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Good afternoon, Chairman Rogers, Ranking Member Cooper, distinguished Members of the subcommittee. I appreciate this opportunity to testify before you today on one of the President's highest defense priorities for Fiscal Year (FY) 2019.

As I say it, the ballistic missile threat has voted and continues to vote today. Given this reality, the Administration has stated that we must take steps to respond quickly to counter the ballistic missile and nuclear weapons developed by our adversaries that are intended to kill Americans, and our allies and friends. To meet this pressing requirement, the President signed into law emergency appropriations requested in the FY 2018 Budget Amendment that provided emergency funding to enhance the nation's missile defense and defeat capabilities. I want to express my appreciation to the Congress for its support in this process. I am pleased to report that the Missile Defense Agency (MDA) is executing these funds with the utmost urgency. The President and the Department of Defense leadership have been very clear in outlining their priorities.

President Donald J. Trump stated on August 23, 2017: *"We are committed to expanding and improving a state of the art missile defense system to shoot down missiles in flight. And we are getting better and better at it. It's actually incredible what's taking place. We will develop better surveillance and long-strike capabilities to prevent our enemies from launching them in the first place."*

Secretary of Defense James Mattis, on September 20, 2017, warned the Department that *"...if we fail to adapt at the speed of relevance, our forces will lose…. "*

The Chairman of the Joint Chiefs of Staff, General Joseph Dunford, Jr., USMC, on October 3, 2017 elaborated on the proximity and extent of the threat facing the United States when he stated: *"Based on the current capacity of the North Korean threat, both the type and the amount of missiles that they possess, we can protect Hawaii today against an ICBM. We can protect the continental United States against an ICBM... As the capacity of the threat increases - that is the size, not just the lethality, of missiles that they may possess - we need to be concerned about ensuring that our ballistic missile defense capability keeps pace with that threat. We do think an increase is warranted."*

And Ms. Ellen Lord, the Under Secretary of Defense for Acquisition and Sustainment, emphasized the importance of moving quickly through our processes to get the best and most advanced capabilities out into the field in a timely manner when she stated: *"It's all about velocity. We are trying to get stuff downrange quickly."*

The 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 ballistic missile attacks of all ranges and in all phases of flight." The MDA budget request of $9.9 billion for FY 2019 will continue the development, rigorous testing and fielding of reliable, increasingly capable, and state-of-the-art defenses for the United States, our deployed forces, and the forces and territories of our allies and partners against current and projected missile threats. This request will maintain current homeland and regional missile defense assets and increase capability and capacity to keep pace with advancing threats. We will continue to collaborate closely with the Warfighter and support the current and future needs of the Combatant Commanders with the development,

testing, deployment, and integration of interceptors, sensors, and the command, control, battle management and communications (C2BMC) system into a multi-domain battle management and command and control system for the Ballistic Missile Defense System (BMDS).

MDA's FY 2019 program plan aligns with the December 2017 *National Security Strategy*[1] and the 2018 *National Defense Strategy*[2] as well as the Fiscal Year 2017, Fiscal Year 2018 and Fiscal Year 2019 President's Budgets that lay out the path forward we are taking for missile defense. Last summer, I laid out three Agency priorities, support the Department's defense strategy, and guide the execution of missile defense program activities.

- First, *we will continue to focus on increasing system reliability to build warfighter confidence* by upgrading, improving, and sustaining deployed systems and executing a rigorous and continuous test and evaluation approach with strong modeling and simulations to mature technologies and validate deployed capabilities.
- Second, *we will increase engagement capability and capacity* by increasing the number of fielded interceptors, building out the sensor architecture with the aim of capturing "birth-to-death" tracking, improving system discrimination and integration, leveraging international partnerships for affordability and interoperability, and working closely with the Combatant Commands to provide integration support and capabilities to meet emergent operational needs.
- Third, *we will address the advanced threat* by working with Combatant Commands and Services to address emerging threats, to include the growing and highly challenging

[1] "The United States is deploying a layered missile defense system focused on North Korea and Iran to defend our homeland against missile attacks." *National Security Strategy of the United States of America*, December 2017, p. 8.
[2] "Investments will focus on layered missile defenses and disruptive capabilities for both theater missile threats and North Korean ballistic missile threats." *Summary of the 2018 National Defense Strategy of the United States of America: Sharpening the American Military's Competitive Edge*, p. 6.

hypersonic glide vehicle and cruise missile threats and by pursuing advanced technologies, such as directed energy, and making prudent and affordable investments in potentially game-changing capabilities.

I can tell you today that the current BMDS meets today's threat, but we require additional capacity and advanced capability to stay ahead of the evolving threat, as is requested in the FY 2019 President's Budget.

Missile Threat

Nearly all of our adversaries are concerned with U.S. missile defenses and have devised various means to complicate missile defense operations. Missile defense countermeasures continue to be developed and fielded. Future supersonic/hypersonic powered 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.

North Korea is committed to developing 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. This past February, North Korea paraded five ballistic missile systems: four of these received their first test launch in 2017. North Korea flight-tested two Hwasong-14 intercontinental ballistic missiles (ICBMs) in July. In their tested configuration, these missiles are capable of reaching North America. In late November 2017, North Korea launched what it described as a new ICBM-the Hwasong-15-which also demonstrated a capability to reach the United States. Pyongyang flew two Hwasong-12 intermediate-range missiles over Japan last

year, placing our allies at potential risk from missile debris. The second of these tests demonstrated a capability to reach over 3,700 kilometers, which can range beyond Guam. The North twice flight-tested a solid-propellant medium-range missile capable of reaching Japan. Based on North Korea's developmental submarine-launched ballistic missile, this system-the Pukguksong-2-is the North's longest-range solid-propellant missile. This advancement is significant because solid-propellant missiles can be prepared for launch more rapidly than liquid-propellant systems. Additional missile launches out of North Korea—from short-range to intercontinental-range—are a near certainty. In addition to further strategic-weapon testing, North Korea has announced that it will focus on producing and deploying nuclear weapons and ballistic missiles in 2018.

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 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 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.

Increasing System Reliability through Testing, Warfighter Collaboration, and Cybersecurity

We continue to enhance the reliability and functionality of current missile defense systems, especially the Ground Based Interceptors and Aegis BMD Weapon System/Standard Missile (SM)-3 performance, build the confidence of Warfighters in the BMDS, and work to reduce the number of interceptors needed to defeat in-flight ballistic missile threats. To increase system reliability and improve warfighter confidence in the system, MDA executes a fully integrated test program that synchronizes the system with the Warfighters trained to operate the system under varying wartime conditions against current and emerging threats. This ensures BMDS capabilities are credibly demonstrated and validated prior to delivery to the Warfighter.

MDA executes a continuous program to improve system reliability and manage service life of our BMDS components. An example is the Ground-based Midcourse Defense (GMD) weapon system. A cornerstone of this effort is our stockpile reliability program (SRP) for Ground Based Interceptors (GBIs). Two GBIs have been removed from the fleet this past year, inspected, and tested to gain understanding of how the GBIs age in the silos. Another GBI will be removed this year for the SRP. From testing to date, we have been able to extend the service life of the C1 and C2 boosters. Another key effort is our Service Life Extension program. This program performs lifetime testing on key components in the kill chain enabling MDA to extend the service life beyond the manufacturer's estimate. This testing allows us to avoid unnecessary maintenance actions and control operations and support costs. MDA also pursues reliability improvements through our development activities. We measure availability and reliability data in the field and target improvements in the GBIs and GMD ground system development programs. A key delivery this year was Ground System 7A, which removed obsolete equipment from the kill chain, eliminated cyber defense vulnerabilities, and improved redundancy for the warfighter. Key

future reliability improvements include delivering the Redesigned Kill Vehicle and upgrading the GMD Communications Network, launch support equipment, and the IFICS Data Terminal High Power Amplifier.

