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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 4: Advanced Component Development & Prototypes (ACD&P)	R-1 Program Element (Number/Name) PE 0603645A / Armored System Modernization - Adv Dev
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	138.300	138.685	170.590	-	170.590	-	-	-	-	-	-
<i>EV7: Combat Vehicle Prototyping</i>	-	138.300	138.685	170.590	-	170.590	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

Armored System Modernization Advanced Development provides maturation of emerging S&T and industry technologies for potential integration to ground combat vehicles. The purpose of this Program Element's (PE) funding is to demonstrate new capabilities to meet current and future military needs and to determine integration potential across the Army portfolio of ground combat vehicles by testing and evaluating a variety of technologies.

B. Program Change Summary (\$ in Millions)

	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>
Previous President's Budget	144.234	151.478	172.700	-	172.700
Current President's Budget	138.300	138.685	170.590	-	170.590
Total Adjustments	-5.934	-12.793	-2.110	-	-2.110
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-15.464			
• Congressional Rescissions	-	-			
• Congressional Adds	-	8.200			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-5.934	-5.529			
• Adjustments to Budget Years	-	-	-2.110	-	-2.110

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: EV7: *Combat Vehicle Prototyping*

Congressional Add: *Program increase: Next generation electrified transmission*

	<u>FY 2020</u>	<u>FY 2021</u>
	-	8.200
Congressional Add Subtotals for Project: EV7	-	8.200
Congressional Add Totals for all Projects	-	8.200

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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>EV7: Combat Vehicle Prototyping</i>	-	138.300	138.685	170.590	-	170.590	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Armored System Modernization Advanced Development will continue the maturation of emerging ground combat vehicle capabilities to provide a bridge from S&T investment to vehicle platform, informing requirements through User Evaluations, identification of capability gaps and reduction of integration risks. The funding will support virtual and physical concept development, trade studies, technical and operational analyses to assess future concepts and designs. This would also include the support for survivability, lethality and other soldier defined system requirements. In addition, this funding will support program management, system integration labs, integration risk reduction, maturation, testing and assessment of various ground combat vehicles technologies.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2020	FY 2021	FY 2022
Title: Government Engineering & Program Management	8.458	15.162	8.097
Description: This effort will support Program Management Office (PMO) support that will cover the costs of government and direct support contractor labor, travel, training, supplies, equipment and facilities to manage the experimental prototyping projects.			
FY 2021 Plans: This funding will support Government program management that will cover the costs of government and direct support contractor labor, travel, training, supplies, equipment and facilities to manage the experimental prototyping program as well as the Program Management Office (PMO). This funding will be allocated for Mission Enabled Technology - Demonstrator (MET-D) Phase II and III, Combat Capabilities Development Command (CCDC) Command, Control, Communications, Computers, Combat Systems, Intelligence, Surveillance, and Reconnaissance (C5ISR) Phase II & Phase III technology maturation, CCDC Armaments center technology qualification, and other program management support offices. It will fund the management of the experimental prototyping program, continued technology maturation, and software and data architecture. This effort will include management of MET-D Phase II during Shakedown testing, Army Test and Evaluation Command (ATEC) Safety Evaluation, and the Soldier Operational Experiment and MET-D Phase III cost and schedule as the project progresses through the design phase and into the build phase.			
FY 2022 Plans: This funding will be allocated for the program management support for Advanced Combat Powertrain, Advanced Combat Vehicle Concepts and Studies, Aided Target Recognition (AiTR), MET-D, and Bradley Hybrid Electric Vehicle (BHEV), XM913 and other			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>combat vehicle technology advancement efforts. It will fund the management and support costs of experimental prototyping projects, continued technology maturation, and applicable software and data architecture updates.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The decrease cost from Fiscal Year (FY) 2021 to FY 2022 is due to allocating engineering efforts to the appropriate Research Development Technology & Evaluation (RDT&E) category.</p>				
<p>Title: Developmental Engineering</p> <p>Description: Efforts will include the continued development and maturation of advanced technology concepts for ground combat vehicles and related support equipment.</p> <p>FY 2022 Plans: This funding for the Ground Vehicle Systems Center (GVSC) will mature the Advanced Combat Engine (ACE) and the Advanced Combat Transmission (ACT) to be ready for production at the end of FY24. A potential target for this effort is the Optionally Manned Fighting Vehicle (OMFV) and other combat vehicle platforms.</p> <p>This funding continues the work to develop the hybrid electric vehicle based on a Bradley platform. The contractor will build, integrate and test a Bradley with components that make up a Hybrid Electric Vehicle. The benefit to the Warfighter is that this will improve survivability by reducing thermal and acoustic signature, provides acceleration, improves lethality, more onboard power for energy based-capabilities such as High Energy Lasers, improved operational endurance/fuel efficiency to start.</p> <p>Other efforts include but are not limited to Advanced Combat Vehicle Concepts and Studies, Aided Target Recognition (AiTR), MET-D and other combat vehicle technology advancement efforts.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The increase from FY 2021 to FY 2022 is due transferring these efforts under the appropriate RDTE category rather than the subsystem level, along with increased level of development activities related to Advanced Combat Powertrain, Advanced Combat Vehicle Concepts and Studies, Aided Target Recognition (AiTR) , MET-D, and Bradley Hybrid Electric Vehicle (BHEV) and other combat vehicle technology advancement efforts.</p>		-	-	85.456
<p>Title: Test & Evaluation</p> <p>Description: Test and Evaluation (T&E) activities include contractor and government testing of prototype vehicles and technologies as well as user evaluations. Testing will be conducted using United States Army test facilities.</p> <p>FY 2021 Plans:</p>		1.388	13.364	40.358

