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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 5: System Development & Demonstration (SDD)</i>	R-1 Program Element (Number/Name) PE 0604820A / <i>Radar Development</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	105.271	122.607	71.259	-	71.259	74.055	31.655	8.578	8.662	0.000	422.087
E10: <i>Sentinel</i>	-	105.271	122.607	71.259	-	71.259	74.055	31.655	8.578	8.662	0.000	422.087

A. Mission Description and Budget Item Justification

This funding line is a key enabler of the Army Modernization Priorities in support of the Sentinel Radar program and will provide for an incrementally fielded Integrated Air and Missile Defense Fire Control System/capability for the composite Army Air and Missile Defense Brigades. The Sentinel system is a key component of the Army Integrated Air and Missile Defense (AIAMD) architecture, providing critical air surveillance of the forward areas. The AIAMD architecture is an integrated fires development effort that includes survivability, resiliency, and effectiveness improvements against advanced threats from near-peer adversaries. This effort includes integration with an evolving common fires mission command, common development tools and processes, and annual test and evaluation to provide data to support program assessments and progress toward closure of performance gaps.

Sentinel A3 consists of a radar-based sensor with its prime mover/power, Identification Friend or Foe (IFF), and Forward Area Air Defense (FAAD) Command, Control and Intelligence (C2I) interfaces. The radar is deployed in both an air defense role and a force protection role for Counter-Rocket, Artillery, and Mortar (C-RAM) missions. The sensor is an advanced three-dimensional battlefield X-Band air defense phased-array radar with an instrumented range of 75 kilometers. Sentinel is capable of operating day or night, in adverse weather conditions, in the battlefield environments of dust, smoke, aerosols and enemy countermeasures. It provides 360-degree azimuth coverage for acquisition tracking. Sentinel contributes to the digital battlefield by automatically detecting, classifying, identifying and reporting targets (cruise missiles, unmanned aircraft systems, rotary wing and fixed wing aircraft). Sentinel acquires targets sufficiently forward of the battle area to allow weapons reaction time and engagement at optimum ranges. Sentinel's integrated IFF reduces the potential for fratricide of US and Coalition aircraft.

The Sentinel A4 Active Electronically Scanned Array (AESA) is the next generation of radar technology to replace the current phase and frequency scanned array used by Sentinel today. Sentinel A4 hardware and software upgrades will extend the range for ground-based surveillance and situational awareness; will have faster and more accurate Non-Cooperative Target Recognition (NCTR) for clearing fires and preventing fratricide; will improve track accuracy, and management of larger track loads; and improve operation in severe/urban clutter. The system will provide simultaneous multi-mission capability and provides hemispherical surveillance to detect and track small targets, such as Unmanned Aircraft Systems (UAS) and Cruise Missiles, in clutter and will detect and track slow targets, such as UAS and Rotary Wing aircraft, at low altitudes in clutter. The system will detect, track, and classify Rocket, Artillery, and Mortar (RAM) threats and will support M-SHORAD, AIAMD, IFPC and Combat Command Operational requirements with Fire Control quality tracks. Sentinel A4 will incorporate the upgraded ANI/TPX-61 IFF with M-Code capability added by replacing the GB-Gram card with M-Code GB-Gram cards.

Sentinel program will develop nascent capability and support Army demonstration and test initiatives to increase integrated offensive and defensive capability across warfighter functions and multiple domains.

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B. Program Change Summary (\$ in Millions)	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	105.271	127.919	0.000	-	0.000
Current President's Budget	105.271	122.607	71.259	-	71.259
Total Adjustments	0.000	-5.312	71.259	-	71.259
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-5.312			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	71.259	-	71.259

Change Summary Explanation

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.

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Appropriation/Budget Activity 2040 / 5					R-1 Program Element (Number/Name) PE 0604820A / <i>Radar Development</i>				Project (Number/Name) E10 / <i>Sentinel</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
E10: <i>Sentinel</i>	-	105.271	122.607	71.259	-	71.259	74.055	31.655	8.578	8.662	0.000	422.087
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project resources the following;
Sentinel A4 detects, tracks, and classifies RAM threats and will support Integrated Air and Missile Defense Battle Command System (IBCS) requirements and contributes sensor support for mitigating current and future Indirect Fire Protection Capability Increment 2 mission requirements as well as Mobile Short Range Air Defense (M-SHORAD) battalions. FY 2023 funding supports the material buy and initial integration for five (5) Initial Operational Test and Evaluation (IOT&E) Systems. Integration for the IOT&E systems will complete in FY2024. These IOT&E systems will field in support of IOT&E testing scheduled to begin in 1QFY2025.

Electronic Attack/Electronic Protect (EA/EP) addresses the electronic countermeasures (ECM) gap. This effort continues through the life of the radar, addressing both changing threats and electronic counter measure gaps.

