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April 2014

# MISSILE DEFENSE

## Mixed Progress in Achieving Acquisition Goals and Improving Accountability

# GAO Highlights

Highlights of [GAO-14-351](#), a report to congressional committees

## Why GAO Did This Study

Since 2002, MDA has spent approximately \$98 billion and has requested \$38 billion more through fiscal year 2018 to develop, test, and field a system to defend against enemy ballistic missiles. The BMDs is comprised of a command and control system, sensors that identify incoming threats, and intercepting missiles. GAO is mandated by law to assess the extent to which MDA has achieved its acquisition goals and objectives, as reported to Congress through its acquisition baselines, and to report on other issues as appropriate. This report examines the agency's progress and any challenges in fiscal year 2013 associated with (1) developing, flight testing, and producing individual systems, which MDA refers to as BMDs elements; and (2) reporting resource and schedule baselines that support oversight. To support this effort, GAO examined MDA's acquisition and test reports, analyzed two of MDA's acquisition baselines—resource and schedule—to discern progress, and interviewed a wide range of DOD and contractor officials.

## What GAO Recommends

GAO recommends (1) any changes to the SM-3 Block IB be flight tested before DOD approves full production; (2) retest the fielded GMD interceptor to demonstrate performance; and (3) improve the content of its schedule baselines. DOD partially concurred with the first, non-concurred with the second, and concurred with the third, stating that the production and testing decisions will be made using the proper DOD processes. GAO believes both recommendations are valid as discussed in this report.

View [GAO-14-351](#). For more information, contact Cristina Chaplain at (202) 512-4841 or [chaplainc@gao.gov](mailto:chaplainc@gao.gov).

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## What GAO Found

In fiscal year 2013, the Missile Defense Agency (MDA) made mixed progress in achieving its acquisition goals to develop, test, and produce elements of the Ballistic Missile Defense System (BMDs). For the first time, MDA conducted an operational flight test that involved warfighters from several combatant commands using multiple BMDs elements simultaneously. The agency also successfully conducted several developmental flight tests that demonstrated key capabilities and modifications made to resolve prior production issues. However, the Aegis BMD and Ground-based Midcourse Defense (GMD) continued to experience testing and development challenges.

- Aegis BMD—while the program successfully conducted three intercept flight tests with the Standard Missile (SM)-3 Block IB missile in support of a full production decision planned for fiscal year 2015, a missile failed during one of these tests. Although the cause of failure is not known, the program plans to move forward with missile production in 2014. The program is also determining whether a key component that is common with the already fielded SM-3 Block IA missile will need to be redesigned.
- GMD—although the program successfully conducted a non-intercept flight test of its upgraded interceptor, the program is nearing a seven year delay in completing its first successful intercept. Until this upgraded interceptor is demonstrated in an intercept test, expected to be conducted in the third quarter of fiscal year 2014, manufacturing and deliveries remain on hold. In July 2013, the GMD program also failed a flight test of its fielded interceptor. This flight test was designed to assess the fielded interceptor under more challenging conditions and to confirm design changes to resolve prior issues. MDA has not yet made a decision on how to proceed since the cause of failure has not been determined.

MDA has improved the clarity of its resource and schedule baselines since it first submitted them to Congress in 2010. However, issues with the content and presentation of these baselines continue to limit the usefulness of the information available to decision makers for oversight. First, as the agency is still in the process of improving the quality and comprehensiveness of the cost estimates that support its resource baselines, for the fourth year, GAO has found that MDA's cost estimates are unreliable. For example, MDA's 2013 cost estimates still do not include operations and support costs for military services which may significantly understate total costs. Congress has recently required MDA to include these costs in future acquisition baselines which may improve transparency. Second, MDA's schedule baselines are presented in a way that makes it difficult to assess progress. Specifically, MDA's 2013 schedule baselines include numerous events but provide very little information about them, making it difficult to understand what the events are and why they are important. Additionally, the 2013 schedule baselines do not compare the current event dates with previously reported dates, so decision makers cannot easily assess how the program is performing over time. Until MDA improves the quality and comprehensiveness of its cost estimates and the content of its schedule information, its baselines will not be useful for decision makers to gauge progress.

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## Abbreviations

Aegis BMD	Aegis Ballistic Missile Defense
AN/TPY-2	Army Navy/Transportable Radar Surveillance and Control Model 2
BAR	BMDs Accountability Report
BMDs	Ballistic Missile Defense System
BMD	Ballistic Missile Defense
C2BMC	Command, Control, Battle Management, and Communications
CE-I	Capability Enhancement-I
CE-II	Capability Enhancement-II
CTV-01	Controlled Test Vehicle-01
DOD	Department of Defense
eMRBM	Extended Medium-Range Ballistic Missile
FTG	Flight Test GMD
FTO	Flight Test Operational
FTM	Flight Test Standard Missile
GMD	Ground-based Midcourse Defense
MDA	Missile Defense Agency
SM-3	Standard Missile-3
THAAD	Terminal High Altitude Area Defense

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April 1, 2014

### Congressional Committees

For over half a century, the Department of Defense (DOD) has been funding efforts to develop a system to detect, track, and defeat enemy ballistic missiles. The current system—the Ballistic Missile Defense System (BMDS)—includes a diverse collection of land-, sea-, and space-based assets located around the globe. Since 2002, the Missile Defense Agency (MDA)—the agency charged with developing an integrated BMDS—has spent over \$98 billion to develop and deploy this highly complex group of systems and has requested an additional \$38 billion for fiscal years 2014 through 2018 to continue its efforts. For over a decade, we have reported on MDA’s progress and challenges in developing and fielding BMDS capabilities as well as transparency, accountability, and oversight issues.<sup>1</sup>

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<sup>1</sup>We delivered the following reports for fiscal years 2003 through 2013: GAO, *Missile Defense: Actions Are Needed to Enhance Testing and Accountability*, [GAO-04-409](#) (Washington, D.C.: Apr. 23, 2004); *Defense Acquisitions: Status of Ballistic Missile Defense Program in 2004*, [GAO-05-243](#) (Washington, D.C.: Mar. 31, 2005); *Defense Acquisitions: Missile Defense Agency Fields Initial Capability but Falls Short of Original Goals*, [GAO-06-327](#) (Washington, D.C.: Mar. 15, 2006); *Defense Acquisitions: Missile Defense Acquisitions Strategy Generates Results but Delivers Less at a Higher Cost*, [GAO-07-387](#) (Washington, D.C.: Mar. 15, 2007); *Defense Acquisitions: Progress Made in Fielding Missile Defense, but Program Is Short of Meeting Goals*, [GAO-08-448](#) (Washington, D.C.: Mar. 14, 2008); *Defense Acquisitions: Production and Fielding of Missile Defense Components Continue with Less Testing and Validation Than Planned*, [GAO-09-338](#) (Washington, D.C.: Mar. 13, 2009); *Defense Acquisitions: Missile Defense Transition Provides Opportunity to Strengthen Acquisition Approach*, [GAO-10-311](#) (Washington, D.C.: Feb. 25, 2010); *Missile Defense: Actions Needed to Improve Transparency and Accountability*, [GAO-11-372](#) (Washington, D.C.: Mar. 24, 2011); *Missile Defense: Opportunity Exists to Strengthen Acquisitions by Reducing Concurrency*, [GAO-12-486](#) (Washington, D.C.: Apr. 20, 2012); *Missile Defense: Opportunity to Refocus on Strengthening Acquisition Management*, [GAO-13-432](#) (Washington, D.C.: Apr. 26, 2013).

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Since 2002, we have been mandated to prepare annual assessments of MDA's progress toward its acquisition goals.<sup>2</sup> To date, we have delivered reviews of MDA's progress covering fiscal years 2003 through 2012 and are currently mandated to issue our final report in 2016. The National Defense Authorization Act for Fiscal Year 2012 mandated that we report our assessment of the extent to which MDA has achieved its stated acquisition goals and objectives, as reported through its acquisition baselines, and also to include any other findings and recommendations on MDA acquisition programs and accountability as appropriate.<sup>3</sup> This report provides our assessment of MDA's acquisition progress in fiscal year 2013. Specifically, it highlights MDA's progress and any challenges associated with (1) developing, flight testing, and producing individual systems, which MDA refers to as BMDS elements; and (2) reporting resource and schedule baselines that support oversight.

To assess MDA's progress and any challenges with developing, testing, and producing the BMDS, we examined the acquisition accomplishments of several missile defense elements and MDA's targets program.<sup>4</sup> We reviewed key management documents including Program Execution Reviews and Baseline Execution Reviews, which detail program accomplishments and areas of concern, and interviewed program element officials. We also examined MDA's master test plan and flight test reports, and discussed the BMDS testing and results with the BMDS

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<sup>2</sup>National Defense Authorization Act for Fiscal Year 2002, Pub. L. No. 107-107, § 232(g) (2001); Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, Pub. L. No. 108-375, § 233 (2004); National Defense Authorization Act for Fiscal Year 2006, Pub. L. No. 109-163, § 232; John Warner National Defense Authorization Act for Fiscal Year 2007, Pub. L. No. 109-364, § 224 (2006); National Defense Authorization Act for Fiscal Year 2008, Pub. L. No. 110-181, § 225; and National Defense Authorization Act for Fiscal Year 2012, Pub. L. No. 112-81, § 232 (2011).

<sup>3</sup>Pub. L. No. 112-81, § 232 (2011).

<sup>4</sup>Specifically, we reviewed the BMDS elements and targets program for which MDA had reported acquisition goals to Congress in its 2013 BMDS Accountability Report (BAR). Our report does not contain an assessment of programs that are not yet mature enough to establish acquisition baselines such as the Aegis Ballistic Missile Defense Standard Missile-3 Block IIA program. Additionally, we did not assess programs that were first introduced in the 2013 BAR including two Upgraded Early Warning Radars because we could not make comparisons to past years. We also did not assess programs that have been transferred to a military service for production, operation, or sustainment such as the Patriot Advanced Capability-3 program. MDA is also cooperatively developing other systems for the defense of Israel, which are not included in the 2013 BAR and therefore not covered in this report.

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Operational Test Agency; DOD's Office of the Director, Operational Test and Evaluation; and DOD's Office of Developmental Test and Evaluation. We also visited several contractor facilities that were working on programs covered in our review.

To assess the progress as well as any remaining challenges MDA faces in reporting resource and schedule baselines that support oversight, we examined the baselines presented in the BMDS Accountability Reports (BAR) for fiscal years 2010 through 2013. To be consistent with last year, we focused our assessment on the resource and schedule baselines as they continue to be the only reported baselines that separately explain when current estimates have deviated to a certain extent from the baselines set in prior BARs and have measurable goals, such as cost estimates and dates of program events. We interviewed officials in MDA's Operations Directorate to discuss their progress in adopting best practices in cost estimating based on our Cost Guide.<sup>5</sup> We also met with officials from MDA's Acquisition Directorate to discuss significant internal and external events and decisions that occurred in fiscal year 2013, such as sequestration, that affected the agency's overall acquisition of the BMDS, as well as how the agency establishes and manages its acquisition baselines.<sup>6</sup> We examined MDA's statutory reporting requirements and interviewed officials within MDA's general counsel's office. In addition, we reviewed DOD policy and guidance to discern how other major defense acquisition programs are required to report baselines and measure program progress.

In addition to this assessment, the National Defense Authorization Act for Fiscal Year 2013 mandated GAO to provide separate assessments on several other missile defense related issues. Specifically, GAO was required to provide briefings on our views and to submit reports as soon as practicable to the congressional defense committees our assessments

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<sup>5</sup>We previously found that MDA's reported cost estimates did not meet GAO's best practices for high-quality estimates and recommended that MDA take steps to improve the quality of its estimates. DOD agreed with this recommendation and stated that MDA would follow GAO's *Cost Estimating and Assessment Guide* for each program reported in the BAR. See [GAO-11-372](#).

<sup>6</sup>Sequestration is generally defined as the cancellation of previously enacted budgetary resources, making largely across-the-board reductions to non-exempt programs, activities, and accounts. In March 2013, because of the absence of legislation to reduce the federal budget deficit, the President ordered sequestration of approximately \$80 billion in fiscal year 2013 budgetary resources across all non-exempt federal government accounts.

