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Report to Congressional Committees

April 2021

MISSILE DEFENSE

Fiscal Year 2020 Delivery and Testing Progressed, but Annual Goals Unmet

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GAO-21-314

GAO Highlights

Highlights of GAO-21-314, a report to congressional committees

April 2021

MISSILE DEFENSE

Fiscal Year 2020 Delivery and Testing Progressed, but Annual Goals Unmet

Why GAO Did This Study

For over half a century, the Department of Defense has funded efforts to defend the U.S. from ballistic missile attacks. This effort consists of diverse and highly complex land-, sea-, and space-based systems and assets located across the globe. From 2002 through 2019, MDA—the agency charged with developing, testing, integrating, and fielding this system of systems—received about $162.5 billion. The agency also requested about $45 billion from fiscal year 2020 through fiscal year 2024.

In fiscal year 2020, MDA's mission broadened to include evolving threats beyond ballistic missiles such as defending against hypersonic missile attacks. With the inclusion of non-ballistic missile threats, the Ballistic Missile Defense System is in the process of transitioning to the Missile Defense System.

Congress included a provision in statute that GAO annually assess and report on MDA's progress. This, our 18th annual review, addresses the progress MDA made in achieving fiscal year 2020 delivery and testing goals.

GAO reviewed planned fiscal year 2020 baselines, along with program changes due to COVID-19 restrictions, and other program documentation and assessed them against responses to GAO detailed question sets and program and baseline reviews. GAO also interviewed officials from MDA and various Department of Defense Combatant Commands.

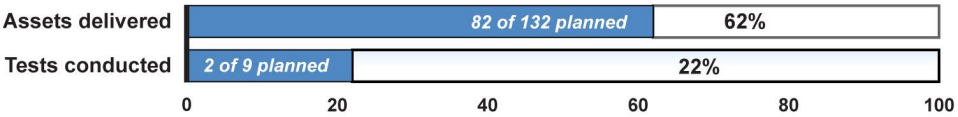
We do not make any new recommendations in this report but continue to track the status of prior recommendations.

View GAO-21-314. For more information, contact John D. Sawyer at 202-512-4841 or SawyerJ@gao.gov.

What GAO Found

In fiscal year 2020, the Missile Defense Agency (MDA) made progress toward achieving its delivery and testing goals for some of the individual systems—known as elements—that combine and integrate to create the Missile Defense System (also known as the Ballistic Missile Defense System). However, MDA did not complete its overall planned deliveries or annual testing. The figure below shows MDA's progress delivering assets and conducting flight tests against its fiscal year 2020 plans.

Percentage of Missile Defense Agency Planned Deliveries and Flight Tests Completed for Fiscal Year 2020



Source: GAO analysis of Missile Defense Agency data. I GAO-21-314

- **Deliveries—**In fiscal year 2020, MDA delivered many assets it had planned. Specifically, MDA was able to deliver 82 missile interceptors for 3 elements. However, MDA was not able to deliver all planned interceptors, including one originally planned for 2018 for the Ground-based Midcourse Defense program, as the program experienced delays related to qualifying parts from a new supplier.
- **Flight testing—**MDA conducted two planned flight tests, but neither was successful. The issues were due to problems with non-MDA assets, but the agency was able to collect important data. In addition, COVID-19 restrictions also affected the planned schedule. However, the delays continue a trend of MDA's inability to conduct planned annual flight testing, resulting in assets and capabilities that are subsequently delayed or delivered with less data than planned.
- **Ground testing—**In fiscal year 2020, MDA continued to implement a new ground testing approach that the agency began in fiscal year 2019. In addition, MDA successfully completed three planned ground tests demonstrating defense capabilities for the U.S., U.S. forces and regional allies. However, MDA delayed two other ground tests to future fiscal years and expects disruptions in fiscal year 2021, in part due to ongoing COVID-19 disruptions.
- **Cyber—**Despite failing to meet annual operational cybersecurity assessments since 2017, MDA canceled its planned fiscal year 2020 operational assessments, instead taking steps to implement a new approach designed to improve cyber system requirements while streamlining cyber test planning. It is premature to assess whether this new approach will achieve its intended goals.

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Abbreviations

AA	Adversarial Assessment
AN/TPY-2	Army Navy/Transportable Radar Surveillance and Control Model- 2
AWS	Aegis Weapon System
BAR	BMDS Accountability Report
BMD	Ballistic Missile Defense
BMDS	Ballistic Missile Defense System
BOA	BMDS Overhead Persistent Infrared Architecture
C2BMC	Command, Control, Battle Management, and Communications
CAPE	Cost Assessment and Program Evaluation
CDR	Critical Design Review
CENTCOM	United States Central Command
COVID-19	Coronavirus Disease 2019
CVPA	Cooperative Vulnerability and Penetration Assessment
DARPA	Defense Advanced Research Projects Agency
DFARS	Defense Federal Acquisition Supplement
DOD	Department of Defense
DOT&E	Director, Operational Test and Evaluation
EPAA	European Phased Adaptive Approach
EUCOM	United States European Command
GBI	Ground-based Interceptor
GMD	Ground-based Midcourse Defense
GM BVT	GMD Booster Vehicle Test
GT	Ground Test
GTD	Ground Test Distributed
GTI	Ground Test Integrated
HAWC	Hypersonic Air-Breathing Weapon Concept
HGV	Hypersonic Glide Vehicle
ICBM	Intercontinental Ballistic Missile
IMTP	Integrated Master Test Plan
INDOPACOM	United States Indo-Pacific Command
IRBM	Intermediate-Range Ballistic Missile
LRDR	Long Range Discrimination Radar
MDA	Missile Defense Agency
MDS	Missile Defense System
MSE	Missile Segment Enhancement
MRBM	Medium-Range Ballistic Missile
NATO	North Atlantic Treaty Organization
NGI	Next Generation Interceptor
OTA	Operational Test Agency

PAC-3	Patriot Advanced Capability-3
RKV	Redesigned Kill Vehicle
SBX	Sea Based X-Band
SM-3	Standard Missile-3
SRBM	Short-Range Ballistic Missile
TBG	Tactical Boost Glide
THAAD	Terminal High Altitude Area Defense
UEWR	Upgraded Early Warning Radar
USNORTHCOM	United States Northern Command

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U.S. GOVERNMENT ACCOUNTABILITY OFFICE
A Century of Non-Partisan Fact-Based Work

441 G St. N.W.
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April 28, 2021

Congressional Committees

For over half a century, the Department of Defense (DOD) has been funding efforts to develop and field a system—known as the Ballistic Missile Defense System (BMDS)—to detect, track, and defeat enemy ballistic missiles. In response to evolving threats that currently include hypersonic and cruise missiles, the focus of the system has broadened in recent years beyond ballistic missiles. To better communicate this revised mission, the Missile Defense Agency (MDA)—the agency charged with developing and integrating this system of systems—now refers to this system as the Missile Defense System (MDS).[1] The MDS includes a diverse and highly complex collection of land-, sea-, and space-based systems and assets located across the globe. From 2002 through 2019, MDA received approximately $162.5 billion and plans to spend an additional $45 billion from fiscal year 2020 through fiscal year 2024 to continue its efforts.

