Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Missile Defense Agency											Date: February 2020	
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 4: *Advanced Component Development & Prototypes (ACD&P)*					R-1 Program Element (Number/Name) PE 0604181C / *Hypersonic Defense*							
COST ($ in Millions)	**Prior Years**	**FY 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
Total Program Element	63.032	132.612	390.204	206.832	-	206.832	107.521	111.084	115.487	118.333	Continuing	Continuing
MD29: *Hypersonic Defense*	63.032	127.222	383.506	196.749	-	196.749	103.254	106.617	109.577	111.878	Continuing	Continuing
MD40: *Program Wide Support*	-	5.390	6.698	10.083	-	10.083	4.267	4.467	5.910	6.455	0.000	43.270
Program MDAP/MAIS Code: 362												

Note

Decrease from FY 2020 to FY 2021 reflects FY 2020 Congressional increases.

The funding request for FY 2021 includes Joint Emergent Operational Need (JEON) PC-0015 requirements.

A. Mission Description and Budget Item Justification

This program element supports a focused program that includes executing the systems engineering process, kill chain technology identification and maturation, providing analysis and assessment of target of opportunity events, and executing near term sensor and command and control capability upgrades to address defense from hypersonic threats, which pose a significant threat.

The Hypersonic Defense effort will develop and demonstrate advanced technologies for future capabilities to counter hypersonic threats. The Missile Defense Agency (MDA) continues to assess architecture alternatives and provide recommendations for future Missile Defense System configurations to keep pace with evolving threats. MDA will leverage and upgrade existing systems, pursue hypersonic threat defeat weapon system capabilities, and develop technologies that augment future Hypersonic Defense architectures. These integrated sets of enhancements will provide incremental capabilities measured by progress and knowledge points in the following areas:

- Systems engineering (architecture analysis, technology prioritization, requirements development, integration planning, test planning & assessment, and lethality)
- Modification of existing Ballistic Missile Defense System (BMDS) Command, Control, Battle Management and Communications (C2BMC) element for hypersonic threats
- Hypersonic Defense Weapon Systems and Component Technology Development to enable a broad set of solutions including kinetic and non-kinetic means for future implementation

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Missile Defense Agency					Date: February 2020
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 4: *Advanced Component Development & Prototypes (ACD&P)*		R-1 Program Element (Number/Name) PE 0604181C / *Hypersonic Defense*			
B. Program Change Summary ($ in Millions)	**FY 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**
Previous President's Budget	130.944	157.425	142.391	-	142.391
Current President's Budget	132.612	390.204	206.832	-	206.832
Total Adjustments	1.668	232.779	64.441	-	64.441
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	232.779			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-2.747	0.000			
• Missile Defeat and Defense Enhancement	0.000	0.000	0.000	-	0.000
• Other Adjustment	4.415	0.000	64.441	-	64.441

Change Summary Explanation

The FY 2020 increase reflects a Congressional add to accelerate Hypersonic Defense programs. This increase provides additional high risk component development and testing for the Glide Phase Defeat Weapon System, as well as additional Engineering Enablers, the leverage and upgrade of existing systems and partner flight test participation.

The FY 2021 increase provides for development of Glide Phase Defeat technologies to inform a future weapon system architecture, and provides advancing development and analysis needed to integrate Aegis BMD Weapon System capabilities with a glide phase defeat weapon to address hypersonic threats.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Missile Defense Agency			Date: February 2020
Appropriation/Budget Activity 0400 / 4	R-1 Program Element (Number/Name) PE 0604181C / *Hypersonic Defense*	Project (Number/Name) MD29 / *Hypersonic Defense*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MD29: *Hypersonic Defense*	63.032	127.222	383.506	196.749	-	196.749	103.254	106.617	109.577	111.878	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Decrease from FY 2020 to FY 2021 reflects the FY 2020 Congressional increase.

A. Mission Description and Budget Item Justification

The Hypersonic Defense effort will develop and demonstrate advanced technologies for future capabilities to counter hypersonic threats.