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of DOD reports on (1) a comprehensive evaluation of alternatives for the Precision Tracking Space System and its conformance with GAO best practices for analyses of alternatives; (2) the Ground-based Midcourse Defense system's test plan; (3) the status and progress of regional missile defense programs, including the adequacy of MDA's existing and planned efforts to deploy a U.S. missile defense in Europe; and (4) the status of efforts to improve the homeland defense capability of the United States.<sup>7</sup> Because this additional mandated work covers the details on many BMDS elements, we do not include appendixes on each of the individual elements as we have done in prior reports under this mandate. For more details on our scope and methodology, see appendix I.

We conducted this performance audit from April 2013 to April 2014 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Background

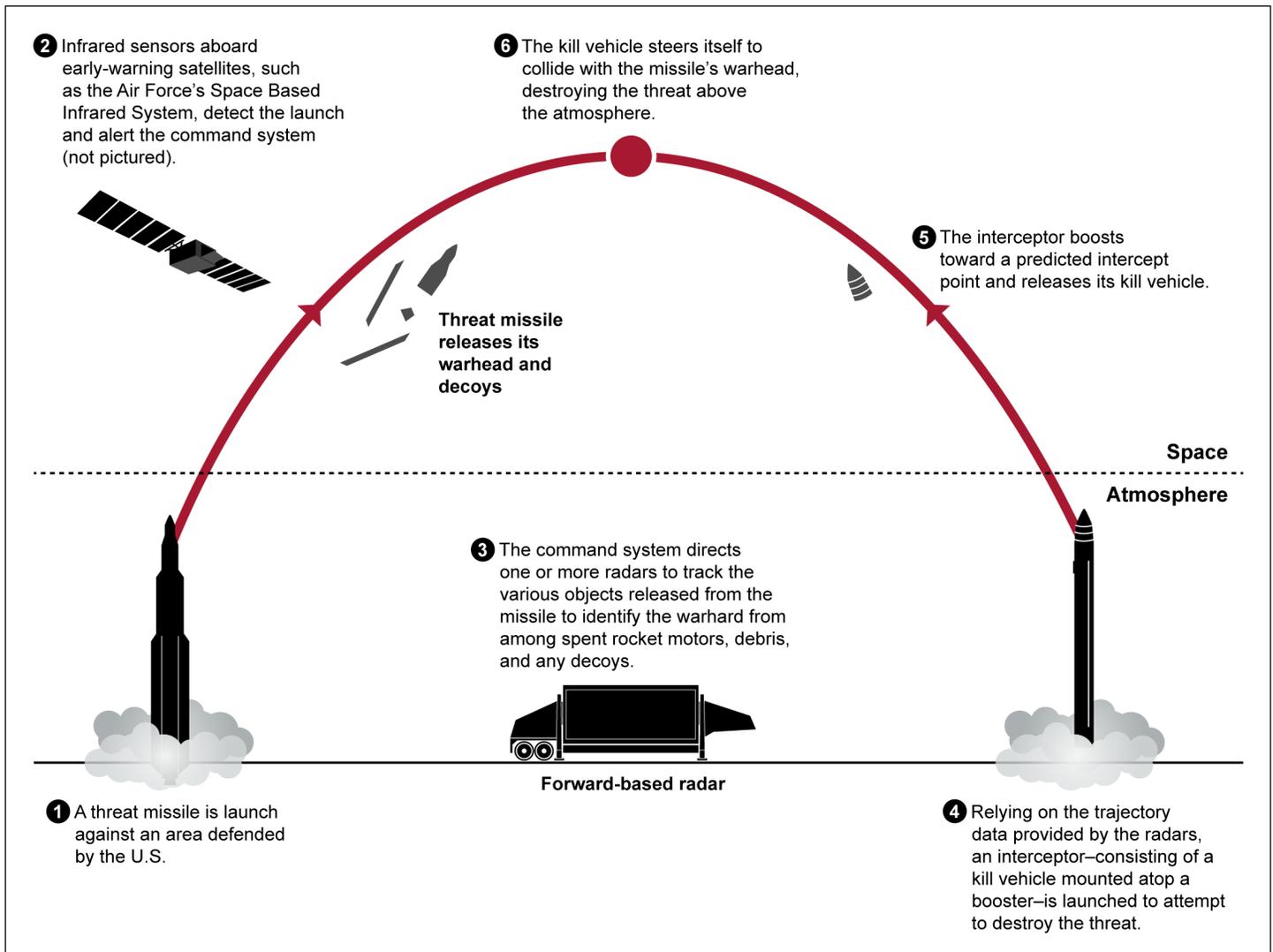
Ballistic missiles have different ranges—short, medium, intermediate, and intercontinental—as well as different speeds, sizes, and performance characteristics. Short-range ballistic missiles have a range of less than 621 miles; medium-range ballistic missiles have a range from 621 to 1,864 miles; intermediate-range ballistic missiles have a range from 1,864 to 3,418 miles; and intercontinental ballistic missiles have a range greater than 3,418 miles. As a result, MDA is developing a variety of systems that, when integrated, provide multiple opportunities to destroy ballistic missiles in flight for the strategic defense of the United States and regional defense of its deployed forces and allies. The BMDS includes space-based sensors; ground- and sea-based radars; ground- and sea-based interceptor missiles; and a command and control system that provides communication links to the sensors and interceptor missiles.

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<sup>7</sup>Pub. L. No. 112-239, § 224(e), 231(e), 229(c), and 228(c). For our assessments of DOD's reports, see GAO, *Missile Defense: Precision Tracking Space System Evaluation of Alternatives*, [GAO-13-747R](#) (Washington, D.C.: July 25, 2013) and *Regional Missile Defense: DOD's Report Provided Limited Information; Assessment of Acquisition Risks is Optimistic*, [GAO-14-248R](#) (Washington, D.C.: Mar. 14, 2014). At the time of publication of this report, our work on DOD's reports on the Ground-based Midcourse Defense system's test plan and homeland defense report is ongoing.

Once a ballistic missile has been launched, these sensors and interceptors track and engage the threat missile during its flight as shown in figure 1.

**Figure 1: Typical Engagement Scenario of the Ballistic Missile Defense System Defending Against an Intercontinental Ballistic Missile**



Source: GAO analysis of MDA data.

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## MDA's Flexible Acquisition Approach

When MDA was established in 2002, the Secretary of Defense granted it exceptional flexibility to set requirements and manage the acquisition of the BMDS in order to meet a presidential directive to deliver an initial defensive capability against ballistic missiles in 2004. This flexibility allows MDA to develop BMDS elements outside of DOD's standard acquisition process until they are mature enough to be handed over to a military service for production and deployment.<sup>8</sup> Because the BMDS's entrance into DOD's acquisition process is deferred, certain laws and policies that generally require major defense acquisition programs to take certain steps at certain phases in the DOD acquisition process do not yet apply to MDA. For example, before a major defense acquisition program begins the product development phase, it must document key performance, cost, and schedule goals in an acquisition baseline that has been approved by a higher-level DOD official.<sup>9</sup> This acquisition baseline is used to measure a program's performance as it progresses. Specifically, as implemented by DOD, major defense acquisition programs' baselines provide decision makers with key goals such as the program's total cost for an increment of work, key dates associated with acquiring a capability, and the weapon's intended performance. Additionally, once a baseline has been approved, DOD's major defense acquisition programs are required to measure performance against their baseline and report certain changes to Congress. For instance, they are required to report certain increases in unit cost (cost divided by the

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<sup>8</sup>The BMDS program meets the definition of a major defense acquisition program, which is defined in 10 U.S.C. § 2430 and implemented by DOD in its acquisition policy. Currently, a major defense acquisition program is defined as an acquisition program that is not a highly sensitive classified program and is designated as a major defense acquisition program or the dollar value for all increments of the program is estimated to require an eventual total expenditure for research, development, test, and evaluation of more than \$480 million in fiscal year 2014 constant dollars or, for procurement of more than \$2.79 billion in fiscal year 2014 constant dollars. DOD develops its major defense acquisition programs through an acquisition process in which programs move through phases of their life cycle including a materiel solution analysis phase, a technology maturation and risk reduction phase, an engineering and manufacturing development phase, a production and deployment phase, and an operations and support phase. See Interim DOD Instruction, 5000.02, "Operation of the Defense Acquisition System" (Nov. 25, 2013).

<sup>9</sup>10 U.S.C. § 2435 requires an approved program baseline description for major defense acquisition programs before the program enters system development and demonstration (now known as engineering and manufacturing development), production and deployment, and full-rate production.

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quantity produced) measured from the original and the current program baseline.<sup>10</sup>

While this flexibility allows MDA latitude to manage the BMDS and enable it to rapidly develop and field new systems, we have previously reported that the agency has used this flexibility to employ acquisition strategies with high levels of concurrency (that is, overlapping activities such as testing and production), which increases the risk for performance shortfalls, costly retrofits, and test problems.<sup>11</sup> We have also reported that this flexibility has hampered oversight and accountability.<sup>12</sup> According to MDA officials, MDA has taken some steps to identify and track concurrency in their programs.

Congress has taken steps to improve the transparency and accountability of BMDS development efforts. For example, in the National Defense Authorization Act for Fiscal Year 2008, Congress required MDA to establish cost, schedule, and performance baselines for certain BMDS elements.<sup>13</sup> MDA first reported baselines for several BMDS elements to Congress in its June 2010 BAR and has continued to report baselines annually. Table 1 describes the six acquisition baselines MDA established and reports in its BAR for individual BMDS elements or major portions of such elements.<sup>14</sup>

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<sup>10</sup>10 U.S.C. § 2433, also known as “Nunn-McCurdy.” Because MDA is not required to prepare a baseline under 10 U.S.C. § 2435, there is no basis for determining unit costs under 10 U.S.C. § 2433.

<sup>11</sup>[GAO-12-486](#).

<sup>12</sup>[GAO-10-311](#).

<sup>13</sup>Pub. L. No. 110-181, § 223(g), *repealed by* Pub. L. No. 112-81, § 231(b) (2011).

<sup>14</sup>MDA’s targets program does not have acquisition baselines because targets are developed to support other BMDS elements and are not operationally fielded. However, MDA does report some cost, schedule, and performance information for its targets program in the BAR.

**Table 1: Missile Defense Agency (MDA) Acquisition Baselines**

<b>Baseline</b>	<b>Description</b>
Resource	Reports costs for all the major categories of a program's life cycle including research and development, procurement, military construction, operations and support, and disposal costs. Also includes unit costs, which are usually reported in two ways: (1) average procurement unit cost—the average cost to produce one unit, and (2) program acquisition unit cost—the average cost to develop and produce one unit. <sup>a</sup>
Schedule	Reports a time line of key development milestones and tasks such as important acquisition decisions, significant increases in performance knowledge, and product deliveries.
Test	Reports a schedule of major flight and ground tests, as well as key model and simulations events.
Operational capacity	Reports information on the fielding plans, capabilities and limitations, and supporting activities for delivering operational capabilities.
Technical	Reports a list of capability needs derived from the warfighters' prioritized capabilities, as well as current and future capabilities. The list describes the functionality of the program and identifies the knowledge a program must meet to proceed.
Contract	Reports a time line for a set of contracts designed to deliver integrated ballistic missile defense system capabilities from request for proposals through proposal receipt, completion of negotiations, contract award, and contract execution.

Source: GAO analysis of MDA's 2013 Ballistic Missile Defense System Accountability Report.

<sup>a</sup>10 U.S.C. § 2432 defines, with respect to a major defense acquisition program, procurement unit cost as the amount equal to (1) the total of all funds programmed to be available for obligation for procurement for the program divided by (2) the number of fully configured end items to be procured. Program acquisition unit cost is defined as the amount equal to (1) the total cost for development and procurement of, and system-specific military construction for, the acquisition program divided by (2) the number of fully configured end items to be produced for the acquisition program.

Most recently, the National Defense Authorization Act for Fiscal Year 2012 amended MDA's baseline reporting requirements.<sup>15</sup> Specifically, the law currently requires MDA to report to the congressional defense committees certain changes or variances in the current baselines from the baselines presented in the prior year's report and from when the baselines were initially established. Additionally, the act allows MDA to revise an initial baseline, which the agency refers to as a "revised initial baseline."

<sup>15</sup>Pub. L. No. 112-81, § 231(a) (2011) (codified as amended at 10 U.S.C. § 225) requires MDA to establish and maintain baselines for certain elements or major portions of elements prior to the product development phase (or its equivalent) and prior to production and deployment, and report these to the congressional defense committees annually. The congressional defense committees are the Committee on Armed Services and the Committee on Appropriations of the Senate; and the Committee on Armed Services and the Committee on Appropriations of the House of Representatives. 10 U.S.C. § 101(a)(16).

