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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 4: Advanced Component Development & Prototypes (ACD&P)</i> | R-1 Program Element (Number/Name) PE 0603327A / <i>Air and Missile Defense Systems Engineering</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 |
|--|-------------|---------|---------|--------------|-------------|---------------|---------|---------|---------|---------|------------------|------------|
| Total Program Element | - | 47.098 | 15.000 | - | - | - | 0.000 | 0.000 | 0.000 | 0.000 | Continuing | Continuing |
| FG9: <i>Air and Missile Defense (AMD) Electronic Warfare</i> | - | 47.098 | 15.000 | - | - | - | - | - | - | - | Continuing | Continuing |

A. Mission Description and Budget Item Justification

Funding in this program supports Cyber and Electromagnetic Activities (CEMA) efforts to conduct operational realistic assessments of Army Integrated Fires performance, identify system vulnerabilities, and develop mitigations against threats across the Cyber and Electromagnetic spectrum. Army radars and sensors, integrated air and missile defense mission command and fire control, Radio Frequency (RF) data and voice networks, and Positioning, Navigation, and Timing (PNT) technology will be assessed against current and postulated threat systems and techniques. Potential solutions developed by the Army, other Services, and Defense agencies (for example Missile Defense Agency) to close identified gaps will be demonstrated and assessed in live and simulated CEMA environments. Assessment events will be conducted approximately every two years. Implementation of potential solutions will occur between events using system-specific funding. The proposed solutions will then be assessed at the next event after implementation.

Included in this line are funds to plan and execute periodic CEMA activities with Army Integrated Fires systems, to include other Service and other Agency radar and sensor systems as appropriate. Upon completion of CEMA demonstration analyses, funding will facilitate initial recommendations for potential mitigations and solutions to Army sensors, C2, and RF data link vulnerabilities. Efforts in this program will also develop tools for use by Army radar and sensor systems to improve overall system performance in contested environments, to include effects-based CEMA Modeling and Simulation (M&S) to assess Army CEMA concepts in Hardware-In-The-Loop (HWIL) environment. Additionally, virtual models of critical hardware and software are being developed and implemented to allow for destructive testing with advanced CEMA threats in a lab environment. There will be continual interface with intelligence communities to maintain cognizance of emerging CEMA threats and incorporate these threats in future CEMA demonstrations. These activities follow a time-phased roadmap that identifies the investments needed to improve the resiliency of Army radar and sensors, C2, and RF data and voice networks in contested CEMA environments.

FY 2021 base funding of \$26.482 million will be used to plan and execute the FY 2021 Survivability Exercise to assess the performance of the Army Integrated Fires architecture, with Joint participants, in a live, tactically relevant, contested CEMA environment. Funds will be used to analyze the performance data of the FY 2021 Survivability Exercise participant weapon systems, identify vulnerabilities, and develop rapid mitigation concepts. Additionally, the funds will be used to execute Cyber Table Tops, continue the development of virtualized critical hardware and software, conduct destructive cyber vulnerability assessments, and integrate artificial intelligence and machine learning into weapon systems to mitigate current and future CEMA threats. FY 2021 OCO funding of \$.500 million will be used to complete operational assessment of ALPS prototype systems in support of a Combatant Commander.

FY23 has no funding.

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| Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army I BA 4: Advanced Component Development & Prototypes (ACD&P)</i> | R-1 Program Element (Number/Name) PE 0603327A / <i>Air and Missile Defense Systems Engineering</i> |
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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 | 47.098 | 0.000 | 0.000 | - | 0.000 |
| Current President's Budget | 47.098 | 15.000 | 0.000 | - | 0.000 |
| Total Adjustments | 0.000 | 15.000 | 0.000 | - | 0.000 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | 15.000 | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | - | - | | | |

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

Project: FG9: *Air and Missile Defense (AMD) Electronic Warfare*

- Congressional Add: *Program increase - cyber and supply chain resiliency*
- Congressional Add: *Program increase - machine learning for integrated fires*
- Congressional Add: *Program increase - software memory protection methods*

| | <u>FY 2021</u> | <u>FY 2022</u> |
|--|----------------|----------------|
| | 22.500 | - |
| | 5.000 | 10.000 |
| | - | 5.000 |
| Congressional Add Subtotals for Project: FG9 | 27.500 | 15.000 |
| Congressional Add Totals for all Projects | 27.500 | 15.000 |