We continue to work closely with independent testers within the Department -- the Director, Operational Test and Evaluation (DOT&E); Deputy Assistant Secretary of Defense, Developmental Test & Evaluation; Service Operational Test Agencies; Combatant Commands, and the Joint Forces Component Command for Integrated Missile Defense -- to develop an Integrated Master Test Plan (IMTP) and execute a robust, cost-effective test program. The IMTP provides a flight- and ground-test program, to include rigorous modeling and simulation, systems engineering and validation, verification and analysis necessary to demonstrate and deliver proven integrated capabilities against the evolving threat.

MDA focuses on BMDS flight and ground testing that rigorously verifies, validates, and accredits models and simulations (M&S) to ensure confidence in the data used to make performance assessments. We use M&S in a robust integrated and distributed ground-test program. In 2018 MDA began the development of a high-fidelity, all-digital, integrated, BMDS-level simulation. This effort will combine the best performance assessment models from across all BMDS elements into an integrated simulation. The all-digital simulation will be able to model full BMDS architectures and excursions that cannot be easily explored in ground tests or flight tests for a more thorough exploration of the BMDS performance space. In FY 2017, MDA successfully demonstrated a prototype of this digital simulation capability.

Our system ground-tests are the primary source for system performance data, and they test our capability across a wide range of threats and environments that cannot be replicated affordably in flight tests. The BMDS Operational Test Agency, which provides an independent

operational assessment of the BMDS, relies heavily on the MDA ground-test program to assess independently MDA's operational capability. The ground-tests allow analysts to characterize BMDS performance under varying conditions, with unconstrained red and blue force limitations, and without the safety, fiscal, and hardware availability limitations of flight-testing. Additionally, with warfighters on console, they are able to use ground-tests to refine Tactics, Techniques, and Procedures. All of the data from ground tests are used to inform DOT&E assessments of BMDS capability.

In addition to 14 element-level ground-tests, we conducted nine developmental and operational system-level ground-tests from October 2016 to present. There are two more system-level ground-tests scheduled for this fiscal year and eight more planned for FY 2019. Last year, we also conducted or participated in more than 20 multi-event exercises and wargames, which are critical to the Combatant Commands and the intensive engineering efforts across the Agency.

Flight-testing uses operational realism to provide data for M&S and demonstrates the performance functions of the system that ground-testing cannot address. One of the key attributes of each flight-test is combining the system under test with the Soldiers, Sailors, Airmen, and Marines that plan to operate the system in wartime under operationally realistic conditions. We also work closely with our allies to prove BMD capabilities are integrated and interoperable before they are fielded. From October 2016 to present, we have executed 27 flight-tests. For the remainder of FY 2018, we will conduct two more flight-tests, and in FY 2019, 12 flight-tests, including the operational test of European Phased Adaptive Approach (EPAA) Phase 3 capabilities and the first salvo test using the Ground-based Midcourse Defense (GMD) system. The Agency also is conducting detailed planning to conduct an Aegis BMD test

against a long-range ballistic missile target and adding an IRBM target to GM CTV-03+ as risk reduction for the homeland defense Redesigned Kill Vehicle (RKV) program. Both tests are planned for FY 2020.

The Warfighter is integrated into our requirements, engineering design/review and test efforts and processes. The Unified Command Plan assigns responsibility to the U.S. Strategic Command (USSTRATCOM) Commander to synchronize planning for global missile defense in coordination with other Combatant Commands, the Services, and appropriate U.S. Government agencies. USSTRATCOM, the central integrator for our requirements, defines the Integrated Air and Missile Defense (IAMD) Warfighter Involvement Process (WIP), which outlines the roles and responsibilities for all participants and establishes the structure for collaboration and advocacy for desired missile defense capabilities and characteristics on behalf of the Warfighter. USSTRATCOM leads the WIP, advocates for the Combatant Commanders' desired IAMD characteristics and capabilities, and provides a Prioritized Capabilities List (PCL) of joint military capability needs to MDA and other appropriate acquisition authorities. The PCL informs MDA's President's Budget Request.

The *Capabilities Document for Homeland Ballistic Missile Defense*, accepted by the Joint Requirements Oversight Council (JROC) in 2014, baselined the current concept and prioritized future capabilities within the homeland defense BMD system based on previously approved Warfighter requirements, acquisition decisions, and current long-term investment strategy. This review included rigorous warfighter coordination and provided the opportunity to the Warfighter to shape the document, which resulted in the JROC accepting the framework and Required Operational Attributes in the document. The Agency now uses those Required Operational

Attributes as the requirements that guide capability development and future program capabilities necessary to make the system effective against threats in the future.

The objective of any development program is to provide effective warfighting capability to the hands of the warfighter as soon as it is technically and operationally feasible. Ultimately, the Services and Combatant Commands will operate and employ these capabilities as required. Upgraded Early Warning Radars, COBRA DANE, and Patriot are examples of systems or components that have successfully transitioned. Transitioning operations and sustainment to Services allows development agencies to re-focus RDT&E activities to address evolving threats. Terminal High Altitude Area Defense (THAAD) and AN/TPY-2 radar transition is in work with the Army and we are developing an agreement on the conditions and terms of transfer. Additionally, we are developing a plan for transition of Standard Missiles to the Navy, as is requested in the FY 2019 President's Budget. MDA will continue to work within the Department on decisions to transfer capability to the Services. As transition is the end goal, each element and component will be evaluated against criteria such as its multi-mission potential; technical maturity; requirements and technical volatility; and interoperability with the overall system to determine the pace at which we will pursue transition.

MDA will also continue to provide the Warfighter operational support by performing the routine mission essential functions of BMDS configuration control, asset management, and operational readiness reporting, providing an operational-level interface to United States Strategic Command, Northern Command, European Command, Central Command, and Pacific Command, and facilitating increased Warfighter participation in development of future missile defense capabilities. MDA will continue to provide support for systems like the globally deployed Aegis BMD/Standard Missile (SM)-3 system, AN/TPY-2 radar (Terminal and Forward-Based Modes),

THAAD, and Command and Control, Battle Management and Communications (C2BMC). MDA also will continue to lead the integration of evolving MDA, Service, and COCOM command and control capabilities through systems engineering analysis and development of technical integration requirements and interface control documents to address the fielding of air, missile, and rocket capabilities by U.S. adversaries.

Getting work on contract and delivering capability as quickly as possible using the unique and broad set of authorities, responsibilities and accountability assigned to the Agency with balanced oversight from the Under Secretary (Research and Engineering) and Under Secretary (Acquisition & Sustainment) are critical to our ability to support the Warfighter and accelerate program decisions and contract actions necessary to counter the rapidly evolving threat. As an example, MDA program offices are expediting activity to put new content on contract to deliver new capability to the Warfighter after receiving $250 million in FY 2017 reprogrammed funds and over $2.0 billion in emergency appropriations requested in the FY 2018 Budget Amendment to support the Missile Defeat and Defense Enhancements (MDDE) initiative. Additionally, our centralized decision authority for program development and contract updates enabled more rapid incorporation of mandatory cybersecurity contract actions. New contract and program strategies, to include the proposed strategy for the Homeland Defense Radar – Hawaii (HDR-H), also are quickly approved and implemented.