In 2010, MDA also established an acquisition process that continues to guide the development of the BMDS. Table 2 identifies the five life cycle phases of MDA's acquisition process.

**Table 2: Missile Defense Agency (MDA) Acquisition Life Cycle Phases for the Ballistic Missile Defense System (BMDS)**

<b>Materiel solutions analysis</b>	<b>Technology development</b>	<b>Product development</b>	<b>Initial production</b>	<b>Production<sup>a</sup></b>
An analysis period to develop potential alternative solutions.	For developing and maturing technology solutions for a capability shortfall.	To further develop the potential BMDS component to refine and mature the design and manufacturing issues.	Used primarily to provide an initial base for production and provide articles for continued testing.	For producing final operational end items to satisfy Warfighter-capability requirements.

Source: MDA Instruction 5013.02-INS (data); GAO (presentation).

<sup>a</sup>According to MDA policy, transition to fielding and therefore, sustainment and support, occurs during the production phase.

The agency has documented the key knowledge that is needed prior to the technology development, product development, initial production, and production phases. For example, prior to entering initial production, an element must demonstrate that its design and manufacturing processes are stable, planned quantities are affordable, and developmental and operational test results show that the user's needs will be met. In general, developmental testing is aimed at determining whether the system design will satisfy the desired capabilities, while operational testing is aimed at determining whether the system is effective, survivable, and suitable in the hands of the user under realistic conditions. Additionally, according to DOD policy, programs entering initial production or production require approval from DOD's Under Secretary of Defense for Acquisition, Technology, and Logistics.

**Description of BMDS Elements**

Table 3 describes the BMDS elements and programs assessed in this report and their current MDA acquisition phase.

**Table 3: Description of Selected Ballistic Missile Defense System (BMDS) Elements and Programs**

BMDS element/ program	Description and key components	MDA acquisition phase and operational status
Aegis Ballistic Missile Defense (BMD) with Standard Missile-3 (SM-3) Block IB and Aegis BMD second generation weapon system software	Aegis BMD is a sea-based system developed to defend against short-, medium-, and intermediate-range ballistic missiles in the middle part of their flight. MDA is developing several versions of missiles and associated ship-based software and processors. <sup>a</sup> The SM-3 Block IB features additional capabilities over the previous SM-3 version to identify, discriminate, and track objects during flight. The Aegis BMD second generation software also provides increased capabilities with its ability to more accurately locate, discriminate, and track more sophisticated threat objects as well as uplink that data to the SM-3 Block IB interceptor faster than the previous software version. All sea-based Aegis BMD systems also include a shipboard radar and command and control systems.	Initial production. Plans to be operational in 2014 and available for regional defense in Europe and other regions in 2015.
Aegis Modernized Weapon System Software	Developed jointly with the Navy, the Aegis modernized weapon system software provides increased capability over the Aegis BMD second generation weapon system software. MDA is currently developing two versions: the first version integrates the Aegis BMD second generation weapon system software with Aegis ship anti-air defense capabilities, while the second version contains a capability upgrade to improve on the types and the numbers of ballistic missiles the system can engage.	Product development. MDA plans to install the software on a total of 13 ships to support regional defenses in Europe and other regions by fiscal year 2018.
Aegis Ashore	A land-based, or ashore, version of Aegis BMD initially using SM-3 Block IB missiles and the capability upgrade version of the Aegis modernized weapon system software, with plans to use various versions of SM-3 missiles and Aegis BMD weapon system software as they become available. Key components include SM-3 missiles, a vertical launch system, an enclosure that houses a radar and command and control system, and Aegis BMD weapon system software. MDA is currently planning to construct three Aegis Ashore sites: one test site in Hawaii and two for the defense of Europe.	Product development. MDA completed the installation at the Hawaii test site and plans to begin flight testing the system in the middle of calendar year 2014 through the middle of 2015. MDA plans to deliver the first operational site in Romania in the end of 2015 and the second site in Poland in the end of 2018 to support the defense of Europe.
Army Navy/Transportable Radar Surveillance and Control Model 2 (AN/TPY-2) <sup>b</sup>	The AN/TPY-2 is a transportable X-band high resolution radar that is capable of tracking ballistic missiles of all ranges. AN/TPY-2 can be used in two modes: in the forward-based mode it is used to support Aegis BMD and Ground-based Midcourse Defense or in the terminal mode used with Terminal High Altitude Area Defense.	Production. MDA has delivered nine AN/TPY-2 radars—five for use in forward-based mode and four for use in terminal mode—worldwide to support regional defenses. Forward-based radars were conditionally accepted by the Army with full acceptance expected by June 2016. MDA plans to procure and deliver three additional radars for use in terminal mode.

BMDS element/ program	Description and key components	MDA acquisition phase and operational status
Command, Control, Battle Management, and Communications (C2BMC)	C2BMC is a globally deployed system that links and integrates individual missile defense elements. It also allows users to plan ballistic missile defense operations, see the battle develop, and manage networked sensors. MDA has released several versions of the software, known as spirals, which continue to improve on the C2BMC's ability to manage information among the BMDS elements. The system also includes hardware such as workstations, servers, and network equipment.	Product development. The latest spiral, known as Spiral 6.4, has been operational since 2011. The next spiral, known as Spiral 8.2, is in product development with plans to be installed in fiscal year 2017.
Ground-based Midcourse Defense (GMD) System	The GMD program is a ground-based defense system designed to defend the United States against a limited intermediate and intercontinental ballistic missile attack in the middle part of their flight. Key components include a ground-based interceptor consisting of a booster with a kill vehicle on top, as well as a communication system and a fire control capability. The kill vehicle uses on-board sensors and divert capabilities to steer itself into the threat missile to destroy it. There are currently two versions of the kill vehicle: the initial design known as the Capability Enhancement-I (CE-I) and the upgraded design known as the Capability Enhancement-II (CE-II).	Product development. CE-I interceptors are fielded for the defense of the United States and are located at Fort Greely, Alaska and Vandenberg Air Force Base, California. CE-II interceptors are in development and have not yet been demonstrated to work as intended through flight testing although 13 have been delivered.
Targets and Countermeasures	MDA develops and manufactures highly complex targets that represent realistic threat scenarios during BMDS flight tests to aid other BMDS elements' developmental efforts. MDA develops and manufactures a variety of targets including short-, medium-, intermediate-, and eventually intercontinental ranges.	Product development. Because targets are developed to support other BMDS elements, they are not operationally fielded.
Terminal High Altitude Area Defense (THAAD)	THAAD is a mobile, ground-based missile defense system designed to defend against short- and medium-range ballistic missiles in the late-middle and end of their flight. THAAD is organized as a battery, which includes interceptors, launchers, an AN/TPY-2 radar, a fire control and communications system, and other support equipment. MDA is also developing a system upgrade, known as THAAD 2.0, to provide an expanded defense against short-to-medium range threats and increase integration with other BMDS elements.	Production. First two THAAD batteries were conditionally accepted by the Army with full acceptance expected by the end of fiscal year 2017. MDA plans to deliver the ground equipment for a total of six batteries by the end of fiscal year 2017 and an inventory of interceptors to fully load six batteries by fiscal year 2020. THAAD 2.0 is in product development with plans to be operational in fiscal year 2019.

Source: GAO analysis of MDA data.

<sup>a</sup>Other Aegis BMD SM-3 interceptor versions include the SM-3 Block IA, SM-3 Block IIA, and SM-3 Block IIB. We did not assess the SM-3 Block IA because it has been in production since 2005 and is currently operational for regional defense in Europe as well as other regions. We also did not assess the SM-3 Block IIA because it is in the technology development phase and therefore does not have cost, schedule, or performance baselines. Lastly, we did not assess the SM-3 Block IIB program because DOD canceled the program in March 2013.

<sup>b</sup>Details on the acquisition progress of MDA's other sensors such as the Sea-based X-band and Cobra Dane radars are not included in this report because they have transitioned to sustainment, and therefore, MDA did not report acquisition baselines for these elements in the 2013 BAR. We also did not assess the Upgraded Early Warning Radars because this was the first year that MDA reported acquisition baselines for this element in the BAR and therefore we could not make comparisons to past years.

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## Missile Defense Acquisition Changes in Fiscal Year 2013

In March 2013, in response to a growing threat from Iran and North Korea, the Secretary of Defense announced steps that affected the acquisition of the BMDS including

- deploying 14 additional ground-based interceptors in Fort Greely, Alaska by 2017;
- deploying a second AN/TPY-2 radar to Japan; and
- shifting the resources from development of the Aegis BMD SM-3 Block IIB interceptor, which was planned to be deployed after 2020 to defend against intercontinental ballistic missiles, to fund the additional ground-based interceptors, as well as develop advanced technology to improve the performance of current and future versions of BMDS interceptors.

In 2013, DOD canceled the Aegis BMD SM-3 Block IIB and the Precision Tracking Space System citing concerns with the programs' high-risk acquisition strategies and technical challenges that GAO has previously raised. We have previously reported that MDA did not consider a broad range of alternatives or fully assess program or technical risks before committing to either program.<sup>16</sup>

In addition, MDA altered its fiscal year 2013 acquisition plan to offset a funding reduction of \$568 million (6.8 percent) in its total available budget for fiscal year 2013. For example, in consultation with key stakeholders such as the Operational Test Agency and DOD's Office of the Director, Operational Test and Evaluation, MDA revised its test plan by combining, delaying, and deleting tests to cut costs. MDA also delayed some development activities for various elements into fiscal year 2014 and beyond.

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<sup>16</sup>The Precision Tracking Space System was to be a satellite system equipped with infrared sensors to track ballistic missiles through their emitted heat. See [GAO-13-747R](#); *Standard Missile-3 Block IIB Analysis of Alternatives*, [GAO-13-382R](#) (Washington, D.C.: Feb. 11, 2013); and [GAO-13-432](#).

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## BMDS Flight Tests Successfully Executed, but Development Challenges Continue

In fiscal year 2013, MDA successfully executed several flight tests that demonstrated key BMDS capabilities and modifications made to resolve prior development issues, but continued to experience failures and delays resulting in less testing and production than planned. For the first time in September 2013, the Aegis BMD and Terminal High Altitude Area Defense (THAAD) programs participated in an operational flight test that resulted in a near simultaneous engagement. Additionally, the Aegis BMD program also successfully conducted flight tests with the SM-3 Block IB missile. However, according to officials from the DOD's Office of the Director, Operational Testing and Evaluation, Aegis BMD experienced a SM-3 Block IB missile failure that is currently being investigated and could result in a modification to a component that is common between the Aegis BMD SM-3 Block IA and IB. Lastly, GMD also successfully conducted a non-intercept test of its upgraded interceptor that is currently in development, but experienced an intercept test failure of the fielded interceptor, the cause of which is still unknown. Further details on the operational test are provided after table 4. In addition, because ongoing testing and development challenges increase the potential to affect the production of the SM-3 Block IB missile as well as delaying understanding of the capabilities and limitations of GMD's fielded interceptor, we also provide additional details for these programs after the table.

Table 4 presents a summary of key accomplishments and challenges for BMDS elements and programs that are in the BAR.

