Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force	Date: March 2024
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603032F / *Future AF Integrated Technology Demos*

COST ($ in Millions)	Prior Years	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total	FY 2026	FY 2027	FY 2028	FY 2029	Cost To Complete	Total Cost
Total Program Element	-	144.712	255.855	248.506	0.000	248.506	283.896	300.599	311.636	318.155	Continuing	Continuing
630320: *Air Force Vanguards*	-	144.712	255.855	248.506	0.000	248.506	283.896	300.599	311.636	318.155	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Program is a concentrated effort to improve Air Force Research Laboratory (AFRL) business practices to accelerate moving emerging technologies into the hands of the warfighter. Vanguard programs draw the operational, acquisitions, and technology communities together into coherent teams to solve the hard Science & Technology (S&T) problems based on Department of the Air Force (DAF) strategic priorities which do not have readily available emerging technology solutions. Teams follow a disciplined process tailorable to accelerate efforts as deemed necessary by the department. This process (known as WARTECH, for WARfighter / TECHnologist) leverages discrete progress gates to deliver S&T efforts organized as Vanguard Pathfinders, Vanguard Prospects, and Vanguards. This construct organizes these multi-disciplinary, capability-focused investments based on characteristics such as effort maturity, established military utility, technical viability and transitionability. Each have built-in off-ramps to promote transition. The process is overseen by an Executive Committee, whose membership includes the DAF Technical Leadership (TEO, HAF/ST, and USSF/STR), operational requirements representatives (HAF A5/7, USSF S5B), and acquisitions communities (SAF/AQR, SAF/SQT).

Vanguard Pathfinders are focused thrust areas which comprise of numerous, exploratory efforts intended to establish military utility and technical viability of concepts under exploration. Extensive socialization occurs within these efforts to inform activities inherent to these emerging investment areas. Concept socialization activities include but are not limited to the codification of the operational champion, planning engagements with other government R&D, exploratory outreach to industry and other non-traditional partners, and the initial identification of potential transition partners. These investments seek to identify and integrate emerging applied research efforts from government labs and/or industry into integrated technology demonstrations. Vanguard pathfinder teams seek to bring appropriate communities together to answer the question "are we solving the right problem" while establishing technical viability of the concepts under consideration. This phase can be accelerated or bypassed for efforts with well understood operational requirements and concepts with established technical viability. Pathfinders serve as the pipeline for DAF's future Vanguards Prospects and Vanguards.

Vanguard Prospects focus on maturing contributing technologies in accordance with the technical objectives of the effort while further engaging acquisitions communities and industry partners. Teams draw in technologies from multiple sources and ensure use of the right technologies. By establishing fielding strategies, teams solve the problem in a transitionable way. Vanguard Prospects provide focused S&T investment to accelerate the maturation of contributing technologies while laying the foundation for full Vanguard status or a Program.

Vanguards build on the foundational work of the earlier stages, maturing and integrating contributing technologies to demonstrate solutions to the department's most pressing S&T problems based on DAF strategic requirements. Vanguard Programs - high risk by design - are focused, Secretary of the Air Force priority initiatives with

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enterprise commitment. They are commissioned by the Assistant Secretary of the Air Force for Acquisition, Technology and Logistics, the Vice Chief of Staff of the Air Force, and the Vice Chief of Space Operations as DAF investments.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities.

This program is in Budget Activity 3, Advanced Technology Development because this budget activity includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

B. Program Change Summary ($ in Millions)	FY 2023	FY 2024	FY 2025 Base	FY 2025 OCO	FY 2025 Total
Previous President's Budget	163.887	255.855	270.984	0.000	270.984
Current President's Budget	144.712	255.855	248.506	0.000	248.506
Total Adjustments	-19.175	0.000	-22.478	0.000	-22.478
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-5.000	0.000			
• SBIR/STTR Transfer	-4.193	0.000			
• Other Adjustments	-9.982	0.000	-22.478	0.000	-22.478

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2023	FY 2024
Project: 630320: *Air Force Vanguards*		
Congressional Add: *Program increase - automated geospatial intelligence detection algorithms*	0.000	-
Congressional Add Subtotals for Project: 630320	0.000	-
Congressional Add Totals for all Projects	0.000	-