Finally, the Missile Defense Agency is cognizant of the growing cyber threat and we continue to work aggressively to ensure the nation's missile defenses are resilient and able to operate in a highly contested cyber threat environment. We are progressively improving the cyber hygiene of our missile defense capabilities by ensuring the cybersecurity infrastructure has the latest security upgrades. MDA remains focused on supporting the DoD Cybersecurity

Campaign through implementation of the DoD Cybersecurity Discipline Implementation Plan -- Four Lines of Effort for: Strong Authentication, Hardening of Systems, Reducing the DoD Attack Surface, and Alignment to Cybersecurity / Computer Network Defense Service Providers across all networks. These four lines of effort are critical to the defense of the MDA networks.

In addition to the four lines of effort, MDA has determined that protection of the nation's BMDS unclassified data requires additional safeguards and enhanced vigilance. As part of these safeguards, MDA has engaged with our defense industrial base corporate partners to ensure cybersecurity is prioritized, addressed and enforced at all levels of the supply chain. The National Institute of Standards and Technology (NIST) has developed a Framework for Improving Critical Infrastructure Cybersecurity. This is a set of industry standards and best practices to help organizations manage cybersecurity risks. Measures include NIST control compliance, industry cybersecurity best practices as well as techniques for providing only the need-to-know unclassified BMD system data to each level of the supply chain. We continue to address industry compliance with applicable DFARs clauses associated with the protection of critical MDA controlled unclassified information and critical data.

Not only are we focused on external threats to our enterprise, but MDA acknowledges the reality of the insider threat as one of the more pervasive threats to be addressed, and we have established and implemented an aggressive Agency Insider Threat Program. This allows us to monitor both internal and external data movement to ensure all unclassified and classified data is handled in accordance with applicable guidance and is also afforded the highest level of protection. We are constantly evaluating our attack data and updating the MDA Emergency Response Team procedures. Abnormalities or violations are quickly identified and thoroughly investigated by both MDA and DoD Insider Threat and Counter Intelligence.

Finally, MDA is actively integrating cybersecurity requirements early into the acquisition life cycle to increase security and reduce overall cost. For example, we are upgrading C2BMC and the GMD ground systems software and hardware to enable enhanced cybersecurity protection capabilities. To better support our Combatant Commanders, this year we successfully executed the first DOT&E Cybersecurity Vulnerability & Penetration Assessment on BMDS platform systems culminating in a system-level assessment during Ground Test Distributed-07a. This is a significant step in understanding the cybersecurity posture of the BMDS and the ability to defend against emerging threats. We continue to develop a culture of cybersecurity knowledge and accountability across the Agency, which fosters awareness down to the user level to anticipate, detect, and respond to cyber issues before they can have an impact.

The MDA office of the Chief Information Officer, which conducts cybersecurity testing involving all the systems to include BMD elements, development labs, test systems to ensure the entire MDA Enterprise is secure, executes several testing efforts across MDA systems on an annual basis: 46 cybersecurity controls validation tests, 50 vulnerability assessments, and 110 software assurance code reviews, for a total of 1,030 test across the Future Years Defense Program (FYDP). MDA also executes BMDS element and system level tests that support fielding of new capability to be included in the Operations Capacity Baseline. Per Section 1647 of the FY 2016 NDAA, MDA is also responsible for MDA weapon system cyber testing and risk mitigation for the congressional report scheduled to be delivered first quarter FY 2020. Over the FYDP there are over 211 cyber tests planned, including developmental and operational Cooperative Vulnerability and Penetration Assessments (CVPA) and Adversarial Assessments.

We have had a comprehensive ongoing effort since 2010 that I believe will go a long way in providing insight and proof of MDA's commitment to cyber protection and testing as a way of

being responsive to DOT&E and working with them on the way-ahead. For example, as the cybersecurity threat has matured, the Terminal High Altitude Area Defense (THAAD) program identified the need to take a proactive approach to cybersecurity. The likelihood and consequence of the cyber-threat was increasing at a pace that necessitated programmatic change. After careful consideration, we created a comprehensive cyber program structure called the *THAAD Security and Networking Division*. This organizational structure is the foundation of THAAD's cyber security model and acts as the enabler for THAAD execution in all areas of cybersecurity. Cybersecurity includes compliance, security engineering, design, development, test, physical security and program security. The key to executing these roles is the understanding of the linkage that cybersecurity has with system engineering and the acquisition processes. By locating cybersecurity into THAAD's system engineering directorate, this aligns cybersecurity functions to the following other functions: software, modeling and simulation, future concepts, requirements, and system integration. This alignment not only ensures cybersecurity is inherit in the system engineering and development life cycles, it is the catalyst to increase THAAD's chances of survival in a cyber-contested environment. We believe this is a proven model that should be considered a best practice.

Increasing Engagement Capability and Capacity

This budget request maintains operational missile defense capabilities for existing operational 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.

Homeland Defense

MDA remains committed to operating, sustaining, and expanding our nation's homeland missile defenses and requests $2.2 billion in FY 2019 for the Ground-based Midcourse Defense (GMD) program. We currently have emplaced 44 operational GBIs and, in accordance with the Fiscal Year 2017 Above Threshold Reprogramming and Fiscal Year 2018 Budget Amendment, plan to expand the fielded GBI fleet to 64 as early as 2023. This increase to GBI capacity is a response by the National Command Authority to the rapidly advancing North Korean threat and has been designated as an "emergency requirement" by the President in the FY18 President's Budget Amendment.

The Agency will continue to demonstrate improved performance through flight- and system-ground testing of homeland defenses, integrate additional capabilities provided by the Long Range Discrimination Radar (LRDR), BMDS system track, and Homeland Defense Radar-Hawaii (HDR-H), plan for a Homeland Defense Radar—Pacific (HDR-P), continue Redesigned Kill Vehicle (RKV) development, enhance the Stockpile Reliability Program, and expand the GBI battle space. We will continue improving our sensors, C2BMC, GMD ground systems hardware/software upgrades, GMD Fire Control (GFC), and kill vehicle software to improve discrimination capabilities and overall system performance. We also will continue to improve confidence in our reliability through increased testing and analysis.

At the same time, MDA is evaluating the technical feasibility of the capability of the SM-3 Block IIA missile, currently under development, against an ICBM-class target in accordance with Congressional legislation. If proven to be effective against an ICBM, this missile could add a layer of protection, augmenting the currently deployed GMD system. As directed by the FY 2018 NDAA language, we will conduct this demonstration no later than December 31, 2020.

Increasing GBI Capacity

In 2013, the Secretary of Defense directed MDA to expand the GBI fleet from 30 to 44 by the end of 2017, in response to provocations from North Korea. The GBI is the nation's primary defense against long-range and intercontinental ballistic missiles. In November 2017, MDA emplaced the 44th GBI at Fort Greely, Alaska (FGA). Achieving this objective required MDA to purchase and field 14 additional GBIs. It also required refurbishment of Missile Field-1 to remediate obsolete hardware, update silo interface equipment, install a hardened mechanical electrical building, and upgrade related mission support systems infrastructure. To support the 44 GBIs within the existing system, MDA also upgraded GFC and ground systems.