The Missile Defense Agency (MDA) will conduct systems engineering activities and technology maturation to develop Missile Defense System architectures for future capabilities to defeat advanced threats. Efforts include kill chain and component allocations for requirements development, performance analysis, integration planning, and ground/flight test planning & assessment for near term and far term architectures.

MDA will continue operationalization and integration of the initial hypersonic tracking capability developed under U.S. Indo-Pacific Command (USINDOPACOM) Joint Emergent Operational Need (JEON) PC-0015 into the C2BMC program of record, Spiral 8.2-5. MDA plans to leverage the lessons learned and analysis from this capability development for the design and development of additional sensors for potential advanced threat applications. In addition, MDA will begin integrating these sensors into C2BMC and continue to enhance advanced threat ground processing to leverage data from these new sensors.

To address the weapon technology required to defeat the hypersonic threat, MDA will focus on the maturation of hypersonic defense component advancements, and the development of weapon concepts through competitive development efforts with industry. MDA will assess those concepts and identify technology component risk reduction efforts for cost, risk, and performance, and refine requirements to inform future development efforts. The Agency will also enhance analysis tools to assess concept designs and provide input to the requirements process.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021
Title: Hypersonic Defense	127.222	0.000	0.000
Articles:	-	-	-
Description: This effort includes the systems engineering, technology development, and near-term component capability development activities required to evolve the BMDS to address hypersonic threats, to include architecture analysis, capability roadmap development, and requirements development. It also includes an assessment of existing and new capabilities, identification, development of new technology and capabilities needed across the kill chain in support of architecture alternatives, and the ability to address advanced threats.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021
N/A ***FY 2021 Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Enacted FY 2020 position is reflected in the breakout of Hypersonic Defense activities to individual Accomplishment sections within this budget project for greater visibility.			
Title: Disruptive Technologies for Future Architecture	0.000	35.543	13.252
Articles:	-	-	-
Description: Provides identification, development of new technology and capabilities needed across the kill chain in support of Hypersonic Defense architecture alternatives, and the ability to address advanced threats. ***FY 2020 Plans:*** - Identify, develop, and demonstrate advanced technologies across the hypersonic defense full kill chain in the key areas of: -- Large field of view, digital focal plane array -- High speed processing & algorithm development -- High data rate, low latency processing and communications - Develop forward looking seeker technology -- Develop propulsion technology to increase maneuverability and energy management -- Accelerate on-chip processing and multi-mode sensor/seeker technologies -- Deliver an integrated single-axis atomic gyroscope-accelerometer capability to navigate under severe acceleration, shock, and vibration -- Mature software algorithms for the kill vehicle -- Mature modeling and simulation architecture through advanced concept development -- Continue development of advanced concepts to counter the evolving threats ***FY 2021 Plans:*** - Provide development of Weapon and Sensor System Component Technologies: -- Initial Digital Focal Plane Array deliveries under the Hypersonic and Ballistic Tracking Space Sensor -- Advanced technology efforts to increase Digital Focal Plane Arrays dynamic range for improved sensitivity across a broader range of threats -- Develop low-cost/light weight Focal Plane Array sensor supporting electronics and cooling for Hypersonic and Ballistic Tracking Space Sensor -- Develop propulsion technology to increase maneuverability and energy management			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021
-- Develop advanced concepts to counter the evolving threats ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Beginning in FY 2020, content per accomplishment has been broken out into further detail for greater visibility. Decrease from FY 2020 to FY 2021 reflects reprioritization of funds in FY 2021 to the Regional Glide Phase Defeat Weapon Systems Accomplishment.			