Change Summary Explanation

Decrease in FY 2025 funding is due to Air Force funding re-prioritization.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Title: WARTECH	0.743	5.590	11.089
Description: The Department of the Air Force needs to provide game-changing leap-ahead capabilities to meet future force designs. This effort identifies transformational science and technology investment opportunities through the WARfighter-			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
TECHnologist (WARTECH) process. The WARTECH process enables the DAF enterprise to collaboratively translate future force design priorities and requirements into targeted multi-disciplinary science and technology investments. WARTECH accelerates capability development and responds to emerging technology opportunities by supporting integrated concept exploration. These investments support activities such as mission thread analyses to demonstrate military utility and software and hardware feasibility assessments. Select efforts will evolve into either a Vanguard Pathfinder to allow for further assessment and maturation or be designated a Vanguard Prospect or Vanguard indicating enterprise-level priority. ***FY 2024 Plans:*** Initiate activities to mature and demonstrate advanced technology solutions, components and sub-system prototypes and models to accomplish successful large-scale widely distributed all-domain warfighter operations. Initiate activities to explore technologies that support achieving all-domain moving target engagement at scale in challenging operational environments. Continue activities exploring sensing technologies, investigating algorithm development to support battle management and command and control solutions, exploring alternative position navigation and timing techniques, and exploring technology development and production of low-cost and high-speed weapons. Continue activities exploring technologies supporting offensive and defensive capabilities. ***FY 2025 Plans:*** - Continue activities performing modeling, simulation, and analyses assessing the military utility of candidate Transformational Component investments - Continue assessments informing decisions to promote candidate technologies into the WARTECH process - Initiate partnering and leveraging of subject matter expertise from federally-funded research and development centers, university-affiliated research centers, and other government agencies to advise and support technological ideation during the WARTECH process ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding increased compared to FY 2024 by $5.499 million due to transfer of FY 2024 funding into newly established Vanguard Prospects CRONUS and E-Gon within this Program.			
Title: Navigation Technology Satellite 3 (NTS-3)	10.877	5.173	4.004
Description: The Vanguard, Navigation Technology Satellite 3, develops and demonstrates advanced space-based navigation system technologies to provide resilient navigation support in contested environments. The demonstration includes a space-based test vehicle, ground-based enterprise command and control, and agile software defined receivers for the user. ***FY 2024 Plans:***			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Complete pre-launch activities. Initiate and complete launch of satellite and early orbit operations. Initiate on-orbit experimentation, including multiple simulated operational test events through both receivers in the field and on-orbit transmitted signals. Initiate experimentation towards defined mission objectives. Continue supporting transition of the overall system for conduct of residual use activities. ***FY 2025 Plans:*** - Continue on-orbit experimentation, including multiple simulated operational test events through both receivers in the field and on-orbit transmitted signals - Continue experimentation of defined mission objectives - Continue supporting transition of the overall system for conduct of residual use activities - Initiate transition of the system for residual use - Initiate experimental data analysis and composition of final report ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased compared to FY 2024 by $1.169 million due to completion of pre-launch and launch activities.			
Title: Skyborg	42.508	0.000	0.000
Description: Skyborg is an autonomous, attritable vehicle architecture suite which will enable the Air Force to posture, produce and sustain multi-mission sorties at sufficient tempo to thwart adversary attempts at quick, decisive action in contested and highly contested environments. Skyborg is organized into three main lines of effort (LOEs). LOE 1 develops, demonstrates, and prototypes the Autonomy Core System (ACS) consisting of Skyborg autonomy architecture and software, enabling machine and manned-unmanned teaming, while also ensuring openness, modularity, and expandability of the Skyborg autonomy mission systems suite. The ACS LOE also develops, demonstrates, and prototypes the hardware components and Open Architecture standards needed to allow modular sensor, communication, and other payload integration into the Skyborg autonomy and vehicle architectures in systems integration laboratories and platforms. LOE 2 (Low-cost vehicles) develops, demonstrates, and prototypes new low cost attritable vehicle concepts and technologies for expeditionary mass generation including sortie generation employment concepts. LOE 3 (Operational Experimentation) conducts analysis and experimentation on concepts of operations and concepts of employment for attritable, autonomous, unmanned systems and assesses the openness, and modular capabilities / sensors integration for autonomous, attritable, aircraft and mission systems. ***FY 2024 Plans:*** Skyborg technology transitioned to USAF Program of Record. ***FY 2025 Plans:***			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Not applicable ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Not applicable			
Title: Golden Horde ***Description:*** Integrate networked collaborative technologies into selected inventory weapon systems. Technologies can include new payloads, weapon datalinks/radios, and autonomous behaviors that are bounded by operator-defined mission rules of engagement. Supports the integration of Air Force weapons into the Joint All-Domain Command/Control network. Develop new standard software and hardware architecture environment to accelerate change for new weapon systems. This environment will integrate new concept designs via simulations, virtual and live testing, and operational analysis, experiments and war games to show the value of collaborative weapons in increasing combat power across the spectrum of conflict. Work with Weapons Program Executive Officer to define requirements for future weapons and Concept of Operations. ***FY 2024 Plans:*** Golden Horde multi-tier digital weapon ecosystem transition to Weapons Program Executive Officer. ***FY 2025 Plans:*** Not applicable ***FY 2024 to FY 2025 Increase/Decrease Statement:*** Not applicable	17.131	0.000	0.000
Title: Rocket Cargo ***Description:*** The Vanguard, Rocket Cargo, is an S&T effort to leverage the multi-billion dollars of commercial investments in large reusable launch vehicles to extend the commercial rocket capabilities and create a novel DOD solution for global reach. DAF S&T efforts and resources are focused on the specific areas that are unique to military transport applications. The S&T objective is to determine the viability, performance, military utility, and business case of the commercial rocket capability. Potential investigation activities will include detailed mission and cost analyses, investigation of the harsh rocket plume interactions with landing surfaces, evaluation of rocket landing capabilities at austere sites, and human factors at landing sites. Investments will also determine the ability to airdrop cargo after reentry, will assess in-flight communications to the rocket, will test cargo environments and novel cargo "loadmaster" designs for rapid load/unload, and will evaluate rocket detectability and vulnerability. ***FY 2024 Plans:*** Continue multi-disciplinary S&T to expand commercial rocket capabilities for DOD global cargo delivery on tactical timelines. Continue investigations of rocket landing viability over a broader range of unprepared sites and non-standard landing surfaces	26.317	42.200	54.200

