Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Missile Defense Agency											Date: March 2019	
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603178C / *Weapons Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
Total Program Element	96.493	28.894	13.400	10.000	-	10.000	10.000	10.000	0.000	0.000	Continuing	Continuing
MD69: *Directed Energy Research*	96.493	28.894	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
MD72: *Interceptor Technology*	-	0.000	13.400	10.000	-	10.000	10.000	10.000	0.000	0.000	0.000	43.400
Program MDAP/MAIS Code: 362												

Note

Directed Energy Research (MD69) laser scaling efforts transferred to the Technology Maturation Initiatives (TMI) Program Element (PE) (0604115C) under the Directed Energy Demonstrator Development project (MD98) in FY 2019.

A. Mission Description and Budget Item Justification

Through FY 2018, the Weapons Technology PE developed and tested a high-powered directed energy laser to build the foundation of the next-generation laser system on a high altitude unmanned airborne platform. The Missile Defense Agency's (MDA) High Energy Laser (HEL) investment incrementally develops scalable, efficient, and compact HEL technology in the laboratory before beginning a high power laser flight test program. The technology required for tracking the target, aiming the laser, and building flight demonstrators is being developed under the TMI PE (0604115C).

In FY 2019, this PE provides the Hypersonic Defense Weapon Systems Concept Definition efforts to enable the Warfighter to counter the growing global hypersonic threat. The concept architectures must provide a kill chain that is highly maneuverable and agile, yet able to engage the hypersonic threats at much greater ranges during the threat's glide phase.

The Phase I Concept Definition effort will contract with twenty-one industry partners to start development of weapon systems concept architectures through a multi-phased approach to provide a near term capability to defeat hypersonic glide vehicles.

For FY 2020, MDA in coordination with the United States Air Force (USAF) is developing engineering and test requirements to support joint USAF/MDA program oversight and verification of a USAF system under development to provide a missile defense capability. Additional details on the USAF system are available at higher classification levels.

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Missile Defense Agency	Date: March 2019
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603178C *I Weapons Technology*

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	5.495	0.000	0.000	-	0.000
Current President's Budget	28.894	13.400	10.000	-	10.000
Total Adjustments	23.399	13.400	10.000	-	10.000
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	20.000	13.400			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.601	0.000			
• Missile Defeat and Defense Enhancement	0.000	0.000	0.000	-	0.000
• Other Adjustment	4.000	0.000	10.000	-	10.000

Change Summary Explanation

Increase in FY 2018 from PB19 to PB20 reflects the enacted congressional adjustment of $20.000 million and an increase of $4.000 million for directed energy.

Increase in FY 2019 from PB19 to PB20 reflects the enacted congressional adjustment of $13.400 million for the acceleration of Hypersonic Defense.

Increase in FY 2020 from PB19 to PB20 provides MDA joint efforts with the USAF to develop engineering and test requirements to support program oversight and verification of a USAF system under development to provide a missile defense capability.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Missile Defense Agency			Date: March 2019
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603178C / *Weapons Technology*	Project (Number/Name) MD69 / *Directed Energy Research*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
MD69: *Directed Energy Research*	96.493	28.894	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

Note

Directed Energy Research (MD69) laser scaling efforts transferred to the TMI PE (0604115C) under the Directed Energy Demonstrator Development project (MD98) in FY 2019.

A. Mission Description and Budget Item Justification

Through FY 2018, the Directed Energy Research project funded the laboratory development of two high energy laser technologies, the Diode Pumped Alkali Laser (DPAL) with Lawrence Livermore National Laboratory (LLNL)and the Fiber Combined Laser (FCL) with the Massachusetts Institute of Technology Lincoln Laboratory (MIT/LL). These laser technologies have considerable promise for scaling to very high average power while simultaneously achieving high system electrical-to-optical efficiencies, exceeding 40 percent, and very low system weight and volume.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Directed Energy Research	28.894	0.000	0.000
Description: Directed Energy Research funded two promising laser technologies: LLNL's DPAL and MIT/LL's FCL. Each technology takes a unique approach to attaining high power. The DPAL scales in power by increasing the size of a single laser gain cell. This approach has the benefit of simplicity of design, but must address very high energy levels within the single cell. LLNL successfully demonstrated over 16 kilowatts (kW) in FY 2016. MDAs key fiber laser investments are targeted at driving the weight per kW of power in the fiber amplifier system down while increasing the individual fiber amplifier power output. MDA joined with the Defense Advanced Research Projects Agency (DARPA) and the USAF to demonstrate 44 kWs in a room-sized, 40 kilogram per kW configuration in FY 2015, to a packaged 7 kilograms per kW, 30 kW system in FY 2018. Specific and/or unique accomplishments to each FY are as follows: ***FY 2019 Plans:*** N/A ***FY 2020 Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Missile Defense Agency		Date: March 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603178C / *Weapons Technology*	**Project (Number/Name)** MD69 / *Directed Energy Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Directed Energy Research (MD69) laser scaling efforts transferred to the TMI PE (0604115C) under the Directed Energy Demonstrator Development project (MD98) in FY 2019.			
Accomplishments/Planned Programs Subtotals	28.894	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
• 0603176C: *Advanced Concepts and Performance Assessment*	17.683	13.017	14.208	-	14.208	14.904	15.142	16.262	16.574	Continuing	Continuing
• 0603180C: *Advanced Research*	23.765	42.565	20.674	-	20.674	21.154	21.521	22.041	22.465	Continuing	Continuing
• 0603890C: *BMD Enabling Programs*	533.993	620.831	571.507	-	571.507	603.672	541.667	574.553	553.969	Continuing	Continuing
• 0604115C: *Technology Maturation Initiatives*	163.947	316.822	303.458	-	303.458	336.139	380.195	300.126	201.668	Continuing	Continuing

