

Missile Defense Agency

Fiscal Year (FY) 2020
Budget Estimates

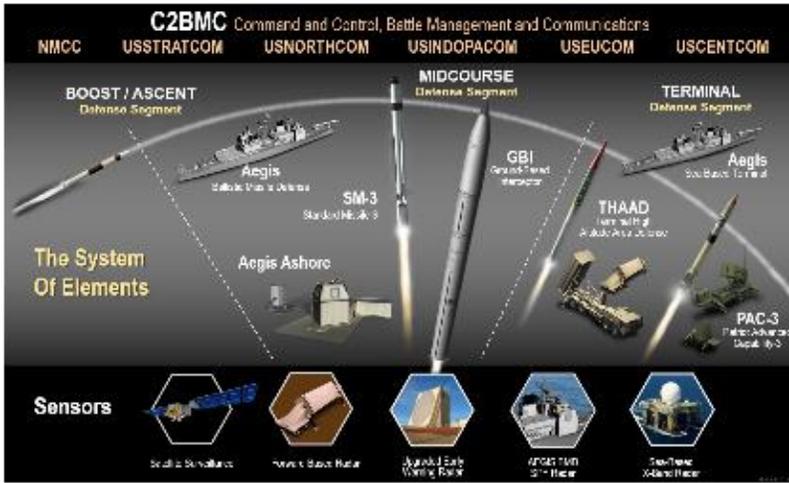


OVERVIEW

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MDA Overview 19-C-0166
Vol2a RDT&E 19-C-0146
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The Missile Defense Agency (MDA) mission is “to develop and deploy a layered Ballistic Missile Defense System to defend the United States, its deployed forces, allies, and friends from missile attacks of all ranges and in all phases of flight.” MDA’s budget request is \$9.431 billion in Fiscal Year (FY) 2020, a decrease of \$1.06 billion from the FY 2019 enacted budget of \$10.491 billion.



The Ballistic Missile Defense System

In FY 2020, MDA will aim to strengthen and expand the deployment of defenses for our Nation, deployed forces, allies, and international partners against increasingly capable missile threats. The missile defense program will support the Warfighter and the needs of the Combatant Commanders by developing, integrating, testing, and deploying interceptors, sensors, and the command and control, battle management and communications (C2BMC) system for the Ballistic Missile Defense System (BMDS). MDA’s priorities for missile defense development and fielding are as

follows: 1) continue to focus on increasing system reliability to build warfighter confidence; 2) increase engagement capability and capacity; and 3) address the advanced threat. This budget request maintains operational missile defense capabilities for existing homeland and regional defense forces and will continue to increase interceptor inventory capacity and use existing technologies to improve sensors, battle management, fire control, and kill vehicle capabilities to address evolving threats. MDA is cognizant of the growing cyber threat and is working to ensure the Nation's missile defenses are resilient and able to operate in a highly contested cyber environment. MDA remains focused on supporting the DoD Cybersecurity Campaign through implementation of the DoD Cybersecurity Discipline Implementation Plan - Four Lines of Effort. The four lines of effort are Strong Authentication, Hardening of Systems, Reducing the DoD Attack Surface, and Alignment to Cybersecurity / Computer Network Defense Service Providers across all networks; all are critical to the reliability of the MDA networks.

I. Missile Threat

Current global trends indicate ballistic and cruise missiles are becoming more capable, due in part to the proliferation of advanced technologies, resulting in systems with global reach, increasing speed, and greater accuracy. Nearly all of our adversaries are concerned with U.S. missile defenses and have devised various means to complicate missile defense operations. Many foreign ballistic and cruise missile systems are progressively incorporating advanced countermeasures, including maneuverable reentry vehicles, multiple independent reentry vehicles, and electro-magnetic jamming, all intended to defeat our missile defense capabilities. Future supersonic/ hypersonic powered



Hypersonic Glide Vehicle

cruise missiles may be launched by large rocket boosters that have traditionally been associated with ballistic missiles. Hypersonic glide vehicles are being developed as a new type of ballistic missile payload. The combination of high speed, maneuverability, and relatively low altitude makes them challenging targets for missile defense systems.

The United States remains vigilant to the pursuit of missile capabilities and nuclear weapons by potential adversaries. North Korea continues to develop a long-range, nuclear-armed missile that is capable of posing a direct threat to the United States. In 2016 and 2017, North Korea conducted over 40 launches of short- medium-intermediate-submarine-launched, and intercontinental-range systems.