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
relevant to rocket delivery directly to the point of need, including landing pad material surface degradation and human factors at the landing site. Continue to leverage commercial full-scale rocket engine tests on concrete and other terrains to update computational simulations and predict landing surface degradation for DOD operations. Complete airdrop S&T on container freefall aerodynamics and stability through wind tunnel experiments to anchor computational fluid dynamics (CFD) models. Initiate new airdrop S&T on the high-speed separation physics for airdrop payload ejection from the rocket, including new wind tunnel capabilities. Continue to leverage commercial rocket ground testing and commercial rocket flights to determine rocket cargo environments and performance, specifically to including 2nd stage rocket reentry and landing maneuvers that are unique to rocket delivery of 30 to 100 tons cargo. Initiate new design tasks for a scheduled FY25 demonstration launch to transport 30 to 100 tons of cargo to an austere site. Initiate experiments of in-flight communications to the rocket during all phases of flight, including hypersonic reentry. Continue quantitative S&T assessment of the rocket detectability and vulnerability, anchored with rocket flight data, to determine implications for military missions; incorporate these details into detailed mission analysis and the capability return on investment. Continue development of mission planning tools for tactical cargo delivery timelines. Initiate testing of rapid cargo load/unload capabilities with DOD partners and optimize these for tactical timelines and the DOD logistics mission set.			
FY 2025 Plans: - Continue multi-disciplinary S&T to expand commercial rocket capabilities for DOD global cargo delivery on tactical timelines - Continue investigations of rocket landing viability over a broader range of unprepared sites and non-standard landing surfaces relevant to rocket delivery directly to the point of need, including landing pad material surface degradation and human factors at the landing site - Complete leveraging of commercial full-scale rocket engine tests on concrete and other terrains to update computational simulations and predict landing surface degradation for DOD operations - Complete airdrop S&T on the high-speed separation physics for airdrop container ejection from the rocket, including wind tunnel capabilities - Initiate airdrop S&T on the payload mid-air system deployment capabilities from an airdropped container - Continue to leverage commercial rocket ground testing and commercial rocket flights to determine rocket cargo environments and performance, specifically to include 2nd stage rocket reentry and landing maneuvers that are unique to rocket delivery of 30 to 100 tons cargo - Complete design tasks for a scheduled FY25 demonstration launch to transport 30 to 100 tons of cargo to an austere site - Initiate tasks for flight readiness and delivery site CONOPS for a demonstration launch to transport 30 to 100 tons of cargo to an austere site - Continue experiments of in-flight communications to the rocket during all phases of flight, including hypersonic reentry - Continue quantitative S&T assessment of the rocket detectability and vulnerability, anchored with rocket flight data, to determine implications for military missions; incorporate these details into detailed mission analysis and the capability return on investment - Continue development of mission planning tools for tactical cargo delivery timelines			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue testing of rapid cargo load/unload capabilities with DOD partners and optimize these for tactical timelines and the DoD logistics mission set ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding increased compared to FY 2024 by $12.000 million. This funding increase is due to initiation of flight readiness and delivery site readiness tasks for a scheduled FY25-26 demonstration launch. Additionally, initiation of new airdrop S&T on payload mid-air system deployment capabilities from an airdropped container, including wind tunnel test campaigns and computational simulations.			
Title: Vanguard Prospect - Resolute Sentry ***Description:*** The Vanguard Prospect, Resolute Sentry, provides real-time multi-domain battlespace awareness in highly contested environments. Develops and demonstrates autonomy foundation integrated software and hardware capabilities that enable cross-domain, cross-platform Intelligence, Surveillance, and Reconnaissance (ISR) via autonomous platforms at the tactical edge in communications degraded and denied environments. Resolute Sentry fuses information from multiple off-board sources with on-board and networked sensors to provide higher fidelity information to the joint force as part of the Sensing Grid feed to the Joint All Domain Command and Control capability. Resolute Sentry leverages Open Mission Systems and Sensor Open Systems Architectures to maximize platform compatibility. ***FY 2024 Plans:*** Continue assessments, development and maturation, integration, and testing of advanced sensor fusion, robust communications, and platform orchestration technologies integrated with advanced computing hardware for autonomous unmanned systems at the tactical edge. Continue modeling, simulation, and analysis of system design trades and Model Based System Engineering activities for the air domain. Continue existing technology maturation plans for sensing systems integration for the air domain, platform data fusion integration and orchestration, and advanced analytics for on-board autonomous systems, systems trades analyses, and software integration. Initiate software development and maturation of software/hardware mission management and multi-platform autonomous system orchestration efforts with industry for integration into the Systems Integration Laboratory/ Hardware Integration Laboratory. Initiate software development interfaces with off-board systems connected to Joint All-Domain Command and Control enterprise. Continue integration of robust communications applications with industry for highly contested environments. Continue integrated systems testing and demonstration planning on experimentation platforms. Initiate hardware purchases for multi-platform flight testing and operational demonstration. Continue Systems Integration Laboratory/Hardware Integration Laboratory, ground, and flight test planning and events supporting system verification and validation activities. Continue transition analysis, planning and documentation of the overall system. ***FY 2025 Plans:***	12.825	30.325	20.353

