49, and that under MDA's FY2024 budget submission, the number is to grow to 56 by FY2025 and 69 by FY2030.[18]

BMD-Capable Aegis Destroyers Forward-Homeported in Spain

On October 5, 2011, the United States, Spain, and NATO jointly announced that four BMD-capable U.S. Navy Aegis destroyers were to be forward-homeported (i.e., based) at the naval base at Rota, Spain.[19] The initial set of four ships was transferred to Rota in FY2014 and FY2015.[20]

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[16] Mike Stone and Gerry Doyle, "Fearing China's Hypersonic Weapons, US Navy Seeks to Arm Ships with Patriot Missiles," *Reuters*, October 25, 2024. See also "US Navy Eyes Patriot Missiles to Counter China's Hypersonic Threats in Pacific," Army Recognition Group, October 25, 2024.

[17] Missile Defense Agency, *Fiscal Year 2025 Budget Estimates, Missile Defense Agency*, March 2024, p. 11. (This is the FY2025 budget justification book for MDA's portion of the Operation and Maintenance, Defense-Wide appropriation account.)

[18] [Statement of] Rear Admiral Douglas L. Williams, USN, Director (Acting), Missile Defense Agency, Before the House Armed Services Committee, Strategic Forces Subcommittee, December 7, 2023, [hearing on] Demand for Theater Missile Defense Assets, pp. 2, 6.

[19] "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 May 18, 2022, 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 May 18, 2022, at https://web.archive.org/web/20120117065346/http:/www.navy.mil/search/display.asp?story_id=63109.

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 (prior to the current arrangement) in 1979. (Source: Sam Fellman, "U.S. To Base Anti-Missile Ships in Spain," Defense News, October 10, 2011: 76.)

[20] The four ships were the destroyers *Ross* (DDG-71) and *Donald Cook* (DDG-75), which moved to Rota in FY2014, and the destroyers *Carney* (DDG-64) and *Porter* (DDG-78), which moved to Rota in FY2015.

They were replaced at Rota by a new set of four BMD-capable U.S. Navy Aegis destroyers in 2020-2022.[21]

Navy officials said the four Rota-based ships can provide a level of level of presence in the Mediterranean for performing BMD patrols and other missions equivalent to what could be provided by about 10 BMD-capable Aegis ships that are homeported on the U.S. east coast, thus effectively releasing about six U.S. Navy BMD-capable Aegis ships for performing BMD patrols or other missions elsewhere.

In February and March 2020, DOD officials testified that DOD was considering forward-homeporting an additional two BMD-capable Aegis destroyers at Rota, which would make for a total of six destroyers at the site.[22] Navy officials testified in 2020 that they supported the idea.[23] On June 28, 2022, the Biden Administration announced that two additional Aegis destroyers would be homeported at Rota.[24] The Navy confirmed that the two additional Aegis destroyers are to be BMD-capable.[25] An October 24, 2022, press report stated that "the U.S. and Spain will soon launch negotiations on a new defense pact for an expanded naval presence in Spain," including the two additional BMD-capable Aegis destroyers. The report stated that "while an official timeline for the ships' arrival in Spain hasn't been set, U.S. military commanders have put 2025 or 2026 as target years."[26] On May 8, 2023, Spain and the United States reportedly signed the new agreement.[27] The first of the two additional ships reportedly arrived at Rota in October 2024.[28] The second additional ship reportedly is scheduled to arrive in 2026.[29]

Aegis Ashore Sites

Two Navy-Operated Sites in Romania and Poland

The land-based version of the Aegis BMD system is called Aegis Ashore. There are two Aegis Ashore sites, both in Europe—one in Romania, and one in Poland. The sites are intended to help defend Europe against ballistic missile threats from countries such as Iran. Each Aegis Ashore site includes a structure housing an Aegis system that is similar to the deckhouse on an Aegis ship,

[21] See, for example, Mallory Shelbourne, "USS Arleigh Burke Arrives in Spain, USS Donald Cook Will Head to Mayport," *USNI News*, April 12, 2021.

[22] See, for example, Paul McCleary, "EUCOM Calls For Two More Ships For Spanish Port," *Breaking Defense*, February 25, 2020; David B. Larter, "Push to Base Six US Navy Destroyers in Spain Could Be Gaining Steam," *Defense News*, March 3, 2020.

[23] See, for example, David B. Larter, "The US Navy's Top Officer Declares Support for Basing 6 Destroyers in Spain," *Defense News*, March 5, 2020. See also John Vandiver, "Rota to Gain Two US Destroyers by Middle of the Decade, EUCOM Chief Says," *Stars and Stripe*s, April 15, 2021.

[24] White House, "Press Gaggle by Press Secretary Karine Jean-Pierre and National Security Advisor Jake Sullivan En Route Madrid, Spain," June 28, 2022. See also Mallory Shelbourne, "Biden Administration Basing Two More Destroyers in Rota, Spain," *USNI News*, June 28 (updated June 29), 2022; Justin Katz, "'A Powerful Signal:' What It Means to Send Two More DDGs to Spain," *Breaking Defense*, July 1, 2022; Aaron Mehta, "US Increasing Troop Presence in Europe, While New NATO Strategy Eyes China," *Breaking Defense*, June 29, 2022; Geoff Ziezulewicz (Associated Press), "Two More Navy Destroyers Will Be Homeported in Rota, Spain," *Navy Times*, June 29, 2022.

[25] Source: Navy Office of Legislative Affairs email to CRS, July 1, 2022.

[26] John Vandiver, "Talks on Addition of 2 Navy Destroyers at Base in Spain Expected to Start Soon," *Stars and Stripes*, October 24, 2022.

[27] Heather Mongilio, "U.S., Spain Agree to Host Two More Warships in Rota," *USNI News*, May 9, 2023.

[28] Alison Bath, "USS Oscar Austin Arrives at New Homeport in Spain, Boosting Missile Defense in Europe," Stars and Stripes, October 16, 2024.

[29] Alison Bath, "Fifth US Navy Destroyer Expected to Arrive in Spain This Fall," *Stars and Stripes*, August 16, 2024.

and 24 SM-3 missiles launched from a relocatable Vertical Launch System (VLS) based on the VLS that is installed in Navy Aegis ships.[30]

The plan to establish the two Aegis Ashore sites in Romania and Poland was announced in 2009, as part of a plan for providing regional BMD defense in Europe called the European Phased Adaptive Approach (EPAA). The Aegis Ashore site in Romania achieved operational certification in May 2016.[31] The site in Poland began construction in May 2016[32] and was initially scheduled to be completed in 2018. Its completion, however, was delayed for years by construction contractor performance issues.[33] At a December 7, 2023, hearing on regional missile defense assets before the Strategic Forces subcommittee of the House Armed Services Committee, Rear Admiral Douglas L. Williams, the acting director of MDA, testified that

> Aegis Ashore Poland, located in Redzikowo, was added to the Operational Capability Baseline in September 2023 with upgrades over the original design and state-of-the-art Integrated Electronic Security System. Aegis Ashore Poland was delivered to the U.S. Navy on October 1, 2023 for operational use and maintenance. The Navy will formally accept Aegis Ashore Poland into their inventory on December 15, 2023. This will complete EPAA Phase 3, originally established in 2009. The Navy will install additional upgrades at Aegis Ashore Poland through May 2024, after which it will transfer to NATO in July 2024 for command and control of Aegis Ashore Poland in the defense of NATO European states against ballistic missile threats originating outside the Euro-Atlantic area.[34]

On July 10, 2024, the Aegis Ashore site in Poland was declared mission-ready by NATO.[35] The site reportedly was officially activated on November 13, 2024.[36]

Navy Interest in Divesting Aegis Ashore Sites It Operates

On January 11, 2021, the Chief of Naval Operations (CNO), Admiral Michael Gilday, released a guidance document for the Navy entitled *CNO NavPlan* (with NavPlan being short for navigation plan) that states

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[30] For additional discussion of the Aegis Ashore sites, see Edward Lundquist, "Aegis Ashore Adapts Sea-Based Missile Defense System to Protect Europe," *National Defense*, September 2016.

[31] See, for example, Amy Forsythe, "U.S. Navy Aegis Ashore Base in Romania Hosts NATO Country Ambassadors," Defense Visual Information Distribution Service (DVIDS), November 19, 2019; "Aegis Ashore," Missile Defense Advocacy Alliance, accessed May 18, 2022, at https://missiledefenseadvocacy.org/defense-systems/aegis-ashore/; US Naval Forces Europe-Africa, "Aegis Ashore Missile Defense System (AAMDS)-Romania Operationally Certified," Defense-Aerospace.com, May 12, 2016.

[32] See, for example, "Aegis Ashore," Missile Defense Advocacy Alliance, accessed May 18, 2022, at https://missiledefenseadvocacy.org/defense-systems/aegis-ashore/.

[33] Source: [Statement of] Vice Admiral Jon A. Hill, USN, Director, Missile Defense Agency, Before the Senate Armed Services Committee, Strategic Forces Subcommittee, May 18, 2022, p. 8. Earlier reporting said construction of the Poland site would be complete by the end of 2022. See, for example, Rich Abott, "Aegis Ashore Poland Set To Be Operational By End Of 2022," *Defense Daily*, November 22, 2021; Jen Judson, "Construction of Aegis Ashore in Poland Nearing Completion," *Defense News*, March 9, 2022. See also Daniel Wasserbly, "US MDA Plans to Turn On Polish Aegis Ashore Site in June, After Years of Delay," *Jane's Defence Weekly*, May 24, 2022.

[34] [Statement of] Rear Admiral Douglas L. Williams, USN, Director (Acting), Missile Defense Agency, Before the House Armed Services Committee, Strategic Forces Subcommittee, December 7, 2023, [on] Demand for Theater Missile Defense Assets, pp. 3-4. See also Jason Sherman, "After 'Grossly Unacceptable Delay,' Aegis Ashore Poland Set for Navy Inventory, Maintenance," *Inside Defense*, December 7, 2023; Joseph Trevithick, "Aegis Missile Defense Site In Poland To Finally Go Operational (Updated)," *The Drive*, December 7, 2023.

[35] John Vandiver, "US Navy Missile Defense Site in Poland Is Mission-Ready, NATO Says," *Stars and Stripes*, July 11, 2024.