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|--|--------------------|----------------|----------------|---------------------|---|----------------------|----------------|----------------|--|-------------------------|-------------------------|-------------------|
| Exhibit R-2A, RDT&E Project Justification: PB 2023 Army | | | | | | | | | | Date: April 2022 | | |
| Appropriation/Budget Activity 2040 / 4 | | | | | R-1 Program Element (Number/Name) PE 0603327A / Air and Missile Defense Systems Engineering | | | | Project (Number/Name) FG9 / Air and Missile Defense (AMD) Electronic Warfare | | | |
| 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 |
| FG9: Air and Missile Defense (AMD) Electronic Warfare | - | 47.098 | 15.000 | - | - | - | - | - | - | - | Continuing | Continuing |
| Quantity of RDT&E Articles | - | - | - | - | - | - | - | - | - | - | | |

Note

Beginning in FY 2022, the Army Long-Range Persistent Surveillance (ALPS) system efforts transition to Program Element 0604741A, Project 126.

A. Mission Description and Budget Item Justification

Funding in this program supports Cyber and Electromagnetic Activities (CEMA) efforts to conduct operational realistic assessments of Army Integrated Fires performance, identify system vulnerabilities, and develop mitigations against threats across the Cyber and Electromagnetic spectrum. Army radars and sensors, integrated air and missile defense mission command and fire control, Radio Frequency (RF) data and voice networks, and Positioning, Navigation, and Timing (PNT) technology will be assessed against current and postulated threat systems and techniques. Potential solutions developed by the Army, other Services, and Defense agencies (for example Missile Defense Agency) to close identified gaps will be demonstrated and assessed in live and simulated CEMA environments. Assessment events will be conducted approximately every two years. Implementation of potential solutions will occur between events using system-specific funding. The proposed solutions will then be assessed at the next event after implementation.

Included in this line are funds to plan and execute periodic CEMA activities with Army Integrated Fires systems, to include other Service and other Agency radar and sensor systems as appropriate. Upon completion of CEMA demonstration analyses, funding will facilitate initial recommendations for potential mitigations and solutions to Army sensors, C2, and RF data link vulnerabilities. Efforts in this program will also develop tools for use by Army radar and sensor systems to improve overall system performance in contested environments, to include effects-based CEMA Modeling and Simulation (M&S) to assess Army CEMA concepts in Hardware-In-The-Loop (HWIL) environment. Additionally, virtual models of critical hardware and software are being developed and implemented to allow for destructive testing with advanced CEMA threats in a lab environment. There will be continual interface with intelligence communities to maintain cognizance of emerging CEMA threats and incorporate these threats in future CEMA demonstrations. These activities follow a time-phased roadmap that identifies the investments needed to improve the resiliency of Army radar and sensors, C2, and RF data and voice networks in contested CEMA environments.

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

| | FY 2021 | FY 2022 | FY 2023 |
|--|----------------|----------------|----------------|
| Title: Advanced Electronic Protection Enhancements | 19.598 | - | - |
| Description: Provides Cyber and Electromagnetic Activities (CEMA) planning, conducts CEMA demonstrations and post-mission analysis. | | | |
| Accomplishments/Planned Programs Subtotals | 19.598 | - | - |