Since 2002, various National Defense Authorization Acts have included provisions for GAO to prepare annual assessments of MDA's progress toward meeting its acquisition goals. Specifically, the National Defense Authorization Act for Fiscal Year 2012, as amended, includes a provision for us to report annually on the extent to which MDA has achieved its acquisition goals and objectives, as reported in its acquisition baselines in the BMDS Accountability Report (BAR); and include any other findings and recommendations on MDA's acquisition programs and accountability, as appropriate.[2]

For 17 years, we have reported on MDA's progress and challenges in developing and fielding BMDS capabilities as well as other transparency, accountability, and oversight issues. This, our 18th annual report, addresses the extent to which MDA progressed in achieving fiscal year

[1]With the inclusion of non-ballistic missile threats (including hypersonic threats and cruise missile threats), the Ballistic Missile Defense System (BMDS) is transitioning to the Missile Defense System (MDS). Until the change is consistent in the Department of Defense and the Missile Defense Agency, the terms will be used interchangeably.

[2]Pub. L. No. 112-81, § 232(a) (2011), as amended by the National Defense Authorization Act for Fiscal Year 2016, Pub. L. No. 114-92 § 1688 (2015), which extended GAO's reviews through fiscal year 2020.

2020 delivery and testing goals for MDS elements, as planned in its annual baseline.[3] In addition, appendixes I-VI contain more detailed information on the 12 MDS elements we assessed in this report, and their fiscal year 2020 activities.

To assess the extent to which MDA and its programs progressed in achieving fiscal year 2020 goals, we reviewed MDA's planned delivery and testing baselines. We assessed their plans as expressed in the April 16, 2019 BAR which aligns with the fiscal year 2020 budget request, its Integrated Master Test Plan, and midyear update.[4] We also evaluated the extent to which Coronavirus Disease 2019 (COVID-19) affected fiscal year plans and MDA's plan to offset any delays in future fiscal years.[5] We assessed the agency's plans and performance against our work on best practices for knowledge-based defense acquisition, Department of Defense Acquisition policy, and the Defense Federal Acquisition Regulation Supplement (DFARS).[6]

For the missile defense elements covered in this report, we provided detailed questionnaires to the MDA programs, element contractors, and DOD entities that focused on fiscal year 2020 plans, changes to their plans due to COVID-19 restrictions, and their achievements prior to and after the COVID-19 restrictions took place. To verify MDA's answers and to determine perturbations to MDA's schedule and testing for future years, we assessed MDA officials' responses, and corroborated their

[3]GAO has initiated a review on MDA's cost estimates and expects to release its findings summer 2021.

[4]We acknowledge MDA completed software builds and related capability deliveries in fiscal year 2020. However, for our review, we focused our assessment on MDA's hardware deliveries, including interceptors.

[5]The outbreak of COVID-19, a strain of coronavirus, was first reported in December 2019, in Wuhan, China. In the weeks that followed, the virus quickly spread around the globe. On January 31, 2020, the Secretary of Health and Human Services declared a public health emergency for the United States, retroactive to January 27, 2020. While a pandemic will not directly damage physical infrastructure, such as power lines or computer systems, it threatens the operation of critical systems by potentially removing the essential personnel needed to operate them from the workplace for weeks or months.

[6]For our prior work on knowledge based defense acquisitions and acquisition best practices, see GAO, *Federal Acquisitions: Congress and the Executive Branch Have Taken Steps to Address Key Issues, but Challenges Endure,* GAO-18-627, (Washington, DC: Sept. 12, 2018); and *Defense Acquisitions: DOD's Revised Policy Emphasizes Best Practices, but More Controls Are Needed*, GAO-04-53 (Washington D.C.: Nov. 10, 2003). For an example of DOD's acquisition policy, see Department of Defense Instruction (DODI) 5000.2T, Operation of the Defense Acquisition System, (Jan. 7, 2015) (incorp. change 6, eff. Jan. 23, 2020).

answers with external DOD entities such as the Office of the Director of Operational Test and Evaluation (DOT&E) and BMDS Operational Test Agency (OTA). In addition, we held phone interviews at an unclassified level with officials from MDS elements, as necessary, to discuss provided answers and with DOD officials to discuss fiscal year acquisition progress. Specifically, we discussed the agency's plans and performance in interviews with agency officials, contractors, and relevant officials in various DOD combatant commands.

We modified our methodology due to COVID-19 restrictions that limited our access to, analysis, and discussion of classified information. For example, one key document used to brief MDA's Director on each system's progress and risks—known as the Director's Program Review—is a classified document. While we were not able to assess the entire document, MDA provided unclassified portions for the fourth quarter of fiscal year 2020.

We conducted this performance audit from April 2020 to April 2021 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.

Background

MDA is responsible for developing a number of systems, known as elements, with the purpose of defending against missile attacks. MDA's mission is to combine these elements into an integrated system-of-systems, known as the MDS. The goal of the MDS is to combine the abilities of two or more elements to achieve objectives that would not have been possible for any individual element. These emergent abilities

are known as integrated capabilities or MDS-level capabilities and are organized by increments.[7]

Table 1 provides a list and description of elements included in our review.