Title: Engineering Enablers	0.000	68.672	44.901
Articles:	-	-	-
Description: Provides systems engineering activities required to evolve the BMDS to address hypersonic threats, to include architecture analysis, capability roadmap development, and requirements development. ***FY 2020 Plans:*** - Execute the Hypersonic Defense program systems engineering process for integrating hypersonic defense capabilities into a layered missile defense system. - Lead Hypersonic Defense program; synchronizing element execution. - Complete analysis and assessments of target of opportunity events. - Perform architectural analysis to define initial Hypersonic Defense missile defense architectures, functional and performance needs using digital engineering techniques and tools. - Develop plans for capability integration; identify and resolve cross element integration technical and scheduling issues. - Update Hypersonic Defense architecture roadmap. - Conduct engineering to examine new track filter algorithms to support hypersonic threat behavior - Develop and provide threat products to support the development of hypersonic defense capabilities - Conduct engineering and modeling and simulation analysis to determine acceptable sensor and window characteristics for hypersonic velocity and temperatures: Window behaviors, boresight error and compensation, atmospheric effects, window mounting, window cover release, and dependence on flight conditions - Perform initial laboratory and wind-tunnel experiments on window behavior and plan experiments - Conduct engineering and modeling and simulation analysis to determine feasibility for different flight controls in endo-atmospheric conductions to achieve sufficient agility and lethality for interceptor - Update hypersonic defense Core Truth Models (CTM) and hardware-in-the-loop (HWIL) models to support testing - Conduct hypersonic defense lethality testing - Perform hypersonic defense gaps analysis ***FY 2021 Plans:*** - Conduct foundational Systems Engineering activities required to develop Hypersonic Defense, including concept definition, requirements and interfaces, system design, integration, test planning, and use of digital engineering tools and practices			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021
-- Provide key products for development and maintenance of the technical baseline -- Assess current BMDS capabilities against hypersonic threats and analyze future HD solutions to counter the evolving threat -- Develop and integrate modeling and simulation tools to validate HD requirements and assess HD performance -- Support HD reviews to coordinate the technical and program baselines to ensure development of a successful capability -- Continue to mature modeling and simulation architecture - Perform engineering analysis, develop requirements, and define interfaces for sensor-to-weapon fire control using C2BMC to lay the path for connectivity, battle management, and sensor tasking to a weapon system such as Aegis - Develop modeling and simulation for glide phase weapon lethality and conduct lethality testing ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Beginning in FY 2020, content formerly planned in the Hypersonic Defense accomplishment has been broken out into further detail for greater visibility. Decrease from FY 2020 to FY 2021 reflects the FY 2020 Congressional plus up.			
Title: Leverage and Upgrade Existing Systems	0.000	86.627	21.212
Articles:	-	-	-
Description: This effort includes the assessment of and upgrades to existing BMD capabilities to address hypersonic threats. ***FY 2020 Plans:*** - Command and Control, Battle Management, Communication (C2BMC) Upgrades: -- Conduct Enterprise Sensor Laboratory (ESL)/C2BMC Hypersonic Defense capability development -- Perform C2BMC Hypersonic Defense integration -- Develop sensor cueing - Ground Sensor Upgrades: For AN/TPY-2 update and develop: -- Hypersonic threat profiles (database updates) -- Impact point prediction updates (threat/non-threat calls) -- Track filter techniques -- Interfaces -- Other (higher classification) - Upgrades and accelerations due to FY 2020 increased funding marks: -- Develop C2BMC expanded capabilities to support hypersonic defense, situational awareness, sensor management, advanced threat typing/custody and engagement coordination. System updates address additional processing, latency improvements and updated reporting -- For AN/TPY-2, update and develop Models & Simulation (M&S), M&S Ground Test support, and Battle Manager Interfaces ***FY 2021 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021