**Hwasong-15
ICBM Launch, 2017**

Iran has ambitious ballistic missile and space launch development programs and continues to attempt to increase the lethality of its ballistic missile force. Iran is fielding increased numbers of theater ballistic missiles and improving its existing inventory. Its progress on space launch vehicles could shorten a pathway to an Intercontinental Ballistic Missile (ICBM). Iran's ballistic missiles are capable of striking targets throughout the region, ranging as far as southeastern Europe. It has used these missiles in the region, conducting retaliatory strikes on ISIS targets in Syria. Iran has steadily increased its regional ballistic missile force, deploying next-generation short- and medium-range ballistic missiles (SRBMs and MRBMs) with increasing accuracy and new submunition payloads. Iran is developing, and has publicized the testing of, SRBMs with anti-ship payloads. Iran also continues to proliferate ballistic missiles to states and non-state groups.



**Simorgh Space Launch
Vehicle, January 2019**

To combat the current threat, this budget request maintains operational homeland and regional missile defense capabilities and continues to increase interceptor inventory capacity. This budget request funds the use of existing technologies to improve sensors, battle management, fire control, and kill vehicle capabilities to address evolving threats, while pursuing game-changing technologies to address the advanced threat.

The following discussion provides a summary of highlights of the major Program Elements, but does not necessarily

examine all funding and activities included within each Program Element.

II. Homeland Defense

MDA remains committed to operating, sustaining, and improving the nation's homeland missile defenses. The budget request includes:

- **Ground-based Midcourse Defense (GMD) (PE 0603882C).** MDA is requesting \$1.2 billion in FY 2020. MDA continues the development and expansion of long-range homeland missile defense capabilities, with 44 currently emplaced Ground Based Interceptors (GBIs) and efforts underway to expand the fielded GBI fleet to 64 in response to the rapidly advancing North Korean threat. MDA continues the efforts to field 20 additional



Missile Field-4 Preparation

GBIs equipped with the Redesigned Kill Vehicle, 20 silos in Missile Field 4 in Fort Greely, Alaska, and two additional silos in Missile Field 1. This will improve protection against North Korean and other ICBM threats as they emerge. To further improve Homeland Defense, MDA will complete the construction, manufacturing, and delivery of an In-Flight Interceptor Communication System (IFICS) Data Terminals (IDT) to be co-located with the Homeland Defense Radar – Hawaii (HDR-H) in FY 2023. MDA will add a Communications Facility at Fort Greely by FY 2024 to ensure Homeland Defense Fire Control redundancy. MDA will also upgrade the capability of key Ground

Systems and Fire Control systems components such as the GMD Fire Control (GFC) equipment, and the GMD Communications Network (GCN). Capability upgrades will include On-Demand Communications (ODC) required for the Redesigned Kill Vehicle (RKV); GMD implementation of BMDS System Track; 2-or/3-stage selectable GBI battle management; Mid-Term Discrimination; enhancements to the Buffer Zone; cybersecurity implementations; and other GFC-Warfighter interface and logic improvements. Technology modernization will mitigate obsolescence issues, improve cybersecurity resilience, reduce life-cycle cost, increase system reliability and operational availability, and simplify the insertion of future technologies.

- **Improved Homeland Defense Interceptors (PE 0604874C).** MDA is requesting \$412.4 million in FY 2020. The Redesigned Kill Vehicle (RKV) will improve reliability and make homeland defenses more robust. The RKV will also help address the evolving threat, improve in-flight communications to better utilize off-board sensor data, and heighten Combatant Commanders’ situational awareness via hit/kill assessment messages. The RKV program is anticipated to be delayed by up to two years with a rescheduling of the RKV Critical Design Review (CDR) from late 2018 to the 2020 timeframe. While the overall RKV design is mature and robust, MDA does not want to enter the CDR until the complete RKV design meets all of the requirements. In accordance with the Integrated Master Test Plan (IMTP) version 20.1, MDA will conduct the first controlled test vehicle flight test of the RKV in FY 2022. The first intercept flight test is planned for FY 2023 with a second intercept flight test in FY 2024. MDA anticipates emplacing 20 additional GBIs tipped with the RKV beginning in the FY 2025 timeframe.

- **Ground-based Midcourse Defense Test (PE 0604887C).** MDA is requesting \$98.1 million in FY 2020 for the GMD Test program, which supports the IMTP version 20.1. This budget request funds developmental/operational ground test campaigns and flight test missions that are essential for system development and fielding interceptors with new capabilities. MDA will execute a non-intercept Ground-based Midcourse Defense Booster Vehicle Test-03 (GM BVT-03), in support of 2- or 3-Stage selectable boost vehicle software that will provide additional engagement battlespace to the warfighter using a GBI launched from VAFB, California in FY 2020. Other efforts also include the three RKV flight tests previously mentioned--one controlled test vehicle and two intercept missions in FY 2022 – 2024.



GBI Emplacement for FTG-11

- **GMD Procurement.** MDA is requesting \$9.5 million in FY 2020. This request funds the mitigation of GBI obsolescence-driven redesign and testing in support of GBI procurements.