Table 1: Description of Missile Defense System (MDS) Elements

MDS element[a]	Description
Aegis Ballistic Missile Defense (BMD) Weapon System	Aegis BMD includes ship- and land-based ballistic missile defense capabilities using a radar, command and control, and Standard Missile-3 (SM-3) interceptors.
Aegis BMD SM-3 Block IB	Aegis BMD SM-3 Block IB features capabilities to identify and track objects during flight to defend against short-, medium-, and intermediate-range ballistic missiles threats.
Aegis BMD SM-3 Block IIA	Aegis BMD SM-3 Block IIA has increased range, more sensitive seeker technology, and an advanced kill vehicle to defend against medium- and intermediate-range ballistic missiles.
Aegis Ashore	Aegis Ashore, a land-based version of Aegis BMD, uses SM-3 interceptors and Aegis BMD capabilities as they become available and will have three locations: one test site in Hawaii and two operational sites—one in Romania and one under construction in Poland.
Command, Control, Battle Management, and Communications (C2BMC)	C2BMC is a globally deployed system of hardware—workstations, servers, and network equipment—and software that links and integrates individual elements, allowing users to plan ballistic missile defense operations, see the battle develop, and manage networked sensors. C2BMC integrates Ballistic Missile Defense System Overhead Persistent Infrared Architecture, which is made up of space-based sensors that support the MDS missions by providing cues and tasking to downstream sensors and weapon systems.
Ground-based Midcourse Defense (GMD)	GMD is a ground-based system with launch, communications, and fire control components that uses interceptors with a booster and a kill vehicle to defend against intermediate- and intercontinental-range ballistic missiles. The fielded inventory of GMD interceptors currently consists of: 20 interceptors equipped with the Configuration (C)1 boost vehicle and Capability Enhancement (CE)-I kill vehicle; 16 interceptors equipped with the C1 boost vehicle and CE-II kill vehicle; and 8 interceptors equipped with the C2 boost vehicle and CE-II Block I kill vehicle.
Sensors - Army Navy/ Transportable Radar Surveillance and Control Model 2 (AN/TPY-2)	AN/TPY-2 is a transportable X-band high-resolution radar capable of tracking ballistic missiles of all ranges that can be used in two modes: (1) forward-based mode—to support Aegis BMD, Terminal High Altitude Area Defense (THAAD), GMD, and allied missile defense engagements, or (2) terminal mode—to support THAAD and Patriot engagements.

[7]As we previously reported, MDA has experienced difficulties in delivering the Increments as planned. Specifically, some of the delivered increments include a more scaled-back capability than originally planned. In addition, in certain cases, the increments were delivered, with insufficient testing to demonstrate the capability against the planned threats. For further details, see GAO, *Missile Defense: Some Progress Delivering Capabilities, but Challenges with Testing Transparency and Requirements Development Need to Be Addressed*, GAO-17-381 (Washington, D.C.: May 30, 2017); *Missile Defense: The Warfighter and Decision Makers Would Benefit from Better Communication about the System's Capabilities and Limitations,* GAO-18-324 (Washington, D.C.: May 30, 2018); and *Missile Defense: Delivery Delays Provide Opportunity for Increased Testing to Better Understand Capability*, GAO-19-387 (Washington, DC.: June 6, 2019).

MDS element[a]	Description
Long Range Discrimination Radar (LRDR)	LRDR will be an S-band radar providing capabilities to track incoming missiles and improve discrimination of the warhead-carrying vehicle from decoys and other non-lethal objects for GMD. Initial fielding is expected in fiscal year 2021.
Sea Based X-Band (SBX)	SBX is a radar capable of tracking, discriminating, and assessing the flight of ballistic missiles. It is mounted on a mobile, ocean-going, semi-submersible platform capable of being positioned to cover any region of the globe. SBX primarily supports the GMD system for defense of the U.S. and is considered a critical sensor for GMD, in part because it is able to provide tracking information to GMD as it targets an incoming threat missile.
Upgraded Early Warning Radars (UEWR)	UEWR is a solid-state, phased-array, long-range radar that detects sea-launched or intercontinental ballistic missiles. Five UEWRs have been upgraded and integrated into the MDS to improve sensor coverage by providing critical early warning, tracking, object classification, and cueing data. UEWRs are located in Beale, California; Fylingdales, United Kingdom; and Thule, Greenland. Clear, Alaska, and Cape Cod, Massachusetts, radars were added to the Operational Capacity Baseline in February 2019 and December 2019, respectively.
Targets and Countermeasures[b]	Targets and Countermeasures provide a variety of highly complex short-, medium-, intermediate-, and intercontinental-range targets to represent realistic threats during MDS flight testing.
Terminal High Altitude Area Defense (THAAD)	THAAD is a mobile, ground-based system to defend against short-, medium-, and limited intermediate-range threats using a battery that consists of interceptors, launchers, a radar, and fire control and communication systems.

Source: GAO analysis of Missile Defense Agency data. | GAO-21-314

[a]MDA is developing and has already fielded additional elements for the MDS that are not included in this report because they fall outside the scope of the BMDS Accountability Report.

[b]Targets and Countermeasures provide assets to test the performance and capabilities of the MDS elements, but these testing assets are not operationally fielded.

MDA's Acquisition Flexibilities and Steps to Improve Traceability and Oversight

When MDA was established in 2002, it was granted exceptional flexibilities to set requirements and manage the acquisition of the BMDS—developed as a single program—that allow MDA to expedite the fielding of assets and integrated missile defense capabilities. These flexibilities allow MDA to diverge from DOD's traditional acquisition life cycle and defer the application of certain acquisition policies and laws designed to facilitate oversight and accountability until a mature capability is ready to be handed over to a military service for production and operation. Some of the laws and policies include such things as:

- obtaining the approval of a higher-level acquisition executive before making changes to an approved baseline,[8]
- reporting certain increases in unit cost measured from the original or current baseline,[9]
- obtaining an independent life-cycle cost estimate prior to beginning system development or production and deployment, and[10]
- regularly providing detailed program status information to Congress, including specific costs, in Selected Acquisition Reports.[11]

In response to concerns related to oversight, Congress and DOD have taken a number of actions. For example, Congress enacted legislation in 2008 requiring MDA to establish cost, schedule, and performance baselines—starting points against which to measure progress—for each element that has entered the equivalent of system development or is being produced or acquired for operational fielding.[12] MDA reported its newly established baselines to Congress for the first time in its June 2010 BAR. Since that time, Congress has required more details for the content of these baselines.[13]

In addition, in 2010, MDA also established an acquisition process that continues to guide the development of the MDS. However, as we reported in July 2020, Congress and the Secretary of Defense are considering whether existing elements that are in production or beyond, known as fielding operations and sustainment, should transfer to the military services, as originally intended by the Secretary of Defense and

[8]Department of Defense Instruction 5000.85, Major Capability Acquisition (August 6, 2020).

[9]10 U.S.C. § 2433.

[10]10 U.S.C. § 2334.

[11]10 U.S.C. § 2432.

[12]Pub. L. No. 110-181, § 223(g) (2008), repealed by Pub. L. No. 112-81, § 231(b)(2) (2011).

[13]See, e.g., Pub. L. No. 112-81, § 231, as amended, codified at 10 U.S.C. § 225, requiring the MDA Director to establish and maintain an acquisition baseline for each program element of the BMDS and each designated major subprogram of such program elements before the date on which the program element or major subprogram enters the equivalent of engineering and manufacturing development and before production and deployment. This law details specific requirements for the contents of the acquisition baseline.

per legislative direction.[14] At this point, most elements are in production or beyond. Table 2 describes the life-cycle phases of MDA's acquisition process.