Leading up to the fielding of 44 GBIs, MDA conducted three successful flight tests. Flight Test Ground-based Midcourse Defense (FTG)-06b, conducted in June 2014, demonstrated long interceptor time-of-flight and Capability Enhancement (CE)-II Exo-atmospheric Kill Vehicle (EKV) capability to discriminate targets and intercept lethal objects from a representative target scene with countermeasures. A controlled test vehicle flight test, GM CTV-02+, conducted in January 2016, evaluated CE-II EKV performance with the newly designed Alternate Divert Thrusters in a non-intercept flight environment while allowing data collection to evaluate system enhancements, advanced discrimination algorithms, and salvo intercept time spacing.

FTG-15, conducted in May 2017, demonstrated viability of the new 3-Stage Configuration 2 (C2) booster and CE-II Block 1 EKV GBI. This was the first ever intercept of an ICBM-class target. The FTG-15 flight test successfully demonstrated our homeland defenses GMD's systems functioned as predicted against a realistic threat ICBM-range target. The upgraded CE-II Block 1 EKV launched on a C2 booster successfully intercepted and destroyed a

target designed to emulate a projected North Korean threat. FTG-15 proved effective engineering and manufacturing of the new GBI as well as improved discrimination algorithms, missile defense architecture and warfighter command and control.

MDA is developing the capability to provide the Warfighter the option of either flying GBIs using all three booster stages or not igniting the third stage, providing performance similar to a 2-stage boost vehicle. This approach will provide additional homeland defense battle-space capability through shorter engagement times without the expense of a separate 2-stage boost vehicle development program. This capability is planned to be tested in Calendar Year (CY) 2019, after which it will be fielded on all boost vehicle configurations.

Redesigned Kill Vehicle

The Redesigned Kill Vehicle (RKV) will improve reliability and make homeland defenses more robust. The RKV will help address the evolving threat, enhance kill vehicle reliability, improve in-flight communications to better utilize off-board sensor data, and heighten Combatant Commanders' situational awareness via hit/kill assessment messages. The program leverages the SM-3 Block IIA kinetic warhead electronic and seeker to provide commonality among Agency interceptors, which is expected to lower costs, reduce risks and increase the speed of technology development and fielding of the RKV. The program schedule will conduct its first controlled test vehicle flight test of the RKV in FY 2020 (GM CTV-03+). The first intercept flight test (FTG-17) is planned for FY 2021 with a second intercept flight test (FTG-18) in FY 2022. We anticipate deploying the RKV beginning in the FY 2022 timeframe.

In 2018 MDA is initiating the GMD portion of MDDE, which will field an additional 20 RKV-equipped GBIs at FGA. MDA will accelerate the RKV production deliveries, construct a new missile field (Missile Field 4) at Fort Greely, install 20 silos, and deliver an additional 20

GBIs tipped with RKVs. We will complete the GMD portion of the MDDE as early as 2023. In addition, MDA will initiate a plan to ensure that no less than 64 GBIs are available to the Warfighter at all times. To accomplish this, MDA will add two silos to MF-1 at FGA and purchase six additional GBI boosters. The additional silos and boosters will enable MDA to deliver an RKV-equipped GBI prior to removing a GBI as we replace the CE-I Kill Vehicles currently in the fleet.

Ground System Upgrades

MDA is continuing with capability upgrades and technology modernization of key ground support and fire control systems components such as the GFC equipment, the GMD Launch Support System, Communications Network, and the In-Flight Interceptor Communication System Data Terminal. The capability upgrades include: GFC-Warfighter interface and logic improvements, 2-/3-stage selectable GBI battle management, discrimination improvements, enhancements to the kill vehicle Target Object Map, and On-Demand Communications for the RKV. Ground system modernization will continue to mitigate obsolescence issues, improve cybersecurity resilience, increase GFC capacity for emerging threat complexity and raid size, reduce life-cycle cost, increase system reliability and operational availability, and simplify the insertion of future technologies.

Defense Sensors

We are investing in radars and developing advanced electro-optical sensors to achieve a diverse sensor architecture that will provide highly accurate midcourse tracking, discrimination and battle damage assessment. We are also leveraging Services' sensors to support the BMD architecture, for example, the Navy's new solid state SPY-6 radar on their Flight III destroyers, the Air Force F-35 Distributed Aperture System, and future Department of Defense and

Intelligence Community space sensors. In this year's budget submission we highlight the continued development of the Long Range Discrimination Radar (LRDR) and Spacebased Kill Assessment (SKA) programs, which will improve system target discrimination and assessment capabilities. Improved sensor coverage and interceptor capabilities will help the Warfighter expand the battle space to reengage threats as needed.

We request $176.1 million to sustain COBRA DANE, the Upgraded Early Warning Radars (UEWR), and the Army Navy/Transportable Radar Surveillance and Control Model-2 (AN/TPY-2) radars. The Services and Combatant Commands, with logistical support from the MDA, operate a fleet of five AN/TPY-2 (Forward Based Mode) radars in Japan, Israel, Turkey, and U.S. Central Command in support of homeland and regional defense.

We request $220.9 million to continue the development of advanced discrimination algorithms for the AN/TPY-2, Sea-Based X-band (SBX) radar, and the UEWRs to counter evolving threats. The discrimination improvements will develop and field integrated capabilities to improve the BMDS ability to identify lethal and non-lethal objects. Beginning in FY 2018, MDA will complete transition to production design activities for next generation Gallium Nitride Transmit/Receive Integrated Multichannel Modules to support the AN/TPY-2 obsolescence and sparing strategy and set the condition for enhanced performance in the future. MDA requests $81.0 million for Ballistic Missile Defense (BMD) Sensors testing activities for planning, analysis, and execution of BMDS flight test events, including pre- and post-test efforts, such as Digital and Hardware-in-the-Loop Pre-Mission Tests, and Post-Flight Reconstruction.

MDA requests $149.7 million for the SBX radar. The SBX is an advanced mobile radar that provides precision midcourse tracking and discrimination capabilities. The SBX participates in flight tests to demonstrate discrimination and debris mitigation improvements. To address the

continued missile test activity of North Korea, our budget request includes funds to extend time at sea and conduct contingency operations for defense of the homeland in the U.S. Pacific Command and U.S. Northern Command areas of responsibility.

We request $164.6 million to continue development of the LRDR. The LRDR is a midcourse sensor that will provide persistent long-range midcourse discrimination, precision tracking, and hit assessment and improve BMDS target discrimination capability while supporting a more efficient utilization of the GMD interceptor inventory. LRDR also will support additional mission areas, including Space Situational Awareness. The LRDR site will be constructed as two separate military construction projects. For FY 2017, Congress fully funded Phase 1 of the LRDR project by providing $155 million for a Shielded Mission Control Facility and Radar Foundation. MDA began military construction of Phase 1 in FY 2017. Phase 2 in FY 2019 will address the shielded Power Plant that includes fuel storage, a maintenance facility, and associated site support. Initial fielding of the LRDR is on schedule for first quarter CY 2020. We are on-schedule for the Technical Capability Declaration in late third quarter or early fourth quarter FY 2021, leading to Warfighter Operational Readiness Acceptance in FY 2022.

The Sensors Analysis of Alternatives (AoA), conducted by the Department to assess the most cost-effective options for enhanced sensor capability to increase Ground Based Interceptor effectiveness against future, complex threats, highlighted the operational value of placing additional discrimination radars in the Pacific. Based on the Sensor AoA finding, MDA completed site surveys for the Homeland Defense Radar-Hawaii (HDR-H) in FY 2017. We requested $21 million in FY 2018 for the HDR-H to conduct source selection activities and award this radar as the first delivery order on a fixed-price indefinite delivery/indefinite quantity (IDIQ) contract. MDA is requesting $62.2 million in FY 2019 for the HDR-H. In addition,

MDA plans to complete site surveys in FY 2018 and competitively award the Homeland Defense Radar-Pacific (HDR-P) by the end of FY 2019 as the second delivery order on the IDIQ contract. MDA is requesting $33.5 million in FY 2019 for the HDR-P. Both radars will close coverage gaps in the Pacific architecture and provide persistent long-range acquisition and midcourse discrimination, precision tracking, and hit assessment to support the defense of the homeland against long-range missile threats.