**Table 4: Selected Ballistic Missile Defense System Acquisition Progress and Challenges**

BMDs element/ program	Progress	Challenges
Aegis Ballistic Missile Defense (BMD) with Standard Missile-3 (SM-3) Block IB and Aegis BMD second generation weapon system software	<ul style="list-style-type: none"> <li>Conducted three flight tests, all of which achieved target intercept, in support of a full production decision in fiscal year 2015.</li> <li>Awarded contracts for 33 SM-3 Block IB missiles.</li> <li>Began installation of Aegis BMD second generation weapons system on two additional ships. After they are completed there will be six ships in that configuration.</li> <li>Delivered 10 SM-3 Block IB research, development, test and evaluation missiles.</li> </ul>	<ul style="list-style-type: none"> <li>SM-3 Block IB interceptor failed in flight during one of the three flight tests. The failure occurred during a salvo test, where two interceptors were launched against a single target. A failure review is ongoing to determine the root cause of the failure and may result in design changes to a component common to the SM-3 Block IA. Effects on production remain unclear.</li> </ul>
Aegis Modernized Weapon System Software	<ul style="list-style-type: none"> <li>Completed installation on the first ship and initiated installation on two additional ships.</li> <li>Completed a review of the capability upgrade design to assess its readiness to proceed with demonstration and testing.</li> </ul>	<ul style="list-style-type: none"> <li>Seventeen-month delay in associated development efforts by the Navy increased MDA program cost. To offset this increase, MDA reduced its engineering support which could affect its ability to resolve development challenges if significant issues arise prior to delivery.</li> <li>Discovery of software defects continues to outpace the program's ability to fix them; fixes may have to be implemented after software is delivered.</li> </ul>
Aegis Ashore	<ul style="list-style-type: none"> <li>Finished assembly of the first operational Aegis Ashore facility at the construction site in New Jersey, fully powered on the combat system for the first time, and validated the Aegis Ashore facility design.</li> <li>Completed installation at the Hawaii test site.</li> <li>Initiated construction of the facility in Romania.</li> </ul>	<ul style="list-style-type: none"> <li>MDA plans to complete development of the first operational facility and award a contract to begin the second before flight testing demonstrates that the facility works with the Aegis modernized weapon system software and interceptors as intended.</li> <li>Flight test delays and cancellations, as well as challenges with development of the Aegis modernized weapon system software increase the risk of discovering performance issues that may require fixes after operational deployment.</li> </ul>
Army Navy/Transportable Radar Surveillance and Control Model 2 (AN/TPY-2)	<ul style="list-style-type: none"> <li>Participated in the first operational system-level flight test of the BMDs in both forward-based and terminal modes in September 2013.</li> <li>Delivered two terminal mode radars.</li> <li>Initiated the deployment of a second forward-based radar to Japan as directed by the Secretary of Defense in March 2013.</li> <li>Achieved agreement with the Army for operation and sustainment cost sharing responsibilities.</li> <li>Increased the total number of radars procured from 11 to 12 and awarded a contract for the additional radar in December 2013.</li> </ul>	<ul style="list-style-type: none"> <li>No significant challenges with the production and delivery schedule of radars 8-11 to support THAAD.</li> <li>According to DOD's Director, Operational Testing and Evaluation assessment, during the conduct of a BMDs operational test, the power unit for the radar experienced anomalous behavior.</li> </ul>

BMDS element/ program	Progress	Challenges
Command, Control, Battle Management, and Communications (C2BMC)	<ul style="list-style-type: none"> <li>Initiated delivery of two sets of software modifications and fixes to the fielded Spiral 6.4.</li> <li>Demonstrated some capability of Spiral 8.2.</li> <li>Participated in the first operational flight test of the BMDS controlling the forward-based AN/TPY-2 and cueing Aegis BMD and THAAD.</li> </ul>	<ul style="list-style-type: none"> <li>Delays in development of Spiral 8.2 require a retrofit to Spiral 6.4 to maintain an early warning capability for GMD.</li> <li>MDA identified additional software modifications for Spiral 6.4 that are needed by fiscal year 2015. However, MDA has yet to define some of them, increasing the risk that it will not meet this date.</li> </ul>
Ground-based Midcourse Defense (GMD) System	<ul style="list-style-type: none"> <li>Successfully achieved all planned objectives for a Capability Enhancement (CE)-II non-intercept flight test, Control Test Vehicle (CTV)-01, in January 2013, in support of Flight Test Ground (FTG)-06b.</li> <li>Began refurbishment of Missile Field 1 and continued emplacing interceptors in Missile Field 2 at Fort Greely, Alaska.</li> <li>Completed the Fort Greely, Alaska Power Plant, the back-up power source for the Missile Defense Complex mission essential equipment.</li> </ul>	<ul style="list-style-type: none"> <li>GMD failed to achieve an intercept using the CE-I kill vehicle during FTG-07 in July 2013. A failure investigation is ongoing and, according to program officials, is expected to be completed in the second quarter of fiscal year 2014.</li> <li>MDA faces significant management, development, and production challenges as it must concurrently: (1) determine the root cause of the FTG-07 failure; (2) successfully execute the demonstration of the CE-II redesign; (3) restart CE-II production to meet fielding obligations; and (4) potentially retrofit already delivered CE-II interceptors.</li> <li>GMD's ongoing testing issues in conjunction with the program's concurrent acquisition practices increase the risk that any new development or production issues will cause major disruptions to the program.</li> </ul>
Targets and Countermeasures	<ul style="list-style-type: none"> <li>Launched 10 targets, including the first flight for its extended medium-range ballistic missile (eMRBM) during the first operational system-level flight test in September 2013.</li> </ul>	<ul style="list-style-type: none"> <li>According to independent testing officials, the expected number of targets to support the first operational test campaign were not available resulting in less data gathered.</li> <li>MDA adjusted its annual flight test plan by deleting two tests, delaying six tests, and modifying the targets used in two tests to reduce target costs.</li> </ul>
Terminal High Altitude Area Defense (THAAD)	<ul style="list-style-type: none"> <li>Successfully conducted two complex intercept tests against medium-range targets.</li> <li>First battery deployed to Guam in April 2013.</li> <li>Began training of the third battery in June 2013.</li> <li>Received approval for production of the sixth battery in October 2012.</li> </ul>	<ul style="list-style-type: none"> <li>According to DOD's Director, Operational Test and Evaluation, some THAAD components did not meet reliability requirements. Their average time between failures and needed repairs is inconsistent and/or inadequate.</li> </ul>

Source: GAO analysis of DOD documents and interviews with DOD officials

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## First System-level Operational Test of the BMDS

After more than 11 years of development of the BMDS, MDA conducted the first system-level operational missile defense flight test called Flight Test Operational-01 (FTO-01) in September 2013. During the test, warfighters from several combatant commands employed multiple missile defense systems including Aegis BMD and THAAD to demonstrate the regional capabilities of U.S. missile defense. This is a significant achievement because it is the first operational test that involved multiple elements working simultaneously. To conduct this test, MDA invested in range assets and conducted other activities to ensure it could test multiple elements at once. For example, MDA conducted its first integrated system-level flight test, known as Flight Test Integrated-01, in October 2012 as a risk-reduction exercise for the operational test.<sup>17</sup> During FTO-01, MDA launched two nearly simultaneous threat-representative medium-range ballistic missile targets including its air-launched extended-medium range ballistic missile (eMRBM) target for the first time.<sup>18</sup> This test was delayed for approximately one year in part because of development problems associated with the eMRBM target. MDA also had to make some adjustments to the FTO-01 test plan because of fiscal year 2013 sequestration. Although MDA preserved its primary objective to demonstrate the interoperability of BMDS elements, it reduced the number of targets included in the test from five to two and removed participation of more mature elements such as the Patriot Advance Capability-3.

The BMDS elements successfully engaged the targets during the test, but according to independent testing officials, full system integration was not achieved. Specifically, according to the DOD's Director, Operational Test and Evaluation, the Aegis ship successfully intercepted one of the targets with a SM-3 Block IA and THAAD successfully intercepted a medium-range target for the second time. In addition, as a planned demonstration of its layered defense, THAAD launched a second interceptor at the target intercepted by the Aegis ship as a contingency in event the SM-3 Block IA did not achieve an intercept. However, DOD's Director, Operational Test and Evaluation, also found that the test failed to achieve

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<sup>17</sup>As we found in April 2013, MDA coordinated multiple combatant commands and missile defense elements to intercept four of five targets launched during the integrated test. See [GAO-13-432](#).

<sup>18</sup>MDA originally planned to use two of its new eMRBM targets for the first time during the operational flight test. According to an agency official, MDA only used one of its eMRBM targets and the second medium-range ballistic missile used in the test was provided from an alternate source.

full integration between all systems due to challenges with system networks, limitations in elements' ability to work together and component failures. For example, the test uncovered several issues with communication networks that are needed for interoperability between all elements. Interoperability is important because it can improve the missile defense effectiveness and enhance individual systems performance beyond operating alone.

### Aegis BMD SM-3 Block IB

The Aegis BMD SM-3 Block IB program largely overcame previous development challenges and successfully intercepted all targets in its last three flight tests as shown in table 5. These tests are required for a full production decision—the last key production authorization by the Under Secretary of Defense, Acquisition, Technology, and Logistics that would allow MDA to produce the remaining 415 interceptors. However, a missile failure of the second interceptor launched during the September 2013 test could increase production risk if design changes are needed.

**Table 5: Most Recent Flight Tests of Second Generation Aegis Ballistic Missile Defense (BMD) and Standard Missile (SM)-3 Block IB**

Test name	Test date	Test overview	Outcome
Flight Test Standard Missile (FTM)-19	May 2013	<ul style="list-style-type: none"> <li>Demonstrated the discrimination capabilities of the ship's weapons system and the interceptor against a complex short-range ballistic missile target.</li> <li>Also demonstrated modifications made to the Aegis BMD second generation weapon system in response to the failure of a SM-3 Block IB flight test in September 2011.</li> <li>Conducted following more than a 15-month delay.</li> </ul>	<ul style="list-style-type: none"> <li>SM-3 Block IB successfully intercepted the target.</li> </ul>
FTM-21	September 2013	<ul style="list-style-type: none"> <li>First salvo test of SM-3 Block IB where two interceptors were launched against a single short-range ballistic missile target.</li> <li>Further assessed the discrimination capabilities of the Aegis BMD second generation weapon system and the SM-3 Block IB.</li> <li>MDA considers this test a success because the first missile intercepted the target, but according to officials from DOD's Office of the Director, Operational Test and Evaluation, the second interceptor failed in flight.</li> <li>Conducted following more than 6-month delay.</li> </ul>	<ul style="list-style-type: none"> <li>First SM-3 Block IB successfully intercepted the target.</li> <li>Second SM-3 Block IB failed in flight.</li> </ul>
FTM-22	October 2013	<ul style="list-style-type: none"> <li>Demonstrated the capability of the Aegis BMD second generation weapon system to engage medium-range targets with the SM-3 Block IB interceptor.</li> <li>Marked the end of initial operational flight testing and evaluation of the system.</li> <li>Conducted following more than a 12-month delay.</li> </ul>	<ul style="list-style-type: none"> <li>SM-3 Block IB successfully intercepted the target.</li> </ul>

Source: GAO analysis of Missile Defense Agency and Director, Operational Test and Evaluation data.

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As we found in April 2013, the SM-3 Block IB production line has been repeatedly disrupted since 2011 due to flight test anomalies caused by malfunctions in two separate sections of the third-stage rocket motor, and development challenges with the throttleable divert and attitude control system—components that maneuver the interceptor in its later stages of flight.<sup>19</sup> These challenges delayed the SM-3 Block IB full production authorization by more than two years to fiscal year 2015. Largely resolving these previous challenges, in fiscal year 2013 the program received permission to procure 33 additional initial production missiles. Although MDA initially planned to award a contract for 29 SM-3 Block IB missiles in fiscal year 2013, it bought four additional missiles in August 2013 to recover an earlier reduction. That reduction occurred to provide funds to resolve technical and production issues. Based on successful intercepts of the last three flight tests, the program also received permission to buy 52 more interceptors in fiscal year 2014.

Despite the three successful intercepts, the effect of the missile failure in September 2013 on the upcoming full production decision remains unclear. Before the program enters into full production, MDA's acquisition management instruction requires it to demonstrate to the Under Secretary of Defense, Acquisition, Technology, and Logistics that there are no significant risks to production and that the planned production quantities are affordable and fully funded. The permission to enter full production is also based on independent assessments of the weapon's effectiveness and suitability by the DOD's Director, Operational Test and Evaluation and the Navy's Commander Operational Test & Evaluation Force. Although the failure investigation is ongoing, preliminary results indicate that the failure occurred in the third-stage rocket motor, a component common to the SM-3 Block IA, which is nearing the end of its production. Different issues with that same component have contributed to previous SM-3 Block IB schedule delays and production disruptions. While the precise cause of the September 2013 failure is under review, MDA documentation indicates that it could potentially result in design changes to the third-stage rocket motor and changes to manufacturing processes. Additionally, retrofits may be required for SM-3 Block IB and SM-3 Block IA interceptors that were already produced. If design changes are necessary, program documentation indicates that they will not be flight tested until the fourth quarter of fiscal year 2015, just prior to the planned

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<sup>19</sup>[GAO-13-432](#).

deployment of the SM-3 Block IB to support the regional defense of Europe and 6 months after its planned full production decision. Consequently, until the program thoroughly understands the extent of needed modifications, if any, and their effects on performance as demonstrated through testing, its production strategy is at risk of cost growth and schedule delays. MDA has experienced these consequences in other elements when it pursued design changes concurrently with production.

