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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Missile Defense Agency **Date:** March 2023

Appropriation/Budget Activity 0400: <i>Research, Development, Test & Evaluation, Defense-Wide / BA 4: Advanced Component Development & Prototypes (ACD&P)</i>	R-1 Program Element (Number/Name) PE 0604115C / <i>Technology Maturation Initiatives</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	467.330	39.200	16.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	522.530
MD98: <i>Directed Energy Demonstrator Development</i>	467.330	39.200	16.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	522.530

Program MDAP/MAIS Code: 362

Note

The decrease from FY 2023 to FY 2024 reflects the Congressional add of \$16.0 million enacted in FY 2023. No funding is requested for this program in FY 2024 and the outyears.

A. Mission Description and Budget Item Justification

Technology Maturation Initiatives (TMI) demonstrates the utility of directed energy for missile defense. The Missile Defense Agency's (MDA) directed energy plan incrementally demonstrates and improves the constituent components required to execute a directed energy acquisition, tracking, and lethality kill chain. The directed energy effort advances the technology readiness levels of emerging and developing technologies, while simultaneously assessing the performance and contributions to the Missile Defense System architecture. TMI included analysis, development, demonstration, systems engineering and test efforts to examine, develop, and improve directed energy systems, disruptive directed energy concepts, sensors, and future missile defense technologies.

Directed Energy Demonstrator Development addressed technology risk reduction and maturation for high powered strategic lasers, beam control, lethality, and related technologies. The efforts remain tightly coupled with Office of the Undersecretary of Defense Research and Engineering (OUSD(R&E)) High Energy Laser Development Road Map, and are essential to mature strategic laser technology.

MDA collaborates with the Combatant Commands, Defense Advanced Research Projects Agency, Department of Energy, Joint Directed Energy Transition Office, Military Departments, National Laboratories and OUSD(R&E) in a systems engineering based strategy to research, analyze, develop and test directed energy weapons technology.

MDA continues to participate in the Department's Directed Energy Reviews.

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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	39.200	0.000	0.000	-	0.000
Current President's Budget	39.200	16.000	0.000	-	0.000
Total Adjustments	0.000	16.000	0.000	-	0.000
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	16.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustment	0.000	0.000	0.000	-	0.000

Change Summary Explanation

Project MD98: Directed Energy Demonstrator Development:
FY 2023 Congressional Add Total \$16.0 million:
- Short pulse laser directed energy demo for hypersonic defense (\$9.0 million)
- Continue Diode Pumped Alkali Laser Development (\$7.0 million)

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Missile Defense Agency										Date: March 2023		
Appropriation/Budget Activity 0400 / 4					R-1 Program Element (Number/Name) PE 0604115C / <i>Technology Maturation Initiatives</i>				Project (Number/Name) MD98 / <i>Directed Energy Demonstrator Development</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
MD98: <i>Directed Energy Demonstrator Development</i>	467.330	39.200	16.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	522.530
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

The decrease from FY 2023 to FY 2024 reflects the Congressional add of \$16.0 million enacted in FY 2023. No funding is requested for this program in FY 2024 and the outyears.