Space provides the critical vantage point necessary to address rapidly advancing threats across multiple regions of interest and the only vantage point for global persistence to address Warfighter requirements. A space-based sensor layer would enable the United States to use interceptor inventory more efficiently and effectively to counter a broad array of threats. Integrated space and terrestrial sensors for tracking, discriminating, cueing and targeting ballistic missile threats can improve missile defense architecture robustness.

We are requesting $16.5 million for the Spacebased Kill Assessment (SKA) program. Using fast frame, infrared sensors, SKA will deliver a kill assessment capability for GMD defense of the homeland as part of an integrated post intercept assessment solution requested in the FY 2014 NDAA. SKA is MDA's pathfinder program to deliver a resilient sensor network in a rapid and affordable manner. Ground segment participation in BMDS flight tests occurred last year; on-orbit deployment of the sensors occurs this year; and we are looking at steps to add SKA to the operational BMDS when SKA proves itself during flight testing next year.

Also, we request $37.0 million for continued operation of the Space Tracking and Surveillance System (STSS) and the Missile Defense Space Center (MDSC) in FY 2019. STSS satellites, which were launched in 2007, have exceeded their life expectancy and have proven to be a good investment. These satellites operate in low earth orbit and continue to collect valuable

test data. The STSS program and the MDSC support concept development activities for future space sensor architecture studies and analyses to address advanced threats.

MDA is currently conducting trade studies and prototype concept design for a potential space-based missile tracking sensor/system. MDA envisions a space-based sensor architecture designed to detect and track traditional and emerging threats using persistent infrared sensing. If pursued, space sensors could be a key element of an integrated and layered BMDS Sensor Architecture. MDA could partner with the U.S. Air Force on requirements definition. MDA also envisions partnering opportunities with the Air Force on ground services, integration, launch, and operations. MDA will leverage the Enterprise Capabilities developed collaboratively between other DoD and federal agencies.

Regional Defenses

There are hundreds of ballistic missiles within range of U.S. forces and allies worldwide. Our FY 2019 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.

Terminal High Altitude Area Defense

Terminal High Altitude Area Defense (THAAD) is a transportable, ground-based missile defense system that defends against short- , medium-, and intermediate-range ballistic missiles in the terminal phase of flight. THAAD provides Combatant Commanders a rapidly deployable capability to deepen, extend, and complement BMDS homeland and regional defenses. THAAD is now 15 for 15 in flight testing. MDA is conducting New Equipment Training for the 7th Battery, which will be ready for operational support to the Army later this calendar year. MDA also continues to deliver interceptors for the U.S. inventory. We have successfully fielded two

THAAD batteries for a Foreign Military Sales case with the United Arab Emirates (UAE), and continue to deliver interceptors for the UAE inventory and provide maintenance and sustainment support.

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 maintenance and supply support of the THAAD battery (including the Terminal Mode AN/TPY-2 radar) stationed in Guam. MDA is strengthening the capability of this regional BMDS presence in response to a United States Forces Korea Joint Emergent Operational Need (JEON) to increase integrated missile defense system interoperability and expand the defended area. This requirement is supported by USSTRATCOM and approved by the Chairman of the Joint Chiefs of Staff (CJCS).

U.S. Pacific Command initiated the deployment of the THAAD system to the ROK on March 6, 2017, implementing the U.S.-ROK Alliance's July 2016 decision to bring the defense capability to the peninsula. In coordination with the Army's Lower Tier Program Office, MDA began a concerted effort in May 2017 to develop an integrated, phased approach to incrementally field capability, delivering improved BMDS capability to the Korean Peninsula, including integration of existing BMD assets to improve engagement options and coverage. The deployment of THAAD contributes to a layered missile defense system and enhances the U.S.-ROK Alliance's defense against North Korean missile threats.

At OSD direction, the Army and MDA developed a draft Memorandum of Agreement (MoA) for the transfer of the THAAD and AN/TPY-2 programs from MDA to the Army. The draft MoA stipulates that when THAAD transfers to the Army, production operations and sustainment program and funding for THAAD and AN/TPY-2 systems would transfer to the

Army, and Research and Development program funding of THAAD and AN/TPY-2 radars would remain in MDA. The MoA was approved by MDA and is currently being reviewed by the Army.

MDA requested $214.2 million in FY 2019 for THAAD development efforts. We will continue development of THAAD software upgrades to address threat packages and defense planning as well as improved capability to engage SRBM, MRBM, and limited IRBM threats. THAAD development and integration will provide enhanced debris mitigation capability, improved interoperability with other BMDS elements, and expanded defended area footprints via remote operation of THAAD Launchers, as well as complete developmental efforts to upgrade and ensure the integrity and availability of positioning, navigation, and timing data for the THAAD weapon system. Finally, we will continue development efforts associated with USFK JEON that provide enhanced THAAD capability against specific USFK threats, improved radar energy allocation, improved THAAD performance against debris and in complex environments, and an accelerated initial capability to remote launchers and increase defended area.

Flight Test THAAD-18 (FTT-18) was conducted in Kodiak, Alaska on July 11, 2017. This test demonstrated THAAD's intercept of an IRBM-class target and THAAD's ability to fire from two launchers. Flight Experiment THAAD-01 (FET-01) was conducted in Kodiak, Alaska on July 30, 2017, which collected critical performance data related to countermeasures. Additionally, THAAD successfully achieved an intercept against the target in that countermeasure environment.

MDA requests $874.1 million to continue procurement of THAAD equipment, including 82 THAAD Interceptors in FY 2019. By the end of FY 2019, MDA will deliver 60 additional THAAD Interceptors to the U.S. Army, for a total of 276 interceptors delivered. MDA requests

$61.0 million for Terminal Defense Testing in FY 2019. We also request $92.6 million of Operations and Maintenance funding to support the maintenance and upkeep of all BMDS-unique items of the fielded THAAD batteries and for all THAAD training devices. In FY 2018 MDA will provide support to seven THAAD batteries, including the two forward batteries stationed in the U.S. Pacific Command's area of responsibility and is prepared to support the U.S. Army in any future deployment around the world.

Aegis Ballistic Missile Defense

Aegis BMD continues to be a 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. The FY 2019 budget request of $767.5 million supports continued advancement of the system to counter the growing threats.

In FY 2017 we completed one Aegis BMD Weapon System installation on an Aegis ship: Aegis BMD 3.6 to Aegis Baseline (BL) 9.C1 (BMD 5.0CU) upgrade. We also initiated two Aegis BMD Weapon System installations on Aegis ships: one Aegis BMD 3.6 to Aegis BL 9.C1 (BMD 5.0CU) upgrade and one non-BMD capable ship to Aegis BL 9.C1 (BMD 5.0CU) upgrade. In FY 2018 we began an additional eight Aegis BMD Weapons Systems installations on Aegis ships: six Aegis BMD 3.6 to 4.X, and two non-BMD capable ships to Aegis BL 9C.2 (BMD 5.1). We also retired the BMD 4.0.2 baseline in FY 2017. We will retire BMD 4.0.3 through upgrades to BMD 4.1 in FY 2019. In FY 2017, we delivered 55 Standard Missile -3 (SM-3) Block IB missiles. Additionally, in FY 2018, we plan to deliver 35 SM-3 Block IB production rounds to the Fleet.