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>The T&E funding will prepare, coordinate, and conduct test and evaluation activities with ATEC for MET-D Phase II Safety Testing to include MET-D Phase II Company-Level Soldier Operational Experiment (SOE). This funding will further develop the MET-D Phase III TEMP and test procedures to support Phase III integration, safety, and demonstration testing. C5ISR will conduct comprehensive and enhanced fabrication, integration, analyst and test and evaluation events along with CCDC conducting qualification testing for survivability and lethality requirements.</p> <p>FY 2022 Plans: T&E efforts include but are not limited to: Advanced Combat Vehicle Concepts and Studies, Bradley Hybrid Electric Vehicle, MET-D, Next Generation Fire Control (NGFC) Technologies, Vehicle Protection Technology Demonstrator, XM913 and other emerging combat vehicle technology advancements.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The increase from FY 2021 to FY 2022 is due reallocating efforts under the appropriate RDTE categories, along with increased level of test and evaluation activities related to Advanced Combat Vehicle Concepts and Studies, Bradley Hybrid Electric Vehicle, MET-D, Next Generation Fire Control (NGFC) Technologies, Vehicle Protection Technology Demonstrator, XM913 and other emerging combat vehicle technology advancements.</p>				
<p>Title: Modeling & Simulation</p> <p>Description: Modeling and simulation efforts will allow for the ability to experiment in a virtual environment. Support will include reviewing studies conducted and determining any significant issues, areas of concern or potential differences to aid in decision making. The results will provide the analytical underpinnings to support development of requirements.</p> <p>FY 2021 Plans: The continued modeling and simulation efforts will produce the ability to experiment in a virtual environment to conduct data collection and results that will inform the physical testing desires of the Soldier Operational Experiments (SOE).The update of models from MET-D Phase II technologies are identified for integration into Phase III will be used to conduct analysis prior to integration in order to inform performance characteristics and identify potential integration challenges. Soldier virtual experiments will be conducted with Phase III technology configuration in conjunction with the Robotic Combat Vehicle (RCV) to determine any Manned Un-Manned Teaming (MUM-T) areas of concern that should be addressed prior to execution of the Phase III SOE.</p> <p>FY 2022 Plans: Government support needed for MET-D Phase II for platform assessment thru modeling and analysis, conduct trade studies, and the ability to assess the platform in a virtual environments to aide in decision making.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>		3.268	7.407	0.388