GBI Maintenance Manager

- **GMD Maintenance and Sustainment.** MDA is requesting \$153.2 million in FY 2020 for the Operation and Maintenance (O&M) of the GMD weapon system. In addition to operation, maintenance and sustainment of the GMD weapon system and operational and support facilities at Fort Greely, Alaska, Vandenberg Air Force Base (VAFB), Fort Drum NY, Schriever AFB, Colorado, and Eareckson Air Station, Alaska, it includes Warfighter training, wargames, and exercises to maintain readiness.

- **Sea-Based X-band (SBX) Radar (PE 0603907C).** MDA is requesting \$128.2 million in FY 2020. The SBX radar provides precision midcourse tracking, debris mitigation, and discrimination capabilities, and the SBX is an integral component in flight tests to demonstrate discrimination and debris mitigation. To address the continued missile test activity in North Korea, the MDA budget request includes funds to extend time at sea and conduct contingency operations for defense of the homeland. Specifically, SBX would log approximately 305 days at sea and 60 days for in-port maintenance in FY 2020, and approximately 330 days at sea annually from FY 2021-2024. The budget request also continues the x86 X-Band Radar (XBR) superdome replacement to address obsolete equipment and increase the XBR processing capabilities. The replacement superdome will be fielded in the 2021 timeframe.



**SBX - Red Dawn
Offshore Support Vehicle**

- **Long Range Discrimination Radar (LRDR)** (PE 0604873C).

MDA is requesting \$136.4 million in FY 2020. The LRDR provides an improved persistent midcourse BMDS discrimination capability in the Pacific sensor architecture. The LRDR will also increase the defensive capacity of the GMD interceptor inventory and address evolving threats. In FY 2020, MDA will complete assembly and installation of the LRDR and conduct system integration and power-up testing at Clear Air Force Station, AK. Initial fielding of the LRDR is planned for 2020 leading to an Operational Acceptance by the Warfighter in the 2022 timeframe. MDA's request includes funding for software Independent Verification and Validation (IV&V), Modeling and Simulation (M&S) efforts, and development of software for BMDS Increment 7 capability.



**Artist Rendering of LRDR site
Upon Completion**

- **Home Defense Radar – Hawaii (HDR-H)** (PE 0604672C).

MDA is requesting \$274.7 million in FY 2020 for the Homeland Defense Radar – Hawaii. The HDR-H will provide a persistent capability, augmented by other sensors, to mitigate the effects of evolving threats to the BMDS, optimize discrimination capability in the Pacific architecture, and increase capability of GBIs in the defense of Hawaii. MDA has awarded a fixed-price incentive contract to manage, develop, build, integrate, test, and field the radar prime mission equipment. The radar prime contractor will deliver a full technical data package that will enable the government to effectively and affordably sustain the system. The HDR-H radar is expected to complete development and initial fielding in FY 2023 for BMDS integration and testing. MDA will request military construction funding for the HDR-H in FY 2021. The radar will be constructed in two phases, Phase 1 in FY 2021 and Phase 2 in FY 2022.



Conceptual HDR-H Configuration

- **Pacific Discriminating Radar (PE 0604673C)**.

MDA is requesting \$6.7 million in FY 2020 for the Pacific Discriminating Radar. In FY 2020, MDA will complete program requirements development activities associated with systems engineering, hardware and software development, discrimination improvements, design reviews, testing, and M&S efforts for radar development. The Pacific Discriminating Radar will provide persistent midcourse discrimination, precision tracking, and hit assessment to support the defense of the Homeland against long-range missile threats and defense against regional threats in the USINDOPACOM area of responsibility. The Pacific Radar is expected to complete fielding in the 2026 timeframe.

III. Regional Defense



**Standard Missile -3 Block IB Launch
From USS DONALD COOK**

There are hundreds of ballistic missiles within range of U.S. forces and its international partners and allies worldwide. MDA's FY 2020 budget request continues to resource and build integrated regional missile defenses that are interoperable with systems deployed by international partners to protect deployed forces, allies and international partners against SRBMs, MRBMs, and IRBMs.

The Aegis Ashore Missile Defense System in Romania currently protects U.S. deployed forces and NATO allies in Europe from ballistic missile threats from the Middle East. MDA will further enhance defensive coverage for NATO allies in Europe against medium- and intermediate-range threats with the deployment of an Aegis Ashore site in Poland and the SM-3 Block IIA and associated Aegis BMD weapon system upgrades for Aegis BMD ships and Aegis Ashore sites. The Aegis Ashore site in Poland is projected to be delivered by 2020. The U.S. Navy will continue

to operate the Aegis Ashore site in Romania as an integral part of NATO's BMD architecture, which includes a forward-based Army Navy/Transportable Radar Surveillance System (AN/TPY-2) in Turkey, BMD-capable Aegis Destroyers homeported in Rota, Spain, SM-3 interceptors, and a command-and-control node operated from Ramstein Air Base, Germany. MDA is using an incremental development approach integrated within the Aegis Baseline (BL) 9 architecture to develop and deliver an additional layer to Aegis BMD with a Sea Based Terminal (SBT) capability. By expanding the capability of the SM-6 missile and associated Aegis weapon system changes, we are delivering capability to maritime forces to protect against anti-ship ballistic missiles and provide a layered defense for forces ashore.