In FY 2019, as part of our overall Aegis BMD request we are requesting $232.92 million for the SM-3 Block IIA Program. This includes the continued integration of the SM-3 Block IIA

into the BMD Weapon Systems, as well as pre-production All-Up-Rounds to support the initial deployment for EPAA Phase 3. In February 2017, we completed SFTM-01, a successful developmental flight test, to demonstrate an organic intercept of a MRBM-class target with an SM-3 Block IIA missile from an Aegis Baseline 9.C1 Ship. This was the first intercept flight test of the SM-3 Block IIA missile, which is a cooperative development program with Japan, and supports the initial production decision for the SM-3 Block IIA and the Aegis BL 9.C2 (BMD 5.1) certification effort, which will certify in 2018. In June 2017, with the execution of SM-3 Block IIA Cooperative Development (SCD) Flight Test Mission (SFTM)-02, we conducted a second SM-3 Block IIA missile flight test using an Aegis Baseline 9.C2 ship. Although this second test did not result in an intercept of the MRBM target, significant accomplishments were still achieved. A Failure Review Board (FRB) determined that an operator's actions at a console resulted in early termination of the SM-3 Block IIA missile in flight.

In January 2018, FTM-29 was conducted with a primary objective to intercept an air-launched IRBM-class target with an SM-3 Block IIA missile. While an intercept was not achieved, FTM-29 successfully demonstrated the ability of the Aegis Weapon System to receive and process remote link track via Command, Control Battle Management, and Communications (C2BMC) from the AN-TPY 2 radar, confirming Engage on Remote functionality. It also resulted in the first launch of a SM-3 Block IIA missile from the Aegis Ashore Missile Defense Test Complex (AAMDTC) at PMRF in Hawaii, which is important for EPAA Phase 3 Aegis Ashore sites in Romania and Poland as well as the potential procurement of Aegis Ashore by the Government of Japan. An FRB is investigating the cause of the failure and unmet objectives will be addressed in future flight testing.

In October 2017, Formidable Shield (FS)-17 was conducted with our NATO allies. This exercise included a successful intercept test of an SM-3 Block IB Threat Upgrade (TU) missile against an MRBM-class target, fired from an Aegis BMD destroyer at the United Kingdom Ministry of Defence Hebrides Range in Scotland, which resulted in the successful transition to full rate production for the SM-3 Block IB TU. This test was a mandatory prerequisite to the full production decision for the SM-3 Block IB Program, which was approved in December 2017. As a result of the full production decision, MDA is requesting 5-year Multi-Year Procurement (MYP) authority for the SM-3 Block IB interceptor for FY 2019 - FY 2023.

In FY 2019, we will conduct Flight Test Operation-03 Event 1 (FTO-03 E1), where two SM-3 Block IIA missiles will simultaneously engage two IRBM-class targets, with one fired from Aegis Ashore Missile Defense Test Center (AAMDTC) at PMRF and the other from a U.S. Navy destroyer. This will demonstrate operational realism in an Engage on Remote (EoR) test scenario for ship launched missiles as well as those launched from operational Aegis Ashore sites in Romania and Poland.

We are strongly committed to further enhancing capability of the Aegis BMD system and continuing to improve the Aegis Weapon System in alignment with Navy requirements. In August 2017, we certified the Aegis BMD 4.1 computer program, delivering BMD 5.0CU capability with Sea Based Terminal defense with the SM-6 missile. We conducted CTV-03 following FS-17 on the Hebrides range, firing a SM-6 Dual I using Aegis BMD 4.1, providing the proper Objective Quality Evidence to certify firing this missile with this computer program. In FY 2018, we will certify Aegis BL 9.C2 (BMD 5.1), that incorporates the SM-3 Block IIA missile and an EoR capability to meet European Phased Adaptive Approach (EPAA) Phase 3 requirements. In FY 2018 we also plan to procure 34 SM-3 Block IBs and 20 SM-3 Block IIAs

(16 SM-3 Block IIAs were requested in the FY 2018 Missile Defeat and Defense Enhancement Budget Amendment and four SM-3 Block IIAs from the FY 2018 President's Budget (PB) submission), and continue efforts on the installation of the Aegis Ashore Deckhouse and equipment in Poland.

In FY 2019, we will continue our commitment to develop, test, and deliver global naval capability to the Warfighter and support defense of our deployed forces and European NATO allies through delivery of EPAA Phase 3 missile defenses. MDA requests a total of $805.8 million in procurement for Aegis BMD, which plays a critical role in both homeland and regional defense. As part of the overall Aegis BMD procurement request, MDA is requesting $411.68 million to procure 37 Aegis SM-3 Block IB missiles and $181.81 million to procure 6 SM-3 Block IIAs, along with associated hardware and support costs. By the end of FY 2019, we plan to have 203 SM-3 Block IBs and 12 SM-3 Block IIAs in inventory. As the part of the procurement budget also requests $97.1 million for Aegis BMD Weapon Systems equipment. Also part of the request, we are asking for $115.21 million for advance procurement for economic order quantities and request permission to enter into a 5-year SM-3 Block IB Multi-Year Procurement (MYP) contract for FY 2019 - FY 2023. MDA will continue to deliver to the Navy SM-3 Block IBs and SM-3 Block IIAs once production has begun, for deployment on land at the Aegis Ashore site in Romania and at sea on multi-mission Aegis ships with BMD capability. In coordination with the U. S. Navy, we continue to expand the Fleet, and by the end of FY 2018 we anticipate having 38 ships (41 by the end of FY 2019) equipped with the Aegis BMD weapon system.

The Navy is working with MDA to integrate the multi-mission Aegis BL 5.3 with Aegis BMD 4.1 into a single computer program. We are actively working with Navy to certify this

capability in FY 2020. MDA also continues collaboration efforts with the U.S. Navy on AN/SPY-1 radar antenna improvements that, when coupled with Aegis BL 5.4, increase radar detection sensitivity. We will continue to align ourselves with the Navy to develop and deliver a comprehensive Integrated Air and Missile Defense capability for the Arleigh Burke Flight III Destroyers, working towards a 2024 Initial Operational Capability. This Computer Upgrade will integrate BMD capability with the advanced Air and Missile Defense Radar (AMDR), also known as the AN/SPY-6, for remote engagements and increased raid capacity with simultaneous multi-mission capabilities.

Adding an additional layer to the Aegis BMD weapon system, we are using an incremental development approach integrated within the Navy's Baseline 9 architecture to develop and deliver a Sea Based Terminal (SBT) capability. By expanding the capability of the SM-6 missile and BMD 5 series weapon systems, we are delivering capability to maritime forces to protect against anti-ship ballistic missiles and provide layered defense for forces ashore.

We executed a non-intercept flight test, Flight Test Experimental (FTX)-21 in May 2016 involving the Aegis Sea Based Terminal defense of the fleet capability against an advanced threat representative target. The target, launched from PMRF in Hawaii, was the first flight of the MRBM-class Type 3 Phase 2 target. A U.S. Navy destroyer, an Aegis Baseline 9.C1 (BMD 5.0 CU) configured Arleigh Burke Destroyer, detected and tracked the target. This was a very important step in ensuring the safety of the fleet and demonstrating the Sea Based Terminal capability.