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

	FY 2021	FY 2022	FY 2023
Title: Product Development	102.259	110.950	55.481
Description: Funding is provided for the following Product Development efforts:			
FY 2022 Plans: Continue integration of firmware, software and hardware for Sentinel A4 EMD assets. Supports build and integration of five (5) Sentinel A4 User Operational Evaluation Systems (UOES) to serve as soldier touch points for feedback prior to initiating Low Rate Initial Production (LRIP). Provides UOES assets to support test events for emerging requirements. Continue to perform technical assessments, concept studies, cost reduction, risk reduction, threat analysis, and required documentation for Sentinel A3.			
FY 2023 Plans: Will continue to build and integration of five (5) Sentinel A4 User Operational Evaluation Systems (UOES) to serve as soldier touch points for feedback prior to initiating Low Rate Initial Production (LRIP). Will provide UOES assets to support test events for emerging requirements. Will initiate build of five (5) Initial Operational Test and Evaluation (IOT&E) assets for delivery in support of system IOT&E. Will continue to perform technical assessments, concept studies, cost reduction, risk reduction, threat analysis, and required documentation for Sentinel A3.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

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Appropriation/Budget Activity 2040 / 5	R-1 Program Element (Number/Name) PE 0604820A / Radar Development	Project (Number/Name) E10 / Sentinel
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022		FY 2023
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FY2022 fully funds build of five (5) User Operational Evaluation Systems (UOES) and continues to support EMD efforts for Sentinel A4. The decrease in FY2023 funds the initial material buy and integration for five (5) Initial Operational Test and Evaluation (IOT&E) assets for the Sentinel A4 program.				
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Title: Test & Evaluation	3.012	7.182		15.778
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Description: Funding is provided for the following Test and Evaluation efforts:

FY 2022 Plans:

Supports Developmental Test for Sentinel A4 EMD assets. Conducts software qualification test and hardware verification testing, field testing against representative targets. Prepare logistics products and required documentation for materiel release of software and hardware upgrades for Sentinel A3.

FY 2023 Plans:

Supports completion of Developmental Test for Sentinel A4 EMD assets. Supports Sentinel A4 Limited User Test (LUT) and Operational Test Agency (OTA) Milestone Assessment Report (OMAR). Will conduct software qualification test and hardware verification testing, field testing against representative targets. Prepares logistics products and required documentation for materiel release of software and hardware upgrades for Sentinel A3.

FY 2022 to FY 2023 Increase/Decrease Statement:

The increase from FY2022 to FY2023 is due to completion of DT and execution of LUT and OMAR in FY2023.

Title: FY22 SBIR/STTR Transfer	-	4.475		-
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Description: SBIR/STTR \$4.475M transferred in accordance with Title 15 USC ?638.

FY 2022 Plans:

SBIR/STTR \$4.475M transferred in accordance with Title 15 USC ?638.

FY 2022 to FY 2023 Increase/Decrease Statement:

SBIR/STTR \$4.475M transferred in accordance with Title 15 USC ?638.

Accomplishments/Planned Programs Subtotals	105.271	122.607		71.259
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C. Other Program Funding Summary (\$ in Millions)

<u>Line Item</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023</u> <u>Base</u>	<u>FY 2023</u> <u>OCO</u>	<u>FY 2023</u> <u>Total</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>FY 2026</u>	<u>FY 2027</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• WK5057: Sentinel Mods	92.380	47.642	166.736	-	166.736	165.199	234.255	234.248	235.052	Continuing	Continuing
• EF9: System Integration and Test	-	-	-	-	-	-	-	-	-	-	-

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Appropriation/Budget Activity 2040 / 5	R-1 Program Element (Number/Name) PE 0604820A / Radar Development	Project (Number/Name) E10 / Sentinel
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C. Other Program Funding Summary (\$ in Millions)

Line Item	FY 2021	FY 2022	FY 2023	FY 2023	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	Cost To	
			Base	OCO	Total					Complete	Total Cost
• EX2: Lower Tier Air Missile Defense (LTAMD) Capability	308.805	297.629	382.147	-	382.147	89.187	89.984	90.002	90.874	0.000	1,348.628
• FM3: Future Interceptor	-	6.895	8.179	-	8.179	8.210	8.202	8.205	8.285	0.000	47.976
• C53101: MSE Missile	678.148	771.696	1,037.093	-	1,037.093	978.741	982.922	991.265	1,002.608	Continuing	Continuing
• EY7: IFPC Increment 2 - Block 1	152.399	182.257	131.093	-	131.093	59.266	10.774	10.778	-	0.000	546.567
• C62002: IFPC INC 2- I BLOCK 1 SYSTEM	62.461	19.053	18.924	-	18.924	386.383	670.667	712.994	722.152	0.000	2,592.634
• FI4: Maneuver - Short Range Air Defense (M-SHORAD)	5.776	39.376	10.363	-	10.363	10.403	10.393	10.397	10.394	0.000	97.102
• C14300: M-SHORAD - Procurement	517.287	331.575	135.747	-	135.747	58.336	205.657	487.003	487.120	Continuing	Continuing
• S40: Army Integrated Air and Missile Defense	213.956	159.873	265.288	-	265.288	289.312	344.958	182.204	131.523	0.000	1,587.114
• BZ5075: IAMD Battle Command System	198.587	296.872	438.967	-	438.967	412.920	457.335	458.445	457.608	Continuing	Continuing
• 0604741A: Air Defense Command, Control and Intelligence - Eng Dev	62.058	59.518	39.541	-	39.541	34.335	49.488	48.268	54.448	Continuing	Continuing
• AD5070: AIR & MSL Defense Planning & Control Sys	62.517	67.193	72.619	-	72.619	-	-	-	-	0.000	202.329