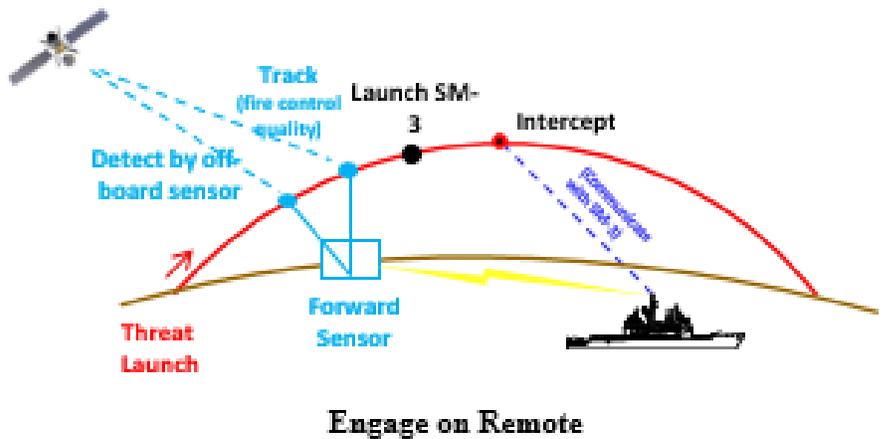
Continued provocations demonstrate the serious threat North Korea poses to the Republic of Korea (ROK), the Asia-Pacific region, and U.S. forward-deployed forces. MDA continues to provide training, maintenance and supply support of the THAAD batteries (including its Terminal Mode AN/TPY-2 radar) stationed in Guam and South Korea. MDA also supports U.S. forward deployed forces with Navy Aegis BMD ships stationed in Japan. This presence provides key defenses for Japan and Guam. MDA also supports Japanese's deployed Navy Aegis ships. MDA is strengthening the capability of this regional BMDS presence in response to a United States Forces Korea Joint Emergent Operational Need (USFK JEON) to increase integrated missile defense system interoperability and expand the defended area. This requirement is supported by United States Strategic Command (USSTRATCOM) and approved by the Chairman of the Joint Chiefs of Staff (CJCS).

Both the Aegis BMD and THAAD systems continue to be key component of the Nation’s regional defense for our deployed forces, allies, partners and friends, and directly supports and expands our homeland defenses with long range surveillance and track capability. MDA proposes to continue funding the development, procurement, testing, operations and sustainment of these systems. The PB 20 request includes:



Crew on the Japan Ship ATAGO and Intercept – Japan Flight Test Mission-05

- Aegis BMD (PE 0603892C).** MDA requests \$727.5 million in FY 2020. The program includes the integration of the SM-3 Block IIA into the Aegis BMD weapon system, transition of the Kinetic Warhead hardware commonality effort to system integration testing, and pre-production of all-up-rounds to support initial deployment. MDA is strongly committed to maintaining and enhancing the Aegis BMD weapon system capability alignment with Navy requirements to improve performance against SRBM, MRBM, and IRBM, as well as demonstrate capability against ICBM threats. Utilizing improved radar discrimination, Aegis BMD will increase capability against longer range and more sophisticated threats. MDA continues software development for Integrated Air and Missile Defense (IAMD) Baseline 9.C2 (BMD 5.1) in support of EPAA Phase 3 and the IAMD Baseline 10 (BMD 6.0). The BMD 6.0 computer upgrade will integrate BMD capability with data provided by the Advanced Air and Missile Defense Radar (AMDR), also known as the AN/SPY-6, for enhanced engagement capability and increased raid capacity. Additionally, MDA continues upgrading the SM-3 Block IB hardware and software to leverage the capability of the SM-3 Block IIA, which is also common with the GMD RKV.



- **Aegis BMD Testing (PE 0604878C).** MDA is requesting \$169.8 million in FY 2020 for the Aegis BMD test program, which supports IMTP version 20.1. Aegis BMD Flight Test Program performs comprehensive testing of Aegis BMD components and demonstrates their interoperability with the BMDS. Using accredited Modeling and Simulation (M&S), the ground test program provides the evidence required for MDA and the Combatant Commanders to transition the capability to the Operational Capacity Baseline. On December 10, 2018, MDA and U.S. Navy sailors manning the Aegis Ashore Missile Defense Test Complex (AAMDTC) at the Pacific Missile Range Facility (PMRF) at Kauai, Hawaii, successfully conducted Flight Test Integrated-03 (FTI-03). The test was of great significance to the future of multi-domain missile defense operations and supports a critical initial production acquisition milestone for the SM-3 Block IIA missile program. MDA will also conduct a flight test to meet the 2018 NDAA requirement to demonstrate a SM-3 Block IIA capability against an ICBM-class target that, if proven, would add an additional layer of protection to augment the currently operational GMD system. As directed by the 2018 NDAA language, MDA will conduct this demonstration no later than December 2020.