Table 2: Missile Defense Agency Acquisition Life-Cycle Phases

Material solution analysis	Technology development	Product development	Initial production	Production
An analysis period to develop potential alternative solutions.	For developing and maturing technology solutions for a capability shortfall.	To further develop the potential Ballistic Missile Defense System 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: Missile Defense Agency Directive 5010.18, GAO (presentation). | GAO-21-314

The agency has documented the key knowledge that is needed prior to the technology development, product development, initial production, and production phases. For example, as part of the process, MDA requires a program to identify alternatives to meet the mission's needs before it can proceed to MDA's technology development phase. MDA officials have stated in the past that they expect that aligning the development efforts with the phases will help to ensure that they obtain the appropriate level of knowledge before allowing acquisitions to move from one phase to the next.

In early March 2020, the Deputy Secretary of Defense issued a memorandum that "establishes policy, assigns responsibilities, and prescribes procedures for MDS research, development, test and evaluation; procurement; and operations and sustainment in order to reduce risk and promote MDS element transfers to the military departments while maintaining agility." The memorandum—which updates the roles, responsibilities, and authorities of MDA, the military departments, and the Office of Secretary of Defense—became effective August 20, 2020. The Secretary of Defense directed MDA to incorporate these changes into its management instruction and manual. According to MDA, some aspects of the memorandum were already a part of the agency's best practices for acquisition and program management; and,

[14]GAO, *Missile Defense: Assessment of Testing Approach Needed as Delays and Changes Persist,* GAO-20-432, (Washington, D.C.: July 23, 2020).

since the memorandum has taken effect, MDA has begun incorporating implementation steps into existing MDA acquisition processes.[15]

Furthermore, to enhance oversight of the information provided in the BAR, MDA continues to incorporate suggestions and recommendations from GAO. However, not all of our recommendations have been fully implemented. For example, in April 2013, we recommended that MDA stabilize its acquisition baselines so that meaningful comparisons can be made over time to support oversight. MDA stated that the information presented in the BAR is sufficient; however, we continue to find that the lack of stable baselines makes comparison difficult and, in some instances, impossible.[16]

Flight, Ground, and Cybersecurity Testing within MDA

MDA's testing baseline—the Integrated Master Test Plan (IMTP)—designates all of its system-level testing for the upcoming and future fiscal years and supports its funding requests. Specifically, it identifies each test by name, including the type of test, any targets (if applicable), and the fiscal year quarter it is planned for execution. The IMTP is finalized and signed annually.[17]

Testing, in general, is performed to collect critical data on individual elements or the integrated system to: (1) determine whether it is properly designed, built, and integrated; (2) understand its performance, including its capabilities and limitations; and (3) support next steps and decisions. MDA's testing, specifically, is both developmental and operational, the

[15]According to agency officials, MDA is currently updating its policies and manuals and expects to issue interim guidance memorandum to address process and oversight changes by February 2021. As such, we did not review these changes in this year's audit.

[16]In May 2020, we sent a letter to the Secretary of Defense, in part, to call attention to areas in which two open recommendations on missile defense should be given high priority by DOD. One of those recommendations included stabilizing baselines and clearly tracking any revisions for missile defense programs. For additional information, see GAO, *Missile Defense: Opportunity to Refocus on Strengthening Acquisition Management*, GAO-13-342, (Washington, D.C.: April 26, 2013).

[17]The annual IMTP is signed by the Director, MDA along with external stakeholders that include the Director, Operational Test and Evaluation; Director, Developmental Test and Evaluation; Commander, Army Test & Evaluation Command; Commander, Navy Operational Test & Evaluation Force; Commander, Air Force Operational Test & Evaluation Center; Commander, Joint Interoperability Command; and Commander, Joint Functional Component Command Integrated Missile Defense representing the Combatant Commands.

former verifying the design is built correctly and the latter demonstrating the system can successfully accomplish its mission in the hands of the warfighter under realistic conditions. In addition, MDA uses multiple methods including ground, cybersecurity, and flight testing to determine whether the element's or MDS's design will satisfy the desired capabilities:

- **Flight Testing**—includes intercept and non-intercept testing. Flight tests use actual elements and their components to assess and demonstrate performance. Flight tests alone are insufficient because they only demonstrate a single collection data point of element and system performance. Flight tests are, however, an essential tool used to both validate performance of the elements and MDS. Flight tests are also necessary to anchor models and simulations and to ensure they accurately reflect real performance. Non-intercept and target only tests enable evaluation of specific performance aspects or scenarios and potentially reduce risks for future tests. The BMDS OTA, DOT&E, and the Combatant Commands—DOD organizations comprised of forces from multiple military services and structured by geographical area or functional responsibilities—assess MDA element- or system-level, performance during developmental and operational testing.
- **Ground Testing**—uses modeling and simulations, which are computer representations that simulate the system's performance to assess the capabilities and limitations of how elements or the MDS perform under a wider variety of conditions than can be accomplished through the limited number of flight tests conducted. Ground tests use a combination of actual element and system-level models, support infrastructure, and virtual targets in order to repeatedly conduct scenarios that may be too costly or subject to constraints as a flight test. To ensure that the models and simulations accurately represent the element- or system level, each undergoes verification, validation, and accreditation—an official certification that it operates as intended in representative, real-world conditions. The BMDS OTA serves as the accreditation agent in support of accreditation efforts for operational test and evaluation purposes. MDA performs the verification, validation, and accreditation for developmental test and evaluation purposes. In 2019, MDA began transitioning to a new ground testing approach, eschewing large scale ground test

campaigns for smaller but more focused ground test sprints, meant to allow MDA more flexibility in test design.[18]

- **Cybersecurity Testing**—includes a Cooperative Vulnerability and Penetration Assessment (CVPA) and an Adversarial Assessment (AA). These operational assessments are intended to identify cyber vulnerabilities, examine potential attack paths, evaluate operational cyber defense capabilities, and identify the potential operational mission effects (e.g., loss of critical operational capability) in a cyber-threat environment while conducting operational missions. Specifically, a CVPA provides initial information about the resilience of a system in an operational context, which is used to identify initial vulnerabilities and to develop the subsequent AA. The AA characterizes the operational effects caused by threat representative cyberattack and the effectiveness of defensive capabilities.