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| Exhibit R-2A, RDT&E Project Justification: PB 2023 Army | | Date: April 2022 | |
| Appropriation/Budget Activity 2040 / 4 | R-1 Program Element (Number/Name) PE 0603327A / Air and Missile Defense Systems Engineering | Project (Number/Name) FG9 / Air and Missile Defense (AMD) Electronic Warfare | |
| | | FY 2021 | FY 2022 |
| Congressional Add: Program increase - cyber and supply chain resiliency | | 22.500 | - |
| <p>FY 2021 Accomplishments: - Continue developing innovative technology to identify and mitigate cyber and supply chain risks to PEO MS weapon system programs.</p> <ul style="list-style-type: none"> - Build a coordinated and consolidated system security engineering support capability to achieve cyber and supply chain survivability and resiliency. - Continue to develop processes to evaluate suppliers and quantify risks to the PEO MS weapon systems. - Improve information analytics and integrate technical disciplines while providing cooperative supply chain risk analyses and cyber risk identification. | | | |
| Congressional Add: Program increase - machine learning for integrated fires | | 5.000 | 10.000 |
| <p>FY 2021 Accomplishments: - Continue Integration of Machine Learning (ML) technology into Army Air and Missile Defense (AMD) weapon systems.</p> <ul style="list-style-type: none"> - Continue design, code, and integrate ML technology into existing CEMA Detection Algorithm (CDA). - Assess applicability of ML CEMA algorithms for use in Army warfighter Training Aids, Devices, Simulator, and Simulations (TADSS). - Continue efforts to detect and recognize the effects of cyber, Positioning, Navigation, and Timing (PNT), and Electronic Warfare (EW) attacks. <p>FY 2022 Plans: Software memory protection and machine learning.</p> <p>Supports memory protection and machine learning in contested environment.</p> | | | |
| Congressional Add: Program increase - software memory protection methods | | - | 5.000 |
| <p>FY 2022 Plans: - Develop technology transition paths for software memory protection methods that align with on-going missile programs and air and defense missile systems</p> <ul style="list-style-type: none"> - Execute prototype implementation of software memory protection methods to immunize missile programs, and air and missile defense systems, from the primary cybersecurity threat to software today, memory corruption exploits | | | |
| Congressional Adds Subtotals | | 27.500 | 15.000 |
| C. Other Program Funding Summary (\$ in Millions) | | | |
| N/A | | | |
| Remarks | | | |

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| Exhibit R-2A, RDT&E Project Justification: PB 2023 Army | | Date: April 2022 |
| Appropriation/Budget Activity 2040 / 4 | R-1 Program Element (Number/Name) PE 0603327A / <i>Air and Missile Defense Systems Engineering</i> | Project (Number/Name) FG9 / <i>Air and Missile Defense (AMD) Electronic Warfare</i> |

D. Acquisition Strategy

Assessment events will be conducted approximately every two years in live and simulated CEMA environments. In addition to Government planning and conduct of assessments, funding will also be provided through various contracts for subject matter expertise.

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| Exhibit R-3, RDT&E Project Cost Analysis: PB 2023 Army | | | | | | | | | | | | Date: April 2022 | | | | |
|--|------------------------|--------------------------------|-------------|---|------------|---------|------------|--|------------|-------------|------------|------------------|------------------|------------|--------------------------|--|
| Appropriation/Budget Activity | | | | R-1 Program Element (Number/Name) | | | | Project (Number/Name) | | | | | | | | |
| 2040 / 4 | | | | PE 0603327A / Air and Missile Defense Systems Engineering | | | | FG9 / Air and Missile Defense (AMD) Electronic Warfare | | | | | | | | |
| Management Services (\$ in Millions) | | | | FY 2021 | | FY 2022 | | FY 2023 Base | | FY 2023 OCO | | FY 2023 Total | | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract | |
| Government Program Management | Various | Various : Various | 5.426 | 0.926 | Nov 2020 | - | | - | | - | | - | Continuing | Continuing | Continuing | |
| Subtotal | | | 5.426 | 0.926 | | - | | - | | - | | - | Continuing | Continuing | N/A | |
| Product Development (\$ in Millions) | | | | FY 2021 | | FY 2022 | | FY 2023 Base | | FY 2023 OCO | | FY 2023 Total | | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract | |
| System Integration Assessment | Various | Various : Various | 7.071 | 2.568 | Nov 2020 | - | | - | | - | | - | Continuing | Continuing | Continuing | |
| Interoperability of Integrated AMD | SS/CPFF | Various : Various | 49.968 | - | | - | | - | | - | | - | 0.000 | 49.968 | - | |
| Cyber and Supply Chain Resiliency | Various | Various : Various | 3.273 | 5.000 | | - | | - | | - | | - | 0.000 | 8.273 | - | |
| Artificial Intelligence and Machine Learning | Various | Various : Various | 14.667 | 22.500 | | - | | - | | - | | - | 0.000 | 37.167 | - | |
| ALPS Development/ Integration | Various | Various : Various | 36.784 | 0.482 | Jan 2020 | - | | - | | - | | - | 0.000 | 37.266 | - | |
| machine learning for integrated fires | TBD | Various : Various | - | - | | 10.000 | Jun 2022 | - | | - | | - | 0.000 | 10.000 | - | |
| Software Memory Protection Methods | TBD | Various : Various | - | - | | 5.000 | Jun 2022 | - | | - | | - | 0.000 | 5.000 | - | |
| Subtotal | | | 111.763 | 30.550 | | 15.000 | | - | | - | | - | Continuing | Continuing | N/A | |
| Support (\$ in Millions) | | | | FY 2021 | | FY 2022 | | FY 2023 Base | | FY 2023 OCO | | FY 2023 Total | | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract | |
| Component Assessments & Research and Trade Studies | Various | Various : Various | 29.344 | 8.801 | Feb 2021 | - | | - | | - | | - | Continuing | Continuing | Continuing | |