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue assessments, development and maturation, integration, and testing of advanced sensor fusion, robust communications, and platform orchestration technologies integrated with advanced computing hardware for autonomous unmanned systems at the tactical edge - Continue modeling, simulation, and analysis of system design trades and Model Based System Engineering activities for the air domain - Continue technology maturation of sensing systems integration, platform data fusion integration and orchestration, and advanced analytics for on-board autonomous systems, systems trades analyses, and software integration - Continue software development and maturation of software/hardware mission management and multi-platform autonomous system orchestration efforts with industry for integration into the Systems Integration Laboratory/Hardware Integration Laboratory - Continue software development interfaces with off-board systems connected to Joint All-Domain Command and Control enterprise - Continue integration of robust communications applications with industry for highly contested environments - Continue integrated systems testing and demonstration planning on experimentation platforms - Complete hardware purchases for multi-platform flight testing and operational demonstration - Continue Systems Integration Laboratory/Hardware Integration Laboratory, ground, and flight test planning and events supporting system demonstration and transition activities - Continue transition analysis, planning and documentation of the overall system ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased compared to FY 2024 by $9.972 million due to reduced number of software development and maturation performers and reduction of hardware purchasing.			
Title: Vanguard Prospect - Long Range Kill Chain ***Description:*** The Vanguard Prospect, Long Range Kill Chain is prototyping and testing advanced techniques that utilize data sources from all domains to form and maintain the best possible targeting information against challenging adversary threats. This effort matures key special communications techniques and hardware required to utilize the assembled targeting information in tactically relevant timelines. The hardware and techniques matured under this effort will be inserted into the end-to-end Hawkeye kill chain. ***FY 2024 Plans:*** Complete development of special communications equipment and technologies suitable for transmitting and receiving fused target data to and from tactically relevant platforms, including over-the-air demonstrations. Initiate demonstrations of over-the-air	4.344	25.882	5.300