MDA Achieved Some of Its Asset Delivery and Testing Goals for Fiscal Year 2020 as Initial Effects of COVID-19 Restrictions Came into Focus

In fiscal year 2020, MDA achieved a portion of its asset delivery plans as outlined in the BAR. Specifically, MDA delivered all planned Aegis Standard Missile (SM)-3 Block IB interceptors. However, MDA was unable to complete its planned deliveries as quality problems with supplier-provided parts contributed to delays. Specifically, deliveries of Aegis SM-3 Block IIA and Terminal High Altitude Area Defense (THAAD) interceptors were only partially completed, and delays continued for an additional homeland defense Ground-Based Interceptor originally expected in fiscal year 2018. MDA conducted two of nine planned flight tests—neither of which were successful, as both encountered technical issues with Army assets—and participated in two additional flight tests with external partners. MDA also completed three ground tests as planned, demonstrating capabilities for the defense of the United States and regional allies. However, MDA delayed two other ground tests planned for fiscal year 2020 and continues to manage ongoing issues related to preparations for one of them. Further, according to MDA

[18]As we reported in July 2020, while the transition to sprints may provide benefits, testing officials raised concerns about the increased pace of testing that was outpacing the availability of software and data needed to validate and accredit models and simulations used in these tests. See GAO-20-432.

officials, MDA did not conduct any of the 17 planned operational cybersecurity tests, but instead implemented a new cyber-test planning approach, approved by the Director, MDA in March 2019.

MDA Met One Asset Delivery Goal for Fiscal Year 2020 as It Worked to Overcome Prior Delays

MDA met asset delivery goals for one of four MDS elements during fiscal year 2020. As table 3 shows, MDA delivered all 35 Aegis BMD SM-3 Block IB interceptors as planned, but fell short of its goals for Aegis BMD SM-3 Block IIA and THAAD interceptors. Delays also continued for a Ground-Based Interceptor initially planned for fiscal year 2018. For additional details on these elements, see appendixes I, III, and VI.

Table 3: Missile Defense Asset Deliveries in Fiscal Year 2020

Asset	Planned delivery	Status
Standard Missile-3 Block IB	35 interceptors	**35 delivered**.
Standard Missile-3 Block IIA	11 interceptors	**Five delivered**. Delivery delays due to a flight test failure and associated corrective actions.
Ground-Based Interceptors	1 interceptor	**0 delivered**. Program continues to experience delays related to qualifying electronic parts from a new supplier for this interceptor, which the Missile Defense Agency originally planned for fiscal year 2018.
Terminal High Altitude Area Defense Interceptors	85 interceptors	**42 delivered.** Deliveries were halted from June through September 2020 while awaiting a qualified replacement for an electronics part that was no longer available. Qualification was subsequently achieved and interceptor deliveries resumed in October 2020.

Source: GAO analysis of Missile Defense Agency data. | GAO-21-314

MDA Did Not Complete Its Annual Flight Test Plan, a Consistent Trend That Limits Insight into the System's Capabilities and Limitations

MDA did not successfully complete its fiscal year 2020 flight test plan. We reported in July 2020 that MDA has struggled over the past decade to execute its annual flight test plan, with MDA frequently revising the schedule by adding new tests and delaying or deleting others.[19] This

[19]GAO-20-432.

trend continued in fiscal year 2020. MDA and the U.S. Army jointly conducted two planned flight tests during fiscal year 2020, but neither was successful as software issues with Army assets led to a no-test declaration in one and a failure in the other.[20] Of the remaining seven tests planned, MDA canceled one and delayed six to future fiscal years. These delays included FTM-44, a developmental test mandated by Congress to evaluate and demonstrate whether an Aegis BMD SM-3 Block IIA is capable of intercepting an intercontinental ballistic missile (ICBM) target.[21] The reasons for these testing disruptions during fiscal year 2020 varied but include the aftereffects of the flight test failure, asset availability, programmatic delays, and COVID-19 travel restrictions. As we have previously reported, testing disruptions—such as the delays and removals of planned tests from the schedule that MDA has experienced since 2010—result in assets and capabilities that are subsequently delayed, or delivered with less data than planned due to reduced testing.[22] Table 4 provides an overview of the nine flight tests planned in MDA's baseline test schedule for fiscal year 2020, as well as an additional test subsequently added to the schedule but delayed due to COVID-19.

[20]A no-test is declared when external factors (e.g., weather) or anomalies with the target (e.g., intercept is not attempted) prevent the flight test from achieving its objectives.

[21]National Defense Authorization Act for Fiscal Year 2018, Pub. L. No. 115-91, § 1680 (2017). MDA conducted FTM-44 in November 2020, prior to the December 31, 2020, legislative deadline. Preliminary reports indicate that the test was a success.

[22]In July 2020, we recommended MDA ensure an independent assessment is conducted of its process for developing and executing the annual flight test plan. DOD concurred with this recommendation and is currently taking steps to implement this recommendation, with its completion planned for September 2021. For further details, see GAO-20-432.

Table 4: Fiscal Year (FY) 2020 Flight Tests

Flight Tests Planned in the Missile Defense Agency's Fiscal Year 2020 Baseline

	Name of planned flight test	Flight test type	Conducted (yes or no)	Status and description	Backlogged test[a]
1	FTX-39	Non-intercept	Yes	**No test.** The test intended to simulate a Patriot Weapon System Patriot Advanced Capability (PAC)-3 Missile Segment Enhancement (MSE) engagement of a threat representative short-range ballistic missile (SRBM) target, utilizing the Patriot Launch-on-Remote (THAAD) capability.[b] However, the target failed after launch and was terminated by the range safety team prior to radar acquisition.	—
2	FTP-27 E2	Intercept	Yes	**Failed.** The test intended to demonstrate a Patriot Weapon System PAC-3 MSE engagement of a threat representative SRBM target, utilizing the Patriot Launch-on-Remote (THAAD) capability. The PAC-3 MSEs failed to intercept the target. However, according to MDA, the test still successfully demonstrated the Launch on Remote (THAAD) capability.	—
3	FTP-27 E1	Intercept	No	**Delayed until FY2021** due to FTP-27 E2 failure review board and return to flight certification.[c]	—
4	FTO-03 (FTO-03 E2)	Intercept	No	**Deleted** due to the loss of Army support for both a Patriot unit and an Army-Navy/Transportable Radar Surveillance and Control Model 2 (AN/TPY-2) radar. Objectives reallocated to future events.	✓
5	GM BVT-03	Non-intercept	No	**Delayed until FY2021** due to the availability of ground-based interceptor hardware and software.	—
6	FTM-44	Intercept	No	**Delayed until FY2021** due to Coronavirus Disease 2019 (COVID-19), associated travel restrictions, and subsequent flight test deconfliction. FTM-44 had already been delayed earlier in the fiscal year for flight test deconfliction following the addition of FEX-01 and programmatic delays to other flight test events.[d]	—
7	FTM-30	Intercept	No	**Delayed until FY2024** to ensure 18-month separation from FTX-23 to support model validation and analysis. Objectives reallocated to ground tests.	✓
8	FTM-32	Intercept	No	**Delayed until FY2023** due to programmatic delays, addition of FEX-01, and deconfliction of test resources and assets.	✓