A. Mission Description and Budget Item Justification

The Directed Energy Demonstrator Development (DEDD) project develops, integrates, and tests the component technologies required to scale electric lasers to hundreds of kilowatts. Laser scaling focused on maturing laser capability to levels sufficient to enter into the Office of the Undersecretary of Defense Research and Engineering High Energy Laser Road Map efforts. The DEDD project provided the necessary technology, test data, and operations familiarity to successfully transition to a higher power directed energy weapon. MDA continues to participate in the Department's Directed Energy Reviews.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2022	FY 2023	FY 2024
Title: Directed Energy Demonstrator Development	39.200	16.000	0.000
Articles:	-	-	-
Description: Laser scaling develops, integrates, and tests the component technologies required for scaling electric lasers while maintaining optimal size, weight, and power metrics and near diffraction limited beam quality.			
FY 2023 Plans:			
Congressional Add: Short pulse laser directed energy demo for hypersonic defense (\$9 million)			
- Collect test data and conduct analysis of the data on the lethality mechanisms of pulsed lasers on missile threats.			
Congressional Add: Continue Diode Pumped Alkali Laser Development (\$7 million)			
- Continue the transition of laser technology out of a National Laboratory to Industry.			
- Study the potential deployment of laser weapons to augment the layered defense capability of the Missile Defense System.			
- Develop concepts for incorporation of directed energy weapons into the Missile Defense System.			
- Develop command and control capabilities to maximize the effectiveness of kinetic and non-kinetic weapons used together synergistically in the future layered Missile Defense System architecture.			
- Develop machine learning based algorithms for phase control, deformable mirror control, and turbulence characterization.			
- Initiate advanced microwave technology improvements, mature components and conduct threat representative assessments.			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Missile Defense Agency		Date: March 2023		
Appropriation/Budget Activity 0400 / 4	R-1 Program Element (Number/Name) PE 0604115C / <i>Technology Maturation Initiatives</i>	Project (Number/Name) MD98 / <i>Directed Energy Demonstrator Development</i>		
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)		FY 2022	FY 2023	FY 2024
<ul style="list-style-type: none"> - Develop and demonstrate a prototype, coherent beam combining scalable direct diode laser to prove that the direct diode concepts are practicable and achievable. - Develop a safe, domestic, battery-based power supply that can support all ground and ship directed energy systems. <p>FY 2024 Plans:</p> <ul style="list-style-type: none"> - No funding is requested in FY 2024 for this effort <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p> <p>Decrease from FY 2023 to FY 2024 reflects the Congressional add.</p>				
Accomplishments/Planned Programs Subtotals		39.200	16.000	0.000
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
Employ various contracting strategies in a flexible manner to maximize the contribution to MDA. Execute through utilization of small businesses, leverage the Nation's engineering centers of excellence (FFRDCs and University Affiliated Research Centers); generate cooperatives with other Government Agencies to provide concept modeling and assessment capability. This strategy uses agency and partner subject matter experts and government model-based assessments to inform Better Buying Power acquisition decisions.				

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2024 Missile Defense Agency **Date:** March 2023

Appropriation/Budget Activity 0400 / 4	R-1 Program Element (Number/Name) PE 0604115C / <i>Technology Maturation Initiatives</i>	Project (Number/Name) MD98 / <i>Directed Energy Demonstrator Development</i>
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Product Development (\$ in Millions)				FY 2022		FY 2023		FY 2024 Base		FY 2024 OCO		FY 2024 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
Directed Energy Demonstrator Development - Adaptive Optics Effectiveness Demonstration	C/CPFF	Various : Various	0.000	9.000	Aug 2022	0.000		0.000		-		0.000	0.000	9.000	0.000
Directed Energy Demonstrator Development - Beam Control and Lethality Demonstration	C/CPFF	Multi : Multi	27.561	0.000		0.000		0.000		-		0.000	0.000	27.561	0.000
Directed Energy Demonstrator Development - Industry Laser Scaling and Technology Transfer	C/CPFF	Boeing : CA	18.412	0.000		0.000		0.000		-		0.000	0.000	18.412	0.000
Directed Energy Demonstrator Development - LPLD Preliminary Design A	C/CPFF	Lockheed Martin : CA	40.494	0.000		0.000		0.000		-		0.000	0.000	40.494	0.000
Directed Energy Demonstrator Development - LPLD Preliminary Design B	C/CPFF	General Atomics : CA	36.841	0.000		0.000		0.000		-		0.000	0.000	36.841	0.000
Directed Energy Demonstrator Development - LPLD Preliminary Design C	C/CPFF	Boeing : CA	36.361	0.000		0.000		0.000		-		0.000	0.000	36.361	0.000
Directed Energy Demonstrator Development - LPLD System Critical Design A (CPU)	C/CPFF	Lockheed Martin : CA	26.000	0.000		0.000		0.000		-		0.000	0.000	26.000	0.000
Directed Energy Demonstrator Development - LPLD	C/CPFF	General Atomics : CA	26.000	0.000		0.000		0.000		-		0.000	0.000	26.000	0.000