- Complete USINDOPACOM JEON response for real time detection warning, tracking, and reporting of Hypersonic Glide Vehicles (HGV) via C2BMC for BMDS situational awareness - Evaluate and support internal synchronization, technology insertion, and program requirements generation and validation - Continue to upgrade C2BMC and sensor cueing to provide C2BMC reporting of HGV tracks to BMDS weapon systems via Link 16 - Evaluate and support internal synchronization, technology insertion, and program requirements generation and validation ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Beginning in FY 2020, content formerly planned in the Hypersonic Defense accomplishment has been broken out into further detail for greater visibility. Decrease from FY 2020 to FY 2021 reflects the FY 2020 Congressional plus up.			
Title: Glide Phase Defeat Weapon System	0.000	88.585	117.384
Articles:	-	-	-
Description: This effort includes the near-term Regional Glide Phase Weapon System (RGPWS) capability maturation with the industry activities required to evolve the BMDS to address hypersonic threats. It also includes the assessment of and upgrades to existing Aegis BMD Weapon System capabilities for a Regional Glide Phase Weapon to address hypersonic threats. ***FY 2020 Plans:*** - Complete concept definition and refine design concepts for the Regional Glide Phase Weapon System. The weapon system designs, concepts and component technologies aid the Agency in establishing the foundation for glide phase weapons. - Conduct hypersonic technology risk reduction activities for the Glide Phase Weapon System - Begin Aegis Weapon System analysis to determine preliminary design modifications to support Glide Phase Weapon Control and Integration, to include physical and software required modifications - Initiate modeling changes needed to incorporate Glide Phase Weapon Control and Integration ***FY 2021 Plans:*** - Conduct RGPWS technical risk reduction activities and concept development/definition - Integrate technology for future demonstration of a RGPWS and collect data to inform future product development efforts - Refine contractor concept definition efforts, focusing on assessments of high risk areas to determine the feasibility of each concept's unique design characteristics - Conduct technical reviews of the RGPWS designs - Continue Aegis Weapon System analysis to determine preliminary physical and software design modifications - Continue modeling changes needed to incorporate Glide Phase Weapon Control and Integration - Begin analysis based on initial modeling to identify system design gaps and integration challenges needed to incorporate Glide Phase Weapon Control changes in the Aegis Weapon System			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021
- Conduct reviews and activities for improving defense against hypersonic threats with the Aegis platform ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Beginning in FY 2020, content formerly planned in the Hypersonic Defense accomplishment has been broken out into further detail for greater visibility. Increase from FY 2020 to FY 2021 provides for development of Glide Phase Defeat technologies to inform a future weapon system architecture, and provides advancing development and analysis needed to integrate Aegis BMD Weapon System capabilities with a glide phase defeat weapon to address hypersonic threats.			
Title: Partnered Flight Test Participation	0.000	104.079	0.000
Articles:	-	-	-
Description: MDA's participation in Partner Flight Test events is critical for data collection across a diverse hypersonic threat set from multiple types of launch platforms. Participation in these test events supports the development and fielding of MDA's Hypersonic Defense capabilities to protect the United States, its allies, and deployed forces in all phases of flight. ***FY 2020 Plans:*** - Fully funds partner flight test participation and associated engineering test data analysis - Collect sensor data to support model validation, threat validation and development of hypersonic defense capabilities - Coordinate with partner flight test teams to ensure test collection resources and assets are integrated in a safe manner ***FY 2021 Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Beginning in FY 2020, content formerly planned in the Hypersonic Defense accomplishment has been broken out into further detail for greater visibility. Decrease from FY 2020 to FY 2021 reflects completion of MDA participation in Partnered Flight Test events.			
Accomplishments/Planned Programs Subtotals	127.222	383.506	196.749