Name of planned flight test	Flight test type	Conducted (yes or no)	Status and description	Backlogged test[a]
9 FTM-33	Intercept	No	**Delayed until FY2021** due to programmatic delays, addition of FEX-01, and deconfliction of test resources and assets.	✓

Flight Tests Added after Publication of Fiscal Year 2020 Baseline

Name of planned flight test	Flight test type	Conducted (yes or no)	Status and description	Backlogged test[a]
1 FTM-31 E1	Intercept	No	**Delayed until FY2021** due to COVID-19 and associated travel restrictions.	✓

Legend:

E – Event
FEX – Flight Test Experiment Other
FTM – Flight Test Aegis Weapon System
FTO – Flight Test Operational
FTP – Flight Test Patriot Weapon System
FTX – Flight Test Other
GM BVT – Ground-based Midcourse Defense Weapon System Booster Vehicle Test
✓ – Backlogged test

Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-21-314

Note: As in previous years, tests where MDA participated but did not possess the primary system under test (e.g., Army's Patriot program or Israel's Iron Dome) were omitted. The Patriot tests included in this report are integration tests with Terminal High Altitude Area Defense (THAAD); Patriot-only tests planned for fiscal year 2020 are not included.

[a]Backlogged tests had already been delayed at least once from a previous fiscal year.

[b]A no-test is declared when external factors (e.g., weather) or anomalies with the target (e.g., intercept is not attempted) prevent the flight test from achieving its objectives. Patriot Launch-on-Remote (THAAD) allows Patriot to launch its MSE interceptor using THAAD AN/TPY-2 track data before Patriot acquires the threat and executes the intercept with its own radar. This increases the coverage area of the Patriot batteries.

[c]MDA and the U.S. Army jointly conducted FTP-27 E1 in October 2020, and preliminary reports indicate that the test was a success.

[d]MDA conducted FTM-44 in November 2020, and preliminary reports indicate that the test was a success.

Both of the planned flight tests conducted by MDA and the U.S. Army in fiscal year 2020 were in support of an urgent regional capability called Patriot Launch-on-Remote (THAAD). This capability allows the Army's Patriot Weapon System to launch its Patriot Advanced Capability (PAC)-3 Missile Segment Enhancement (MSE) interceptor using THAAD Army Navy/Transportable Radar Surveillance and Control Model 2 (AN/TPY-2) radar track data before Patriot acquires the threat and executes the intercept with its own radar. This increases the coverage area of the Patriot batteries.

- In the first test, named FTX-39, the primary objective was a simulated PAC-3 MSE intercept of a threat representative short-range ballistic missile (SRBM) target utilizing Patriot Launch-on-Remote (THAAD).

However, the range safety team terminated the Army-supplied Black Dagger target after a software error caused it to drift outside of acceptable flight safety boundaries. The termination occurred prior to the THAAD AN/TPY-2 radar acquiring the target. Consequently, THAAD and Patriot did not collect data on the target. MDA declared this a no-test.

- In the second test, named FTP-27 E2, the primary objective was a live intercept of a threat representative SRBM target with two PAC-3 interceptors utilizing Patriot Launch-on-Remote (THAAD). The interceptors failed and a subsequent Army failure review board found the root cause was that the compact disk used to update the two interceptors was missing a portion of the necessary software.[23] According to MDA, the test still successfully demonstrated the Patriot Launch-on-Remote (THAAD) capability despite the failed intercept. Specifically, MDA officials noted that Patriot received the remote track data from THAAD's AN/TPY-2 radar, developed a firing solution, launched its interceptors, detected and correlated with the remote track, and provided guidance uplinks. DOT&E concurred that the test demonstrated this capability, while BMDS OTA officials stated the significance of the test failure was low with regard to the operational force and future of Patriot Launch-on-Remote (THAAD).[24]

As MDA broadens its mission in response to evolving threats, the agency plans to participate in flight tests conducted by external partners such as the U.S. Army, U.S. Navy, U.S. Air Force, and Defense Advanced Research Projects Agency (DARPA). In fiscal year 2020, MDA participated in one such flight test to support the development of hypersonic defense capabilities.[25] MDA also participated in an international test to collect data for future Aegis engagements. An

[23]According to MDA, this anomaly does not impact any current PAC-3 or PAC-3 MSE fielded software.

[24]The follow-up to this test—FTP-27 E1, which had been delayed from fiscal year 2020 pending the outcome of the failure review board—was conducted in October 2020. Early reports indicate that the PAC-3 MSEs successfully intercepted the target. We will discuss this test further in a subsequent report.

[25]In contrast to ballistic missile payload trajectories, hypersonic glide vehicle (HGV) payloads are capable of maneuvering or changing direction on the way to a target, which makes tracking difficult. The 2019 Missile Defense Review confirmed MDA's lead role in developing defenses against HGVs. According to MDA officials, fully achieving this capability will require the development of wholly new intercept systems, supporting technologies, and a new sensor architecture. For additional information about MDA's new responsibility for addressing hypersonic threats, see GAO-20-432.

overview of the flight tests planned and executed with external partners is included in table 5.

Table 5: Additional Flight Tests Planned for Fiscal Year 2020 with Missile Defense Agency (MDA) and External Partners

Name of added flight test		Flight test type	Conducted (yes or no)	Status and description
1	FEX-01	Non-intercept	Yes	**Met MDA test objectives.** The U.S. Navy and U.S. Army executed a launch of a hypersonic glide body to inform hypersonic technology development. MDA monitored and gathered tracking data to support the development of a hypersonic defense capability.
2	Pacific Dragon 2020	Non-intercept	Yes	**Met MDA test objectives.** Trilateral ballistic missile tracking and Tactical Data Link information-sharing event with the Japanese Maritime Self-Defense Force, Republic of Korea Navy, and U.S. Navy. MDA used the test for risk reduction to collect data for future Aegis Ballistic Missile Defense flight tests.
3	HAWC-4	Non-intercept	No	**Delayed.** The Hypersonic Air-Breathing Weapon Concept (HAWC) program is a joint Defense Advanced Research Projects Agency (DARPA) and U.S. Air Force effort that seeks to develop and demonstrate critical technologies to enable an effective and affordable air-launched hypersonic cruise missile. MDA added four HAWC tests to its schedule for fiscal year 2020 and planned to collect data and characterize sensor performance for Modeling & Simulation and algorithm development for hypersonic defense capabilities. According to MDA, DARPA is working to reschedule these tests.
4	HAWC-5	Non-intercept	No	
5	HAWC-7	Non-intercept	No	
6	HAWC-9	Non-intercept	No	
7	TBG-1	Non-intercept	No	**Delayed.** Missile Defense System tracking exercise to support the development of a hypersonic defense capability.[a]

Legend:

FEX – Flight Test Experiment Other
HAWC – Hypersonic Air-Breathing Weapon Concept
TBG – Tactical Boost Glide

Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-21-314

[a]According to MDA, TBG-1 was conducted during the first quarter of fiscal year 2021.