**GMD**

Although the GMD program made progress in resolving a prior CE-II intercept failure, test failures and development challenges continue to disrupt the program and increase the cost to demonstrate the new CE-II. The GMD program first attempted to demonstrate the CE-II interceptor in January 2010 but subsequently experienced a number of setbacks in both the CE-II and the fielded CE-I, as seen in table 6 below.

**Table 6: Critical Ground-based Midcourse Defense (GMD) Flight Tests**

Test name	Test date	Test overview
Flight Test Ground (FTG)-06	January 2010	<ul style="list-style-type: none"> <li>• First intercept attempt with Capability Enhancement (CE)-II to prove the interceptor design works as intended.</li> <li>• Intended to demonstrate an intercept of a longer range target in more challenging conditions.</li> <li>• Was first planned to occur in first quarter fiscal year 2008 but was delayed to January 2010 due to developmental challenges and target availability.</li> <li>• Failed to intercept because of a quality control issue and consequently the CE-II's design and performance capabilities were not demonstrated as planned. However, the quality control issue has since been resolved.</li> </ul>
FTG-06a	December 2010	<ul style="list-style-type: none"> <li>• Re-test of FTG-06 using CE-II with similar objectives.</li> <li>• Failed to intercept because of guidance system component failure and consequently the CE-II's design and performance capabilities were not demonstrated as planned.</li> <li>• The Missile Defense Agency (MDA) halted CE-II production until the failure cause was identified and corrected.<sup>a</sup></li> </ul>
Controlled Test Vehicle (CTV)-01	January 2013	<ul style="list-style-type: none"> <li>• Non-intercept, diagnostic flight test of the CE-II to demonstrate performance of a redesigned guidance system component.</li> <li>• Successfully achieved all test objectives.</li> <li>• Additional ground testing revealed further corrective actions were needed.</li> </ul>

Test name	Test date	Test overview
FTG-07	July 2013	<ul style="list-style-type: none"> <li>• First CE-I intercept attempt in almost 5 years.</li> <li>• Similar test capability performance objectives as FTG-06 but with a CE-I.</li> <li>• Also intended to demonstrate the efficacy of CE-I upgrades implemented over the last 5 years, including software changes to enhance performance.</li> <li>• Failed to intercept, although all of the other BMDS elements in the flight test performed as planned and the interceptor was launched.</li> <li>• Failure review is ongoing with expected completion, according to program officials, by the second quarter of fiscal year 2014.</li> </ul>
FTG-06b	Projected third quarter fiscal year 2014	<ul style="list-style-type: none"> <li>• Re-test of FTG-06/FTG-06a using a CE-II with similar objectives.</li> <li>• Intended to demonstrate the successful mitigation to the FTG-06a failure cause.</li> <li>• Experienced approximately 2 years of delays to conduct the test.</li> <li>• Successful intercept needed to resume CE-II production.</li> <li>• The program is pursuing another design effort to address performance concerns and serve as an alternative plan if the mitigation to be demonstrated in FTG-06b is unsuccessful.</li> </ul>

Source: GAO analysis of MDA data.

Note: For more information, see [GAO-14-350R](#).

<sup>3</sup>MDA halted all assembly, integration, manufacture, and refurbishment of CE-II kill vehicles until the CE-II mitigation is successfully demonstrated in flight testing, including an intercept flight test.

Developing a mitigation to the FTG-06a failure has proven more difficult than initially expected. The program initially planned to conduct FTG-06b in the third quarter of fiscal year 2012 but the test has since been delayed to at least the third quarter of fiscal year 2014 because of challenges resolving test failures. For example, while initial results from CTV-01 indicated the redesigned guidance system component could be used to resolve the problem that caused the FTG-06a failure, subsequent ground testing revealed that only one-third of those produced could be used in future interceptor production or flight tests because the component's performance was uncertain. The program mitigated the issue by implementing software and hardware modifications and delivered the redesigned component for kill vehicle integration in October 2013. However, according to MDA, the program experienced further delays in the FTG-06b test while it implemented changes based on assessments from the ongoing FTG-07 failure review. Consequently, confirmation that the CE-II design works as intended has been delayed by nearly seven years and costs have increased by over \$1 billion because of the CE-II development challenges and test failures.

In July 2013, MDA conducted the FTG-07 developmental test to understand the performance of the fielded CE-I against a longer range target in more challenging conditions and assess the performance of

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upgrades. This interceptor was fielded before completing developmental testing, leading MDA to undertake retrofit efforts and upgrades to fix issues identified during testing. According to acquisition best practices, developmental testing should be complete before beginning production and fielding in order to, among other reasons, avoid the need for retrofits and upgrades to fix issues discovered during testing. The test failed, delaying understanding of the capabilities and limitations of upgrades to the fielded CE-I. Shortly after the test failure, the Director, MDA stated a failure review was initiated to not only identify the root cause of the failure, but also provide a comprehensive review of potential CE-I failures and identify any correlations with the CE-II. Since then, according to program officials, MDA has identified a kill vehicle component common to both interceptors that could be associated with the FTG-07 failure. However, it remains unclear what, if any, design changes, retrofits, or other corrective actions to the CE-I or CE-II are necessary since the failure review is not complete. According to MDA officials, they have not determined if they will re-conduct the flight test. If the CE-I is not flight tested again, the warfighter will not have a full understanding of the capabilities and limitations of the upgrades to the CE-I interceptor, the original purpose of the FTG-07 test.

Overall, GMD's ongoing testing issues in conjunction with concurrent acquisition practices have caused—and will likely continue to cause—major disruptions to the program. We previously found that, in 2004, MDA committed to a highly concurrent development, production, and fielding strategy for the CE-II interceptor and began delivering interceptors in 2008.<sup>20</sup> Because MDA moved forward with CE-I and CE-II interceptor production before completing its flight testing program, test failures have exacerbated disruptions to the program. For example, because the program has delivered approximately three-fourths of the interceptors for fielding, the program faces difficult and costly decisions on how it will implement corrections from prior test failures. Also, the program has had to add tests that were previously not planned and delay tests that are necessary to understand the system's capabilities and limitations. As a result of these development challenges, the GMD program will likely continue to experience delays, disruptions, and cost growth.

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<sup>20</sup>[GAO-12-486](#).

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## MDA Made Its Resource and Schedule Baselines Clearer, but Further Actions Needed to Enhance Their Use for Oversight

MDA has taken some steps to improve the clarity of its resource and schedule baselines, but issues with the content and presentation of these baselines continue to limit the usefulness of the information available to decision makers for oversight of BMDS development efforts. Since 2011, we have found deficiencies in the quality of the cost estimates that underpin MDA's resource baselines and reported on the efforts MDA has undertaken to improve those estimates. In 2013, we found the agency made little progress addressing the underlying quality issues with those cost estimates that we raised. As a result, this is the fourth year we have found that the cost estimates that support MDA's resource baselines are not sufficiently reliable to support oversight. However, according to MDA officials, the agency is taking steps to improve the quality of its cost estimates to support the resource baselines it plans to report in its 2014 BAR. Assessing MDA's progress in achieving its schedule goals is also difficult because MDA's schedule baselines are not presented in a way that allows decision makers to understand or easily monitor progress. Until MDA improves the quality and comprehensiveness of its cost estimates and the clarity of its schedule information, its baselines may not be useful for decision makers.

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## MDA Made Limited Improvements to Its Resource and Schedule Baselines

In its 2013 BAR, MDA continued to make useful changes to its reported resource and schedule baselines. We found in March 2011 that MDA's schedule and resource baselines had several shortcomings that limited their usefulness for oversight, such as not explaining variances or significant changes in the baselines.<sup>21</sup> Additionally, we found in April 2013 that, in its 2012 BAR, MDA only reported annual progress by comparing its current estimates for unit cost and scheduled activities against the prior year's estimate and adjusted the content of the baselines from year to year in such a way that they were no longer comparable.<sup>22</sup> As a result, MDA's baselines were not useful for tracking longer term progress or for holding the agency accountable.

MDA took some action to improve the completeness and clarity of the BAR baselines by:

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<sup>21</sup>GAO-11-372.

<sup>22</sup>GAO-13-432.

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- identifying the date of the initial baseline and, if applicable, the date when the initial baseline was most recently revised for each element or major portion of an element reported in the BAR;
  - explaining most of the significant cost and schedule changes from the current baseline estimates against both the estimates reported in the prior year's BAR and the latest initial baseline; and
  - making the baselines easier to read by removing cluttered formatting such as strikethroughs and highlights that made some of the events listed in past BARs unreadable.<sup>23</sup>

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## MDA's 2013 Resource Baselines Remain Unreliable

Since MDA first reported baselines in June 2010, we have found that the underlying information supporting its resource baselines does not meet the GAO best practice standards for high-quality cost estimates.<sup>24</sup> MDA's resource baselines reported in its 2013 BAR remain unreliable because the agency is still in the process of improving the quality of the cost estimates that support its baselines. We asked to review the cost estimates that support the resource baselines reported in the 2013 BAR, but MDA officials stated that the agency had not fully implemented its cost estimating handbook and that the cost estimates were not ready for our review. According to officials, MDA is still performing reviews of past cost estimates to bring them up to the agency's new standards and plans to complete these efforts to support the cost estimates reported in its 2014 BAR. In addition, according to officials from DOD's Office of the Director for Cost Assessment and Program Evaluation, they did not perform an independent cost estimate for any of the cost estimates supporting the

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<sup>23</sup>The 2013 BAR also incorporated changes MDA had previously made to improve the completeness and clarity of its resource and schedule baselines. For example, we found in April 2013 that, in its 2012 BAR, MDA began reporting the full range of life cycle costs borne by MDA; defining more clearly what costs are presented in the resource baselines and noting when costs were excluded from the estimate; and adding a separate delivery table that provides more detailed information on deliveries and inventories. See [GAO-13-432](#).

<sup>24</sup>GAO, *GAO Cost Estimating and Assessment Guide*, [GAO-09-3SP](#) (Washington, D.C.: March 2009).

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**GAO-11-372**

In March 2011, we assessed MDA's life-cycle cost estimates using the *GAO Cost Estimating and Assessment Guide*, which is based on best practices in cost estimating and identifies key criteria for establishing high-quality cost estimates. Our review found that the estimates we assessed were not comprehensive, lacked documentation, were not completely accurate, or were not sufficiently credible. We recommended that MDA (1) take steps to ensure its cost estimates are high quality, reliable cost estimates that are documented to facilitate external review and (2) obtain independent cost estimates for each baseline.

**GAO-13-432**

In April 2013, we recommended that the Secretary of Defense direct the MDA Director to include in its resource baseline cost estimates all life cycle costs, specifically the operations and support costs, from the military services in order to provide decision makers with the full costs of ballistic missile defense systems.

resource baselines reported in the 2013 BAR.<sup>25</sup> We have found that completing these steps could further improve the quality of MDA's cost estimates.<sup>26</sup>

Additionally, MDA has made little progress improving the comprehensiveness of the cost estimates that support its resource baselines. Similar to past years, the cost estimates reported in the 2013 BAR also do not include the operation and support costs funded by the individual military services, which we concluded in April 2013 may result in significantly understated life cycle costs for some BMDS elements. In response to our April 2013 recommendation, DOD agreed that decision makers should have insight into the full life cycle costs of DOD programs, but the department stated that the BAR should only include content for which MDA is responsible. Because MDA already reports the estimated acquisition costs and some of the operation and support costs for the acquisitions in the annual BAR, we concluded that annual document to be the most appropriate way to report the full costs to Congress. Additionally, we concluded that good budgeting requires that the full costs of a project be considered when making decisions to provide resources and, therefore, both DOD and Congress would benefit from a comprehensive understanding of the full costs of MDA's acquisition programs. Until MDA's resource baselines are based on reliable information and are comprehensive, they will not be useful for decision makers to understand progress or make well-informed investment decisions.

In the National Defense Authorization Act for Fiscal Year 2014, Congress took steps to address concerns over MDA's cost estimates by requiring MDA to report to the congressional defense committees on its efforts to improve the quality of the cost estimates included in its acquisition

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<sup>25</sup>DOD's Office of the Director of Cost Assessment and Program Evaluation provides independent analytic advice to the Secretary of Defense on all aspects of the Defense program including the cost-effectiveness of defense systems by ensuring that the costs of DOD programs are accurate and complete. According to officials from DOD's Office of Cost Assessment and Program Evaluation, the last independent cost estimate they conducted for an active BMDS program was for THAAD procurement costs in 2010 but they have continued to support MDA with other independent cost assessments since that time. For example, they examined some costs for several BMDS elements as a part of their fiscal year 2012 review of the costs associated with deploying a U.S. missile defense in Europe. Additionally, the officials said they started but never completed an independent cost estimate for Aegis BMD in support of the SM-3 Block IB full production decision because MDA delayed the decision from fiscal year 2012 to 2015.