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
performance of special communications techniques with a specific radio intended for use in selected tactical platforms, including assessment against known and anticipated adversary threats. ***FY 2025 Plans:*** -Complete demonstration of over-the-air performance of special communications techniques with a specific radio intended for use in selected tactical platforms, including assessment against known and anticipated adversary threats ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased compared to FY 2024 by $20.582 million due to completion of communications equipment development.			
Title: Vanguard Prospect - Area Effects Demonstration ***Description:*** The Vanguard Prospect, Area Effects Demo, advances the development of high-speed area effects concepts. The effort consists of modeling and simulation conducted in conjunction with aerodynamic ground and flight testing to validate the modeling tools. The physics-based computations and ground testing provide risk reduction for future high-speed vehicle concepts. ***FY 2024 Plans:*** Continue validating modeling and simulation tools using data obtained through ground testing of various flight-representative components. Complete the design and fabrication of the experimental test vehicle as well as the design, fabrication, and integration of the area effects concept. Initiate flight test integration activities to include software in the loop testing; hardware in the loop testing; environmental testing; and other form, fit, function, and acceptance testing. Initiate a flight test demonstrating the area effects concept. Using the flight test results, evaluate the accuracy of the pre-test simulations and inform future tool development efforts. ***FY 2025 Plans:*** - Complete validating modeling and simulation tools using data obtained through ground testing of various flight-representative components. - Complete flight test integration activities to include software in the loop testing; hardware in the loop testing; environmental testing; and other form, fit, function, and acceptance testing - Complete flight testing, demonstrating the area effects concept - Complete post-test analysis using the flight test results, evaluate the accuracy of the pre-test simulations and inform future tool development efforts ***FY 2024 to FY 2025 Increase/Decrease Statement:***	10.112	18.247	10.950

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
FY 2025 funding decrease compared to FY 2024 by $7.297 million due to completion of design and fabrication of flight test hardware.			
Title: Vanguard Prospect - Fight Tonight ***Description:*** The Vanguard Prospect, Fight Tonight, develops and demonstrates a transformational gaming engine and Artificial Intelligence based military planning capability enabling the Department of the Air Force to develop, assess, and continuously adapt the employment of combat power at the pace and scale needed for peer conflict, achieving decision advantage across highly dynamic and contested environments. ***FY 2024 Plans:*** Complete development of software capability for theater scale plans rehearsal and analysis of plan options. Complete development of plan adaptation from real-time data feeds. Complete development of scalability and performance improvements to match pace and scale of target environment. Continue human-AI teaming assessment and apply findings to optimize system. Continue demonstration of operational level planning capability on representative classified network and data, scaling software for digital plan rehearsal and plan adaptation and integrate with existing data used for operational mission. Initiate Systems Integration Laboratory deployment and user-driven assessment of software system effectiveness with Department of the Air Force operational planners. Continue and accelerate transition planning of the software systems addressing critical process and technology gaps. ***FY 2025 Plans:*** - Complete human-AI teaming assessment and apply findings to optimize system - Continue demonstration of operational level planning capability on representative classified network and data, scaling software for digital plan rehearsal and plan adaptation and integrate with existing data used for operational mission - Continue Systems Integration Laboratory deployment and user-driven assessment of software system effectiveness with Department of the Air Force operational planners - Continue and accelerate transition planning of the software Systems addressing critical Department of the Air Force process and technology gaps - Initiate Integration with Air Operations Center software Systems of Record ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decrease compared to FY 2024 by 35.518 million due to completion of the software development and initial demonstration of the developed capability. Results from initial demonstration will inform an upcoming decision regarding the next phase of this effort.	19.855	39.118	3.600
Title: Vanguard Prospect - CRONUS	0.000	15.518	36.388