[36] Jaroslaw Adamowski, "NATO Activates Poland Antimissile Site, as Warsaw Ups Ammo Production," *Defense News*, November 20, 2024.

> To remain ahead of our competitors, we will divest ourselves of legacy capabilities that no longer bring sufficient lethality to the fight. This includes divestment of experimental Littoral Combat Ship hulls, legacy Cruisers, and older Dock Landing Ships. It also includes divesting non-core Navy missions like Aegis-ashore. Transferring shore-based Ballistic Missile Defense sites to ground forces enables Sailors to focus on their core missions at sea and frees up resources to increase our lethality.[37]

A January 12, 2021, press report states

> The chief of naval operation's new call to focus on sea control and power projection could lead the service to shed other non-core missions the Navy conducts today, such as manning Aegis Ashore missile defense sites.
>
> The biggest problem is, no one else has agreed to take over that mission yet….
>
> … no one else operates Aegis systems today, and no one has yet agreed to take over Aegis Ashore, Rear Adm. Paul Schlise, the director of surface warfare on the CNO's staff (OPNAV N96), said today during a panel presentation at the Surface Navy Association's annual symposium.
>
> "It's been an ongoing discussion in the building here. Right now we've got the Aegis Ashore sites in Europe, and there's discussions about potentially more sites in other places. The general discussion has been, this is not a core Navy mission. Sailors really belong at sea serving in ships. And we've got a good number of highly qualified folks serving in those sites, they're going a great job," he said.
>
> "But I think what the CNO teed up is, is this a core Navy mission? I don't think it is. And so there's been some discussion with the Army. The Army, of course, has some missile defense capability and of course great soldiers that serve in those roles. But they don't have any experience with that [Aegis Combat System], the systems that have been installed or are in progress in Romania and Poland. So that's been a running discussion."
>
> Schlise said the discussion is taking place at the Office of the Secretary of Defense level. Without any final decisions, though, the Navy could not shed Aegis Ashore spending in its most recent budgeting work, the Fiscal Year 2022 request that will come out after the Biden administration comes in and can review it.
>
> "For the purposes of this past budget cycle, it was just kind of tabled. So we'll have to see where that discussion goes. As always, here in the building, it's about money. So if that transition were to be considered and approved for moving forward, to transition it to another service, 'who's going to pay' will of course be part of the discussion," Schlise said.[38]

Japan Planned and Later Canceled Two Sites

Prior to June 2020, Japan had planned to procure and operate two Aegis Ashore systems.[39] The two systems reportedly were to have been equipped with a new Lockheed-made radar called the Long Range Discrimination Radar (LRDR) rather than the Raytheon-made SPY-6 AMDR that is being installed on U.S. Navy Flight III DDG-51s, and reportedly were to go into operation by 2023.[40] On June 15, 2020, however, Japan announced that it had suspended implementation of its

[37] U.S. Navy, Chief of Naval Operations, *CNO NavPlan*, January 2021, p. 10. See also Richard R. Burgess, "CNO: Divest Aegis Ashore Sites to Ground Forces," *Seapower*, January 11, 2021.

[38] Megan Eckstein, "Navy Wants to Shed Aegis Ashore Mission, But Army Still Hasn't Agreed to Take It," *USNI News*, January 12, 2021.

[39] Yomiuri Shimbun, "Akita, Yamaguchi to Get Aegis Ashore/GSDF Involvement Expected to Strengthen Missile Defense," *The Japan News*, November 11, 2017. See also Kyodo, "Japan Mulling News Missile Interceptor Deployment to Guard Against North Korea," *South China Morning Post*, November 11, 2017.

[40] Anthony Capaccio, "Japan in Talks With U.S. on Buying Aegis Missile Defense," *Bloomberg*, November 7, 2017.

Aegis Ashore initiative due to cost growth and technical concerns.[41] On June 25, 2020, Japan confirmed that it had canceled the plan for deploying the two Aegis Ashore sites. Rather than building the two Aegis Ashore systems, Japan is instead building two additional BMD-capable Aegis ships.[42] The two ships reportedly are scheduled to enter service in March 2028 and March 2029.[43] A June 23, 2023, press report stated that once the two additional BMD-capable Aegis ships go into service, Japan's other eight BMD-capable destroyers will revert to anti-air-warfare (AAW) operations.[44]

Use of Aegis BMD Elements in Guam Missile Defense System

After studying various possible BMD system architectures for Guam, DOD proposed a system combining elements of the Aegis BMD system with elements of Army BMD systems. A March 30, 2022, press report states

> The Missile Defense Agency's initial plan for the architecture to protect Guam turns to proven systems to help the agency meet a 2026 fielding deadline, according Vice Adm. Jon Hill, the agency's director.
>
> The defense of Guam from potential ballistic, cruise and hypersonic missile attacks has become a priority for the MDA, which is seeking $539 million in fiscal 2023 to continue to design and develop multiple-land based radar systems, procure weapon system components and initiate military construction planning and design activity.
>
> "Current forces are capable of defending Guam against today's North Korean ballistic missile threats," Dee Dee Martinez, the MDA's comptroller said in a March 28 Pentagon budget briefing. "However, the regional threat to Guam, including from China, continues to rapidly evolve."...
>
> The architecture will not be a fixed missile defense site like Aegis Ashore in Romania and Poland, Hill said. "Think of it as a distributed system." He added that the agency is interested in using mobile launchers.
>
> The architecture will include Navy SM-3 and SM-6 missiles, the Patriot air-and-missile defense system and the Army's Terminal High Altitude Area Defense System (THAAD). A THAAD battery has been operating on Guam since 2013.
>
> Those elements will be connected through the Army's Integrated Battle Command System, a command-and control-system that connects sensors and shooters on the battlefield. The agency will also use the Aegis weapon system's fire control capability, Hill said.

[41] See, for example, Rich Abott, "Japan Suspends Aegis Ashore Due To Technical And Cost Concerns," *Defense Daily*, June 15, 2020; Sam LaGrone, "Japan Backing Away From Aegis Ashore," *USNI News*, June 15, 2020; Mari Yamaguchi, "Japan to Scrap Costly Land-Based US Missile Defense System," *Associated Press*, June 15, 2020; Mike Yeo, "Japan Suspends Aegis Ashore Deployment, Pointing to Cost and Technical Issues," *Defense News*, June 15, 2020; Brad Glosserman, "Canceling Aegis Ashore Raises Problems—and Hopes," *Japan Times*, June 17, 2020.

Prior to the June 15, 2020, announcement, Japan had announced in early May that it would evaluate alternatives to the Akita Prefecture site due to strong local opposition to that site. (Masaya Kato, "Japan's Missile Shield Deployment Scuppered by Local Resistance," *Nikkei Asian Review*, May 7, 2020.)

[42] See, for example, Dzirhan Mahadzir, "Japan Locks in Funding for 2 New Aegis Destroyers," *USNI News*, December 20, 2023; Thomas Newdick, "Japan's Missile Defense Ships Will Now Be Multi-Role, Cruiser-Like," *The Drive*, August 31, 2023; Yoshihiro Inaba, "Japan's New ASEV Ships Will Boast An Impressive 128 VLS Cells," *Naval News*, June 3, 2023.

[43] Megan Eckstein, "SPY-7 Radar Tracks Live Space Objects Ahead of Delivery to Japan," *Defense News*, April 12, 2024.

[44] Ridzwan Rahmat, "Japan to Revert Aegis Destroyers for Air-Defence Roles Once BMD Ships Come Online," *Janes Defence Weekly*, June 23, 2023.

> "Patriot [has] a fabulous capability for cruise missile defense, and that's our first focus area," Hill said. "And we have the ability within Aegis to enable that, but, right now, we are doing ballistic missiles, hypersonic, on the Aegis part of that overall integrated architecture and then the cruise missile piece will be with the Army systems."
>
> While MDA is focused on using existing technology to make up the architecture, it will consider new technology, including the Mid-Range Capability missile the Army will field in FY23, as it becomes available, according to Hill....
>
> "That topology of the island … it is a tough place," Hill said. "An Aegis Ashore site is limited in what it can do because of the the rise and the fall of the hills, you got radar, it's not a flat earth, and it's certainly not flat on Guam, so we've done some really incredible work and analysis over the last couple years ... by dispersing the systems and making sure everything's networked."[45]

Aegis BMD Development Philosophy and Flight Tests

The Aegis BMD development effort, including Aegis BMD flight tests, has been 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, with each step being tested and validated before moving on to the next step.[46] For a summary of reported Aegis BMD flight tests since 2002, see **Table A-1** in the **Appendix**.

Allied Participation and Interest in Aegis BMD Program

Japan

Eight BMD-Capable Aegis Destroyers

Japan operates eight BMD-capable Aegis destroyers—the eighth was commissioned into service in March 2021.[47] As mentioned above, rather than building two Aegis Ashore systems, Japan is building two additional BMD-capable Aegis ships that are scheduled to enter service in March 2028 and March 2029, at which point Japan's other eight BMD-capable destroyers reportedly will revert to anti-air-warfare (AAW) operations. Japanese BMD-capable Aegis ships have participated in some of the flight tests of the Aegis BMD system using the SM-3 interceptor (see **Table A-1** in **Appendix**).

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[45] Jen Judson, "MDA's Plan to Protect Guam Relies on Field-Proven Systems," *Defense News*, March 30, 2022. See also Thomas Newdick and Tyler Rogoway, "Our First Look At Land-Based Aegis Missile Defense System In Guam," *The War Zone*, October 21, 2024; Robert Peters, *The Plan to Defend Guam from Missile Threats Is Years from Completion: More Investment Is Needed Now*, Heritage Foundation, January 9, 2024, 7 pp.; Jason Sherman, "OMB Reveals Land-Based VLS Also Part of New Guam Missile Defense Architecture," *Inside Defense*, July 13, 2022; Rich Abott, "MDA Decides On Guam Defense Architecture," *Defense Daily*, March 29, 2022; Jason Sherman, "DOD Picks SPY-7 for Land-Based Aegis, Giving Lockheed First U.S. Customer for New Radar," *Inside Defense*, May 6, 2022.

[46] See, for example, "Aegis BMD: "Build a Little, Test a Little, Learn a Lot," USNI blog, March 15, 2010, accessed May 18, 2022, 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 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 May 18, 2022, at https://web.archive.org/web/20100706133017/https:/www.marshall.org/pdf/materials/743.pdf.