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
The decrease in cost from FY 2021 to FY 2022 is due to completion of the majority of MET-D Phase II M&S efforts.				
<p>Title: Experimental Prototyping</p> <p>Description: Experimental prototyping allows for maturation of emerging S&T and industry technologies. This includes XM913, Advanced Combat Powertrain, Advanced Combat Vehicle Concepts and Studies, Advanced Lightweight Track, High Voltage Power Controller, MET-D Phase II, Vehicle Protection Technology Demonstrator and Other Technology Advancements.</p> <p>Experimentation will inform requirements, identify mitigations for capability gaps and reduce technology integration risks.</p> <p>FY 2021 Plans: This funding will deliver MET-D experimental prototypes in FY 2023. The MET-D efforts will continue system level prototype development and integration; maintain existing system level software; and develop software upgrades based on results from previous MET-D Experimentation. The system software upgrades will support integration of advanced technologies, improvements for MUM-T, additional autonomous behaviors, improvements in electrical power and network architecture, advancements in slip ring technologies, and enhancements to CCDC C5ISR technologies. This funding will also support the development of technologies to include but not limited to; unmanned turret, Unmanned Aircraft Systems (UAS) and Unmanned Ground Systems (UAS/UGS) target feed, 3D printing, suspension/track, Pre Shot/Laser warning, Aided Target Recognition, Modular Active Protection System (MAPS), 50mm MCAS, and hybrid electric power, that will be integrated onto the Optionally Manned Fighting Vehicle (OMFV) and other legacy platforms/vehicles.</p> <p>FY 2022 Plans: This funding will support prototype builds for the following technologies: XM913, Advanced Combat Powertrain, Advanced Combat Vehicle Concepts and Studies, Advanced Lightweight Track, High Voltage Power Controller, MET-D Phase II, Vehicle Protection Technology Demonstrator and Other Technology Advancements.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The increase in funding from FY 2021 to FY 2022 is due to the increase in the level of efforts for experimental prototyping and advanced technologies.</p>		124.278	31.508	36.291
<p>Title: Powertrain Maturation</p> <p>Description: This effort will emphasize improving the Advanced Combat Engine (ACE) and the Advanced Combat Transmission (ACT) subsystem maturity and reduce engine and transmission cost and manufacturing time. The Ground Vehicle Systems Center (GVSC) will conduct maturation and demonstration activities to expedite technology transition from laboratory to operational use and prepare for low rate initial production of the advanced combat engine and transmission. This effort will conduct the evaluation of reliability, maintainability, and logistical analyses necessary to transition to a vehicle platform and conduct maturation to the</p>		0.908	4.000	-

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>components as a result of these evaluations. The ACE may increase Power Density, increase efficiency (> 48%), and decrease heat rejection (> 20%). The ACT will have advanced Multi-Speed Transmissions and be adaptable to a wide range of engine input speeds, flexible design configuration and packaging, high efficiency geared steering system and > 90% efficiency in all gears.</p> <p>FY 2021 Plans: Focus is on the manufacturability of the design which includes replacing expensive custom subcomponents with mass produced hardware and improving the assembly process to use more automation and create less waste. These efforts will result in iterative engine and transmission prototypes that require performance and durability testing to ensure they can be integrated while maintaining their performance capabilities. These will be the foundation for the reliability, maintainability, and logistical analyses necessary to transition to a vehicle platform.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The decrease from FY 2021 to FY 2022 is due reallocating these efforts under the appropriate RDTE category rather than the subsystem level.</p>				
<p>Title: Other support & technology costs</p> <p>Description: This effort from the Ground Vehicle Systems Center is to support the Optionally Manned Tank and various technology sprints.</p> <p>FY 2021 Plans: Based on feedback from the MET-D Phase II Experiment and advancements in technology, MET-D Phase III will also develop and update software, crew station training simulators, and software test benches in order to represent the new integrated system functionality prior to physical integration for Phase III. The efforts include but are not limited to, maturing and experimenting with Manned Un-Manned Teaming in conjunction with the Robotic Combat Vehicle, and maturing, integrating and experimenting with a variety of technologies for the OMFV and other legacy combat vehicles/platforms within the Maneuver portfolio. This effort also includes the CCDC C5ISR Army mission command software maturation, architecture maturation, technical and operational analytical studies, and mission targeting support software and algorithms. The CCDC Armaments center will also conduct technology maturation and qualification of survivability and lethality requirements. The funding will support other efforts such as the development of the XM-913 development/qualification and the development of the ammunition.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The decrease from FY 2021 to FY 2022 is due reallocating these efforts under the appropriate RDTE category rather than the subsystem level.</p>		-	59.044	-
Accomplishments/Planned Programs Subtotals		138.300	130.485	170.590

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	FY 2020	FY 2021
Congressional Add: Program increase: Next generation electrified transmission	-	8.200
FY 2021 Plans: Working though Cummins-Allison Transmission to accelerate the development and address the technical challenges of an electrified transmission in a combat vehicle, including maturing subsystem development, vehicle level integration, and demonstration through government testing.		
Congressional Adds Subtotals	-	8.200

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy

These level of efforts provide the focused investment for the development and demonstration of technology and prototyping for future combat vehicles in the battlefield. The purpose of this funding is to integrate the next generation of technology enabled capabilities developed in the S&T portfolio to demonstrate new capabilities to meet emerging military needs, provide hardware for Soldier operational evaluation/feedback, to determine integration potential across the current Army portfolio of ground vehicles and to develop platform level prototypes.