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• 0603176C: *Advanced Concepts and Performance Assessment*	12.720	46.201	14.910	-	14.910	15.178	16.205	16.879	17.300	Continuing	Continuing
• 0603180C: *Advanced Research*	42.100	27.674	18.687	-	18.687	18.883	18.975	19.720	20.222	Continuing	Continuing
• 0603884C: *Ballistic Missile Defense Sensors*	382.759	352.288	281.957	-	281.957	576.699	656.539	574.703	593.592	Continuing	Continuing

Exhibit R-2A, RDT&E Project Justification: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• 0603890C: *BMD Enabling Programs*	614.855	634.449	599.380	-	599.380	552.815	544.582	560.863	582.675	Continuing	Continuing
• 0603892C: *AEGIS BMD*	724.731	737.269	814.936	-	814.936	674.825	553.402	478.000	449.145	Continuing	Continuing
• 0603896C: *Ballistic Missile Defense Command and Control, Battle Management & Communication*	500.965	549.756	593.353	-	593.353	593.330	546.471	581.376	543.971	Continuing	Continuing
• 1206895C: *Ballistic Missile Defense System Space Programs*	96.146	140.565	32.068	-	32.068	28.591	41.201	39.090	39.630	Continuing	Continuing

Remarks

D. Acquisition Strategy

To optimize Missile Defense System performance, MDA leverages the nation's engineering centers of excellence at government agencies, Military Services, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), and industry. The executing agents use varying contracting strategies in a flexible manner to maximize their contribution to the Missile Defense System. MDA acquires products and services by competitive means to the extent that is possible, practical and uses the Advanced Technology Broad Area Announcement process to award concept definition contracts.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Missile Defense Agency			Date: February 2020
Appropriation/Budget Activity 0400 / 4	R-1 Program Element (Number/Name) PE 0604181C / *Hypersonic Defense*	Project (Number/Name) MD29 / *Hypersonic Defense*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Hypersonic Defense - BMDS C2BMC Upgrades	C/Various	Various : AL	13.375	20.270	Nov 2018	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Hypersonic Defense - BMDS Sensor Upgrades - AN/TPY-2	SS/CPFF	Raytheon : MA	1.896	14.578	Nov 2018	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Hypersonic Defense - BMDS Sensor Upgrades - LRDR	C/FFP	Lockheed Martin : NJ	1.822	10.185	Feb 2019	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Hypersonic Defense - Component Technology for Sensors and Weapons	MIPR	Various : AL	10.949	9.551	Nov 2018	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Hypersonic Defense - Sensor Technology - Advanced Threat Tracking and Analysis / Low Latency Processing	MIPR	Various : AL, CA	7.368	5.648	Dec 2018	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Hypersonic Defense - Sensor Technology - Sensor Concept and Development	MIPR	Various : AL	6.714	14.808	Nov 2018	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Hypersonic Defense - Systems Engineering	Allot	MDA : AL, VA	3.914	1.530	Oct 2018	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Hypersonic Defense - Systems Engineering -- CSS	C/CPFF	TEAMS : AL, VA	3.250	3.438	Nov 2018	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Hypersonic Defense - Systems Engineering -- FFRDC/UARC	MIPR	Various : VA, AL	2.000	5.257	Nov 2018	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Hypersonic Defense - Systems Engineering -- Industry	C/CPAF	Boeing : AL	2.500	1.039	Nov 2018	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Hypersonic Defense - Technology Development Program Operations	Allot	MDA : AL, VA	4.466	7.395	Nov 2018	0.000		0.000		-		0.000	Continuing	Continuing	Continuing

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Missile Defense Agency		Date: February 2020
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Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Hypersonic Defense - Weapon Concept Definition & Risk Reduction	C/Various	Various : AL	4.778	33.523	Feb 2019	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Disruptive Technologies for Future Architecture - Hypersonic Defense - Component Technology for Sensors and Weapons	MIPR	Various : AL	0.000	0.000		13.852	Nov 2019	5.460	Dec 2020	-		5.460	Continuing	Continuing	Continuing
Disruptive Technologies for Future Architecture - Hypersonic Defense - Sensor Technology - Advanced Threat Tracking and Analysis / Low Latency Processing	MIPR	Various : AL, CA	0.000	0.000		6.623	Nov 2019	0.000		-		0.000	Continuing	Continuing	Continuing
Disruptive Technologies for Future Architecture - Hypersonic Defense - Sensor Technology / Sensor Concept and Development	MIPR	Various : AL	0.000	0.000		15.068	Nov 2019	7.792	Dec 2020	-		7.792	Continuing	Continuing	Continuing
Engineering Enablers - Hypersonic Defense - Systems Engineering	Allot	MDA : AL, VA	0.000	0.000		3.000	Nov 2019	7.909	Nov 2020	-		7.909	Continuing	Continuing	Continuing
Engineering Enablers - Hypersonic Defense - Systems Engineering - Lethality and Analysis	Various	Various : Various	0.000	0.000		8.600	Feb 2020	5.000	Nov 2020	-		5.000	Continuing	Continuing	Continuing
Engineering Enablers - Hypersonic Defense - Systems Engineering - M&S	C/CPAF	Northrop Grumman : AL	0.000	0.000		6.600	Feb 2020	0.000		-		0.000	Continuing	Continuing	Continuing
Engineering Enablers - Hypersonic Defense -	Various	Various : Various	0.000	0.000		10.600	Feb 2020	0.000		-		0.000	Continuing	Continuing	Continuing