**Aegis Ashore Missile Defense
Test Complex, Hawaii**

- **Aegis Procurement.** MDA requests a total of \$697.8 million in FY 2020 for SM-3 Procurement. The request procures 30 SM-3 Block IB and seven SM-3 Block IIA missiles. Each missile variant can be used on Aegis BMD ships and at the Aegis Ashore sites in Romania and Poland. The request provides a five-year Multiyear Procurement, for SM-3 Block IB missiles ending in FY 2023. The procurement budget also requests \$124.9 million for Aegis BMD weapon systems consisting of Aegis shipset equipment, software, and installation materials. The budget also requests \$25.7 million for the Aegis Ashore site in Poland.

- **Aegis BMD Maintenance and Sustainment.** MDA is requesting \$75.2 million in FY 2020 in Operation and Maintenance (O&M) funding. The Aegis BMD program will perform missile recertification, repair efforts, and Ordnance Assessment/Surveillance. This funding supports BMD Computer Program, Ship Equipment, Aegis Ashore Romania sustainment, and Fleet integration support.



THAAD Launch

Also key to Regional Defense capability is the Terminal High Altitude Area Defense (THAAD) weapon system. THAAD is a globally transportable, ground-based missile defense system that defends against short-, medium-, and limited intermediate-range ballistic missiles in the terminal stage of flight both inside and outside the atmosphere. THAAD provides Combatant Commanders a rapidly deployable capability to deepen, extend, and complement BMDS homeland and regional defenses. MDA supports forward-deployment of one THAAD battery in Guam, one THAAD Battery in the Republic of Korea (ROK), and plans additional OCONUS THAAD Battery deployments in FY 2019 and FY 2020.

MDA PB 20 request includes:

- **BMD Terminal Defense (PE 0603881C).** MDA is requesting \$302.8 million for THAAD development efforts in FY 2020. MDA will continue the development of multiple, independent THAAD software upgrades to address the evolving threat, improve the Warfighter’s defense planning and, improved capability to engage



Patriot Advanced Capability-3 Launch

SRBM, MRBM, and limited IRBM threats. THAAD development and integration will provide enhanced debris mitigation capability and, improved interoperability with other BMDS elements, expand defended areas via remote operation of THAAD Launchers, and initiate development efforts to utilize the Terminal Mode radar to report hypersonic threats to the BMDS. Finally, MDA continues development efforts associated with USFK JEON that provides enhanced THAAD capability against specific USFK threats, integrates THAAD's capability to detect and track threat ballistic missiles at longer

ranges with the Patriot Advanced Capability – 3 Missile Segment Enhancement (PAC-3 MSE) to take advantage of its full kinematic capability, integrate MSE launchers and missiles into the THAAD weapon system, and accelerates initial capability to remote launchers and increase defended area.

- **BMD Terminal Defense Testing (PE 0604876C).** MDA requests \$25.1 million for Terminal Defense Testing in FY 2020, which supports IMTP version 20.1. This includes THAAD support of Army’s Lower Tier Project Office demonstration of Patriot Launch on Remote (THAAD) in two events as well as demonstration of THAAD’s capability to intercept an Intermediate Range Ballistic Missile (IRBM) in FTO-03.

- **THAAD Procurement.** MDA is requesting \$425.9 million for THAAD procurement in FY 2020 for 37 THAAD interceptors, obsolescence mitigation, production and training support, and procurement of tooling and equipment for the THAAD stockpile reliability and recertification program.



THAAD Battery

- **THAAD Operations and Maintenance.** MDA is requesting \$99.8 million of Operations and Maintenance (O&M) in FY 2020 to support the maintenance and upkeep of all BMDS unique items of the fielded THAAD Batteries, as well as for all THAAD training devices. MDA will provide support to seven THAAD batteries, including the two forward batteries stationed in U.S. Indo-Pacific Command area of responsibility.

IV. Developing New Capabilities

MDA is investing in advanced technology today to prepare for tomorrow's threats by improving system performance and effectiveness. This budget request will continue development of technology improvements for the current BMDS, along with breakthrough technologies for integration into the future BMDS. These efforts include advanced discrimination techniques, hypersonic defense technology, high-powered lasers, and Neutral Particle Beam (NPB). MDA is investigating solutions that reduce the cost per kill while addressing BMDS performance gaps, to improve homeland performance at dramatically reduced cost.