<sup>26</sup>[GAO-13-432](#), [GAO-11-372](#), and [GAO-10-311](#).

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baselines.<sup>27</sup> For example, the act requires MDA to report on a description of and schedule for planned actions to improve its cost estimates, as well as an assessment of how the planned improvements align with GAO's cost estimating best practices. We are also required to provide our views on the content of MDA's report. Additionally, the act requires that the life cycle cost estimate included in the agency's acquisition baselines include a description of the operations and support functions and costs for which the military services are responsible, in addition to the costs borne by MDA.

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### MDA's Schedule Baseline Reporting Makes Assessing Progress Difficult

MDA's schedule baselines are presented in a way that makes it difficult for decision makers to understand a program's planned activities and therefore hold programs accountable for their performance. According to GAO's *Schedule Assessment Guide*, a reliable program schedule includes all activities required to complete a project, but the schedule should not be too detailed to interfere with its use.<sup>28</sup> For example, presenting decision makers with a high-level summary of the schedule is a best practice because schedules that include too many milestones or have too much detail make it difficult to manage progress. Additionally, the activities included on the schedule should have descriptive names that clearly communicate the work required. MDA's 2013 BAR schedule baselines include numerous events but provide very little information about them, making it difficult to understand what the events are and why they are important. For example, the milestones identifying significant increases in performance for C2BMC Spiral 8.2 are numbered with no description of the capabilities they represent. Additionally, several of the events reported for Aegis modernized weapon system software are titled with abbreviations that are not explained in the BAR.

In addition, MDA does not present any comparisons of event dates with previously reported dates. In contrast, DOD's major defense acquisition programs report a comparison of current schedule estimates against their original and current schedule goals. According to GAO's *Schedule Assessment Guide*, comparing the current schedule to the baseline schedule to track deviations from the plan provides decision makers valuable insight into program risk and can help identify where corrective

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<sup>27</sup>Pub. L. No. 113-66, § 231.

<sup>28</sup>GAO, *GAO Schedule Assessment Guide*, [GAO-12-120G](#) (Washington, D.C.: May 2012).

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action may be needed.<sup>29</sup> While removing the formatting that identified changes in prior BARs made the schedule baselines easier to read, doing so removed the ability for decision makers to see if the planned dates for events had changed. As a result, decision makers must consult past versions of the BAR to identify any changes in the planned schedule for a specific event, which can be difficult or impossible in some cases. For example, we found in April 2013 that we were unable to compare the current estimated dates for the activities presented in the Aegis Ashore schedule baseline to the dates baselined in the 2010 BAR because activities were split into multiple events, renamed, eliminated, or moved to several other Aegis BMD schedule baselines.<sup>30</sup> During the course of our audit we raised this issue with MDA and, according to agency officials, MDA is open to considering alternative formats for presenting the schedule baseline in future version of the BARs. Until MDA improves the content of its schedule baselines, decision makers will not be able to assess how a program is performing over time.

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## Conclusions

During fiscal year 2013, MDA was able to make some significant acquisition progress, including the first operational system-level flight test involving multiple BMDS elements, but it continued to experience difficulties achieving its goals for testing. This has resulted in delaying progress on individual elements, delaying understanding of the overall performance of the BMDS, and fielding assets before all testing is complete. The most significant acquisition effects have been experienced on the Aegis BMD SM-3 Block IB and GMD program where testing and development challenges have led to failure investigations and increased the risk of continued cost growth and schedule delays. Both programs conducted flight tests and made progress in resolving design flaws in 2013, but still have further development, testing, and production issues to address. For Aegis BMD SM-3 Block IB, the failure of its interceptor in a September 2013 flight test means that a key component may need to be redesigned and that change confirmed to work in additional flight testing. For GMD, the failure of the deployed CE-I interceptor in a July 2013 flight test compounds its challenge because the program did not gain the expected understanding of the effectiveness of software upgrades planned for the operational fleet and now must determine the cause of the

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<sup>29</sup>[GAO-12-120G](#).

<sup>30</sup>[GAO-13-432](#).

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failure. As a result, for both programs, to the extent that software or hardware changes are necessary to resolve the cause of these failures, new flight tests will likely be needed to demonstrate both the effectiveness of any resolutions and, for GMD, understand the performance of the software upgrades that were the original purpose of the test.

Additionally, for over a decade, we have reported that MDA provides Congress with only limited insight into the acquisition progress for individual programs. While MDA has taken steps to improve the clarity of the baselines it reports to Congress, the agency's cost and schedule reporting still lacks the quality, completeness, and clarity necessary to track actual cost or schedule growth over time. Specifically, the agency has not addressed all of the critical gaps in the quality of its underlying cost estimates used to develop its resource baselines that we have identified over the years. Until corrective actions are implemented and substantial improvements are made to MDA's cost estimates, its reported resource baselines will not be useful for decision makers to hold MDA accountable for its performance or make informed decisions on how best to allocate limited resources. Congress recently amended the requirements for the cost estimates MDA must report in its baselines, which may enhance the transparency into MDA's cost estimating processes. As a result, we do not make any new recommendations regarding cost at this time. However, additional actions can be taken in the schedule baselines to improve the ability of decision makers to understand what program events are most critical and identify whether the dates for those critical events have changed. Until improvements are made, the schedule baselines will not be a useful tool for providing oversight of the BMDS.

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## Recommendations for Executive Action

We recommend that the Secretary of Defense take the following three actions to strengthen MDA's acquisitions and help support oversight.

1. To the extent that MDA determines hardware or software modifications are required to address the September 2013 Aegis BMD SM-3 Block IB failure, we recommend that the Secretary of Defense direct,
  - a) the Director of the MDA to verify the changes work as intended through subsequent flight testing, and
  - b) the Under Secretary of Defense, Acquisitions, Technology, and Logistics to delay the decision to approve the program's full

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production until such testing demonstrates that the redesigned missile is effective and suitable.

2. To demonstrate the CE-I's effectiveness against a longer range target in more challenging conditions and to confirm the design changes implemented to improve performance, as well as any changes needed to resolve the July 2013 CE-I flight test failure work as intended, we recommend that the Secretary of Defense direct MDA's Director to conduct a flight test of the CE-I interceptor once the cause of the failure has been determined and any mitigations have been developed.
3. To improve the content of the schedule baselines it reports to Congress for monitoring program performance, we recommend that the Secretary of Defense direct MDA's Director to take the following actions as MDA implements other improvements required by the Congress:
  - a) Focus the information included in the schedule baselines to highlight critical events.
  - b) For each event included in the schedule baseline, provide a description of the event explaining what it entails and why it is important.
  - c) Present the schedule baseline in a format that allows decision makers to identify any changes made from the current estimated date to the date reported in not only the prior year's BAR but also to the date established in the initial baseline.

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## Agency Comments and Our Evaluation

DOD provided written comments on a draft of this report. These comments are reprinted in appendix II. DOD also provided technical comments, which were incorporated as appropriate.

DOD partially concurred with our first recommendation, non-concurred with our second recommendation and concurred with our third recommendation. The department partially concurred with our first recommendation to flight test any modifications that may be required to the Aegis BMD SM-3 Block IB as a result of September 2013 failure, before the Under Secretary of Defense, Acquisitions, Technology, and Logistics approves full production. In its comments, DOD acknowledged that if modifications are required they will be tested, but added that the type of testing—flight or ground testing—will depend on the magnitude of such modifications. The department also believes that the component currently tied to the failure, has a successful testing history and thus expects to meet the reliability requirement needed for the full production

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decision in fiscal year 2015. However, there have now been three flight test anomalies associated with this component over the last three years. According to Aegis BMD officials, they are considering design changes for this component. Since the fiscal year 2015 full production decision is the commitment by the Under Secretary of Defense, Acquisitions, Technology, and Logistics to produce several hundred missiles, this decision should be supported by an assessment of the final product under operational mission conditions to ensure that it is effective and suitable. As such, we maintain our recommendation that before the program is approved for full production, flight testing should demonstrate that any modifications work as intended.

DOD did not concur with our second recommendation to complete the original purpose of the July 2013 CE-I flight test once the cause of that failure has been determined and any mitigations have been developed. In its response, DOD stated that the decision to flight test a CE-I interceptor will be made by the Director, MDA, based on the judgment of stakeholders from the Office of the Secretary of Defense and combatant commands on the need to perform a test. The DOD response focused almost exclusively on the steps it is taking to identify the cause of the July 2013 failure and mitigate it and did not address the main part of our recommendation—determining the effectiveness of the CE-I under more challenging conditions and confirming that design changes previously made improve performance. These were the objectives of FTG-07. In our view, resolving these performance questions remains important. Since the FTG-07 failure review is still ongoing, we cannot assess whether DOD should conduct a CE-I test for the sole purpose of demonstrating corrective actions, to the extent any are needed, to address the cause of the failure. While we acknowledge that DOD must balance several competing GMD priorities, including which flight tests to conduct, and conducting another CE-I flight test may not be feasible in the immediate future, we also maintain that demonstrating CE-I intercept capabilities should continue to be a priority for DOD since the CE-I interceptor constitutes a multi-billion dollar investment by DOD and serves as the primary defense of the United States homeland against enemy ballistic missile attacks.

In addition to responding to our recommendations, the department's letter raised additional concerns about our draft report. First, DOD disagreed with our statement that because the BMDS entrance into DOD's acquisition process is deferred, it is exempt from certain acquisition laws and policies that generally provide oversight of major defense acquisition programs. DOD stated that MDA is not exempt from acquisition-related

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laws because, while it is not captured by several statutes, Congress has provided legislation specific to MDA to ensure oversight and accountability. We clarified the language in our report to remove the term exempt. However, because of the acquisition flexibility it has been granted, MDA is not yet required to apply certain laws and policies to the BMDS. We have found that while the flexibility allows MDA latitude to manage the BMDS and to rapidly develop and field new systems, we have also found that this flexibility has hampered oversight and accountability. Our report recognizes the actions Congress has taken to improve the transparency and accountability of the BMDS development efforts through legislation specific to MDA, particularly to require MDA to report baselines to Congress. However, there are a number of requirements that are triggered by phases of the DOD acquisition process that are important to sound acquisition management. For example, we have previously found that MDA is not yet required to conduct an analysis of alternatives to compare potential solutions and determine the most cost effective weapon system to acquire nor is MDA yet required to obtain an independent cost estimate prior to beginning product development.

Second, DOD stated that it disagreed with our assessment that MDA's cost estimates are not sufficiently reliable to support oversight, suggesting that the report be revised to include more of MDA's efforts to improve the quality of its cost estimates. Since 2011, we have found that there are issues with the cost estimates and baseline reporting, including incomplete cost estimates due to the exclusion of military service operation and support costs as well as instability in the content of the baselines, which makes assessing progress difficult or impossible. While the draft report was being reviewed by DOD, we met with MDA officials who discussed more of their efforts to improve their cost estimates; however, we were not provided sufficient information to change our determination. We did clarify the report to better reflect the efforts they have undertaken. DOD stated in its response that MDA has included previously unreported costs in the baselines it provides to Congress, which we have previously found is an improvement to the amount of information reported to Congress, but which does not demonstrate that the quality of the cost estimates themselves have improved. DOD stated in its response that it has provided joint operation and support costs documentation for two programs reported in the 2013 BAR. However, we did not assess the joint operation and support costs because they were not included in the 2013 resource baselines reported to Congress. DOD also stated in its response that it received an assessment from us on cost estimate documentation for a third program. We did not perform a formal assessment of the third program because it was cancelled and not

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included in the 2013 BAR. In order to assist MDA in improving its cost estimates, we did informally assess the third program's cost estimate, but reached no conclusion as to its quality. However, we noted several issues in that informal review. For example, we concluded that because MDA did not provide a cost model to support the estimate we were unable to check the cost estimate for accuracy. Finally, DOD stated in its response that MDA has published and implemented a cost estimating handbook. We have previously found that fully implementing that handbook could improve the quality of MDA's cost estimates. However, during this review, we specifically asked to review the cost estimate documentation supporting MDA's fiscal year 2013 BAR baselines in order to assess its progress in implementing that handbook. An MDA senior cost official told us that the agency was working to fill in documentation gaps on existing cost estimates and that the estimates were not ready for us to review. In the course of our work, we concluded and informed MDA that the cost estimating process defined in that handbook has not been applied to any systems that are currently baselined or part of the BMDS. Until MDA is able to provide us with documentation that supports the actual baselines reported to Congress so we can independently assess the quality of the cost estimates, we have no basis to change our assessment.