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| Exhibit R-3, RDT&E Project Cost Analysis: PB 2023 Army | | | | | | | | | | | | Date: April 2022 | | | |
| Appropriation/Budget Activity 2040 / 4 | | | | R-1 Program Element (Number/Name) PE 0603327A / Air and Missile Defense Systems Engineering | | | | Project (Number/Name) FG9 / Air and Missile Defense (AMD) Electronic Warfare | | | | | | | |
| Support (\$ in Millions) | | | | FY 2021 | | FY 2022 | | FY 2023 Base | | FY 2023 OCO | | FY 2023 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Subtotal | | | 29.344 | 8.801 | | - | | - | | - | | - | Continuing | Continuing | N/A |
| Test and Evaluation (\$ in Millions) | | | | FY 2021 | | FY 2022 | | FY 2023 Base | | FY 2023 OCO | | FY 2023 Total | | | |
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Demonstration Planning and Execution | Various | Various : Various | 15.794 | 6.821 | Nov 2020 | - | | - | | - | | - | Continuing | Continuing | Continuing |
| Subtotal | | | 15.794 | 6.821 | | - | | - | | - | | - | Continuing | Continuing | N/A |
| Project Cost Totals | | | 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 | | | 162.327 | 47.098 | 15.000 | - | - | - | 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 / 4 | R-1 Program Element (Number/Name) PE 0603327A / Air and Missile Defense Systems Engineering | Project (Number/Name) FG9 / Air and Missile Defense (AMD) Electronic Warfare |

| 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 | |
| FY21 Survivability Exercise Planning Efforts | █ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FY21 Survivability Exercise | | █ | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FY21 Survivability Exercise Analysis and Trade Studies | | | █ | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FY 21 Survivability Exercise Report and Implementation | | | | | | █ | | | | | | | | | | | | | | | | | | | | | | | |
| Air and Missile Defense Systems Hardware Virtualization | █ | | | | █ | | | | | | | | | | | | | | | | | | | | | | | | |
| Interoperability of Integrated Air and Missile Defense (Congress | █ | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| Exhibit R-4A, RDT&E Schedule Details: PB 2023 Army | | Date: April 2022 |
| Appropriation/Budget Activity 2040 / 4 | R-1 Program Element (Number/Name) PE 0603327A / Air and Missile Defense Systems Engineering | Project (Number/Name) FG9 / Air and Missile Defense (AMD) Electronic Warfare |

Schedule Details

| Events | Start | | End | |
|---|---------|------|---------|------|
| | Quarter | Year | Quarter | Year |
| P-11 Demonstration | 2 | 2018 | 3 | 2018 |
| P-11 Analysis Efforts, Trade Studies, and Implementation | 3 | 2018 | 1 | 2019 |
| P-12 Demonstration Planning Efforts | 4 | 2018 | 4 | 2019 |
| P-12 Demonstration | 4 | 2019 | 1 | 2020 |
| P-12 Analysis Efforts, Trade Studies, and Implementation | 1 | 2020 | 4 | 2020 |
| FY21 Survivability Exercise Planning Efforts | 4 | 2020 | 2 | 2021 |
| FY21 Survivability Exercise | 2 | 2021 | 3 | 2021 |
| FY21 Survivability Exercise Analysis and Trade Studies | 3 | 2021 | 1 | 2022 |
| FY 21 Survivability Exercise Report and Implementation | 2 | 2022 | 4 | 2022 |
| Air and Missile Defense Systems Hardware Virtualization | 2 | 2019 | 4 | 2022 |
| Interoperability of Integrated Air and Missile Defense (Congressional Adds) | 4 | 2018 | 2 | 2021 |