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2022 Army											Date: May 2021				
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Product Development (\$ in Millions)				FY 2020		FY 2021		FY 2022 Base		FY 2022 OCO		FY 2022 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			
NGCV Contract(s)	C/Various	Various : Various	36.925	44.583	Mar 2020	-		-		-		-	0.000	81.508	-
Prototyping with Industry	C/Various	Various : Various	15.324	79.695	Feb 2020	-		-		-		-	0.000	95.019	-
Powertrain Maturation	Various	Various : Various	-	0.908	Jul 2020	4.000	Jul 2021	-		-		-	Continuing	Continuing	Continuing
Other support & technology costs	Various	Various : Various	-	-		59.044	Jul 2021	-		-		-	Continuing	Continuing	Continuing
Experimental Prototyping	Various	Various : Various	-	-		31.508	Jul 2021	36.291	Jun 2022	-		36.291	Continuing	Continuing	Continuing
Next Generation Electrified Transmission	Various	Various : Various	-	-		8.200	Aug 2021	-		-		-	0.000	8.200	-
Developmental Engineering	Various	Various : Various	-	-		-		85.456		-		85.456	0.000	85.456	-
Subtotal			52.249	125.186		102.752		121.747		-		121.747	Continuing	Continuing	N/A

Remarks

Program decrease experimental prototyping costs by \$15,464K in FY21.
Congressional add \$8,200K for Next Generation Electrified Transmission in FY21.

Support (\$ in Millions)				FY 2020		FY 2021		FY 2022 Base		FY 2022 OCO		FY 2022 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			
Program Management	MIPR	PM/PEO : Warren, MI	32.240	8.458	Jan 2020	15.162	Jan 2021	8.097	Jan 2022	-		8.097	Continuing	Continuing	Continuing
Subtotal			32.240	8.458		15.162		8.097		-		8.097	Continuing	Continuing	N/A

Test and Evaluation (\$ in Millions)				FY 2020		FY 2021		FY 2022 Base		FY 2022 OCO		FY 2022 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			
Modeling & Simulation	MIPR	Various : Various	4.834	3.268	Mar 2020	7.407		0.388		-		0.388	Continuing	Continuing	Continuing
Test & Evaluation	MIPR	Various : Various	8.000	1.388	Jun 2020	13.364		40.358		-		40.358	Continuing	Continuing	-
Subtotal			12.834	4.656		20.771		40.746		-		40.746	Continuing	Continuing	N/A