[47] See, for example, Xavier Vavasseur, "Japan Commissions New Maya-Class AEGIS Destroyer JS Haguro はぐろ DDG-180," *Naval News*, March 19, 2021; Yomiuri Shimbun, "Japan Commissions 8th Aegis Destroyer Haguro," *Japan News*, March 20, 2021.

Cooperative Development of SM-3 Block IIA Missile

As mentioned earlier, Japan cooperated with the United States on development the SM-3 Block IIA missile. Japan developed certain technologies for the missile, and paid for the development of those technologies, reducing the missile's development costs for the United States. A July 6, 2018, press report states that "the U.S. and Japan are looking to jointly develop next-generation radar technology that would use Japanese semiconductors to more than double the detection range of the Aegis missile defense system."[48]

South Korea

An October 12, 2018, press report states that "the South Korean military has decided to buy ship-based SM-3 interceptors to thwart potential ballistic missile attacks from North Korea, a top commander of the Joint Chiefs of Staff revealed Oct. 12."[49] An October 16, 2023, press report states that South Korea's newest Aegis destroyer will be BMD-capable.[50]

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, and Australia. 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.

FY2025-FY2029 MDA Procurement and R&D Funding

The Aegis BMD program is funded mostly through MDA's budget. The Navy's budget provides additional funding for Aegis BMD-related efforts. **Table 1** shows requested (FY2025) and projected (FY2026-FY2029) MDA procurement and research and development funding for Aegis BMD efforts under MDA's FY2025 budget submission.

[48] Nikkei staff writers, "US Taps Japan Radar Tech to Double Missile Defense Range," *Nikkei Asian Review*, July 6, 2018.

[49] Jeff Jeong, "South Korea to Buy Ship-Based Interceptors to Counter Ballistic Missile Threats," *Defense News*, October 12, 2018.

[50] YoungHak Lee, "South Korea's First KDX III Batch II Aegis Destroyer Started Sea Trials," *Naval News*, October 16, 2023.

Table 1. FY2025-FY2029 MDA Procurement and R&D Funding for Aegis BMD Efforts

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

	FY25 (req.)	FY26 (proj.)	FY27 (proj.)	FY28 (proj.)	FY29 (proj.)
Procurement					
Aegis BMD (line 29)	85.0	0	0	0	0
(SM-3 Block IB missile quantity)	*(0)*	*(0)*	*(0)*	*(0)*	*(0)*
SM-3 Block IIA (line 31)	406.4	382.7	386.9	450.0	434.0
(SM-3 Block IIA missile quantity)	*(12)*	*(12)*	*(12)*	*(12)*	*(12)*
Aegis BMD hardware and software (line 37)	32.0	27.9	25.4	13.9	11.9
SUBTOTAL Procurement	**523.4**	**410.6**	**412.3**	**463.9**	**445.9**
Research and development					
Aegis BMD (PE 0603892C) (line 84)	649.3	602.8	539.8	649.6	714.4
Aegis BMD Test (PE 0604878C) (line 118)	135.0	169.7	143.3	154.4	168.7
Land-based SM-3 (PE 0604880C) (line 120)	22.2	22.5	22.9	23.0	23.5
SUBTOTAL RDT&E	**806.5**	**795.0**	**706.0**	**827.0**	**906.6**
TOTAL	**1,329.9**	**1,205.6**	**1,118.3**	**1,290.9**	**1,352.5**

Source: Table prepared by CRS based on FY2025 MDA budget submission.

Research and development funding in the table for the land-based SM-3 is funding for Aegis Ashore sites. MDA's budget also includes additional funding not shown in the table for operations and maintenance (O&M) and military construction (MilCon) for the Aegis BMD program.

Issues for Congress

Annual Funding Request

One issue for Congress is whether to approve, reject, or modify MDA's annual procurement and research and development funding requests for the program. In considering this issue, Congress may consider various factors, including whether the work that MDA is proposing to fund for the fiscal year in question is properly scoped and scheduled, and accurately priced.

Estimating and Reporting Costs

Another issue for Congress concerns the adequacy of MDA's cost estimating and its reporting of costs. A February 2022 GAO report on MDA's cost estimating and reporting of costs for missile defense programs, including the Aegis BMD program, states

> The Department of Defense's (DOD) Missile Defense Agency (MDA) is continuing efforts to deliver systems to the warfighter that will protect against enemy missiles. However, shortfalls persist with MDA's program and flight test cost estimates and reporting.
>
> **Program cost estimates.** MDA continues to omit the military services' operations and sustainment costs from the program life-cycle cost estimates.... By omitting these costs, MDA limits decision-makers' insight into the full financial commitments needed for affordability and funding determinations....
>
> *Flight test cost estimates.* Accuracy issues linger with MDA's flight test cost estimates that could skew the agency's annual $1.3 billion [flight test] funding request, such as not being

> regularly updated with actual costs. However, MDA is taking steps to improve these cost estimates by using a new cost model, among other things....
>
> **Program cost reporting.** MDA continues to adjust program baselines without clear traceability over time. MDA also forgoes recurrent comparisons to the original baseline. Such adjustments and omissions impede decision-makers' awareness of each program's cost performance and total system cost....
>
> **Flight test cost reporting.** Congress required MDA to report on flight test costs, but we found the information lacking due to the agency's reporting methodology. MDA only accounted for about $1.3 billion of at least $3.5 billion in funding the agency requested for flight testing between March 2017 and September 2020. Moreover, the reporting requirement ended in December 2021. Without further reporting on complete flight test costs, Congress does not have information needed to facilitate holding the agency accountable for its spending.[51]

Potential for Intercepting ICBMs

Another issue for Congress is what role the Aegis BMD program should play in defending the U.S. homeland against attack from ICBMs. With the advent of the SM-3 Block IIA interceptor, DOD is evaluating the potential for the Aegis BMD system to intercept certain ICBMs. Section 1680 of the FY2018 National Defense Authorization Act (H.R. 2810/P.L. 115-91 of December 12, 2017) directed DOD to "conduct a test to evaluate and demonstrate, if technologically feasible, the capability to defeat a simple intercontinental ballistic missile threat using the standard missile 3 block IIA missile interceptor." DOD's January 2019 missile defense review report stated the following:

> The SM-3 Blk IIA interceptor is intended as part of the regional missile defense architecture, but also has the potential to provide an important "underlay" to existing GBIs [ground-based interceptors] for added protection against ICBM threats to the homeland. This interceptor has the potential to offer an additional defensive capability to ease the burden on the GBI system and provide continuing protection for the U.S. homeland against evolving rogue states' long-range missile capabilities.
>
> Congress has directed DoD to examine the feasibility of the SM-3 Blk IIA against an ICBM-class target. MDA will test this SM-3 Blk IIA capability in 2020. Due to the mobility of sea-based assets, this new underlay capability will be surged in a crisis or conflict to further thicken defensive capabilities for the U.S. homeland. Land-based sites in the United States with this SM-3 Blk IIA missile could also be pursued.[52]

On November 16, 2020, MDA announced that the congressionally directed ICBM-intercept flight test, called FTM-44, had been conducted on that date and had resulted in a successful intercept of the ICBM-representative target. MDA stated that "FTM-44, originally scheduled for May 2020, was delayed due to restrictions in personnel and equipment movement intended to reduce the spread of COVID-19. FTM-44 satisfies a Congressional mandate to evaluate the feasibility of the SM-3 Block IIA missile's capability to defeat an ICBM threat before the end of 2020."[53] A November 17, 2020, press report about the flight test stated that "the unarmed ICBM was a replica of a target flown against the Ground-based Midcourse Defense system during a March

[51] Government Accountability Office, *Missile Defense[:] Addressing Cost Estimating and Reporting Shortfalls Could Improve Insight into Full Costs of Programs and Flight Tests*, GAO-22-104344, February 2022, highlights page (PDF page 2 of 58).

[52] Department of Defense, *Missile Defense Review 20*19, released January 17, 2019, p. 55. David Axe, "The U.S. Navy's New Missile Defense Is a Bad Idea," *National Interest*, January 17, 2019.

[53] Missile Defense Agency News release 20NEWS-0003, "U.S. Successfully Conducts SM-3 Block IIA Intercept Test Against an Intercontinental Ballistic Missile Target," November 16, 2020.

2019 flight test that featured a salvo launch of a pair of interceptors."[54] An April 2021 GAO report on deliveries and testing of U.S. missile defense systems in FY2020 stated the following:

> MDA's effort to include the SM-3 Block IIA interceptor in a new "layered" homeland defense against intercontinental ballistic missile (ICBM) threats targeting the U.S. could introduce considerable cost, schedule, and performance uncertainty to a program that has just entered initial production. The GMD weapon system currently provides defense against ICBMs, but this new effort would add the SM-3 Block IIA and THAAD weapon system as layers underneath that provided by GMD. For further details on the GMD and THAAD weapon systems see their respective appendixes.
>
> ICBM intercepts are more challenging than the IRBM intercepts for which the SM-3 IIA was originally designed. MDA's most recent attempt to create a system for intercepting ICBMs, known as the Redesigned Kill Vehicle (RKV), re-used some parts from the SM-3 Block IIA. DOD cancelled the RKV before it could complete development after significant cost and schedule overruns and questions about the ability of the design to overcome specific performance risks. Parts re-used from the SM-3 Block IIA were implicated in some of the RKV's performance shortfalls. Even so, planning for an anti-ICBM capability for the SM-3 Block IIA continued during and even after the RKV's termination.
>
> Achieving such a capability will require surmounting several challenges. According to MDA, during the November 2020 flight test named FTM-44, the SM-3 Block IIA struck a simple ICBM target. This was not an operational test, however, and it was executed under highly favorable conditions. More development work is needed for the SM-3 Block IIA to support a layered homeland defense capability. MDA documents show that the agency now plans to develop and procure an upgraded version of the SM-3 Block IIA for the specific purpose of fulfilling the homeland defense mission.[55]

A May 13, 2021, press report stated

> The Missile Defense Agency proved that a Navy destroyer with a Standard Missile-3 Block IIA can stop a simple intercontinental ballistic missile threat, but more work remains to prove whether this combination could contribute to homeland defense, the MDA director said Wednesday [May 12].
>
> Vice Adm. Jon Hill described the Flight Test Aegis Weapon System (FTM) 44, which took place in the Pacific in November after pandemic-related delays earlier in the year: A simple ICBM target was launched from the Army's Ronald Reagan Ballistic Missile Defense Test Site on the Kwajalein Atoll in the Marshall Islands. Satellites detected the launch, and a slew of satellites and sensors, including on the Pacific Missile Range Facility in Hawaii, tracked the target. Arleigh Burke-class destroyer USS John Finn (DDG-113), positioned hundreds of miles east of Hawaii, launched an SM-3 Block IIA missile from its deck based on its best fire control solution at the time, and the missile itself maneuvered to successfully hit the target as it received more information in flight.
>
> The goal of the test, Hill said while speaking at the annual McAleese FY 2022 Defense Programs Conference, was "to prove that we have the ability to leverage the robustness in the [Aegis] program, so that was really the first test just to see if it's feasible. And we learned a lot."
>
> Hill said the crew of John Finn, with limited data due to limited sensor coverage across the vast Pacific, maneuvered the ship to get the highest probability of kill.