Third, DOD disputed that MDA has not obtained independent cost estimates from DOD's Office of the Director of Cost Assessment and Program Evaluation for any of the elements GAO reviewed since 2010. In response, we clarified the language in the report so that it specifically refers to the lack of independent cost estimates completed for any of the resource baselines reported to Congress in the 2013 BAR. We also clarified in the report that DOD's Office of the Director of Cost Assessment and Program Evaluation has assessed other BMDS costs. DOD was unable to provide us with documentation of independent cost estimates completed for MDA's BAR baselines, therefore, we have no basis to change our determination.

Lastly, DOD identified 35 "technical and factual errors" in its technical comments. However, upon review we found that 29 were not technical or factual errors, but rather different conclusions, errors in DOD's comments, or required additional substantiation that was not provided. We determined that 6 were actual technical or factual errors and therefore made the appropriate changes in those circumstances.

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We are sending copies of this report to the Secretary of Defense and to the Director, MDA. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-4841 or [chaplainc@gao.gov](mailto:chaplainc@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.

A handwritten signature in black ink, appearing to read 'Cristina Chaplain', with a stylized, cursive script.

Cristina Chaplain  
Director, Acquisition and Sourcing Management

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*List of Committees*

The Honorable Carl Levin  
Chairman  
The Honorable James Inhofe  
Ranking Member  
Committee on Armed Services  
United States Senate

The Honorable Richard Durbin  
Chairman  
The Honorable Thad Cochran  
Ranking Member  
Subcommittee on Defense  
Committee on Appropriations  
United States Senate

The Honorable Howard McKeon  
Chairman  
The Honorable Adam Smith  
Ranking Member  
Committee on Armed Services  
House of Representatives

The Honorable Rodney Frelinghuysen  
Chairman  
The Honorable Pete Visclosky  
Ranking Member  
Subcommittee on Defense  
Committee on Appropriations  
House of Representatives

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# Appendix I: Objectives, Scope, and Methodology

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To assess the Missile Defense Agency's (MDA) progress and any challenges associated with developing, testing, and producing the ballistic missile defense system (BMDS) during fiscal year 2013, we examined the acquisition accomplishments of several missile defense elements and MDA's targets program. Specifically, we reviewed the Aegis Ballistic Missile Defense (Aegis BMD) with Standard Missile-3 (SM-3) Block IB; Aegis Ashore; Aegis Modernized Weapon System Software; Army/Navy Transportable Radar Surveillance and Control Model 2 (AN/TPY-2); Command, Control, Battle Management, and Communications (C2BMC); Ground-based Midcourse Defense (GMD) System; Targets and Countermeasures; and Terminal High Altitude Area Defense (THAAD) elements because, as reported in the 2013 BMDS Accountability Report (BAR), these elements or programs have entered MDA's product development, initial production, or production acquisition phase, but are not yet mature enough to be transferred to a military service and enter the formal DOD acquisition cycle for full-rate production and deployment.<sup>1</sup> We reviewed key management documents for fiscal year 2013 including Program and Baseline Execution Reviews, which detailed program accomplishments and areas of concerns, and interviewed program element officials. We also examined MDA's master test plan and flight test reports, and discussed the element- and BMDS-level test programs and test results with the BMDS Operational Test Agency and the Department of Defense's (DOD) Office of the Director, Operational Test and Evaluation and office of Developmental Test and Evaluation. In addition, we also met with officials from MDA's functional directorates including the Engineering Directorate to discuss the agency's process for delivering and integrating BMDS capabilities as well as the Directorates for Acquisition and Operations to discuss significant internal and external events and decisions that occurred in fiscal year 2013, such as sequestration, that affected the agency's overall acquisition of the BMDS.

To assess the progress made as well as any remaining challenges MDA faces in reporting resource and schedule baselines that support oversight, we examined MDA's reported baselines in the 2010, 2011,

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<sup>1</sup>The 2013 BAR also includes acquisition information for modernizing and integrating the Upgraded Early Warning Radars in Clear, Alaska and Cape Cod, Massachusetts into the BMDS. We did not include these elements in our review because this was the first year MDA reported these baselines in the BAR and therefore we could not make comparisons to past years.

2012, and 2013 BARs.<sup>2</sup> To be consistent with last year, we focused our assessment on the resource and schedule baselines as they continue to be the only reported baselines that have measurable goals, such as cost estimates and dates of program events, and separately explain when current estimates have deviated to a certain extent from the baselines set in prior BARs. We also examined the National Defense Authorization Act for Fiscal Year 2012, which required MDA to establish and maintain baselines for program elements or major portions of such program elements and outlined the information to be included in MDA's baselines, as well as interviewed officials within MDA's general counsel's office.<sup>3</sup> We also interviewed officials in MDA's Acquisitions Directorate about how the agency establishes and manages its acquisition baselines and met with MDA officials in the Operations Directorate to discuss their progress in adopting best practices in cost estimating based on our Cost Guide.<sup>4</sup> We also reviewed findings and recommendations from several of our past reports to see if MDA had made progress in improving the completeness, clarity, and stability of its reported resource and schedule baselines.<sup>5</sup> In addition, we examined DOD acquisition policy such as the Interim DOD Instruction 5000.02 issued in November 2013 and the Defense Acquisition University's *Defense Acquisition Guidebook* to discern how other major defense acquisition programs are required to report baselines and measure program progress. We also reviewed GAO's cost and schedule guides, which outline best practices for establishing and managing program cost and schedule estimates.<sup>6</sup>

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<sup>2</sup>MDA's acquisition baselines include a resource, schedule, test, operational capacity, technical, and contract baselines.

<sup>3</sup>Pub. L. No. 112-81, § 231(a) (2011), *codified at* 10 U.S.C. § 225.

<sup>4</sup>In March 2011, we found that MDA's reported cost estimates did not meet GAO's best practices for high-quality estimates and recommended that MDA take steps to improve the quality of its estimates. DOD agreed with this recommendation and stated that MDA would follow the GAO *Cost Estimating and Assessment Guide* for each program reported in the BAR. See GAO, *Missile Defense: Actions Needed to Improve Transparency and Accountability*, [GAO-11-372](#), (Washington, D.C.: Mar. 24, 2011).

<sup>5</sup>GAO, *Missile Defense: Opportunity to Refocus on Strengthening Acquisition Management*, [GAO-13-432](#), (Washington, D.C.: Apr. 26, 2013); *Schedule Best Practices Provide Opportunity to Enhance Missile Defense Agency Accountability and Program Execution*, [GAO-12-720R](#) (Washington, D.C.: July 19, 2012); and [GAO-11-372](#).

<sup>6</sup>GAO, *GAO Cost Estimating and Assessment Guide*, [GAO-09-3SP](#) (Washington, D.C.: March 2009) and *Schedule Assessment Guide: Best Practices for Project Schedules*, [GAO-12-120G](#) (Washington, D.C.: May 2012).

To gauge the extent to which MDA reported changes or variances in the current baselines from the baselines presented in the prior year's BAR and from when the baselines were initially established, we compared the 2013 BAR resource and schedule baselines for each BMDS element in our review to the baselines presented in the 2012 and 2010 BARs. In order to compare unit costs calculated in different years, there were instances where it was necessary to convert prior cost estimates to match the base year of the estimates presented in the 2013 BAR.<sup>7</sup> We performed these conversions using indexes published by the Office of the Secretary of Defense (Comptroller) in the National Defense Budget Estimates, commonly referred to as the "Green Book."

The National Defense Authorization Act for Fiscal Year 2013 directed GAO to provide separate assessments on several other missile defense related issues. Specifically, GAO was required to provide briefings on our views and to submit reports as soon as practicable to the congressional defense committees our assessments of DOD reports on (1) a comprehensive evaluation of alternatives for the Precision Tracking Space System and its conformance with GAO best practices for analyses of alternatives; (2) the Ground-based Midcourse Defense system's test plan; (3) the status and progress of regional missile defense programs, including the adequacy of MDA's existing and planned efforts to deploy a U.S. missile defense in Europe; and (4) the status of efforts to improve the homeland defense capability of the United States.<sup>8</sup> Because this additional mandated work covers the details on many BMDS elements, we do not include appendixes on each of the individual elements as we have done in prior reports under this mandate.

Our work was performed at MDA locations including its headquarters in Fort Belvoir, Virginia and various program offices in Dahlgren, Virginia and Huntsville, Alabama. In Fort Belvoir, we met with officials from MDA's Acquisition and Operations Directorates. In Dahlgren, we spoke with

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<sup>7</sup>By comparing costs presented in the same base year, we were able to ensure that cost changes in these dollar amounts were not due to inflation.

<sup>8</sup>Pub. L. No. 112-239, § 224 (e), § 231 (e), § 229 (c), and § 228 (c). For our assessments of DOD's reports, see GAO, *Missile Defense: Precision Tracking Space System Evaluation of Alternatives*, [GAO-13-747R](#) (Washington, D.C.: July 25, 2013) and *Regional Missile Defense: DOD's Report Provided Limited Information; Assessment of Acquisition Risks is Optimistic*, [GAO-14-248R](#) (Washington, D.C.: Mar. 14, 2014). At the time of publication of this report, our work on DOD's reports on the Ground-based Midcourse Defense system's test plan and homeland defense is ongoing.

officials from the Aegis BMD SM-3 Block IB, Aegis Ashore, and Aegis Modernized Weapon System Software program offices. In Huntsville, we interviewed program officials for BMDS Sensors, C2BMC, GMD, and THAAD as well as officials in MDA's Acquisition and Cost Directorates.

We also visited several contractor facilities that were working on programs covered in our review. These facilities were located in Huntsville and Courtland, Alabama as well as Tucson and Chandler, Arizona. In Huntsville, we discussed the manufacturing of the Aegis BMD SM-3 Block IB interceptor with Raytheon officials and met with GMD's prime contractor, Boeing, to discuss progress in resolving development challenges and their plans to deliver additional interceptors. In Courtland, we met with officials from Lockheed Martin to discuss the production of the extended medium-range ballistic missile target, which was used in flight test operational 01 on September 10, 2013. In Tucson and Chandler, Arizona, we met with GMD's subcontractors Raytheon and Orbital to discuss their progress in resolving development challenges with the interceptor, flight testing, and future development efforts. We also interviewed officials from various testing agencies located in Arlington, Virginia and Huntsville, Alabama. In Arlington, we met with officials from DOD's Director, Operational Test and Evaluation, as well as DOD's Director of Developmental Test and Evaluation, to discuss MDA's test plans and results from recent tests. Lastly, in Huntsville, we spoke with officials from the BMDS Operational Test Agency to discuss MDA's performance assessment.

We conducted this performance audit from April 2013 to April 2014 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

# Appendix II: Comments from the Department of Defense



ACQUISITION

## ASSISTANT SECRETARY OF DEFENSE

3015 DEFENSE PENTAGON  
WASHINGTON, DC 20301-3015

MAR 24 2014

Ms. Cristina Chaplain  
Director, Acquisition and Sourcing Management  
U. S. Government Accountability Office  
441 G Street, N.W.  
Washington, DC 20548

Dear Ms. Chaplain:

This is the Department of Defense (DoD) response to the GAO Draft Report, "MISSILE DEFENSE: Mixed Progress in Achieving Acquisition Goals and Improving Accountability" (GAO 14-351) dated February 20, 2014 (GAO Code 121138).

The Department partially concurs with GAO Recommendation 1 regarding addressing September 2013 AEGIS BMD SM-3 Block 1B failure. The Department non-concurs with GAO Recommendation 2 regarding testing of CE-I interceptors. The Department concurs with Recommendation 3 regarding improving the content of schedule baselines reported to Congress. The rationale for our position is included in the enclosure. I submitted separately a list of technical and factual errors for your consideration.

The Department also has significant concerns with comments in GAO's Draft Report in the following areas:

**Compliance with DoD Acquisition Process and Certain Laws:** GAO states that because the Ballistic Missile Defense System (BMDS) entrance into DoD's acquisition process is deferred, the MDA is exempt from certain acquisition laws and policies that generally provide oversight to major defense acquisition programs within DoD.