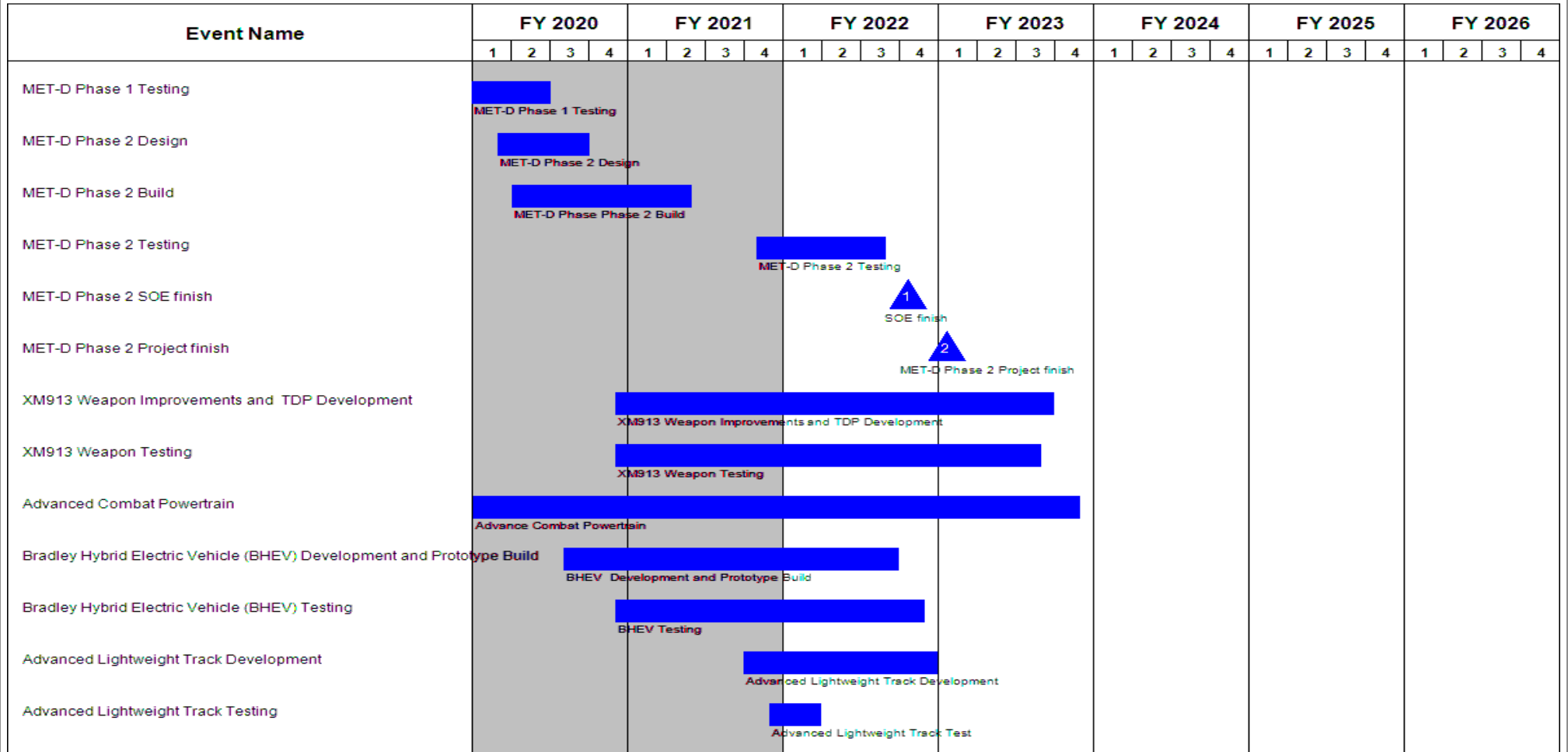
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Exhibit R-3, RDT&E Project Cost Analysis: PB 2022 Army							Date: May 2021				
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	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	Cost To Complete	Total Cost	Target Value of Contract		
Project Cost Totals	97.323	138.300	138.685	170.590	-	170.590	Continuing	Continuing	N/A		

Remarks

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Exhibit R-4, RDT&E Schedule Profile: PB 2022 Army		Date: May 2021
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Exhibit R-4, RDT&E Schedule Profile: PB 2022 Army			Date: May 2021
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Event Name	FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025				FY 2026			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Advanced Combat Vehicle Concepts and Studies					[Redacted]				[Redacted]				[Redacted]															
High Voltage Power Controller Prototype					[Redacted]				[Redacted]				[Redacted]															
High Voltage Power Controller Testing					[Redacted]				[Redacted]				[Redacted]															

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Exhibit R-4A, RDT&E Schedule Details: PB 2022 Army		Date: May 2021
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Schedule Details

Events	Start		End	
	Quarter	Year	Quarter	Year
MET-D Phase 1 Testing	4	2019	2	2020
MET-D Phase 2 Design	1	2020	3	2020
MET-D Phase 2 Build	2	2020	2	2021
MET-D Phase 2 Testing	4	2021	3	2022
MET-D Phase 2 SOE finish	4	2022	4	2022
MET-D Phase 2 Project finish	1	2023	1	2023
XM913 Weapon Improvements and TDP Development	4	2020	3	2023
XM913 Weapon Testing	4	2020	3	2023
Advanced Combat Powertrain	1	2020	4	2023
Bradley Hybrid Electric Vehicle (BHEV) Development and Prototype Build	3	2020	3	2022
Bradley Hybrid Electric Vehicle (BHEV) Testing	4	2020	4	2022
Advanced Lightweight Track Development	4	2021	4	2022
Advanced Lightweight Track Testing	4	2021	1	2022
Advanced Combat Vehicle Concepts and Studies	2	2021	3	2023
High Voltage Power Controller Prototype	2	2021	2	2022
High Voltage Power Controller Testing	3	2021	2	2022