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Systems Engineering - Threat Engineering															
Engineering Enablers - Hypersonic Defense - Systems Engineering -- CSS	C/CPFF	TEAMS : AL, VA	0.000	0.000		11.308	Nov 2019	9.283	Nov 2020	-		9.283	Continuing	Continuing	Continuing
Engineering Enablers - Hypersonic Defense - Systems Engineering -- FFRDC/UARC	MIPR	Various : AL, VA	0.000	0.000		24.000	Nov 2019	21.680	Jan 2021	-		21.680	Continuing	Continuing	Continuing
Engineering Enablers - Hypersonic Defense - Systems Engineering -- Industry	C/CPAF	Boeing : AL	0.000	0.000		4.564	Nov 2019	1.029	Nov 2020	-		1.029	Continuing	Continuing	Continuing
Leverage and Upgrade Existing Systems - Hypersonic Defense - BMDS C2BMC	Various	Various : Various	0.000	0.000		25.313	Nov 2019	0.000		-		0.000	Continuing	Continuing	Continuing
Leverage and Upgrade Existing Systems - Hypersonic Defense - BMDS C2BMC Upgrades (Prime)	C/CPIF	Lockheed Martin : AL	0.000	0.000		0.000		2.000	Nov 2020	-		2.000	Continuing	Continuing	Continuing
Leverage and Upgrade Existing Systems - Hypersonic Defense - BMDS C2BMC Upgrades for HD	C/CPAF	Northrop Grumman : CO	0.000	0.000		14.942	Jan 2020	19.212	Nov 2020	-		19.212	Continuing	Continuing	Continuing
Leverage and Upgrade Existing Systems - Hypersonic Defense - BMDS Sensor Upgrades	C/FFP	Lockheed Martin : NJ	0.000	0.000		6.948	Nov 2019	0.000		-		0.000	Continuing	Continuing	Continuing
Leverage and Upgrade Existing Systems - Hypersonic Defense -	SS/CPFF	Raytheon : MA	0.000	0.000		39.424	Nov 2019	0.000		-		0.000	Continuing	Continuing	Continuing

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
BMDS Sensor Upgrades - AN/TPY-2															
Glide Phase Defeat Weapon System - Hypersonic Defense - Technology Development Program Operations	Allot	MDA : AL, VA	0.000	0.000		6.759	Nov 2019	4.230	Nov 2020	-		4.230	Continuing	Continuing	Continuing
Glide Phase Defeat Weapon System - Hypersonic Defense - Weapon Concept Definition and Risk Reduction	C/Various	Various : AL	0.000	0.000		81.826	Feb 2020	113.154	May 2021	-		113.154	Continuing	Continuing	Continuing
		Subtotal	63.032	127.222		279.427		196.749		-		196.749	Continuing	Continuing	N/A

Remarks

N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Partnered Flight Test Participation - Partner Flight Test Participation	MIPR	Space and Missile Defense Command/ US Maritime Administration/ Pacific Missile Range Facility/ Ronald Reagan Test Site/ L3/JHU/APL/ MDIOC/ Lockheed Martin/AMRDEC/ NSWC/NAWC : AL/ CA/CO/DC/HI/TN/TX	0.000	0.000		104.079	Jan 2020	0.000		-		0.000	0.000	104.079	0.000
		Subtotal	0.000	0.000		104.079		0.000		-		0.000	0.000	104.079	N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Remarks N/A															
		Project Cost Totals	63.032	127.222		383.506		196.749		-		196.749	Continuing	Continuing	N/A

Remarks

Award Dates reflect date of first obligation. Additional obligations may incrementally occur throughout the year.