[54] Jason Sherman, "SM-3 Block IIA Intercepts ICBM Target, Validating Potential for Homeland Defense 'Underlayer,'" *Inside Defense*, November 17, 2020.

[55] Government Accountability Office, *Missile Defense[:] Fiscal Year 2020 Delivery and Testing Progressed, but Annual Goals Unmet*, GAO-21-314, April 2021, p. 24. See also Jen Judson, "Watchdog Expresses Concern over Using US Navy Interceptor for Homeland Missile Defense," *Defense News*, April 29, 2021.

"It maneuvered, shot the missile; lots of uncertainty because of lack of sensor coverage for such a long-range flight where we were doing the exercise. So what we actually saw was a really high divert [from the missile]. So kind of two walkaways from that first test, which is why I think it was really important, was that it was the longest propagated error or uncertainty that we've ever seen in any test. And then we had the highest divert—that meant the [SM-3 IIA] missile was maneuvering to actually take it out, and it still took it out, which is really great," Hill continued.

"In terms of feasibility, did we accomplish the mission? Absolutely. Every test objective achieved in November."

Hill was asked about an April Government Accountability Office report that cited concerns about the Aegis Combat System/SM-3 IIA pairing for the homeland defense mission—as opposed to the regional defense mission it was built for, to protect a high-value asset such as an aircraft carrier from an intermediate-range missile—and whether the simple ICBM target used in the November test was representative of the real world.

"So what's next? What's next is to go against a more complex intercontinental ballistic missile threat, and maybe even change the scenario. This scenario was a defense of Hawaii scenario against a rogue nation—you guess which one out there in the Pacific—and in the future we're going to go to a more complex [threat], and that's within the next couple years," he said.

"So we're still analyzing data from November, and then we're going to make upgrades and changes to the combat system, and we'll make changes to the missile in terms of threat set to take on a higher end class threat."

MDA and the military services would have to further integrate systems together to make this a credible layer in the homeland defense network, Hill said. During the November test, the MDA commanded and controlled the event from the Missile Defense Interoperability and Operations Center in Colorado Springs, Colo., using the Command and Control Battle Management and Communication System (C2BMC) to receive satellite and sensor data and feed it to John Finn, which fired its missile on remote without having access to the sensor data itself. While that worked in a controlled environment, for a permanent homeland defense mission the ship would need to be better integrated into U.S. Northern Command's network to fully share information and targeting data.

Hill said that Aegis has been integrated to operate with the Terminal High Altitude Area Defense system, and THAAD has been integrated with the Patriot missile defense system, but MDA hasn't integrated all the regional defense systems with homeland defense systems.

Beyond the actual integration and engineering work, Hill added that there was a policy question to answer, too.

"Do we want ships in that role of being off the West Coast … defending against ICBMs as a layer to the Ground-Based Mid-Course Defense? That's an incredible conversation, we're having that now, and it's hard to predict where it will go."

Asked on Thursday during the Naval Postgraduate School's acquisition research symposium if the Navy has the capacity and appetite to use destroyers for homeland defense, Hill said much of it comes down to what ships are available for the mission.

"I think if you asked Gen. [Glen] VanHerck from NORTHCOM about his confidence in defending the nation today, the answer would be confident. But as the threat evolves, right, you start to see a little change in that view. And so it's been viewed for a while that the Navy can play a role in that area, but it becomes an asset problem," Hill said. "There are

> only so many ships we have up there. And they're multi-mission ships, and they have a lot of roles around the globe to execute."[56]

A June 22, 2021, press report stated

> The Pentagon's No. 2 official has ordered 11 missile interceptors transferred from research and development for possible deployment on Navy ships in the Pacific or European regions after a test in November indicated they could stop an intercontinental ballistic missile.
>
> In the test, the USS John Finn intercepted a mock ICBM intended to simulate one that could be launched at Hawaii by North Korea. The destroyer, operating near Hawaii, fired off one of the Standard Missile-3 model Block IIA interceptors built by Raytheon Technologies Corp. at the target launched from Kwajalein Atoll in the Marshall Islands.
>
> Deputy Defense Secretary Kathleen Hicks informed Congress May 27 of her rationale for transferring the interceptors, although she didn't disclose it publicly.
>
> "The missiles have conducted successful intercept tests and their deployment is in the important interest of our national security," Hicks spokesman Jamal Brown said in an email this month. The transfer to the Navy marks the first major missile defense initiative of the Biden administration.
>
> Although the Navy's Aegis combat system, which launched the missile, and the interceptor "were not designed to defeat an ICBM-class target, this test demonstrated some potential limited capability," Vice Admiral Jon Hill, director of the Missile Defense Agency, said in testimony to Congress last week.[57]

Required vs. Available Numbers of BMD-Capable Aegis Ships

Another potential issue for Congress concerns required versus available numbers of BMD-capable Aegis ships. Some observers have expressed concern about the potential operational implications of a shortfall in the available number of BMD-capable relative to the required number. Regarding the required number of BMD-capable Aegis ships, an August 15, 2018, Navy information paper states the following:

> The [Navy's] 2016 Force Structure Assessment [FSA][58] sets the requirement [for BMD-capable ships] at 54 BMD-capable ships, as part of the 104 large surface combatant requirement, to meet Navy unique requirements to support defense of the sea base and limited expeditionary land base sites….
>
> The minimum requirement for 54 BMD ships is based on the Navy unique requirement as follows. It accepts risk in the sourcing of combatant commander (CCDR) requests for defense of land.
>
> - 30 to meet CVN escort demand for rotational deployment of the carrier strike groups
>
> - 11 INCONUS for independent BMD deployment demand
>
> - 9 in forward deployed naval forces (FDNF) Japan to meet operational timelines in USINDOPACOM

[56] Megan Eckstein, "MDA: Test of DDG, Standard Missile-3 IIA a Good Start, But More Work Needed on Homeland Defense Mission," *USNI News*, May 13, 2021. See also Jason Sherman, "MDA Planning Second SM-3 Block IIA Flight Test Against ICBM Target; New Development and Upgraded Interceptor Needed," *Inside Defense*, May 12, 2021; Rich Abott, "MDA Planning Second Test of SM-3 IIA Against ICBM Target," *Defense Daily*, May 17, 2021.

[57] Anthony Capaccio, "U.S. Navy Ships Close to Getting Interceptors That Could Stop an ICBM," *Bloomberg*, June 22, 2021.

[58] The FSA is the Navy's analysis, performed every few years, that establishes the Navy's ship force structure requirements. For further discussion, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

- 4 in FDNF Europe for rotational deployment in EUCOM.[59]

Burden of BMD Mission on U.S. Navy Aegis Ships

A related potential issue for Congress is the burden that BMD operations may be placing on the Navy's fleet of Aegis ships, particularly since performing BMD patrols requires those ships to operate in geographic locations that may be unsuitable for performing other U.S. Navy missions, and whether there are alternative ways to perform BMD missions now performed by U.S. Navy Aegis ships, such as establishing more Aegis Ashore sites. A June 16, 2018, press report states the following:

> The U.S. Navy's top officer wants to end standing ballistic missile defense patrols and transfer the mission to shore-based assets.
>
> Chief of Naval Operations Adm. John Richardson said in no uncertain terms on June 12 that he wants the Navy off the tether of ballistic missile defense patrols, a mission that has put a growing strain on the Navy's hard-worn surface combatants, and the duty shifted towards more shore-based infrastructure.
>
> "Right now, as we speak, I have six multi-mission, very sophisticated, dynamic cruisers and destroyers—six of them are on ballistic missile defense duty at sea," Richardson said during his address at the U.S. Naval War College's Current Strategy Forum. "And if you know a little bit about this business you know that geometry is a tyrant.
>
> "You have to be in a tiny little box to have a chance at intercepting that incoming missile. So, we have six ships that could go anywhere in the world, at flank speed, in a tiny little box, defending land."
>
> Richardson continued, saying the Navy could be used in emergencies but that in the long term the problem demands a different solution.
>
> "It's a pretty good capability and if there is an emergent need to provide ballistic missile defense, we're there," he said. "But 10 years down the road, it's time to build something on land to defend the land. Whether that's AEGIS ashore or whatever, I want to get out of the long-term missile defense business and move to dynamic missile defense."
>
> The unusually direct comments from the CNO come amid growing frustration among the surface warfare community that the mission, which requires ships to stay in a steaming box doing figure-eights for weeks on end, is eating up assets and operational availability that could be better used confronting growing high-end threats from China and Russia.
>
> The BMD mission was also a factor in degraded readiness in the surface fleet. Amid the nuclear threat from North Korea, the BMD mission began eating more and more of the readiness generated in the Japan-based U.S. 7th Fleet, which created a pressurized situation that caused leaders in the Pacific to cut corners and sacrifice training time for their crews, an environment described in the Navy's comprehensive review into the two collisions that claimed the lives of 17 sailors in the disastrous summer of 2017.
>
> Richardson said that as potential enemies double down on anti-access technologies designed to keep the U.S. Navy at bay, the Navy needed to focus on missile defense for its own assets.

[59] Navy information paper dated August 15, 2018, entitled "Ballistic Missile Defense (BMD) Capable Ships requirement," provided by Navy Office of Legislative Affairs to CBO and CRS on August 15, 2018. The information paper was requested by CBO.