While it is true the BMDS is deferred from entering the DoD's acquisition processes in accordance with DoDD 5134.09, the BMDS must be managed consistent with the principles of DoDD 5000.01 and DoDI 5000.02. Although a February 2010 SECDEF Ballistic Missile Defense Report validated there is no reason for the MDA to be brought into the full DoD 5000 process, the MDA is not exempt from acquisition-related laws. The BMDS is not captured by several statutes, but Congress provided legislation specific to MDA to ensure oversight and accountability of the BMDS.

**Cost Estimates Reliability:** GAO states that since 2011 they have found deficiencies in the quality of the cost estimates that underpin the MDA's resource baselines and the efforts the MDA has undertaken to improve those estimates. In 2013, GAO claimed the agency made little progress addressing underlying quality issues with those cost estimates. This is the fourth year GAO has found that the cost estimates are not sufficiently reliable to support oversight. Additionally, GAO found the MDA has not fully implemented its cost estimating handbook because the agency is still performing reviews of past cost estimates to bring them up to their new standards and did not provide the GAO any revised estimates based on these standards for the BMDS elements included in their 2013 BAR.

The Department disagrees with GAO's assessment and recommends this language be revised to include MDA's demonstrated efforts to improve the quality of its cost estimates. Since 2010, the MDA has greatly improved the quality of its cost estimates. Specifically, the MDA has added GAO recommended information to its baselines including disposal costs, sunk costs in the Targets resource plans, and variances to Program Acquisition Unit Cost (PAUC) and Average Procurement Unit Cost (APUC). MDA has published and implemented, in collaboration with the GAO and other Government agencies including NASA, its MDA DO Cost Estimating and Analysis Handbook, which uses best practices from the Comptroller General of the United States.

MDA has provided the GAO with documentation for the Joint Cost Estimates for Operations and Support cost for the THAAD and the AN/TPY-2 programs (both programs in the 2013 BAR). The MDA received a GAO assessment of the MDA Precision Tracking Surveillance System (PTSS) program cost estimate and its associated documentation developed under the MDA DO Cost Estimating and Analysis Handbook. The results of GAO's review showed that the MDA processes and procedures for developing and documenting cost estimates have improved significantly since the GAO's assessments outlined in the March 2011 GAO report. For the PTSS cost estimate, the MDA received assessments of: "Substantially Met" for the criteria of "Credibility and Accuracy" and "Partially Met" for the criteria of "Comprehensiveness and Well-documented."

**Independent Cost Estimates (ICE):** GAO states that MDA has not obtained independent cost assessments from DOD's Office of the Director for Cost Assessment and Program Evaluation (CAPE) for any of the elements GAO reviewed since 2010. The Department disagrees with the GAO assessment. From September 2009 to August 2013, MDA requested CAPE perform eleven independent cost estimates or multi-year procurement analyses to support multiple program decisions. Congressional authorization committees also requested a review in 2012 for EPAA and the FY 2013 NDAA directed CAPE to perform an ICE on the Precision Tracking Surveillance System (which MDA had previously requested in 2011). The MDA received briefings on three cost assessments from the CAPE during this period for THAAD (2010), the European Phased Adaptive Approach (2012), and the Precision Tracking Surveillance System (2013). Although the MDA requested an ICE for the SM-3 Block IB in 2009, 2010 and 2013, the CAPE decided they would perform a portfolio Aegis BMD ICE. This formal portfolio Aegis BMD ICE has not been delivered. It should be noted that while developing the Congressionally-requested EPAA ICE, the CAPE completed independent cost estimates on the AEGIS Weapon System (AWS), AEGIS SM-3 Block IB and IIB missiles, and the Aegis Ashore program. All of these estimates encompass the main components of what would be the Aegis BMD portfolio ICE.

**Aegis BMD SM-3 Block IB:** GAO states that despite the last three successful intercepts the effect of the missile failure in September 2013 on the upcoming full production decision remains unclear. Consequently, GAO believes that until the program thoroughly understands the extent of needed modifications, if any, and their effects on performance as demonstrated through testing, any production strategy is at risk of cost growth and schedule delays. GAO notes that the MDA has experienced these consequences with other program elements when it pursued design changes concurrently with production.

MDA agrees that any SM-3 Block IB hardware or software modifications made to correct the failure experienced in the second missile during FTM-21 (September 2013) must be subject to appropriate testing.

The full-rate production decision will be vetted through proper DoD processes including DOT&E analysis; Program, Acquisition and Budget Development Committee assessment; and Missile Defense Executive Board. The additional details are noted in Department response to Recommendation 1.

**Ground-Based Midcourse Defense (GMD):** GAO states that although the GMD program made progress in resolving a prior Capability Enhancement (CE)-II intercept failure, test failures and development challenges continue to disrupt the program and increase cost to demonstrate the new CE-II. GAO notes it remains unclear what, if any, design changes, retrofits, or other corrective actions to the CE-I or CE-II are necessary since the failure review is not complete. GAO concludes that as a result of these development challenges, the GMD program will likely continue to experience delays, disruptions, and cost growth.

The decision to flight test a CE-I interceptor will be made by the Director, MDA, based on the judgment of OSD and COCOM stakeholders on the need to perform a test. The MDA recommends continuation of the current test plan with focus on flight test of improvements to the CE-II interceptor, versus more testing of a CE-I interceptor. There have been three successful CE-I flight tests (all successful intercepts) with the FTG-07 configuration. The MDA is developing corrective actions to mitigate the failure modes identified by the FTG-07 Failure Review Board. The additional details are noted in MDA response to Recommendation 2.

**BMDS Accountability Report (BAR) Schedule Baselines:** GAO states the manner in which MDA's schedule baselines are presented makes it difficult for decision makers to understand a program's planned activities and, therefore, hold programs accountable for their performance.

MDA has made changes in the 2014 BAR which will be submitted this month. As the BMDS and its program elements mature, the MDA strives to stabilize program baselines for its component programs. In 2010, the MDA established initial baselines for all the BMDS component programs in the product development phase or later and created a formal process to maintain configuration control of these baselines. The MDA has reported these baselines annually to the Congress in the BAR. The additional details are noted in Department's response to Recommendation 3.

We appreciate the opportunity to comment on the draft report. My point of contact for this effort is Lt Col Peter Jackson, 703-695-7328, peter.e.jackson.mil@mail.mil.

Sincerely,



Katrina McFarland

Enclosures:  
As stated.

GAO DRAFT REPORT DATED FEBRUARY 20, 2014  
GAO-14-351 (GAO CODE 121138)

MISSILE DEFENSE: MIXED PROGRESS IN ACHIEVING ACQUISITION  
GOALS AND IMPROVING ACCOUNTABILITY”

DEPARTMENT OF DEFENSE COMMENTS  
TO THE GAO RECOMMENDATION

**RECOMMENDATION 1:** To the extent that MDA determines hardware or software modifications are required to address the September 2013 Aegis BMD SM-3 Block IB failure, we recommend that the Secretary of Defense direct,

- a) The Director of the MDA to verify the changes work as intended through subsequent flight testing, and
- b) The Undersecretary of Defense, Acquisition, Technology, & Logistics to delay the decision to approve the program’s full production until such testing demonstrates that the redesigned missile is effective and suitable.

**DoD RESPONSE:** Partially Concur.

a) The Department agrees that any SM-3 Block IB hardware or software modifications made to correct the failure experienced in the second missile during FTM-21 (September 2013) must be subject to appropriate testing. MDA will verify the efficacy of the SM-3 Block IB, including any such modifications, by rigorous testing. Testing methods will depend on the type and magnitude of changes to the SM-3 Block IB and may include ground and/or flight tests as appropriate.

b) The full-rate production decision will be vetted through proper DoD processes including DOT&E analysis; Program, Acquisition and Budget Development Committee assessment; and Missile Defense Executive Board review prior to a final approval by the Undersecretary of Defense, Acquisition, Technology, & Logistics. The SM-3 Block IB component which is under review due to the failure, the Third Stage Rocket Motor (TSRM), is common to the SM-3 Block IA and has successfully completed 20 of 22 flight tests and 24 of 24 ground tests. Based on the TSRM’s history of success along with the demonstrated reliability of the other missile components, MDA assesses that SM-3 Block IB can achieve its threshold reliability requirement and remain on schedule for a Full Rate Production Decision in FY15.

**RECOMMENDATION 2:** The GAO recommends that the Secretary of Defense direct MDA’s Director to conduct a flight test of the CE-I interceptor once the cause of the July 2013 CE-I flight test failure has been determined and any mitigations have been developed.

**DoD RESPONSE:** Non-Concur. The decision to flight test a CE-I interceptor will be made by the Director, MDA, based on the judgment of OSD and COCOM stakeholders on the need to perform a test.

1) FTG-07 Analysis: The Flight Test Ground Based Interceptor (FTG)-07 investigation determined two key factors produced the FTG-07 anomaly which led to failure of the Exoatmospheric Kill Vehicle (EKV) to separate from the boost vehicle: 1) the EKV battery design allows for leakage current; and 2) the lack of common system ground/leak paths allows for differentials across grounds which can upset electrical components. As the most probable root cause was being developed, MDA began examining test reports from previously fired EKV batteries of like or same configuration as well as began execution of a focused battery hot-fire test program. Although the analysis is incomplete, data collections to date do not indicate that there is a high probability of recurrence of the FTG-07 failure mode.

2) CE-I Flight Testing: There have been three successful CE-I flight tests (all successful intercepts) with a like configuration to FTG-07. MDA will assess the future CE-I flight testing plan as part of the overall Integrated Master Test Plan.

3) Short Term Mitigation for CE-I – Software: MDA is developing corrective actions to mitigate the FTG-07 failure modes identified by the FTG-07 Failure Review Board. In the short term, MDA is pursuing CE-I EKV software that could enable recovery, in flight, if exposed to the failure mode. This software is currently being developed and will be verified by extensive ground testing. Following development and testing, a decision will be made on fielding the software to all CE-I EKVs. Ground testing is an effective way to verify preventative software without requiring a flight test.

4) Longer Term Mitigation for CE-I – Hardware: MDA is developing improvements to the EKV battery as further mitigation to the FTG-07 failure mode. Following completion of ground test qualification, MDA intends to flight test these improvements in FTG-09 (currently scheduled for FY2015) using a CE-II configured GBI. The CE-I EKV battery design is the same as the CE-II EKV battery design.

**RECOMMENDATION 3a:** To improve the content of the schedule baselines it reports to Congress for monitoring program performance, GAO recommends that the Secretary of Defense direct MDA's Director to focus the information included in the schedule baselines to highlight critical events.

**RECOMMENDATION 3b:** To improve the content of the schedule baselines it reports to Congress for monitoring program performance, GAO recommends that the Secretary of Defense direct MDA's Director to provide a description of each event included in the schedule baseline explaining what it entails and why it is important.

**RECOMMENDATION 3c:** To improve the content of the schedule baselines it reports to Congress for monitoring program performance, GAO recommends that the Secretary of Defense

direct MDA's Director to present the schedule baseline in a format that allows decision makers to identify any changes made from the current estimated date to the date reported in not only the prior year's BAR but also to the date established in the initial baseline.

**DoD RESPONSE:** Concur with 3a-3c. The annual BMDS Accountability Report (BAR) to Congress presents the baselines MDA uses to manage the individual BMDS component programs. These baselines (to include the Schedule baselines) provide the critical information, data, and milestones MDA manages the programs by as directed by 10 USC 225. The baselines do not include detailed background descriptions of the data on the baselines.

MDA's 2014 BAR (anticipated completion is mid-March 2014) presents detailed information describing significant changes to the baselines. The BAR provides significant changes, for each baseline, from the initial or revised initial baseline to the current baseline estimate and the significant changes from the 2013 BAR to the current baseline estimate.

In response to GAO's request, in addition to the Schedule baselines and the listing of significant changes for each BMDS component program, MDA will provide additional background information, beginning in the current BAR (2014 BAR), on some key critical events and milestones. MDA can provide: the date of the event from initial baseline (or revised baseline, as appropriate), the date of the event from the prior year's BAR, the date of the event from the current baseline estimate, and a short description of the event and why it's important. MDA will continue to refine this information for the next BAR.

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# Appendix III: GAO Contact and Staff Acknowledgments

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## GAO Contact

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## Acknowledgments

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