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Description: The objective of the Combat Refueling & Operations Networked Universal System (CRONUS) program is a technology insertion into the Next Generation Air-refueling System (NGAS) Program of Record (PoR)'s Technology Maturity and Risk Reduction (TMRR) phase. CRONUS is an operational concept which enables "fueling the fight" - delivering fuel to airborne assets where and when needed to support the joint force to include contested areas. To project combat power, an airborne platform, whether it be a counter-air, strike, or Intelligence, Surveillance, and Reconnaissance (ISR), must be able to operate within contested or highly contested operational environments. The CRONUS concept includes real-time dynamic Air Refueling Battle Management (ARBM) and Automated Air-to-Air Refueling (A3R). The CRONUS ARBM effort will provide automation to the tracking and scheduling of aerial refueling within contested areas, while the A3R effort will focus on automating the mechanical aspects of the aerial refueling process to include automated refueling and receiving equipment. ***FY 2024 Plans:*** Early work for this effort was accomplished under the WARTECH effort within this Program in FY 2023. - Initiate ARBM requirements analysis through direct interaction with operational battle managers leading to mission task analysis products that will inform the necessary attributes of the ARBM algorithms - Initiate ARBM algorithm development based on the mission task analysis products and use cases/vignettes -- This effort will include modeling and simulation of vignettes based on inputs from Air Mobility Command (AMC) - Initiate model-based system engineering (MBSE) for battle management modeling - Initiate the design and implementation of both hardware in the loop (HIL) and software in the loop (SIL) environments - Continue Modeling and Simulation work under the WARTECH effort to provide operational utility analysis of the concepts developed under CRONUS. Implement operationally relevant models for communication of mission data between platforms and the ARBM - Initiate A3R requirements analysis to inform the derivation of attributes for the A3R system - Initiate modeling and simulation of A3R in relevant MBSE models, leveraging available digital engineering artifacts and expertise and developing the MS&A tools where required - Initiate development of the sensors, logic, and algorithms necessary for tanker-receiver pairing as part of the A3R Relative Navigation system - Initiate development of the fully automated mechanical system to enable automated air-to-air refueling as part of the A3R boom automation system - Initiate A3R program support ***FY 2025 Plans:*** - Complete ARBM requirements analysis to inform ARBM algorithm attributes			

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- Continue ARBM algorithm development, test, and evaluation based on the modeling and simulation operational utility analysis. Implement improvements to the algorithms required to improve system level performance - Continue MBSE collaboration with the C3BM program office to refine the system models and capture new aspects related to the CRONUS algorithm development - Continue HIL/SIL environment development and implementation - Initiate end-to-end system testing to demonstrate the ARBM capabilities with human-in-the-loop evaluations - Continue Modeling and Simulation operational utility analysis based on updates/improvements of the ARBM algorithms - Continue A3R requirements analysis - Continue modeling and simulation of A3R in relevant MBSE models. Advance MBSE tool and artifact development - Continue the development of the sensors, logic, and algorithms necessary for tanker-receiver pairing as part of the A3R Relative Navigation system - Continue the development of the fully automated mechanical system to enable automated air-to-air refueling as part of the A3R boom automation system - Initiate certification with advanced analysis for ground testing of A3R's automated boom system ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding increase compared to FY 2024 by $20.870 million due to increased investment to full staffing of efforts, increased effort towards A3R certification testing, and ARBM system testing.			
Title: Vanguard Prospect - Ephemeral Paragon (E-Gon)	0.000	10.588	32.941
Description: E-Gon is a comprehensive electromagnetic warfare (EW) solution being developed via open standards, utilizing adaptive/cognitive methodologies to meet the requirements of a complex and congested electromagnetic operating environment, specifically to address unknown and/or complex emitters. Rapid development, assessment, and integration of new techniques is needed to operate in an evolving electromagnetic spectrum environment which requires the ability to sense the electromagnetic spectrum and make decisions and/or recommendations based on an understanding of that environment. ***FY 2024 Plans:*** Early work for this effort was accomplished under the Vanguard Pathfinder - Integrated Electronic Warfare effort within this Program in FY 2023. - Initiate maturation efforts on separate electromagnetic warfare methodologies - Initiate algorithm maturation and assessment to support future integration into minimum viable product - Initiate subsystems capabilities assessments to support minimum viable product integration and testing ***FY 2025 Plans:***			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Continue maturation efforts on electromagnetic warfare methodologies - Continue algorithm maturation and assessment to support integration into minimum viable product - Continue assessment and evaluation efforts for sub systems, and algorithms to test the minimum viable product - Initiate integration of subsystems, algorithms, and electromagnetic warfare methodologies towards an instantiation of the minimum viable product - Initiate incremental systems test and capabilities assessments of integrated components ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY2025 funding increase compared to FY2024 of 22.353 million for increased assessment and maturation of the underlaying sub-systems and algorithms. Increase includes the integration of those sub-systems and assessment of overall system performance. FY2025 will utilize the frameworks established in FY2024 to assess, improve, and integrate the sub systems, systems, and algorithms required to achieve the minimum viable product which requires increases to teams and additional assessment events. An increase in engineering team size is expected for FY2025 to accomplish required technical efforts and an additional team to manage integration efforts.			
Title: Analysis for Emerging Vanguard Pipeline ***Description:*** Conduct operational analysis and mission thread engineering activities assessing military utility and cost-effective implementations of emerging technology opportunities under consideration in the WARTECH process. ***FY 2024 Plans:*** Initiate activities performing modeling, simulation, and analyses assessing the military utility of candidate Transformational Component investments. Continue assessments informing decisions to promote candidate technologies in the WARTECH process. ***FY 2025 Plans:*** This effort has been integrated into the WARTECH effort in this program. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased compared to FY 2024 by $10.350 million. This decrease reflects the integration of analysis activities into the WARTECH effort in this program.	0.000	10.350	0.000
Title: Vanguard Pathfinder - Integrated Electronic Warfare ***Description:*** The Department of the Air Force has a need to identify, protect against and counter any use of electromagnetic spectrum (EMS) effects as well as naturally occurring phenomena that degrade, neutralize, or destroy friendly combat capability. This effort identifies, assesses, integrates, and demonstrates material and non-material solutions to support EMS protection and	0.000	12.412	12.926