> "We're going to need missile defense at sea as we kind of fight our way now into the battle spaces we need to get into," he said. "And so restoring dynamic maneuver has something to do with missile defense.[60]

A June 23, 2018, press report states the following:

> The threats from a resurgent Russia and rising China—which is cranking out ships like it's preparing for war—have put enormous pressure on the now-aging [U.S. Navy Aegis destroyer] fleet. Standing requirements for BMD patrols have put increasing strain on the U.S. Navy's surface ships.
>
> The Navy now stands at a crossroads. BMD, while a burden, has also been a cash cow that has pushed the capabilities of the fleet exponentially forward over the past decade. The game-changing SPY-6 air and missile defense radar destined for DDG Flight III, for example, is a direct response to the need for more advanced BMD shooters. But a smaller fleet, needed for everything from anti-submarine patrols to freedom-of-navigation missions in the South China Sea, routinely has a large chunk tethered to BMD missions.
>
> "Right now, as we speak, I have six multimission, very sophisticated, dynamic cruisers and destroyers—six of them are on ballistic missile defense duty at sea," Chief of Naval Operations Adm. John Richardson said during an address at the recent U.S. Naval War College's Current Strategy Forum. "You have to be in a tiny little box to have a chance at intercepting that incoming missile. So we have six ships that could go anywhere in the world, at flank speed, in a tiny little box, defending land."
>
> And for every six ships the Navy has deployed in a standing mission, it means 18 ships are in various stages of the deployment cycle preparing to relieve them.
>
> The Pentagon, led by Defense Secretary Jim Mattis, wants the Navy to be more flexible and less predictable—"dynamic" is the buzzword of moment in Navy circles. What Richardson is proposing is moving standing requirements for BMD patrols away from ships underway and all the associated costs that incurs, and toward fixed, shore-based sites, and also surging the Navy's at-sea BMD capabilities when there is an active threat....
>
> In a follow-up response to questions posed on the CNO's comments, Navy spokesman Cmdr. William Speaks said the Navy's position is that BMD is an integral part of the service's mission, but where long-term threats exist, the Navy should "consider a more persistent, land-based solution as an option."
>
> "This idea is not about the nation's or the Navy's commitment to BMD for the U.S. and our allies and partners—the Navy's commitment to ballistic missile defense is rock-solid," Speaks said. "In fact, the Navy will grow the number of BMD-capable ships from 38 to 60 by 2023, in response to the growing demand for this capability.
>
> "The idea is about how to best meet that commitment. In alignment with our national strategic documents, we have shifted our focus in an era of great power competition—this calls us to think innovatively about how best to meet the demands of this mission and optimize the power of the joint force."...
>
> While the idea of saving money by having fixed BMD sites and freeing up multimission ships is sensible, it may have unintended consequences, said Bryan McGrath, a retired destroyer skipper and owner of the defense consultancy The FerryBridge Group.
>
> "The BMD mission is part of what creates the force structure requirement for large surface combatants," McGrath said on Twitter after Defense News reported the CNO's comments. "Absent it, the number of CG's and DDG's would necessarily decline. This may in fact be desirable, depending on the emerging fleet architecture and the roles and missions debate

[60] David B. Larter, "The US Navy Is Fed Up with Ballistic Missile Defense Patrols," *Defense News*, June 16, 2018. See also Paul McLeary, "Will Budget Crunch Pentagon Laser & Space Investments?" *Breaking Defense*, November 13, 2018.

> underway. Perhaps we need more smaller, multi-mission ships than larger, more expensive ones.
>
> "But it cannot be forgotten that while the mission is somewhat wasteful of a capable, multi-mission ship, the fact that we have built the ships that (among other things) do this mission is an incredibly good thing. If there is a penalty to be paid in peacetime sub-optimization in order to have wartime capacity—should this not be considered a positive thing?"
>
> McGrath went on to say that the suite of combat systems that have been built into Aegis have been in response to the BMD threat. And indeed, the crown jewels of the surface fleet—Aegis Baseline 9 software, which allows a ship to do both air defense and BMD simultaneously; the Aegis common-source library; the forthcoming SPY-6; cooperative engagement—have come about either in part or entirely driven by the BMD mission....
>
> A Navy official who spoke on condition of anonymity, to discuss the Navy's shifting language on BMD, acknowledged the tone had shifted since the 2000s when the Navy latched onto the mission. But the official added that the situation more than a decade later has dramatically shifted.
>
> "The strategic environment has changed significantly since the early 2000s—particularly in the western Pacific. We have never before faced multiple peer rivals in a world as interconnected and interdependent as we do today," the official said. "Nor have we ever seen technologies that could alter the character of war as dramatically as those we see emerging around us. China and Russia have observed our way of war and are on the move to reshape the environment to their favor."
>
> In response to the threat and Defense Secretary Jim Mattis' desire to use the force more dynamically, the Navy is looking at its options, the official said. "This includes taking a look at how we employ BMD ships through the lens of great power competition to compete, deter and win against those who threaten us."[61]

A January 29, 2019, press report states the following:

> The Navy is looking to get out of the missile defense business, the service's top admiral said today, and the Pentagon's new missile defense review might give the service the off-ramp it has been looking for to stop sailing in circles waiting for ground-based missile launches.
>
> This wasn't the first time Adm. John Richardson bristled in public over his ships sailing in "small boxes" at sea tasked with protecting land, when they could be out performing other missions challenging Chinese and Russian adventurism in the South China Sea and the North Atlantic….
>
> "We've got exquisite capability, but we've had ships protecting some pretty static assets on land for a decade," Richardson said at the Brookings Institute. "If that [stationary] asset is going to be a long-term protected asset, then let's build something on land and protect that and liberate these ships from this mission."
>
> Japan is already moving down the path of building up a more robust ground-based sensor and shooter layer, while also getting its own ships out to sea armed with the Aegis radar and missile defense system, both of which would free up American hulls from what Richardson on Monday called "the small [geographic] boxes where they have to stay for ballistic missile defense."[62]

[61] David B. Larter, "As Threats Mount, US Navy Grapples with Costly Ballistic Missile Defense Mission," *Defense News*, June 23, 2018.

[62] Paul McLeary, "The Navy Has Had Enough of Missile Defense And Sees Its Chance," *Breaking Defense*, January 28, 2019.

Allied Burden Sharing: U.S. vs. Allied Contributions to Regional BMD Capabilities

Another related potential issue for Congress concerns allied burden sharing—how allied contributions to regional BMD capabilities and operations compare to U.S. naval contributions to overseas regional BMD capabilities and operations, particularly in light of constraints on U.S. defense spending, worldwide operational demands for U.S. Navy Aegis ships, and calls by some U.S. observers for increased allied defense efforts. The issue can arise in connection with both U.S. allies in Europe and U.S. allies in Asia. Regarding U.S. allies in Asia, a December 12, 2018, press report states the following:

> In June, US Navy Chief of Naval Operations (CNO) Admiral John Richardson said during a speech at the US Naval War College that the US Navy should terminate its current practice of dedicating several US Navy warships solely for Ballistic Missile Defense (BMD).
>
> Richardson wanted US warships to halt BMD patrols off Japan and Europe as they are limiting, restrictive missions that could be better accomplished by existing land-based BMD systems such as Patriot anti-missile batteries, the US Terminal High Altitude Area Defense (THAAD) anti-missile system and the Aegis Ashore anti-missile system.
>
> In the months since dropping his bombshell, Richardson—and much of the debate—has gone quiet.
>
> "My guess is the CNO got snapped back by the Pentagon for exceeding where the debate actually stood," one expert on US naval affairs told Asia Times.
>
> But others agree with him. Air Force Lt Gen Samuel A Greaves, the director of the US Missile Defense Agency (MDA), acknowledges Richardson's attempts to highlight how these BMD patrols were placing unwelcome "strain on the (US Navy's) crews and equipment."
>
> But there are complications. While it may free US Navy warships for sea-control, rather than land defense, there is a concern that next- generation hypersonic cruise missiles could defeat land-based BMD systems, such as Aegis Ashore, while the US Navy's Aegis-equipped warships offer the advantages of high-speed mobility and stealth, resulting in greater survivability overall.
>
> As Japan prepares to acquire its first Aegis Ashore BMD system – and perhaps other systems such as the THAAD system which has been deployed previously in Romania and South Korea – the possibility that the US Navy will end its important BMD role represents abrupt change….
>
> Japan's decision to deploy Aegis Ashore can fill in any gap created by a possible US Navy cessation of BMD patrols. "The land-based option is more reliable, less logistically draining, and despite being horrendously expensive, could be effective in the sense that it provides a degree of reassurance to the Japanese people and US government, and introduces an element of doubt of missile efficacy into [North Korean] calculations," said [Garren Mulloy, Associate Professor of International Relations at Daito Bunka University in Saitama, Japan], adding, however, that these systems could not cover Okinawa.
>
> "Fixed sites in Japan could be vulnerable, and the Aegis vessels provide a flexible forward-defense, before anything enters Japanese airspace, but with obviously limited reactions times," Mulloy said. "Aegis Ashore gives more reaction time – but over Japanese airspace."…
>
> The silence about this sudden possible shift in the US defense posture in the western Pacific is understandable: it is a sensitive topic in Washington and Tokyo. However, the Trump

> administration has urged its allies to pay more for their own defense needs and to support US troops deployed overseas.
>
> Meanwhile, Tokyo needs to proceed cautiously given the likelihood that neighbors might view a move on BMD as evidence that Tokyo is adopting an increasingly aggressive defense posture in the region.
>
> But for them, it is a no-win situation. If the US does ditch the BMD patrol mission, China and North Korea might view the shift as equally menacing given that it greatly enhances the US Navy's maritime warfare capabilities.[63]

Conversion of Hawaii Aegis Test Site

Another potential issue for Congress is whether to convert the Aegis test facility in Hawaii into an operational land-based Aegis BMD site. DOD's January 2019 missile defense review report states, in a section on improving or adapting existing BMD systems, that

> Another repurposing option is to operationalize, either temporarily or permanently, the Aegis Ashore Missile Defense Test Center in Kauai, Hawaii, to strengthen the defense of Hawaii against North Korean missile capabilities. DoD will study this possibility to further evaluate it as a viable near-term option to enhance the defense of Hawaii. The United States will augment the defense of Hawaii in order to stay ahead of any possible North Korean missile threat. MDA and the Navy will evaluate the viability of this option and develop an Emergency Activation Plan that would enable the Secretary of Defense to operationalize the Aegis Ashore test site in Kauai within 30 days of the Secretary's decision to do so, the steps that would need to be taken, associated costs, and personnel requirements. This plan will be delivered to USDA&S, USDR&E, and USDP within six months of the release of the MDR.[64]

A January 25, 2019, press report states the following:

> The Defense Department will examine the funding breakdown between the Navy and the Missile Defense Agency should the government make Hawaii's Aegis Ashore Missile Defense Test Center into an operational resource, according to the agency's director.
>
> "Today, it involves both Navy resources for the operational crews—that man that site—as well as funds that come to MDA for research, development and test production and sustainment," Lt. Gen. Sam Greaves said of the test center when asked how the funding would shake out between the Navy and MDA should the Pentagon move forward with the recommendation.[65]

Potential Contribution from Lasers

Another potential issue for Congress concerns the potential for ship-based lasers to contribute in coming years to Navy terminal-phase BMD operations and the impact this might eventually have on required numbers of ship-based BMD interceptor missiles. Another CRS report discusses the potential value of ship-based lasers for performing various missions, including, potentially, terminal-phase BMD operations.[66]

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[63] Peter J. Brown, "Japan, US Silent over Ending Ballistic Missile Patrols," *Asia Times*, December 12, 2018.