Remarks

These programs are an integral part of the Army Integrated Air and Missile Defense (AIAMD) architecture.

D. Acquisition Strategy

Sentinel A3 and its predecessors were procured from Raytheon as a non-developmental item. The US Government does not have adequate data rights for the Sentinel A3 and its predecessors; therefore no other contractor has the technical ability to modify the Sentinel A3 radar or Sentinel A3 software. The modifications for Sentinel A3 fall into these categories: Electronic Attack/Electronic Protect; Signal Data Processor; North Finding Module; Medium Bandwidth; Resiliency and Software Assurance Modification (RSAM); Counter Rocket Artillery and Mortar (C-RAM), Low Slow Small, Unmanned Aircraft Systems, Cruise Missiles; and Mode S. Electronic Attack/Electronic Protect will be an ongoing effort to ensure Sentinel A3 remains relevant in the field until A4 is fielded.

For the Sentinel A4 modification, Lockheed Martin was competitively awarded a Fixed Price Incentive Firm (FPIF) contract to develop a modified Sentinel with a new Active Electronically Scanned Array (AESA) antenna. The contract award to Lockheed Martin includes EMD with priced options for LRIP. Fifteen RDTE funded assets are on contract with Lockheed Martin including five (5) EMD prototypes, five (5) UOES assets and five (5) IOT&E assets. A contract is planned to support full rate production in FY2025.

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Appropriation/Budget Activity	R-1 Program Element (Number/Name)	Project (Number/Name)
2040 / 5	PE 0604820A / <i>Radar Development</i>	E10 / <i>Sentinel</i>

Sentinel is a component of an integrated fires development effort that includes survivability, resiliency, and effectiveness improvements against advanced threats from near-peer adversaries. This effort includes integration with an evolving common fires mission command, common development tools and processes, and annual test and evaluation to provide data to support program assessments and progress toward closure of performance gaps.

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 5	R-1 Program Element (Number/Name) PE 0604820A / Radar Development	Project (Number/Name) E10 / Sentinel
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Management Services (\$ in Millions)				FY 2021		FY 2022		FY 2023 Base		FY 2023 OCO		FY 2023 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			
Management Support	Various	Various : Multiple	12.509	4.592	Nov 2020	4.679	Nov 2021	4.768	Nov 2022	-		4.768	Continuing	Continuing	Continuing
FY22 SBIR/STTR Transfer	TBD	Various : Various	-	-		4.475		-		-		-	0.000	4.475	-
Subtotal			12.509	4.592		9.154		4.768		-		4.768	Continuing	Continuing	N/A

Product Development (\$ in Millions)				FY 2021		FY 2022		FY 2023 Base		FY 2023 OCO		FY 2023 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			
Sentinel A3 Modifications	Various	Raytheon & Various : Fullerton, CA / Various	11.436	-		-		-		-		-	0.000	11.436	-
Electronic Attack/ Electronic Protect	Various	Raytheon & Various : Fullerton, CA / Various	25.859	5.313	Jan 2021	5.327	Jan 2022	4.000	Jan 2023	-		4.000	Continuing	Continuing	-
Active Electronically Scanned Array (A4)	C/FPIF	Lockheed Martin & Search, Track, Acquire, Radiate, Eliminate (PM STARE) : Syracuse, NY and Huntsville, AL	113.679	91.160	Jan 2021	100.944	Jan 2022	46.713	Jan 2023	-		46.713	Continuing	Continuing	-
Mode S	Various	Raytheon & Various : Fullerton, CA / Various	7.823	-		-		-		-		-	0.000	7.823	-
Resiliency and Software Assurance Modification (RSAM) upgrade	Various	Raytheon & Various : Fullerton, CA / Various	2.209	-		-		-		-		-	0.000	2.209	-
Counter Rocket Artillery and Mortars	Various	Raytheon & Various : Fullerton, CA / Various	3.677	1.194	Jan 2021	-		-		-		-	0.000	4.871	-
Subtotal			164.683	97.667		106.271		50.713		-		50.713	Continuing	Continuing	N/A