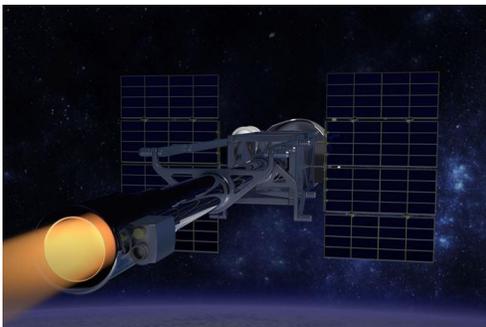
- **Hypersonic Defense (PE 0604181C).** MDA requests \$157.4 million for FY 2020. MDA will develop near term sensor and command and control capability upgrades for defense from hypersonic threats in response to the Defense Science Board's recommendations to develop and deliver a set of material solutions to address and defeat hypersonic threats. MDA will then demonstrate incremental progress in integrated hypersonic defense development by modifying existing BMDS sensors and C2BMC; defining weapon concepts and investing in key technologies to enable a broad set of kinetic and non-kinetic solutions, and conducting ground, airborne, and space-based technology experiments to track representative hypersonic threats.



Hypersonic Glide Vehicle

- **Technology Maturation Initiatives (PE 0604115C).** MDA is requesting \$303.5 million in FY 2020 for Technology Maturation Initiatives to demonstrate sensor capabilities against ballistic targets and advanced threats to improve tracking performance and operational utility. MDA will complete integration and begin

flight testing of an advanced sensor system to improve tracking precision to Aegis engage-on-remote and discrimination performance levels with the goal of migrating this technology to a space sensor layer. Working with national laboratories and industry, MDA will address laser scaling by investing in the laser component technology required to demonstrate efficient electric lasers. MDA will conduct component demonstration to prove out laser capability. The addition of the Neutral Particle Beam effort will design, develop, and conduct a feasibility demonstration for a Space-Based Directed Energy intercept layer. These efforts will leverage past and current work on particle beam and related enabling technologies as well as laser scaling, pointing, and



**Neutral Particle Beam
Conceptual Demonstrator**

stability to provide a component technology to improve the cost-benefit and size, weight and power for an operational system. This future system will offer new kill options for the BMDS and adds another layer of protection for the homeland.

- **Advanced Research Program (PE 0603180C).** MDA is requesting \$20.7 million in FY 2020, to conduct innovative research and development with small businesses, universities, and international partners to seek emerging technology and advance future missile defense capability. MDA continues to capitalize on the creativity and innovation of the nation's small business community, academia, and other partners to enhance the BMDS.
- **Multi-Object Kill Vehicle (Common Kill Vehicle Technology / PE 0603294C).** MDA is requesting \$13.6 million in FY 2020, to establish the technology foundation for killing multiple lethal objects from a single

interceptor. The more kill vehicles put on an interceptor, the greater the raid capacity of the Ground-based Midcourse Defense system. MOKV has the potential to significantly enhance homeland defense capabilities against the threat at a lower cost per engagement. MDA competitively awarded contracts to three major prime contractors in 2017 to reduce the technical risk for MOKV product development. The MOKV Technology Risk Reduction effort will culminate with component demonstrations specific to the three industry concepts.

- **Advanced Concepts & Performance Assessment (PE 0603176C).** MDA is requesting \$14.2 million in FY 2020, to centralize advanced technology concept modeling, simulation, and performance analysis. The program delivers independent assessments of government, university, and industry technology concepts that, along with



Artificial Intelligence Concept

systems engineering requirements, support acquisition strategy decisions and defines our technology focus areas. The request will fund independent government assessments of industry sensor, directed energy, and interceptor technology concepts and mature related tracking, discrimination, and sensor fusion algorithms. Assessment activities include development of Hypersonic Defense, Artificial Intelligence and Machine Learning Initiatives, and Left through Right Integration key technology areas. The innovative structured concept definition and assessment methodology enables the MDA to validate focus areas, verify contractor technology solutions, and evaluate promising concepts in future Missile Defense System architectures.

V. Space

- **BMD Space Program (PE 1206895C).** MDA is requesting \$27.6 million in FY 2020. This request funds the Spacebased Kill Assessment (SKA) experiment, which uses a network of fast frame rate and infrared sensors hosted on commercial satellites to deliver an experimental kill assessment capability tailored to homeland



SKA Sensor

defense. As MDA’s pathfinder program to host military payloads on commercial satellites, SKA proved that commercial hosting can deploy assets on orbit quickly – around half the time of the average traditional space program – and at a significant cost savings. To increase the Department’s overall experience with commercial hosting, MDA collected and shared its SKA lessons learned with several organizations, including DARPA and the U. S. Air Force. SKA sensors on orbit today have performed a variety of MDA flight tests and engineering activities. FY 2020 will see a focus on steps necessary to potentially add the SKA system to the operational BMDS.