[64] Department of Defense, *Missile Defense Review 2019*, released January 17, 2019, pp. 55-56.

[65] Mallory Shelbourne, "DOD to Determine Funding Breakdown for Aegis Ashore Repurposing," *Inside the Navy*, January 25, 2019.

[66] See CRS Report R44175, *Navy Shipboard Lasers: Background and Issues for Congress*, by Ronald O'Rourke.

Program Deliveries, Testing, and Technical Risk

Another potential oversight issue for Congress concerns deliveries, testing, and technical risk in the Aegis BMD program.

May 2023 GAO Report

A May 2023 GAO report on U.S. BMD systems, including the Aegis BMD system, stated the following:

> DELIVERIES
>
> MDA did not meet its fiscal year 2022 goal for SM-3 Block IB interceptors as five planned interceptors were delivered after the fiscal year ended. MDA, however, delivered nine backlogged interceptors that were previously delayed due to a flight test failure. The Aegis program temporarily halted deliveries to investigate the failure, but missile production did not stop and deliveries subsequently resumed.
>
> MDA also did not meet its goal for SM-3 Block IIA interceptors. Three interceptors planned for fiscal year 2022 were not delivered. MDA was able to deliver six backlogged interceptors that we previously reported were delayed due to missile assembly issues. The Aegis program addressed the issues, which allowed them to resume deliveries.
>
> As reported by the agency, in August 2022, the Director, MDA approved an acquisition strategy to align SM-3 Block IB and Block IIA production under one contract. This production alignment is expected to maximize efficiencies in program management and obsolescence monitoring, among other synergies. According to MDA officials, they have not identified any disadvantages with this strategy. This acquisition strategy is currently under review by the Under Secretary of Defense for Acquisition and Sustainment to support a production decision for SM-3 Block IIA.
>
> TESTING
>
> Aegis BMD conducted four flight tests in fiscal year 2022, including a successful intercept test event that demonstrated its interoperability with Japanese and Korean systems. The last test—Flight Test Experiment Aegis Weapon System-01—gathered data while an SM-3 Block IIA interceptor engaged a modified medium range ballistic missile target in a non-intercept test.
>
> Aegis BMD conducted two planned ground tests. Ground Test Integrated (GTI)-09 Sprint 1 provided data to support decisions related to system capabilities affecting United States European Command and United States Central Command. GTI-ISR 21 assessed the system's interoperability with Israeli missile defense systems. Aegis BMD also participated in GTI-08a—a delayed test originally planned for fiscal year 2020—which provided data to support system capabilities decisions for Aegis and other missile defense system elements.
>
> A planned Aegis BMD operational cyber test was delayed to fiscal year 2024 due to MDA's changes to its test plan that affected planned ground and cyber tests.
>
> OTHER PROGRAM INFORMATION
>
> **Aegis Ashore**
>
> We reported in June 2022 that delivery of the Aegis Ashore system to Poland was originally planned for fiscal year 2018, but that construction challenges delayed delivery.1 Total projected costs increased by 12 percent, including additional costs for retaining engineering and security services during the delays. The site remains under construction, but MDA officials stated there are no known technical risks. In addition, the Aegis Ashore program recently met key milestones. Specifically, Aegis Light Off occurred in June 2022, which signifies the initial powering up of the weapon system to observe if all integrated systems

are operational. The program completed physical installation of the system and demonstrated it in October 2022. MDA expects to declare the site safe and technically capable in early 2023 and Navy acceptance is anticipated for later in the year.

Safe Service Life Extension

The Aegis program has been able to extend the safe service life of SM-3 Block IA and Block IB interceptors to ensure the interceptors can be used with no additional safety risk. Under this effort, the safe service life of Block IA interceptors increased from 12 to 18 years and Block IB interceptors increased from 8 to 12 years. The safe service life of Block IIA interceptors is currently 12 years and MDA is assessing the possibility to increase this to 16, or possibly up to 20, years. MDA officials described the process to extend an interceptor's safe service life, which includes testing and analysis of aged missile components to determine their suitability for extended service. The testing and analysis is conducted by industry and government stakeholders and subject matter experts at various locations and laboratories. MDA officials said safe service life extensions have helped address the challenge of meeting the Navy's interceptor inventory requirements, which typically entail high volume procurements and consistent repair and recertification throughput.

Software Development

MDA officials stated the Navy started implementing a multi-stage Development, Security, and Operations strategy to deliver software upgrades to Aegis platforms. The Navy started using a software factory—an automated process to develop software—in fiscal year 2021 and now plans to eliminate their legacy system for developing and delivering coded software capability in fiscal year 2024.2 According to MDA officials, by fiscal year 2030 the Navy intends for this approach to be the sole means for developing and delivering coded software capability to all Aegis platforms. MDA officials explained this strategy provides the opportunity to significantly increase the speed of software deliveries to the fleet, as well as reduce costs and cybersecurity risk by integrating security functions in the development process. They stated, however, there is risk since it is a significant transition from current development strategies. They said the transition would require extensive retraining and hiring of government personnel to fully execute the strategy, as well as additional costs to develop the new required tools, such as software, models, and infrastructure.[67]

Regarding the development of a capability for the SM-6 to intercept hypersonic missiles, the GAO report stated

MDA has two main efforts under development to defend against hypersonic weapons:

• Glide Phase Intercept (GPI) is a program that includes a missile being designed to be fired from Aegis-equipped ships to intercept a hypersonic weapon in the middle (or "glide") phase of its flight path.

• Hypersonic and Ballistic Tracking Space Sensor (HBTSS) is an effort to develop space-based sensors to track and support the intercept of a hypersonic weapon….

GPI is expected to work with existing and future systems to provide hypersonic defense. After a missile launch, SDA's wide field of view satellites, capable of viewing large portions of the globe, detect the threat launch and send sensor measurement data to BOA, which generates track data with accuracy sufficient to cue HBTSS. HBTSS then acquires the deployed Hypersonic Glide Vehicle (HGV) and collects precision angle measurements. These measurements are processed by HBTSS, BOA, and Command, Control, Battle Management, and Communications (C2BMC) to provide fire control quality tracks on the HGV to Aegis for support of an engagement using GPI….

[67] Government Accountability Office, *Missile Defense[:] Annual Goals Unmet for Deliveries and Testing*, GAO-23-106011, May 2023, pp. 22-23.

GPI STATUS AND CHALLENGES

Events and Milestones

By the early 2030s, the GPI program plans to deliver a prototype capability for testing, demonstration data to inform further development, and 10 interceptors to be used for testing. The program established a plan to acquire the capability and identified key events and milestones for tracking development. The plan includes competitive development of the GPI missile leveraging multiple contractors to begin the effort, but only one contractor is anticipated to be selected to complete delivery of the prototype capability. In fiscal year 2022, MDA reported that three contractors were awarded Other Transaction Agreements to initiate work on the GPI program.1 Later, in the fiscal year the program reported selecting two contractors to continue the development of GPI into the next phase of the acquisition process, technology development. In fiscal year 2023, the program expects to focus efforts on technology maturity and applying top level requirements to component level designs in preparation for the Preliminary Design Review….

The Preliminary Design Review is currently planned by the end of fiscal year 2027. The GPI program also anticipates down-selecting from two to one contractor near this date to continue until completing delivery of the prototype capability….

Challenges

Previously we found in June 2022 that MDA had not planned to conduct an Independent Cost Estimate (ICE) or Independent Technical Risk Assessment (ITRA) for the GPI program before the product development phase, which is after the technology development phase. These assessments are required for certain elements by DOD Directive-Type Memorandum 20-002 to mitigate risk. Since our reporting, MDA officials stated the Office of Cost Assessment and Program Evaluation (CAPE) completed a preliminary ICE for the GPI program in the August 2022 timeframe. As of February 2023, CAPE is working to finalize the ICE pending the final President's Budget program schedule. MDA officials also stated the Office of the Under Secretary of Defense for Research and Engineering completed an ITRA for the GPI program in the August 2022 timeframe as well. According to MDA, the ITRA found that the program should address technical risks earlier in the development schedule by building and testing hardware. The ITRA also recommended earlier testing. We plan to review the ICE and ITRA to assess whether MDA has acquired knowledge to manage risk for the GPI program.[68]

January 2024 DOT&E Report

A January 2024 report from DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual report for FY2023—states the following regarding the Aegis BMD system:

> Aegis BMD has demonstrated the capability to intercept non-separating, simple-separating, and complex-separating ballistic missiles in the midcourse phase of flight with Standard Missile-3 (SM-3) guided missiles, although flight testing and M&S have not addressed all expected threat types, threat features, and raid sizes. Aegis BMD has also demonstrated a capability to intercept select ballistic missiles in the terminal phase of flight with SM-6 guided missiles. Flight testing in FY23 verified some of the corrective actions to address failure review board findings from the two Sea-Based Terminal Increment 2 flight tests in FY21. All fielded Aegis BMD variants have demonstrated sufficient reliability, with operational availabilities that exceed the specification. The SM-3 Block IIA missile is reliable as it meets its threshold reliability metric, but not with statistical confidence because of the relatively small number of live firings and ground test data collection events to date. The MDA has implemented a process to monitor the health and

[68] Government Accountability Office, *Missile Defense[:] Annual Goals Unmet for Deliveries and Testing*, GAO-23-106011, May 2023, pp. 34-35.

status of deployed SM-3 Block IIA missiles, which will provide additional reliability data for future assessments.[69]

Legislative Activity for FY2025

Summary of Action on FY2025 MDA Funding Request

Table 2 summarizes congressional action on the FY2025 request for MDA procurement and research and development funding for the Aegis BMD program.