In December 2016, we conducted a detection, tracking, and intercept test (FTM-27) to further assess the capability of Sea Based Terminal Increment 1 in the Aegis Baseline 9.C1 (BMD 5.0CU) Weapon System. During this test we fired a salvo of two SM-6 Dual I missiles

against the MRBM-class target launched out of PMRF. In this no-notice test, the sailors on the consoles aboard a U.S. Navy destroyer demonstrated the ability to conduct a critical terminal defense engagement in a ship-defense role. This was the first intercept test of this kind and it gave us greater confidence in the reliability and performance of our Sea Based Terminal defense capabilities. We conducted an additional test of the Sea Based Terminal Increment 1 capability in April 2017 (FTM-27 Event 2). During this test we fired a salvo of two SM-6 Dual I missiles against the MRBM target launched out of PMRF. In this no-notice test, the sailors on the consoles aboard a U.S. Navy destroyer again demonstrated the ability to conduct a critical terminal defense engagement in a ship-defense role. This test demonstrated improved SM-6 Dual I performance and further increased fleet confidence in the deployed SBT capability.

Sea Based Terminal Increment 2, which further improves our endo-atmospheric defensive capabilities, is on schedule to be certified and operational in the 2018-2019 timeframe. We conducted a successful Critical Design Review for ship defense in April 2017 for the SM-6 Dual II Sea-Based Terminal defense interceptor and conducted missile and weapon system integration testing in 2017. The first intercept flight test supporting Sea Based Terminal Increment 2 is planned for first quarter of FY 2019.

We continue to support the European Phased Adaptive Approach as a U.S. contribution to NATO BMD, providing coverage and protection of NATO European territory, populations, and forces against the increasing threat of ballistic missile proliferation in the Middle East. Currently, there is an operational Aegis Ashore site located in Romania. NATO's BMD architecture also includes the U.S. contributions of a forward-based AN/TPY-2 in Turkey, four BMD-capable Aegis destroyers homeported in Rota, Spain, SM-3 interceptors, and a command-and-control node at Ramstein Air Base, Germany.

In FY 2018, we will continue our commitment to develop, test, and deliver global Naval capability to the Warfighter and support defense of our deployed forces and European NATO allies through supporting the operational readiness of EPAA Phase 2 and efforts to deliver Phase 3 to improve defensive coverage against medium- and intermediate-range threats, which includes delivery of the Aegis Ashore site in Poland. Aegis Ashore site construction in Poland began in FY 2016. That site will be equipped with the upgraded Aegis Baseline 9 weapon system with BMD 5.1 and a capability to launch SM-3 Block IIAs. This new SM-3 variant will support the EPAA Phase 3 technical capability declaration. The Aegis Weapon System upgrades are further enhanced by spiral upgrades to C2BMC and AN/TPY-2 sensors, enabling Engage on Remote capability and extended defensive coverage for NATO Europe.

Military construction (MILCON) delays due to an unsatisfactory rate of construction progress at the Aegis Ashore site in Poland will push the EPAA Phase 3 Technical Capability Declaration from December 2018 to CY 2020. Efforts by the Missile Defense Agency and the Army Corps of Engineers to mitigate the MILCON delays included creation of an onsite Poland Integrated Project Office to administer the MILCON contract and facilitate continuous and real-time assessment of the construction contractor's performance. Efforts also included the U.S. Government continuing to provide supplemental program leadership, subject matter experts and additional quality assurance personnel to Poland; proactive use of contractual incentives, establishment of joint weekly program updates with the MDA Director and Army Corps' North Atlantic Commanding General; and quarterly Flag and General Officer reviews onsite. Despite these efforts, by December 6, 2017, it became evident that it was no longer possible to mitigate MILCON delays through compression of, and concurrency between, the non-MILCON elements of the project. At that time, the government decided to rebaseline the project schedule given the

likelihood of continued schedule erosion and the consumption of all margin. The rebaseline effort is on-going.

MDA FY 2019 budget request includes $15.0 million in Defense Wide Procurement and $27.7 million in Research, Development, Test & Evaluation (RDT&E) funds to address the multiple actions required to field Aegis Ashore in Poland and continued operations of other Aegis Ashore sites. Given the MILCON delays and the requirement to be on-site for at least another year, MDA's FY 2019 budget request includes funding to complete combat system adaptation, integration, installation, and testing to ensure delivery of EPAA Phase 3 capability to the warfighter. This capability ensures our ability to defend U.S. assets in Europe and meet EPAA Phase 3 commitment to our NATO allies. Given the successful efforts of controlling military construction costs, MDA does not anticipate a need to increase our MILCON budget in support of Aegis Ashore Poland.

Command and Control, Battle Management, and Communications and Regional Sensors

We request $475.2 million in FY 2019 for the 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. We continue to 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 control and tasking of forward-based AN/TPY-2 radars and the LRDR radar. C2BMC operators and maintainers deploy forward in some of the world's hottest threat spots and continue to provide around-the-clock support to the local commanders.

In FY 2019, we will complete testing and deployment of C2BMC Spiral 8.2-3 and BMDS Overhead Persistent Infra-Red Architecture (BOA) 6.1, in support of EPAA Phase 3 / Aegis BMD Engage-on-Remote functionality. Initial deployments will be to U.S. Central Command and U.S. European Command followed by U.S. Northern Command and U.S. Pacific Command providing enhanced tracking capabilities to the Warfighter. C2BMC also will initiate integration of a sea-based mobile sensor in the S8.2-3 timeframe that will provide enhanced tracking for emerging threats. We will continue development of C2BMC Spiral 8.2-5, which provides system level discrimination data, BOA 7.0 to provide advance threat warning capability, and threat characterization solutions and support command and control integration of the LRDR into the BMDS by 2021 to support a Robust Homeland Defense capability. C2BMC will initiate Increment 7 development tasks for command and control of the HDR-H radar and Robust Post Intercept Assessment supporting our homeland defense focus.

We continue supporting incremental improvements to 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 from sources such as the Space Based Infra-Red System (SBIRS), using the BMDS OPIR architecture. C2BMC will update hardware/software to increase cybersecurity through implementation of the DoD Cybersecurity Discipline Implementation Plan - Four Lines of Effort. We are conducting over 63 cyber-focused C2BMC tests and assessments involving multiple agencies over the FYDP to ensure the system is cyber-secure.

Finally, MDA continues to support the AN/TPY-2 (Terminal Mode) radars as part of a forward-deployed Terminal High Altitude Area Defense (THAAD) batteries in Guam and the Republic of Korea.

International Cooperation

The FY 2019 budget request includes funding for regional missile defense capabilities to protect deployed U.S. forces, reassure allies and partners, and build cooperative regional security architectures. MDA has engagements with over twenty countries and international organizations and is committed to expanding work with our international partners through joint analyses, partner missile defense acquisition decisions, cooperative research and development projects, deployment of BMD assets, Foreign Military Sales (FMS), and co-production efforts.

MDA continues to emphasize allied and partner investments in their own missile defense capabilities, which create more effective regional security architectures that complement U.S. regional missile defense capabilities. We continue to execute an FMS case with the United Arab Emirates for two THAAD batteries, including launchers, radars, and interceptors. Both batteries have been delivered to the UAE and have achieved Initial Operational Capability (IOC). MDA is actively engaged with several nations, particularly those in the Arabian Gulf region, to provide program information and cost data that may inform future decisions to procure THAAD and other missile defense systems. In 2016, MDA completed a regional Ballistic Missile Early Warning System architecture study for the Gulf Cooperation Council (GCC), analyzing sensor and C4I options for defense of the region. We are continuing to discuss the study's findings with the GCC nations. Additionally, MDA received a Letter of Request from the Kingdom of Saudi Arabia for seven THAAD batteries in April 2017. MDA is working with the Saudis to finalize the Letter of Offer and Acceptance.