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force	Date: March 2024
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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
survivability of air and space platforms, personnel, systems, systems of systems, and equipment. This effort includes algorithm and tool development with modeling, simulation and analysis and hardware-in-the loop testing. ***FY 2024 Plans:*** Initiate activities assessing, integrating, and demonstrating advanced electronic warfare technology solutions, components and sub-systems, to accomplish warfighter relevant engagements at scale. Initiate implementation of open, flexible, and reprogrammable hardware and software architectures, applications and algorithms that enable threat environment data collection and analysis/synthesis to assess operationally optimized situational awareness and demonstrate countermeasures, waveforms/ techniques against modern and emerging threats in challenging electromagnetic (EM) spectrum operating environments. Initiate activities integrating, demonstrating, and advancing the technical maturity of software algorithms, adaptive techniques and autonomy-based approaches and assess awareness of and responses to threats across the EM spectrum. These activities include the integration and demonstration of hardware and software applications and algorithms in simulated environments and field experiments. ***FY 2025 Plans:*** - Continue activities assessing, integrating, and demonstrating advanced electronic warfare technology solutions, components and sub-systems, to accomplish warfighter relevant engagements at scale - Continue implementation of open, flexible, and reprogrammable hardware and software architectures, applications and algorithms that enable threat environment data collection and analysis/synthesis to assess operationally optimized situational awareness and demonstrate countermeasures, waveforms/techniques against modern and emerging threats in challenging electromagnetic (EM) spectrum operating environments - Continue activities integrating, demonstrating, and advancing the technical maturity of software algorithms, adaptive techniques and autonomy-based approaches and assess awareness of and responses to threats across the EM spectrum. These activities include the integration and demonstration of hardware and software applications and algorithms in simulated environments and field experiments -Initiate modeling and simulation from material to vehicle to identify and mature EMS protection and integrate data into applicable program offices -Initiate system, subsystem, and component level testing to baseline performance EMS protection material performance -Initiate integration of EMS protection and survivability techniques and principles within select systems of interest -Initiate technical transition into industry for application into component and warfighter systems -Initiate technology demonstration and training aid capabilities to develop tactics, training, and procedures for aircrew and platforms to operate in and around EMS threat contested environments ***FY 2024 to FY 2025 Increase/Decrease Statement:***			