Table 2. Summary of Congressional Action on FY2025 MDA Funding Request

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

		Authorization			Appropriation		
	Request	**HASC**	**SASC**	**Final**	**HAC**	**SAC**	**Final**
Procurement							
Aegis BMD (line 29)	85.0	185.0	85.0	335.0	85.0	557.0	
(SM-3 Block IB missile quantity)	*(0)*	*(18)*	*(0)*	*n/a*	*(0)*	*n/a*	
SM-3 Block IIA (line 31)	406.4	406.4	471.4	471.4	406.4	406.4	
(SM-3 Block IIA missile quantity)	*(12)*	*(12)*	*(12)*	*(12)*	*(12)*	*(12)*	
Aegis BMD hardware and software (line 37)	32.0	32.0	32.0	32.0	32.0	32.0	
Subtotal Procurement	**523.4**	**623.4**	**588.4**	**838.4**	**523.4**	**995.4**	
Research, development, test, and evaluation (RDT&E)							
Aegis BMD (PE 0603892C) (line 84)	649.3	738.5	738.5	738.5	659.3	738.5	
Aegis BMD test (PE 0604878C) (line 118)	135.0	136.2	136.2	136.2	135.0	116.5	
Land-based SM-3 (PE 0604880C) (line 120)	22.2	22.2	22.2	22.2	22.2	22.2	
Subtotal RDT&E	**806.5**	**896.9**	**896.9**	**896.9**	**816.5**	**877.2**	
TOTAL	**1,329.9**	**1,520.3**	**1,485.3**	**1,735.3**	**1,339.9**	**1,872.6**	

Source: Table prepared by CRS based on DOD's original FY2025 budget submission, committee and conference reports, and explanatory statements on FY2025 National Defense Authorization Act and FY2025 DOD Appropriations Act.

Notes: HASC is House Armed Services Committee; **SASC** is Senate Armed Services Committee; **HAC** is House Appropriations Committee; **SAC** is Senate Appropriations Committee. n/a is not available—the missile procurement quantity was not specified.

FY2025 National Defense Authorization Act (H.R. 8070/S. 4638/H.R. 5009)

House

The House Armed Services Committee, in its report (H.Rept. 118-529 of May 31, 2024) on H.R. 8070, recommended the funding levels shown in the HASC column of **Table 2**.

[69] Director, Operational Test & Evaluation, *FY 2023 Annual Report*, January 2024, pp. 340-341.

The recommended net increase of $100 million for line 29 includes a reduction of $85.0 million for "Program decrease—spares" and an increase of $185.0 million for "Program increase—restore SM–3 IB production." (Page 447)

The recommended increase of $89.2 million for line 84 is for "Guam Defense System—INDOPACOM UPL [U.S. Indo-Pacific Command unfunded priorities list]."[70] (Page 488)

The recommended increase of $1.2 million for line 118 is for "Guam Defense System—INDOPACOM UPL."[71] (Page 490)

H.Rept. 118-529 states

> PAC–3 Aegis integration
>
> The committee is encouraged by efforts of the Navy and industry to increase missile capacity on Aegis ships via onboarding new effectors such as the PAC–3 Missile Segment Enhancement (MSE) for its integrated air and missile defense and sea control missions. Utilizing a proven Army missile in full-rate production offers strategic and economic advantages, enhances interoperability between branches of the military, ensures reliability and performance, and most importantly brings on additional capacity needed for ships to stay on station, performing the Navy's most critical missions.
>
> Therefore, the committee directs the Secretary of the Navy to provide a briefing to the House Committee on Armed Services not later than February 1, 2025, on the status of integrating PAC–3 MSE into the Aegis ships weapon and combat systems as well as a plan to accelerate efforts toward future flight test events. (Page 25)

Senate

The Senate Armed Services Committee, in its report (S.Rept. 118-188 of July 8, 2024) on S. 4638, recommended the funding levels shown in the SASC column of **Table 2**.

The recommended increase of $65.0 million for line 31 is for "Expand SM–3 IIA production capacity to 36/yr." (Page 467)

The recommended increase of $89.2 million for line 84 is for "Guam Defense System (GDS)."[72] (Page 510)

The recommended increase of $1.2 million for line 118 is for "Guam Defense System (GDS)."[73]

S.Rept. 118-188 also states (emphasis added)

> **Directed energy weapons and their role in integrated air and missile defense**
>
> On May 8, 2024, the Strategic Forces Subcommittee held its annual budget hearing "To Receive Testimony on the Department of Defense Activities in Review of the Defense Authorization request for Fiscal Year 2025 and the Future Year's Defense Program." The witnesses testified that the invasion of Ukraine by Russia, and the April 14 attack by Iran and its proxies, in which 300 unmanned aerial vehicles, cruise and ballistic missiles were

[70] USINDOPACOM's UPL for FY2025 includes an item entitled Guam Defense System, totaling $430.1 million, for "Resources the development of a Missile Defense System for the defense of Guam against ballistic, hypersonic, and cruise missile threats." Included in this UPL item is, among other things, $89.2 million for line 84.

[71] USINDOPACOM's UPL for FY2025 includes an item entitled Guam Defense System, totaling $430.1 million, for "Resources the development of a Missile Defense System for the defense of Guam against ballistic, hypersonic, and cruise missile threats." Included in this UPL item is, among other things, $1.2 million for line 118.

[72] See footnote 70.

[73] See footnote 71.

directed against Israel and U.S. target, had changed the landscape of integrated air and missile defense.

The President's budget request for fiscal year 2025 included $28.4 billion for missile defense and related activities, including Over-the-Horizon Radars, Space-Based Missile Warning and Tracking, and a Next Generation Interceptor for the Ground-based Midcourse Defense system. However, within this budget request, the Missile Defense Agency requested just $10.4 billion—a $500.0 million decrease compared to the fiscal year 2024 enacted budget total. This overall decrease affects **three critical areas where the committee believes the Department of Defense (DOD) should be making greater efforts**: the development of capabilities to intercept and defeat hypersonic missiles; fielding operationally relevant directed energy systems; and **the use of highly capable missile defense interceptors to destroy relatively inexpensive unmanned aerial system threats**.

In addition, the President's budget request for the only program in the Department focused on defeating a hypersonic missile during its glide phase, the Glide Phase Interceptor, decreased from $209.0 million in fiscal year 2024 to $182.0 million in fiscal year 2025—a $27.0 million reduction in funding at a time when hypersonic missile threats are growing rapidly. In an attempt to optimize these relatively limited resources for such a difficult, high-risk endeavor, the Missile Defense Agency will down-select to one vendor—rather than adhering to the Government Accountability Office best practice of maintaining two vendors through the initial test phases of the interceptor. Acknowledging this decrease in funding, the Office of the Secretary of Defense witness acknowledged that U.S. hypersonic defenses are inadequate and that DOD needed to focus on hypersonic defenses.

The committee is also concerned that DOD is using multi-million-dollar missile defense interceptors against $20,000 UAVs, rather than investing in directed energy systems whose cost per shot has the potential to be essentially de-minimis. Missile interceptor costs range from $10.0 million for an SM–3 Block IB missile to $22.0 million for an SM–3 Block IIA missile. At the same time, the budget for directed energy—where the cost of each shot could be a few dollars—has decreased from $1.65 billion in fiscal year 2023 to $789.0 million for fiscal year 2025. **The Department also chose the fiscal year 2025 request to eliminate funding for production of the less-costly SM–3 Block IB, while holding production for the more expensive SM–3 Block IIA at the minimum sustaining rate of 12 per year.**

The Department is making progress in many missile defense areas, such as the development of proliferated space sensors for tracking, the AEGIS weapon system, and the SM–3 Block IIA missile for ballistic missile defense. However, the committee recognizes that DOD must take steps to expand its missile defense capacity, as well as its baseline capability, to adequately address rapidly proliferating traditional and asymmetric missile threats. **The committee strongly encourages DOD to** pursue much more robust future budgets for the Glide Phase Interceptor and directed energy programs, as well as to **reconsider ill-advised decisions to cut existing, combat-proven missile defense capabilities like the SM–3 Block IB missile, when the need for such assets is clearly growing.** (Pages 319-320)

Final

The joint explanatory statement for the House-Senate agreement on H.R. 5009 that was released on December 7, 2024, recommends the funding levels shown in the authorization final column of **Table 2**.

The recommended increase of $250 million for line 29 is for "Restore SM–3 IB production." (Page 540)

The recommended increase of $65.0 million for line 31 is for "Expand SM–3 IIA production capacity to 36/yr." (Page 540)

The recommended increase of $89.2 million for line 84 is for "Guam Defense System—INDOPACOM UPL [unfunded priorities list]." (Page 594)

The recommended increase of $1.2 million for line 118 is for "Guam Defense System—INDOPACOM UPL [unfunded priorities list]." (Page 597)

FY2025 DOD Appropriations Act (H.R. 8774/S. 4921)

House

The House Appropriations Committee, in its report (H.Rept. 118-557 of June 17, 2024) on H.R. 8774, recommended the funding levels shown in the HAC column of **Table 2**.

The recommended increase of $10.0 million for line 84 is for "Program increase—SM-3 advanced capability DACS (divert and attitude control system) demonstration." (Page 225)

Senate

The Senate Appropriations Committee, in its report (S.Rept. 118-204 of August 1, 2024) on S. 4921, recommended the funding levels shown in the SAC column of **Table 2**.

The recommended increase of $472.0 million for line 29 is for "Program increase: SM–3 Block IB continued production (emergency)." The missile procurement quantity was not specified.