MDA Completed Some Fiscal Year 2020 Ground Testing as It Implements Its New Approach

MDA successfully conducted three planned ground tests in fiscal year 2020, demonstrating defense capabilities for the U.S., U.S. forces, and regional allies. In addition, MDA conducted another test in support of U.S. Central Command verifying operational communications of a new AN/TPY-2 radar site. However, MDA delayed two other ground tests to future fiscal years.[26] The delayed ground tests were intended to demonstrate capability for the European Phased Adaptive Approach and

[26]One of the delayed ground tests split into two tests. See table 6.

further homeland, regional ally, and U.S. forces' defense. Ground testing disruptions will continue in fiscal year 2021, according to the BMDS OTA, as MDA addresses pre-testing element-level integration issues that have been exacerbated by ongoing COVID-19 disruptions. MDA also continues to face challenges with the accreditation of models and simulations used during ground testing, an issue we previously reported.[27] Table 6 provides an overview and status of fiscal year 2020 ground tests.

Table 6: Fiscal Year 2020 Ground Tests

Name of planned ground test		Combatant Commands	Conducted (yes or no)	Status and description
1	GTI-07c	U.S. Northern Command (USNORTHCOM) and U.S. Indo-Pacific Command (INDOPACOM)	Yes	**Met objectives.** Evaluated homeland and regional defense capabilities.
2	GTI-20 Sprint 1	U.S. European Command (USEUCOM) and U.S. Central Command (CENTCOM)	Yes	**Met objectives.** Evaluated software updates in support of the European Phased Adaptive Approach (EPAA) Phase 3 Technical Capability Declaration.
3	GTI-20 Sprint 2	USNORTHCOM and INDOPACOM	Yes	**Met objectives.** Evaluated Terminal High Altitude Area Defense (THAAD) and Patriot performance for regional defense.
4	GTD-07b (Aegis Ashore)	USEUCOM and CENTCOM	No	**Delayed** due to military construction delays at the Aegis Ashore Missile Defense System Poland site. Test was expected to collect data for the EPAA Phase 3 Technical Capability Declaration.
5	GTI-08	USNORTHCOM and INDOPACOM	No	**Divided and delayed.** GTI-08 was divided into GTI-08a and GTI-08b to coincide with Increment 6, which was divided into 6B.1 and 6B.2.[a]

Legend:

GTD – Ground Test Distributed
GTI – Ground Test Integrated

Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-21-314

[a]MDA capability deliveries are organized around Increments, or sets of capabilities, which are realized by upgrading and integrating MDS elements. For additional information on our reporting on MDA's incremental approach, see GAO-17-381.

Among the delayed ground tests from fiscal year 2020 was GTI-08—expected to assess performance in defense of the United States and the Asia-Pacific region from varying range attacks—which MDA split into GTI-

[27]In May 2018, we recommended that models used for operational tests be validated and accredited for such assessments. While DOD concurred with this recommendation and is actively working with the BMDS OTA to resolve any issues, according to BMDS OTA officials, some models remain unaccredited. Therefore, it is premature to close out this recommendation, but we will continue to track MDA's progress on taking the necessary steps to implement this recommendation. For further details on the risks of using unaccredited models, see GAO-18-324.

08a and GTI-08b. This adjustment came after MDA conducted a replan of Increment 6B and split those planned capability deliveries into Increment 6B.1 and Increment 6B.2. According to MDA, Increment 6B.1 provides complex, integrated upgrades across the MDS and requires interdependent software upgrades across multiple systems. In April 2020, MDA revised the Increment 6B.1 ground testing schedule to support element software deliveries and incorporate risk reduction testing, which is designed to reduce risk to interoperability and integration prior to the formal ground test—in this case, GTI-08a. This revision also delayed the expected Operational Capacity Baseline date of Increment 6B.1 from the third quarter of fiscal year 2021 to the first quarter of fiscal year 2022.[28]

According to the BMDS OTA, GTI-08a is delayed until the third quarter of fiscal year 2021. Element-level testing discovered problems with integrating the system-level framework, and COVID-19 restrictions worsened this issue by delaying the necessary software development and system-level testing. The GTI-08a issues are also delaying other planned ground tests until fiscal year 2022.

MDA continues to make progress addressing modeling and simulations limitations, though some challenges remain. According to the BMDS OTA, cooperation from MDA on providing data necessary for model accreditation continued in fiscal year 2020. The BMDS OTA and MDA also collaborated with the intelligence community to develop a threat accreditation plan and threat implementation processes for the framework and element models and simulations, which the BMDS OTA said has been the top accreditation issue.

Conversely, MDA has not been able to fully implement and resolve all issues related to its new ground test sprint approach, which we reported on in July 2020.[29] The BMDS OTA raised a concern that the rapid tempo of these sprints does not currently allow modeling and simulations accreditation to keep pace. According to DOT&E, the first series of sprints in fiscal year 2019 went relatively smoothly because many of the models were the same versions used during testing in fiscal year 2018. In fiscal year 2020, MDA used multiple models that remain unaccredited for the

[28]MDA makes capability deliveries through approved changes to its Operational Capacity Baseline. Proposed changes to the baseline are coordinated with the warfighter, including the affected combatant commands. The combatant commands then assess these element capabilities to determine whether to accept them.

[29]For further details on MDA's new ground test sprint approach, see GAO-20-432.

three ground tests conducted. As we reported in May 2018, the use of unaccredited models increases the risk that test results are distorted, and leaves decision makers without key information on how the system will perform.[30] According to MDA, the latest revision to the Ground Test Concept of Operations included processes that the agency expects will address this concern moving forward.