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Appropriation/Budget Activity 0400 / 4	R-1 Program Element (Number/Name) PE 0604115C / <i>Technology Maturation Initiatives</i>	Project (Number/Name) MD98 / <i>Directed Energy Demonstrator Development</i>
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Product Development (\$ in Millions)				FY 2022		FY 2023		FY 2024 Base		FY 2024 OCO		FY 2024 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
System Critical Design B (CPU)															
Directed Energy Demonstrator Development - LPLD System Critical Design C (CPU)	C/CPFF	Boeing : CA	26.000	0.000		0.000		0.000		-		0.000	0.000	26.000	0.000
Directed Energy Demonstrator Development - Laser Lethality Demonstration	C/CPFF	General Atomics, AFRL, Redstone Testing Center, White Sands Missile Range : CA, AL, NM	4.178	7.200	Sep 2022	0.000		0.000		-		0.000	0.000	11.378	0.000
Directed Energy Demonstrator Development - Laser Scaling	C/Variou	MIT LL, LLNL : MA, CA	136.658	0.000		0.000		0.000		-		0.000	0.000	136.658	0.000
Directed Energy Demonstrator Development - Laser Scaling - Diode Pumped Alkali Laser (CPU)	Various	Multi, LLNL : CA	41.400	6.000	Jun 2022	7.000	Apr 2023	0.000		-		0.000	0.000	54.400	0.000
Directed Energy Demonstrator Development - Machine Learning Adaptive Optics	C/Variou	Various : Various	0.000	2.500	Sep 2022	0.000		0.000		-		0.000	0.000	2.500	0.000
Directed Energy Demonstrator Development - Microwave Technology Assessment	C/CPFF	RAYTHEON : AZ	0.000	5.500	Jul 2022	0.000		0.000		-		0.000	0.000	5.500	0.000
Directed Energy Demonstrator Development - Performance Analysis	Various	MIT LL, Aviation and Missile Research Development and Engineering Center (AMRDEC), Combat Capabilities Development	12.469	0.000		0.000		0.000		-		0.000	0.000	12.469	0.000

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2024 Missile Defense Agency											Date: March 2023				
Appropriation/Budget Activity 0400 / 4						R-1 Program Element (Number/Name) PE 0604115C / <i>Technology Maturation Initiatives</i>					Project (Number/Name) MD98 / <i>Directed Energy Demonstrator Development</i>				

Product Development (\$ in Millions)				FY 2022		FY 2023		FY 2024 Base		FY 2024 OCO		FY 2024 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
		Command - Aviation and Missile Center (CCDC-AMC), AFRL, USAFA, Semquest : MA, AL, NM, CO													
Directed Energy Demonstrator Development - Short Pulsed Laser Lethality Assessment	MIPR	UNIVERSITY OF ROCHESTER : NY	0.000	9.000	Sep 2022	9.000	Sep 2023	0.000		-		0.000	0.000	18.000	9.000
Directed Energy Demonstrator Development - Technology Transfer/Component Development	C/CPIF	Boeing : CA	16.209	0.000		0.000		0.000		-		0.000	0.000	16.209	0.000
Subtotal			448.583	39.200		16.000		0.000		-		0.000	0.000	503.783	N/A