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

Significant Event Complete ▲ Significant Event Planned △ Milestone Decision Complete ★ Milestone Decision Planned ☆ Element Test Complete ◆ Element Test Planned ◇ System Level Test Complete ● System Level Test Planned ○ Complete Activity ✦ Planned Activity ✧

	FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
C2BMC System Requirements Review / Preliminary Design Review	▲																											
Hypersonic Defense Sensor and Weapons Component Technology Development Contract Award		▲																										
AoA Completion				▲																								
Weapon Systems Concept Definition Contract Award #2				▲																								
AN/TPY-2 Capability Development	✧	✧	✧	✧	✧	✧	✧	✧																				
LRDR Capability Development	✧	✧	✧	✧	✧	✧	✧	✧																				
Weapon Systems Concept Definition & Risk Reduction (Phases 1 and 2)	✧	✧	✧	✧	✧	✧	✧	✧																				
Hypersonic Threat Sensor Technology Development	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧												
C2BMC Capability Development	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧
Hypersonic Defense Sensor & Weapons Component Technology Capability Development	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧
Hypersonic Defense Sensor and Weapons Component Technology Performance Testing			✧	✧	✧	✧	✧	✧	✧	✧	✧	✧																
AN/TPY-2 System Requirements Review				▲																								
Weapons Technology Risk Reduction Contract(s) Award							✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD29 / *Hypersonic Defense*

Schedule Details

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
C2BMC System Requirements Review / Preliminary Design Review	1	2019	1	2019
Hypersonic Defense Sensor and Weapons Component Technology Development Contract Award	2	2019	2	2019
AoA Completion	4	2019	4	2019
Weapon Systems Concept Definition Contract Award #2	4	2019	4	2019
AN/TPY-2 Capability Development	1	2019	4	2020
LRDR Capability Development	1	2019	4	2020
Weapon Systems Concept Definition & Risk Reduction (Phases 1 and 2)	1	2019	4	2020
Hypersonic Threat Sensor Technology Development	1	2019	4	2022
C2BMC Capability Development	1	2019	4	2025
Hypersonic Defense Sensor & Weapons Component Technology Capability Development	1	2019	4	2025
Hypersonic Defense Sensor and Weapons Component Technology Performance Testing	3	2019	4	2021
AN/TPY-2 System Requirements Review	4	2019	4	2019
Weapons Technology Risk Reduction Contract(s) Award	3	2020	3	2026

Exhibit R-2A, RDT&E Project Justification: PB 2021 Missile Defense Agency			Date: February 2020
Appropriation/Budget Activity 0400 / 4	R-1 Program Element (Number/Name) PE 0604181C / *Hypersonic Defense*	Project (Number/Name) MD40 / *Program Wide Support*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MD40: *Program Wide Support*	-	5.390	6.698	10.083	-	10.083	4.267	4.467	5.910	6.455	0.000	43.270
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Program Wide Support (PWS) is allocated on a pro-rata basis across multiple Agency PEs each fiscal year based on the total Agency budget, and therefore fluctuates per PE by fiscal year.

A. Mission Description and Budget Item Justification

PWS contains non-headquarters management costs in support of MDA functions and activities across the entire MDS. These functions include Government Civilians and Contract Support Services. This effort provides integrity and oversight of the MDS as well as supports MDA in the development and evaluation of technologies that will respond to the changing threat. Additionally, PWS includes personnel to support global deployments performing deployment site preparation and activation, and provides facility capabilities for MDA Executing Agent locations worldwide. Other MDA wide costs include: physical and technical security; civilian drug testing; audit readiness; the Science, Technology, Engineering, and Mathematics (STEM) program; legal services and settlements; travel and agency training; office, equipment, vehicle, and warehouse leases; utilities and base operations across multiple geographic locations; commercial and ancillary facility services; management of all facility aspects regardless of lifecycle stage; supplies and maintenance; compliance with statutory environmental requirements; data and unified communications support; materiel and readiness and central property management of equipment; Facilities Sustainment, Restoration and Modernization (FSRM) program, (formerly Real Property Maintenance) to keep the Department's inventory of facilities in good working order; and similar operating expenses. PWS is allocated on a pro-rata basis across most Agency PEs and therefore fluctuates per PE by fiscal year based on the total Agency budget in that fiscal year.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021
Title: Program Wide Support	5.390	6.698	10.083
Articles:	-	-	-
Description: PWS contains non-headquarters management costs in support of MDA functions and activities across the entire MDS. These functions include Government Civilians and Contract Support Services. This effort provides integrity and oversight of the MDS as well as supports MDA in the development and evaluation of technologies that will respond to the changing threat. Additionally, PWS includes personnel to support global deployments performing deployment site preparation and activation, and provides facility capabilities for MDA Executing Agent locations worldwide. Other MDA wide costs include: physical and technical security; civilian drug testing; audit readiness; the Science, Technology, Engineering, and Mathematics (STEM) program; legal services and settlements; travel and agency training; office, equipment, vehicle, and warehouse leases; utilities and base operations across multiple geographic locations; commercial and ancillary facility services; management of all facility aspects regardless of lifecycle stage; supplies and maintenance; compliance with statutory environmental requirements; data and unified communications support; materiel and readiness and central property management of equipment; Facilities Sustainment, Restoration and Modernization (FSRM) program, (formerly Real Property Maintenance) to keep the Department's inventory of			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD40 / *Program Wide Support*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021
facilities in good working order; and similar operating expenses. PWS is allocated on a pro-rata basis across most Agency PEs and therefore fluctuates per PE by fiscal year based on the total Agency budget in that fiscal year. ***FY 2020 Plans:*** - SEE ABOVE. ***FY 2021 Plans:*** - SEE ABOVE. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Decrease from FY 2020 to FY 2021 reflects the PWS allocation on a pro-rata basis across multiple Agency PEs each fiscal year based on the total Agency budget, and therefore fluctuates per PE by fiscal year.			
Accomplishments/Planned Programs Subtotals	5.390	6.698	10.083