- **Space Tracking and Surveillance System (STSS) satellite operations and sustainment (PE 1206893C).** MDA is requesting \$35.8 million in FY 2020. The satellites, which were launched in 2009, have far exceeded their life expectancy and have proven to be a very good investment. STSS consists of two satellites operating in Low Earth Orbit and provides risk reduction data for a potential operational BMDS tracking and surveillance constellation in the areas of sensor management, target signatures, discrimination, and fire control loop closure. STSS will continue participating in MDA test events and data collections providing battlespace awareness, technical intelligence, and space situational awareness to the Warfighter. This request also funds the Missile Defense Space Center (MDSC), which provides a collaborative environment to exploit and integrate STSS and other national security space assets for ballistic missile defense. Both the STSS program and the MDSC are also supporting concept development activities for space sensor architecture studies and analyses to address advanced threats.



Space Tracking and Surveillance System Satellite

VI. Other Program Highlights

- **BMD Radars Program Maintenance and Sustainment** supports both homeland and regional defense missions. MDA is requesting \$194.3 million in FY 2020 to sustain COBRA DANE, the Upgraded Early Warning Radars (UEWR), and the AN/TPY-2 radars. The Services and Combatant Commands, with logistical support from MDA, operate AN/TPY-2 (Forward Based Mode) radars in Japan (two radars), Israel, Turkey, and United States Central Command (USCENTCOM) in support of regional defense. MDA continues to support the AN/TPY-2 radar (Terminal Mode) as part of forward-deployed THAAD batteries in Guam and South Korea.



**Thule UEWR
Greenland**

- **BMD Sensors (PE 0603884C, Budget Project MD11).** MDA is requesting \$263.5 million in FY 2020 to provide periodic software updates for the AN/TPY-2, COBRA DANE, Sea-Based X-Band, and UEWR radars to counter evolving threats, and to develop future radar capabilities through system engineering, software development, and testing. This project includes development of advanced algorithms for the BMD Sensors to improve the ability to discriminate between lethal and non-lethal objects, as well as Modeling and Simulation (M&S) efforts that include enhanced sensor models, development of Radio Frequency scene generators, integration of digital simulations into the BMDS M&S architecture, and Verification, Validation, and Accreditation of radar models.



**Cobra Dane Radar
Shemya, Alaska**

- **Sensors Test (PE 0604879C).** MDA is requesting \$105.5 million in FY 2020. This includes planning, analysis and execution of BMDS flight test events, including pre- and post-test efforts such as Digital and Hardware-in-the-Loop (HWIL) Pre-Mission Tests and Post-Flight Reconstruction. Sensors Test also provides planning, analysis and execution for BMDS-level ground tests identified in the IMTP version 20.1.

- **Command and Control, Battle Management and Communication (C2BMC) (PE 0603896C).** MDA is requesting \$564.2 million in FY 2020 for C2BMC. C2BMC provides persistent acquisition, tracking, cueing, discrimination, and fire-control quality data to Aegis BMD, GMD, THAAD, Patriot, and coalition partners to support homeland and regional defense. MDA’s C2BMC capabilities



Command and Control

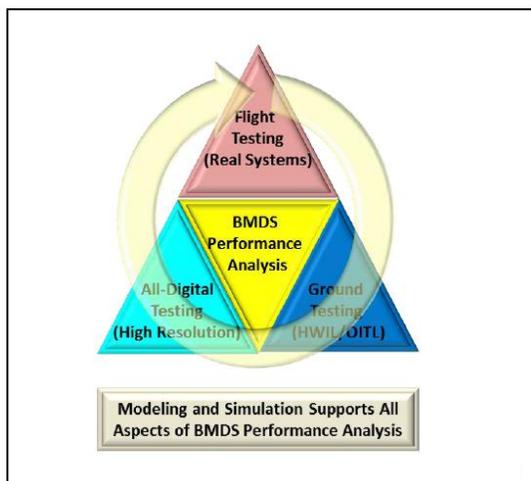
support Warfighter command, control and battle management needs across the globe by providing the Combatant Commander with the BMD planner, situational awareness tools, and battle management capability to support global BMD situational awareness, coalition operations, weapons release authority for homeland defense, and to control and task a variety of BMDS radars. C2BMC operators and maintainers deploy to some of the world's most threatening regions and continue to provide around-the-clock support to the local commanders. In FY 2020, MDA will sustain the C2BMC fielded capability (Spiral 8.2-3) in NORTHCOM, INDOPACOM, EUCOM and