The recommended increase of $89.2 million for line 84 is for "AEGIS BMD (emergency)." (Page 250)

The recommended net reduction of $18.489 million for line 118 includes an unspecified recommended reduction of $19.689 million and a recommended increase of $1.2 million for "AEGIS BMD TEST (emergency)." (Page 251)

The use of the term *emergency* for the above recommended funding increases means that they would be designated as being for an emergency requirement pursuant to Section 251(b)(2)(A)(i) of the Balanced Budget and Emergency Deficit Control Act of 1985. For further discussion of recommended additional emergency appropriations in S. 4921, see pages 8-9 of S.Rept. 118-204.

Appendix. Reported Aegis BMD Flight Tests

Table A-1 presents a summary of reported Aegis BMD flight tests since January 2002. The table does not include

- an operation on February 20, 2008, in which a BMD-capable Aegis cruiser operating northwest of Hawaii used a modified version of the Aegis BMD system with the SM-3 missile to shoot down an inoperable U.S. surveillance satellite that was in a deteriorating orbit; or
- flight tests of the Guam missile defense system.

Table A-1. Reported Aegis BMD Flight Tests From January 2002 to the Present

Date	Country	Name of flight test of exercise	Ballistic Missile Target	Reported as successful?
Exo-atmospheric (using SM-3 missile)				
1/25/02	US	FM-2	Unitary short-range (TTV)	Yes
6/13/02	US	FM-3	Unitary short-range (TTV)	Yes
11/21/02	US	FM-4	Unitary short-range (TTV)	Yes
6/18/03	US	FM-5	Unitary short-range (TTV)	**No**
12/11/03	US	FM-6	Unitary short-range (TTV)	Yes
2/24/05	US	FTM 04-1 (FM-7)	Unitary short-range (TTV)	Yes
11/17/05	US	FTM 04-2 (FM-8)	Separating short-range (MRT)	Yes
6/22/06	US	FTM 10	Separating short-range (TTV)	Yes
12/7/06	US	FTM 11	Unitary short-range (TTV)	**No**
4/26/07	US	FTM 11 Event 4	Unitary short-range (ARAV-A)	Yes
6/22/07	US	FTM 12	Separating short-range (MRT)	Yes
8/31/07	US	FTM-11a	Classified	Yes
11/6/07	US	FTM 13	Unitary short-range (ARAV-A)	Yes
			Unitary short-range (ARAV-A)	Yes
12/17/07	Japan	JFTM-1	Separating short-range (MRT)	Yes
11/1/08	US	Pacific Blitz	Unitary short-range (ARAV-A)	Yes
			Unitary short-range (ARAV-A)	**No**
11/19/08	Japan	JFTM-2	Separating short-range (MRT)	**No**
7/30/09	US	FTM-17	Unitary short-range (ARAV-A)	Yes
10/27/09	Japan	JFTM-3	Separating short-range (MRT)	Yes
10/28/10	Japan	JFTM-4	Separating short-range (MRT)	Yes
4/14/11	US	FTM-15	Separating intermediate range (LV-2)	Yes
9/1/11	US	FTM-16 E2	Separating short-range (ARAV-B)	**No**
5/9/12	US	FTM-16 E2a	Unitary short-range (ARAV-A)	Yes
6/26/12	US	FTM-18	Separating short-range (MRT)	Yes

Date	Country	Name of flight test of exercise	Ballistic Missile Target	Reported as successful?
10/25/12	US	FTI-01	Separating short-range (ARAV-B)	**No**
2/12/13	US	FTM-20	Separating medium-range (MRBM-T3)	Yes
5/15/13	US	FTM-19	Separating short-range (ARAV-C)	Yes
9/10/13	US	FTO-01	Separating medium-range (eMRBM-T1)	Yes
9/18/13	US	FTM-21	Separating short-range (ARAV-C++)	Yes
10/3/13	US	FTM-22	Separating medium-range (ARAV-TTO-E)	Yes
11/6/14	US	FTM-25	Separating short-range (ARAV-B)	Yes
6/25/15	US	FTO-02 E1	Separating medium-range (IRBM T1)	n/a[a]
10/4/15	US	FTO-02 E2	Separating medium-range (eMRBM)	n/a[b]
10/20/15	US	ASD-15 E2	Separating short-range (Terrier Orion)	Yes
11/1/15	US	FTO-02 E2a	Separating medium-range (eMRBM)	**No**
12/10/15	US (Aegis Ashore)	FTO02 E1a	Separating medium-range (IRBM T1)	Yes
2/3/17	US-Japan	SFTM-01	Separating medium-range (MRT)	Yes
6/21/17	US-Japan	SFTM-02	Medium-range target	**No**
10/15/17	US	FS17	Medium-range target	Yes
1/31/18	US (Aegis Ashore)	FTM-29	Intermediate-range target	**No**
9/11/18	Japan	JFTM-05	Simple separating target	Yes
10/26/18	US	FTM-45	Medium range target	Yes
12/10/18	US (Aegis Ashore)	FTI-03	Intermediate-range target	Yes
11/16/20	US	FTM-44	ICBM target	Yes
5/26 and 30/2021	US-Netherlands	ASD/FS21[c]	Non-separating MRBM target	Yes[c]
4/9/22[f]	US	FEM-01	Medium range target	Outcome not reported
8/9/22	US	Part of Pacific Dragon exercise	ARAV-B SRBM target	Yes
11/16/22[e]	US-Japan	JFTM-07	Medium-range T4-E target	Yes
11/18 or 19/22[e]	US-Japan	JFTM-07	Short-range target	Yes
10/25/23	US	Vigilant Wyvern/ FTM-48	Two short-range targets	Yes
2/8/24	US	FTX-23	Medium Range Ballistic Missile (MRBM) target	Yes
Endo-atmospheric (using SM-2 missile Block IV missile and [for MMW E1 and subsequent] SM-6 Dual I missile)				
5/24/06	US	Pacific Phoenix	Unitary short-range target (Lance)	Yes
6/5/08	US	FTM-14	Unitary short-range target (FMA)	Yes

Date	Country	Name of flight test of exercise	Ballistic Missile Target	Reported as successful?
3/26/09	US	Stellar Daggers	Unitary short-range target (Lance)	Yes
7/28/15	US	MMW E1	Unitary short-range target (Lance)	Yes
7/29/15	US	MMW E2	Unitary short-range target (Lance)	Yes
12/14/16	US	FTM-27	Unitary short-range target (Lance)	Yes
8/29/17	US	FTM-27 E2	Medium-range target (MRBM)	Yes
5/29/21	US	FTM-31	Medium-range target (MRBM)	**No**
7/24/21	US	FTM-33	Two SRBM targets	Yes and **unconfirmed**[d]
3/30/23	US	FTM-31 E1a	Medium-Range target (MRBM)	Yes (2-missile salvo)
3/28/24	US	Stellar Laelaps/ FTM-32	Advanced Medium Range Ballistic Missile (MRBM) target	Yes

Sources: Table presented in MDA fact sheet, "Aegis Ballistic Missile Defense Testing," February 2017, accessed on May 18, 2022, at https://web.archive.org/web/20170929180757/https:/www.mda.mil/global/documents/pdf/aegis_tests.pdf, and (for flight tests subsequent to February 2017) MDA news releases, Jason Sherman, "U.S. Intercepted Ballistic Missile Target over Pacific while China Exercised around Taiwan," *Inside Defense*, August 12, 2022; and Wyatt Olson, "Missile-Defense Exercise Off Hawaiian Island Includes First Live-Fire Intercept," *Stars and Stripes*, August 16, 2022.

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.

a. MDA's table shows this as a test that did not result in the launch of an SM-3. MDA as of August 3, 2015, had not issued a news release discussing this event. MDA's count of 31 successful intercepts in 37 launches through July 29, 2015, does not appear to include this test, suggesting that this was considered a "no test" event—a test in which there was a failure that was not related to the Aegis BMD system or the SM-3 interceptor. Press reports state that the test was aborted due to a failure of the target missile. (Andrea Shalal, "U.S. Skips Aegis Ashore Missile Test After Target Malfunction," *Reuters*, June 26, 2015.) MDA's table similarly shows the test of December 7, 2006, as a test that did not result in the launch of an SM-3. MDA issued a news release on this test, which stated that an SM-3 was not launched "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 [SM-3] 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." MDA counts the test of December 7, 2006, as an unsuccessful intercept in its count of 31 successful intercepts in 37 launches through July 29, 2015.

b. MDA's table shows this as a test that did not result in the launch of an SM-3. MDA as of November 10, 2015, had not issued a news release discussing this event. MDA's count of 32 successful intercepts in 39 launches through November 1, 2015, does not appear to include this test, suggesting that this was considered a "no test" event—a test in which there was a failure that was not related to the Aegis BMD system or the SM-3 interceptor.

c. ASD/FS21 was an at-sea demonstration that occurred during a multilateral naval exercise called Formidable Shield 2021. In the demonstration, a Dutch frigate used its radar to provide early warning track data to a U.S. Navy destroyer that used the data to calculate a firing solution and launch its interceptor. Some press reports state that ASD/FS21 involved two successful ballistic missile intercepts, rather than the one shown in the table.

d. MDA stated that "based on initial observations, one target was successfully intercepted. At this time, we cannot confirm the second target was destroyed." ("MDA Test Intercepts Target," MDA News Release 21-NEWS-0012, July 24, 2021.)

e. A November 21, 2022, MDA new released stated: "The Japan Maritime Self-Defense Force (JMSDF) and the United States Missile Defense Agency (MDA) announce the successful completion of a two-week missile

f. defense event incorporating two live fire exercises." (Missile Defense Agency, "Japan Missile Defense Flight Test Successful," 22-NEWS-0009, November 21, 2022.) Presss reports stated that two intercept events occurred on November 16 and November 18 or 19. (Dzirhan Mahadzir, "Two Japanese Destroyers Score in Ballistic Missile Defense Test off Hawaii," *USNI News*, November 21, 2022; Rich Abott, "Japanese Destroyers First Successfully Test SM-3 In Ballistic Missile Defense Test," *Defense Daily*, November 22, 2022.)

g. For a press report about the SM-3 flight test of April 9, 2022, see Jason Sherman, "MDA Acknowledges Clandestine SM-3 Block IIA Experiment of Classified Capability," *Inside Defense*, January 26, 2023.

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