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 5	R-1 Program Element (Number/Name) PE 0604820A / Radar Development	Project (Number/Name) E10 / Sentinel
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Test and Evaluation (\$ in Millions)				FY 2021		FY 2022		FY 2023 Base		FY 2023 OCO		FY 2023 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			
Sentinel A3 Modifications	Various	Raytheon & Various : Fullerton, CA / Various	3.440	-		-		-		-		-	0.000	3.440	-
Electronic Attack/ Electronic Protect	Various	Raytheon & Various : Fullerton, CA / Various	4.724	1.816	Jan 2021	0.840	Jan 2022	0.225	Jan 2023	-		0.225	Continuing	Continuing	-
Mode S	Various	Raytheon & Various : Fullerton, CA / Various	3.012	-		-		-		-		-	0.000	3.012	-
Resiliency and Software Assurance Modification (RSAM) upgrade	Various	Raytheon & Various : Fullerton, CA / Various	0.500	-		-		-		-		-	0.000	0.500	-
Counter Rocket Artillery and Mortars	Various	Raytheon & Various : Fullerton, CA / Various	0.220	1.196	Jan 2021	-		-		-		-	0.000	1.416	-
Active Electronically Scanned Array (A4)	C/FPIF	Lockheed Martin & Search, Track, Acquire, Radiate, Eliminate (PM STARE : Syracuse, NY and Huntsville, AL	-	-		6.342	Jan 2022	15.553	Jan 2023	-		15.553	Continuing	Continuing	-
Subtotal			11.896	3.012		7.182		15.778		-		15.778	Continuing	Continuing	N/A

	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	189.088	105.271	122.607	71.259	-	71.259	Continuing	Continuing	N/A

Remarks

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Exhibit R-4, RDT&E Schedule Profile: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 5	R-1 Program Element (Number/Name) PE 0604820A / Radar Development	Project (Number/Name) E10 / Sentinel
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Event Name	FY 2021				FY 2022				FY 2023				FY 2024				FY 2025				FY 2026				FY 2027			
	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
Sentinel A3																												
Electronic Attack/Electronic Protect (EA/EP)																												
EA/EP																												
Counter Rocket Artillery and Mortars																												
C-RAM Mode																												
Active Electronically Scanned Array (AESA) (A4)																												
Engineering Manufacturing and Development Prototype Build																												
EMD Prototype Build and Integration																												
Critical Design Review																												
1 CDR																												
Contractor Verification Testing																												
CVT																												
Developmental Test																												
Developmental Test																												
Limited User Testing																												
LUT																												
Operational Test Agency (OTA) Milestone Assessment Report																												
OMAR																												
Milestone C																												
2 MS C																												
User Operational Evaluation System Build and Integration																												
UOES Build and Integration																												
Initial Operational Test and Evaluation System Build and Integration																												
IOT&E Asset Build and Integration																												

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Exhibit R-4, RDT&E Schedule Profile: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 5	R-1 Program Element (Number/Name) PE 0604820A / <i>Radar Development</i>	Project (Number/Name) E10 / <i>Sentinel</i>
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Event Name	FY 2021				FY 2022				FY 2023				FY 2024				FY 2025				FY 2026				FY 2027			
	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
Initial Operational Test and Evaluation (IOT&E)																												

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Exhibit R-4A, RDT&E Schedule Details: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 5	R-1 Program Element (Number/Name) PE 0604820A / <i>Radar Development</i>	Project (Number/Name) E10 / <i>Sentinel</i>
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Schedule Details

Events	Start		End	
	Quarter	Year	Quarter	Year
Sentinel A3	2	2019	4	2030
Electronic Attack/Electronic Protect (EA/EP)	2	2015	4	2030
Mode S	2	2018	4	2020
Resiliency and Software Assurance Modification (RSAM) upgrade	4	2019	4	2020
Counter Rocket Artillery and Mortars	2	2020	4	2021
Active Electronically Scanned Array (AESA) (A4)	4	2019	4	2033
Milestone B	4	2019	4	2019
Engineering Manufacturing and Development Prototype Build and Integration	2	2020	2	2022
Preliminary Design Review	2	2020	2	2020
Critical Design Review	2	2021	2	2021
Contractor Verification Testing	4	2021	2	2022
Developmental Test	2	2022	2	2023
Limited User Testing	3	2023	3	2023
Operational Test Agency (OTA) Milestone Assessment Report	3	2023	3	2023
Milestone C	3	2023	3	2023
User Operational Evaluation System Build and Integration	1	2022	2	2023
Initial Operational Test and Evaluation System Build and Integration	3	2023	4	2024
Initial Operational Test and Evaluation (IOT&E)	1	2025	2	2025