Remarks

D. Acquisition Strategy

The acquisition strategy for Directed Energy Research (MD69), consists of partnering with Industry, DARPA, USAF, FFRDCs, and UARCs. MDA will leverage Agency and partner subject matter experts and use government model based assessments to inform Better Buying Power philosophy acquisition decisions. The MDA will then award contracts to industry and universities via the Advanced Technology Innovation Broad Agency Agreement (BAA) and competitive procurements to develop and demonstrate promising components and integrated systems in realistic test environments.

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Missile Defense Agency			Date: March 2019
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603178C / *Weapons Technology*	Project (Number/Name) MD72 / *Interceptor Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
MD72: *Interceptor Technology*	-	0.000	13.400	10.000	-	10.000	10.000	10.000	0.000	0.000	0.000	43.400

Note

FY 2019 reflects the congressional adjustment for acceleration of Hypersonic Defense. Other Hypersonic Defense efforts are funded in PE 0604181C in FY 2020 and out years.

A. Mission Description and Budget Item Justification

In FY 2019, MDA along with industry partners will develop Hypersonic Defense Weapon Systems concept architectures (weapon and kill chain) that are able to engage the hypersonic threats at much greater ranges during the threat's glide phase and in terminal phase for layered defense.

The weapon systems concepts will provide MDA insight into architecture performance, cost, and schedule for future development efforts.

Hypersonic Defense Weapon Systems Concept Definition seeks investigation of a broad trade space for innovative concepts that can provide affordable, reliable, and robust capabilities to negate hypersonic vehicle threats.

For FY 2020, MDA in coordination with the United States Air Force (USAF) is developing engineering and test requirements to support joint USAF/MDA program oversight and verification of a USAF system under development to provide a missile defense capability.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Hypersonic Defense Weapon Systems Concept Definition	0.000	13.400	0.000
Description: This effort conducts Hypersonic Defense Weapon Systems Concept Definition with industry to develop weapon systems concepts through a multi phased approach to provide a near term capability to destroy hypersonic vehicle threats. Specific and/or unique accomplishments to each FY are as follows: ***FY 2019 Plans:*** - Complete industry Phase I Concept Definition for a Hypersonic Defense Weapon Systems architecture with the delivery of initial contractor concepts for further concept refinement of performance, operational employment, cost, and schedule. ***FY 2020 Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Decrease from FY2019 to FY2020 reflects the FY2019 congressional plus up for acceleration of Hypersonic Defense.			
Title: USAF/MDA Missile Defense Capability	0.000	0.000	10.000

Exhibit R-2A, RDT&E Project Justification: PB 2020 Missile Defense Agency		Date: March 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603178C / *Weapons Technology*	**Project (Number/Name)** MD72 / *Interceptor Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Description: For FY 2020, MDA in coordination with the United States Air Force (USAF) is developing engineering and test requirements to support joint USAF/MDA program oversight and verification of a USAF system under development to provide a missile defense capability. ***FY 2019 Plans:*** N/A ***FY 2020 Plans:*** Develop engineering and test requirements in support of a joint USAF/MDA missile defense capability. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Increase from FY 2019 to FY 2020 reflects the initiation of a joint USAF/MDA missile defense capability. Additional details on the USAF system are available at higher classification levels.			
Accomplishments/Planned Programs Subtotals	0.000	13.400	10.000

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
• 0604181C: *Hypersonic Defense*	63.032	130.944	157.425	-	157.425	142.391	116.931	119.780	122.078	0.000	852.581

Remarks

D. Acquisition Strategy

To optimize Missile Defense System (MDS) performance, MDA leverages the nation's engineering centers of excellence at government agencies, Military Services, FFRDC, UARCs and industry. The executing agents use varying contracting strategies in a flexible manner to maximize their contribution to the MDS. MDA acquires products and services by competitive means to the extent that is possible, practical and uses the BAA process to award concept definition contracts.

E. Performance Metrics

N/A