MDA Did Not Conduct Any Planned Fiscal Year 2020 Operational Cybersecurity Assessments, as the Agency Restructures Its Approach

MDA improved its cybersecurity planning and testing efforts in recent years; however, it did not conduct any of its planned operational cybersecurity assessments needed to assess vulnerabilities in fiscal year 2020.[31] Specifically, in fiscal year 2020, MDA planned 17 operational cybersecurity assessments—13 element-level cooperative assessments and four adversarial assessments—but completed none (see table 7).[32]

Table 7: Fiscal Year 2020 Operational Cybersecurity Assessments

	Cooperative Vulnerability and Penetration Assessment		Adversarial Assessment	
Element	**Planned**	**Completed**	**Planned**	**Completed**
Aegis Ballistic Missile Defense	5	0	2	0
Army Navy/Transportable Radar Surveillance and Control Model 2	2	0	1	0
Command, Control Battle Management, and Communications	2	0	1	0
Ground-based Midcourse Defense	0	0	0	0
Long Range Discrimination Radar	1	0	0	0
Sea-Based X-Band Radar	2	0	0	0

[30]GAO-18-324.

[31]Operational cybersecurity testing consists of two types of assessments: a Cooperative Vulnerability and Penetration Assessment (CVPA) and an Adversarial Assessment (AA). A CVPA provides initial information about the resilience of a system in an operational context, which is used to develop the subsequent AA. The AA characterizes the operational effects caused by threat representative cyberattack and the effectiveness of defensive capabilities.

[32]Fiscal Year 2020 operational cyber tests were designed to assess Increments 5 (11 assessments) and 6 (six assessments). Increment 5 is the deployed MDS increment, while Increment 6 is a future capability currently in development.

Element	Cooperative Vulnerability and Penetration Assessment		Adversarial Assessment	
	Planned	Completed	Planned	Completed
Terminal High Altitude Area Defense	1	0	0	0
Total	**13**	**0**	**4**	**0**

Source: GAO analysis of Missile Defense Agency data. | GAO-21-314

According to MDA officials, the agency did not execute the cooperative vulnerability and adversarial assessments because MDA officials felt the information that would have been obtained from these tests was not needed, as all fiscal year 2020 Operational Capability Baseline decisions that relied on this information had already been completed. In addition, during fiscal year 2020, the agency began re-structuring its cybersecurity test planning efforts to align with its March 2019 four-phase cybersecurity test concept of operations.[33] Moving forward, cyber tests will be planned and documented in the test baseline using the same process as flight and ground tests. For example, under the new approach, internal and external stakeholder input will inform cyber test requirements, which in turn will drive cyber test design and execution of testing for each capability increment. MDA officials stated that this new approach will improve cyber system requirements while streamlining cyber test planning, resource allocation, and results analysis. However, it is too soon to know how effective the new approach will be until it is fully implemented.[34]

The lack of testing during fiscal year 2020 coupled with persistent testing shortcomings over the last 3 years are representative of a broader MDA cybersecurity development issue. For instance, we reported in July 2020 that MDA conducted its largest combined cooperative cyber assessment in fiscal year 2019, as well as the first operational adversarial assessment, but failed to meet its fiscal year 2019 testing goals. We also reported that MDA failed to complete the cybersecurity testing for

[33]Phases one and two involve requirements setting and cyber test planning, while phases three and four consist of test execution and analysis and reporting of results. For further details, see Missile Defense Agency DT-102, *Ballistic Missile Defense System Cybersecurity Test Concept of Operations (MDA Policies and Procedures for Execution*) (March 19, 2019).

[34]Due to COVID-19 restrictions, GAO and MDA were unable to hold classified meetings to discuss specifics about MDA's new approach. We plan on assessing the new approach and its effectiveness in future reviews.

capabilities delivered in 2017 and 2018 and did not address deficiencies from prior year's shortfalls.[35]

Moreover, in 2020, DOT&E assessed that completed cybersecurity testing contained limitations, and its results were insufficient for Increments 4, 5, and 5A operational assessments.[36] In addition, according to the BMDS OTA, although cyber operational testing began in June 2017, some MDS elements have not received any cyber operational testing to date, while others have only received partial testing of cyber defensive postures. DOT&E and BMDS OTA have made recommendations to address shortfalls in MDA's cyber testing, noting that further element-level testing is needed to identify and address system cybersecurity vulnerabilities, not just for planned capability but also for currently deployed MDS capability increments. However, program documentation does not indicate any planned cybersecurity testing for already delivered increments.[37] Consequently, continued testing, as DOT&E and the BMDS OTA recommends, is critical to identify and address vulnerabilities that could result in disruption of operations by an adversary for MDA and its missile defense system.

Agency Comments

We are not making any recommendations in this report. We provided DOD with a draft of this report. MDA provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees, 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.

[35]GAO-20-432.

[36]Increment deliveries signify delivery of integrated MDS-level capabilities, which are designed to improve effectiveness and efficiency of the MDS over its constituent elements working independently. Increments 4, 5, and 5A are intended to increase defenses in the United States and those of our allies in the European and Asian regions. For additional information, see GAO-17-381.

[37]Fiscal year 2020 cyber testing was intended to assess current Increment 5 and the future Increment 6. No cyber tests were conducted during fiscal year 2020 and tests planned for fiscal year 2021 will only assess future Increment 6.

If you or your staff have any questions about this report, please contact me at (202) 512-4841 or SawyerJ@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 VII.

John D. Sawyer
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Appendix I: Aegis Ballistic Missile Defense (Aegis BMD)

(Appendix I through VI, see attached PDF in PDF Portfolio)

Appendix II: Command, Control, Battle Management, And Communications (C2BMC)

(Appendix I through VI see attached PDF in PDF Portfolio)

Appendix III: Ground-Based Midcourse Defense (GMD)

(Appendix I through VI see attached PDF in PDF Portfolio)

Appendix IV: Sensors

(Appendix I through VI see attached PDF in PDF Portfolio)

Appendix V: Targets and Countermeasures

(Appendix I through VI see attached PDF in PDF Portfolio)

Appendix VI: Terminal High Altitude Area Defense (THAAD)

(Appendix I through VI see attached PDF in PDF Portfolio)

Appendix VII: GAO Contact and Staff Acknowledgments

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Staff Acknowledgments

In addition to the contact named above, LaTonya Miller, Assistant Director; Matthew Ambrose; Pete Anderson; Jasmina Clyburn; Lori Fields; Cody Gesuelli; Helena Johnson; Joe Kirschbaum; Kaelin Kuhn; Jennifer Leotta; Michael Moran; Wiktor Niewiadomski; Miranda Riemer; Sylvia Schatz; Steven B. Stern; Brian Tittle; Hai V. Tran; and Alyssa Weir made key contributions to this report.

Related GAO Products

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