Remarks
N/A

Support (\$ in Millions)				FY 2022		FY 2023		FY 2024 Base		FY 2024 OCO		FY 2024 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
Directed Energy Demonstrator Development - Advisory and Assistance Services	C/CPFF	MDA Multi : AL, NM	8.013	0.000		0.000		0.000		-		0.000	0.000	8.013	0.000
Directed Energy Demonstrator Development - Engineering and Technical Services	MIPR	Aviation and Missile Research Development and Engineering Center (AMRDEC), Combat Capabilities Development	2.221	0.000		0.000		0.000		-		0.000	0.000	2.221	0.000

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2024 Missile Defense Agency **Date:** March 2023

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Support (\$ in Millions)				FY 2022		FY 2023		FY 2024 Base		FY 2024 OCO		FY 2024 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
		Command - Aviation and Missile Center (CCDC-AMC) : AL													
Directed Energy Demonstrator Development - FFRDC	FFRDC	Aerospace : AL, NM	3.317	0.000		0.000		0.000		-		0.000	0.000	3.317	0.000
Directed Energy Demonstrator Development - Facility Support	Various	377th ABW, Phoenix : NM	0.483	0.000		0.000		0.000		-		0.000	0.000	0.483	0.000
Directed Energy Demonstrator Development - Facility Sustainment	C/CPFF	Multi : AL, NM	1.281	0.000		0.000		0.000		-		0.000	0.000	1.281	0.000
Directed Energy Demonstrator Development - Information Technology	C/CPFF	Northrop Grumman, Jacobs Technology : CO	3.282	0.000		0.000		0.000		-		0.000	0.000	3.282	0.000
Directed Energy Demonstrator Development - Travel	Allot	MDA Multi : AL, NM	0.150	0.000		0.000		0.000		-		0.000	0.000	0.150	0.000
Subtotal			18.747	0.000		0.000		0.000		-		0.000	0.000	18.747	N/A

Remarks
N/A

	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	467.330	39.200	16.000	0.000	-	0.000	0.000	522.530	N/A

Remarks
N/A

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Exhibit R-4, RDT&E Schedule Profile: PB 2024 Missile Defense Agency **Date:** March 2023

Appropriation/Budget Activity 0400 / 4	R-1 Program Element (Number/Name) PE 0604115C / <i>Technology Maturation Initiatives</i>	Project (Number/Name) MD98 / <i>Directed Energy Demonstrator Development</i>
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	FY 2022				FY 2023				FY 2024				FY 2025				FY 2026				FY 2027				FY 2028			
	◆	◆	◆	◆																								
Laser Scaling Development - Diode Pumped Alkali Laser (DPAL)	◆	◆	◆	◆																								
Laser Scaling Development – DPAL 60 kW-Class Lab Demo	◆	◆	◆	◆																								
Laser Scaling Development – DPAL 60 kW-Class Lab Demo with Beam Quality measurement		◆	◆	◆																								
Laser Scaling Development - Diode Pumped Alkali Laser (DPAL) Continued						◇	◇	◇																				
Optimize laser performance						◇	◇	◇																				
Studies for transision of technology from the Laboratory to Industry						◇	◇	◇																				

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Exhibit R-4A, RDT&E Schedule Details: PB 2024 Missile Defense Agency		Date: March 2023
Appropriation/Budget Activity 0400 / 4	R-1 Program Element (Number/Name) PE 0604115C / <i>Technology Maturation Initiatives</i>	Project (Number/Name) MD98 / <i>Directed Energy Demonstrator Development</i>

Schedule Details

Events	Start		End	
	Quarter	Year	Quarter	Year
Laser Scaling Development - Diode Pumped Alkali Laser (DPAL)	1	2022	4	2022
Laser Scaling Development DPAL 60 kW-Class Lab Demo	1	2022	4	2022
Laser Scaling Development DPAL 60 kW-Class Lab Demo with Beam Quality measurement	2	2022	4	2022
Laser Scaling Development - Diode Pumped Alkali Laser (DPAL) Continued	2	2023	4	2023
Optimize laser performance	2	2023	4	2023
Studies for transistion of technology from the Laboratory to Industry	2	2023	4	2023