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD40 / *Program Wide Support*

Support ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Program Wide Support - Agency Operations Management	Various	Various : Multi, AL, CA, CO, VA	0.000	0.082	Aug 2019	0.100	Aug 2020	1.979	Nov 2020	-		1.979	0.000	2.161	0.000
Program Wide Support - Agency Operations and Support Other Agency Services	MIPR	Various : Multi: AK/ AL/CA/CO/HI/MD/ VA/NJ/NY/OCONUS	0.000	0.000		0.000		0.265	Nov 2020	-		0.265	Continuing	Continuing	Continuing
Program Wide Support - Agency Operations and Support Services	C/Various	Various : Multi: AK, AL, CA, CO, HI, VA	0.000	5.308	Aug 2019	0.000		0.000		-		0.000	0.000	5.308	0.000
Program Wide Support - Agency Operations, Sustainment and GPC	C/FFP	Various : Multi: AK, AL, CA, HI, NY, NM, VA	0.000	0.000		0.000		3.469	Nov 2020	-		3.469	Continuing	Continuing	Continuing
Program Wide Support - Facilities Maintenance	MIPR	Various : Multi: AK, AL, CA, CO, HI, VA	0.000	0.000		6.598	Nov 2019	0.000		-		0.000	0.000	6.598	0.000
Program Wide Support - Facilities and Maintenance SRM	MIPR	Various : Multi: AK, AL, CA, CO, HI, VA	0.000	0.000		0.000		4.370	Dec 2020	-		4.370	Continuing	Continuing	Continuing
		Subtotal	0.000	5.390		6.698		10.083		-		10.083	Continuing	Continuing	N/A

Remarks

N/A

	Prior Years	FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	0.000	5.390		6.698		10.083		-		10.083	Continuing	Continuing	N/A

Remarks

Award Date reflects date of first obligation. Additional obligations may incrementally occur throughout the year.

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD40 / *Program Wide Support*

Significant Event Complete ▲ Significant Event Planned △ | Milestone Decision Complete ★ Milestone Decision Planned ☆ | Element Test Complete ◆ Element Test Planned ◇ | System Level Test Complete ● System Level Test Planned ○ | Complete Activity ✦ Planned Activity ✧

	FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
MD40 Program-Wide Support	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧	✧

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Missile Defense Agency		Date: February 2020
Appropriation/Budget Activity 0400 / 4	**R-1 Program Element (Number/Name)** PE 0604181C / *Hypersonic Defense*	**Project (Number/Name)** MD40 / *Program Wide Support*

Schedule Details

	Start		End	
Events	**Quarter**	**Year**	**Quarter**	**Year**
MD40 Program-Wide Support	1	2019	4	2025