CENTCOM Areas of Responsibilities, which includes the following capability: Mobile Sensor Phase 1 and BMDS Overhead Persistent Infra-Red Architecture (BOA) 6.1 track data to the BMDS, support for Space Situational Awareness with AN/TPY-2 radars, and Aegis engage on remote, which can provide a five-fold increase in defended area coverage when compared to individual weapon system organic capability. MDA will continue development of Spiral 8.2-5, which integrates LRDR into the BMDS for support of homeland defense. This Spiral provides initial situational awareness and tracking capability for Hypersonic threats, significantly expands Space Situational Awareness capabilities for the Air Force with LRDR, integrates the Army's IAMD Battle Management System into the BMDS, and develops Initial BMDS System Track for homeland defense. MDA will initiate development tasks for Robust Post Intercept Assessment supporting our regional defense focus and BMDS shoot-assess-shoot capability. MDA continues to improve the BMDS to keep pace with emerging threats worldwide by investing in the development, integration and testing of advanced algorithms to improve track and discrimination capabilities and enhance the use of space-based sensor data, using the BMDS OPIR architecture. Finally, MDA will continue to update its architecture to increase cybersecurity by assessing the risk of C2BMC architecture against possible attack. C2BMC capabilities will be involved in multi-agency cyber-focused tests and assessments planned for in FY20 to identify and correct cyber vulnerabilities.



Threat Detection And Early Warning

- **MDA Engineering (PE 0603890C, Budget Projects MD24, and MD31).** MDA is requesting \$252.8 million in FY 2020 to perform the system-level engineering required to design, build, test, assess and field the integrated



BMDS. MDA Engineering defines BMDS architectures and functional requirements for integrated BMDS capabilities to defeat the evolving threats, analyzes architecture alternatives to address future threats, enables interoperability between U.S. forces and international partners, and drives future capability development from a system perspective to maximize the effectiveness of BMD technologies. MDA Engineering also performs pre- and post-mission analysis for BMDS tests, and assesses BMDS performance in order to deliver capabilities to the warfighter. In FY 2020, MDA will complete the engineering and technical assessment for the EPAA Phase 3 Technical Capability Declaration (TCD) to provide confidence to the Warfighter that the Aegis Ashore site in Poland

will operate as designed. MDA employs system-level and element-level models and simulations to verify BMDS performance and assess BMDS capability to engage and defeat complex threats across a spectrum of scenarios that cannot be demonstrated in flight tests. As a result, MDA is able to deliver to the Warfighter evolving, integrated, and layered BMDS performance and capabilities that have been thoroughly assessed and validated through testing and Modeling and Simulation. In this budget, MDA is pursuing improvements to both system-level digital simulation and integrated system-level ground test simulations.

- **MDA Testing.** MDA, in collaboration with our IMTP stakeholders, plans and executes a fully integrated test program that synchronizes the system under test with the Warfighters trained to operate the system under varying wartime conditions against current and emerging threats. Stakeholders, who are also IMTP signatories, include: Director, Operational Test & Evaluation (DOT&E); Director, Developmental Test and Evaluation (DT&E); Commander, Joint Functional Component Command for Integrated Missile Defense (JFCC IMD) representing Combatant Commands (CCMD); Service Operational Test Agencies (OTA) and Commander, Joint Interoperability Test Command (JITC). For flight testing, the Agency incorporates the nine operational



Ground Tests



Flight Tests



Exercises and Wargames

realism criteria defined by the Ballistic Missile Defense System Response to National Defense Authorization Act Section 234, for Fiscal Year 2005, Increasing Operational Realism. Thirty-nine of the sixty-nine flight tests in the BMDS Test Program are currently planned to achieve these criteria. For system-level ground testing, all tests culminate in operational testing with Warfighters on console and independent operational assessments by the BMDS Operational Test Agency Team. This ensures that BMDS capabilities are credibly demonstrated and validated prior to delivery to the Warfighter. MDA, in conjunction with IMTP stakeholders, work to identify and incorporate all testing requirements into the IMTP, which is a comprehensive, highly integrated, complex, cost-effective series of flight tests, ground tests, cybersecurity testing, exercises, and wargames.

- **Israeli Programs.** MDA’s work with the Israeli Missile Defense Organization is a testament to the strong missile defense partnership we maintain with Israel. MDA is requesting \$500 million for Israeli programs in FY2020. This funding level remains consistent with the Memorandum of Understanding that the United States and Israel signed in 2016. This budget continues MDA's longstanding support of U.S.-Israeli Cooperative BMD Programs, to include the co-development and co-production of the David's Sling Weapon System and Upper Tier Interceptor, and improvements to the Arrow Weapon System. The Department continues to support co-production efforts for the Iron Dome program to provide critical defense against short-range rockets and artillery. In FY 2020, the MDA budget will also support several flight tests across the Israeli portfolio. These continued joint efforts provide Israel with a three-tiered defense to defend from ballistic missiles, rockets, and cruise missiles and ensures Israel maintains its qualitative military edge against its adversaries.



Arrow-3 Flyout

VII. Summary

MDA requests \$9.431 billion in FY 2020 to strengthen and expand the deployment of defenses for our Nation, deployed forces, allies, and international partners against an increasingly proliferated and advanced missile threat.



MISSILE DEFENSE AGENCY