MDA has a strong cooperative missile defense partnership with Israel through our continued work with the Israeli Missile Defense Organization. MDA's FY19 request is consistent with the funding 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.

We continue to make progress with our Japanese counterparts on the Standard Missile-3 Block IIA (SM-3 Block IIA), our largest co-development effort, which supports extended deterrence and establishes an important vehicle for closer defense cooperation ties. The development work remain on track for first delivery of the missile in the 2018 timeframe. The United States will deploy the SM-3 Block IIA to the fleet and at Aegis Ashore sites to improve and expand defenses against MRBM and IRBM threats. We are committed to delivering the SM-3 Block IIA to meet global threat requirements and support EPAA Phase 3.

Our FY 2019 budget request also supports Allied participation in tests, exercises, and wargames.

Addressing the Advanced Threat

We must make investments in advanced technology today to prepare for tomorrow’s threats by improving system performance and effectiveness. This budget request will continue the development of breakthrough technologies for integration into the BMDS, including discrimination improvements, Multi-Object Kill Vehicle technology, hypersonic defense technology, and high-powered lasers that have potential use against threat missiles in the boost phase of flight. We need to investigate solutions that reduce reliance on expensive kinetic interceptors. Scalable, efficient, and compact high-energy lasers could change future, missile defense architectures. By improving reliability, enhancing discrimination, and expanding battle

space, I believe we can reduce the cost per kill. MDA is developing technology to address gaps in the BMDS and dramatically drive down the cost of defending the homeland.

MDA requested $148.8 million for Technology Maturation Initiatives to conduct ground and airborne demonstrations of advanced sensor systems and refine directed energy technologies for missile defense. MDA is committed to developing and demonstrating directed energy and laser technologies that could be integrated into the BMDS, and we are actively testing a broad range of potential concepts, including both tracking and defensive lasers that could be deployed on a variety of platforms. Once we mature the required power, one potential concept the Agency is exploring is an Unmanned Aerial Vehicle-mounted laser that could destroy ICBMs in the boost phase at long standoff ranges. This concept requires precision tracking and a highly stable, lightweight, accurately pointed laser beam. We are currently testing a number of technologies to determine if this is a viable concept.

We are operating MQ-9 aircraft outfitted with passive sensors to help us understand boost-phase intercept tracking and how an airborne layer could augment our existing sensor network. In 2019, we will add tracking lasers to these aircraft to increase precision and range and determine how these compact lasers could further influence sensor design. In addition, we are developing advanced sensors and testing them from ground sites to improve discrimination accuracy and validate performance against targets of opportunity. What we learn from these ground and airborne tests could influence future space-based sensor systems.

We will complete three industry preliminary designs in 2018 of a multi-kilowatt class electric laser on a high-altitude airborne platform to demonstrate beam stabilization technology. In 2019 we will finish the design and begin fabrication of this first-of-a-kind system.

We continue to advance the state of the art for scaling electric laser power in efficient packaging. Both Diode Pumped Alkali Laser and Fiber Combing Laser technology have the potential to meet missile defense requirements. In 2019, we will concentrate on compact component development at the national laboratories and work with Industry and the Services to investigate other promising laser technologies. Based on the results of these and other tests, we will work closely with the Department to determine the best way to integrate directed energy and laser sensing into the missile defense system.

MDA requests $189.8 million for the Multi-Object Kill Vehicle (MOKV) effort to establish the technology foundation for killing multiple lethal objects from a single interceptor. The more kill vehicles we can put on an interceptor, the greater the raid capacity of our Ground-based Midcourse Defense system. MOKV has the potential to significantly enhance homeland defense capabilities at a lower cost per engagement against the threat. 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 demonstrations of hardware-in-the-loop prototypes. Our current plan is for an MOKV demonstrated capability in the 2027 timeframe.

We request $120.4 million in FY 2019 for the Hypersonic Defense effort to execute the systems engineering process, identify and mature full kill chain technology, provide analysis and assessment of target of opportunity events, and execute near term space sensor technology and multi-domain command and control capability upgrades to address defense from hypersonic threats. This effort will execute the Defense Science Board's recommendations to develop and deliver a set of material solutions to address and defeat hypersonic threats informed by a set of near-term technology demonstrations. An integrated set of enhancements will provide

incremental capability measured by progress and knowledge points in the following areas: establishment of systems engineering needs and requirements to identify alternative material solutions; execution of a series of sensor technology demonstrations; modification of existing BMDS sensors and the C2BMC element for hypersonic threats; and definition of weapon concepts and investments in key technologies to enable a broad set of solutions, including kinetic and non-kinetic means.

MDA requests $20.4 million for the Advanced Research Program to continue capitalizing on the creativity and innovation of the Nation's small business community and academia to enhance the Ballistic Missile Defense System. Advanced Research conducted research and material solution analysis to identify initiatives and technology to include missiles, sensors, and command and control components in the defense against current and future threats. We are fostering cutting edge research between U.S. and foreign universities of allied nations through international cooperative technology development projects.

We request $13.0 million for the Advanced Concepts & Performance Assessment effort, which centralizes advanced technology concept modeling, simulation, and performance analysis and delivers independent assessments of government, university, and industry technology concepts that, along with systems engineering requirements, support acquisition strategy decisions and define our technology focus areas.

We also will continue to support trade studies, systems engineering, modeling and simulation, and prototype design for a potential space-based missile defense architecture.

Conclusion

Mr. Chairman and Members of the Subcommittee, in closing, our FY 2019 budget funds comprehensive missile defense development efforts, including several critical capabilities

required by the Warfighter. We will continue to increase the reliability as well as the capability and capacity of fielded homeland and regional missile defense systems and make measured investments in advanced technology to counter the adversary missile threat.

Based on the current capacity of the North Korean threat, both the type and the amount of missiles that they possess, we can protect the continental United States and Hawaii today against an ICBM. However, as the threat increases in size and lethality, we need to ensure that our systems are reliable and our ballistic missile defense capability and capacity keep pace with that threat. With its FY 2019 President's Budget request, MDA will support the National Defense Strategy with the continued development and deployment of an integrated, layered missile defense system to defeat current and projected missile threats, allowing the nation to compete, deter, and win.

We must evolve our missile defense capabilities to outpace growing and increasingly complex threats. The addition of another Fort Greely Missile Field and twenty GBIs to the operational inventory will address the increasing numbers of threat missiles we may have to counter against the homeland. Sixty-four GBIs and urgent improvements in sensor coverage, to include the addition of a Medium Range Discrimination Radar and advanced discrimination improvements, will enable the United States to improve protection of the country. This budget request also will help grow the number of THAAD and SM-3 Block IB interceptors available to the warfighter to improve regional missile defenses.

Continuing the approach employed by my predecessors, I am completely committed to MDA's audit process to demonstrate our careful stewardship of the resources provided us. I am equally committed to MDA's full transparency in our engagements with the congressional defense committees, the Government Accountability Office, and Department's Inspector General.

I also would like to recognize the brave men and women who serve in our Armed Forces at home and abroad and who operate the BMDS. Our Nation is fortunate to have such a capable fighting force.

I appreciate your continued support for MDA and this critical mission, and I look forward to answering the committee's questions. Thank you.