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force	Date: March 2024
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C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
FY 2025 funding increased compared to FY 2024 by $0.514 million as described in the plans above.			
Title: Vanguard Pathfinder - Integrated Networks ***Description:*** The Department of the Air Force has a need to communicate with Joint and Coalition partners and to provide battle management during complex military operations. This effort identifies and assesses accessible, resilient, and secure bi-directional information exchange technology solutions, components, and sub-systems, to enable seamless movement of data to the right place at the right time informing effective decision making on military relevant timescales. Efforts support the integration of applications and algorithms into flexible hardware and software architectures to achieve movement of appropriate data across multiple security levels, and modeling and simulation to assess information exchanges for large-scale all-domain warfighter operations. ***FY 2024 Plans:*** Initiate efforts identifying technology in the areas of next-generation cross domain solutions incorporated into flexible networking architectures demonstrating the technical feasibility of improved communication methods. Initiate supporting emulation efforts establishing the scalability of emerging technologies. These activities may include the integration and demonstration of hardware and software applications and algorithms in simulated environments and field experiments. ***FY 2025 Plans:*** - Continue development of next-generation cross domain solutions through design and prototyping - Continue ground emulation evaluation of hardware and software applications received from selected vendors to assess scalability of emerging technologies. Emulation environment to include hardware and software necessary to optimally route mission data across multiple security levels and heterogenous networks - Initiate the MS&A integration with multi-domain data transport efforts to assess how networks from multiple domains enhance aerial network & kill-chain in complex information security use cases to identify risks, challenges and synergies. Assess scalability to large number of network nodes in air and mission performance under various network conditions - Initiate integration of software and hardware designs to address any deficiencies discovered during ground simulations - Initiate integrated demonstration planning ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased compared to FY 2024 by $1.624 million. This decrease is due to requirement for further analysis ensuring technical scope complies with the transformational capability assessment.	0.000	12.502	10.878
Title: Vanguard Pathfinder - Enabling Technology for Agile Basing	0.000	13.000	0.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force	Date: March 2024
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603032F / *Future AF Integrated Technology Demos*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Description: The Department of the Air Force is evaluating agile basing concepts to prepare against threats to its forward operating bases from evolving adversary capabilities. This effort encompasses assessment and maturation of technologies that will enhance survivability in agile basing scenarios. ***FY 2024 Plans:*** Initiate activities developing technologies and metrics evaluating effectiveness of technologies for improving resilience of agile operating bases. Initiate efforts maturing capabilities that invoke a combination of techniques and technologies in support of agile basing defense, enable modeling and simulation to assess their effectiveness and vulnerabilities. ***FY 2025 Plans:*** Technologies within this topic area have been identified as requiring further applied research maturation. ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased compared to FY 2024 funding by 13.000 million due to higher priorities within this program.			
Title: Vanguard Pathfinder - Advanced Emulation for Test and Training ***Description:*** The Department of Air Force has a need to prepare our forces for joint military operations through simulation of major conflicts and training activities. This effort integrates, assesses and demonstrates mature science and technology solutions supporting test and training in the synthetic environment to enable future force operations. ***FY 2024 Plans:*** Initiate development and demonstration of a Synthetic Operational Test and Training Infrastructure capability to support test, training, and experimentation for multi-domain operations by integrating high-fidelity command and control functions with existing test and training infrastructure. Initiate cross disciplinary research for autonomous collaborative platform development to further enhance system integration laboratory supporting next-generation autonomy. ***FY 2025 Plans:*** - Continue development and demonstration of a Synthetic Operational Test and Training Infrastructure capability to support test, training, and experimentation for multi-domain operations by integrating high-fidelity command and control functions with existing test and training infrastructure - Continue cross disciplinary research for autonomous collaborative platform development to further enhance system integration laboratory supporting next-generation autonomy ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding decreased compared to FY 2024 by $3.185 million due to higher priority efforts within this program.	0.000	14.950	11.765
Title: Vanguard Pathfinder - Integrated Combat Effects	0.000	0.000	34.112

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force	Date: March 2024
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603032F / *Future AF Integrated Technology Demos*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
Description: The Department of the Air Force has a need to pursue leap ahead technologies to enable offensive and defensive, warfighting combat effects. Investments should develop, assess and demonstrate standoff capabilities with increased responsiveness and affordability to jointly deter or blunt peer-adversary offensive operations. This effort integrates and demonstrates affordable long-range missile technologies for transition to diverse future joint weapon systems. Key attributes of these concepts will enable survivable, affordable, and effective kinetic and non-kinetic capabilities. Efforts support the integration of these concepts for large-scale warfighter operations in contested environments. This effort is not a new start but breaks out activities previously identified under the WARTECH effort in this program into a discrete effort for further investment. ***FY 2024 Plans:*** In FY 2024 activities for this effort were executed within the WARTECH effort in this Program. ***FY 2025 Plans:*** - Initiate the investigation of selected weapon component technologies for further maturation and subsystem integration - Initiate the design and development of range- and lethality-enhancing subsystem technologies - Initiate the design of new weapon concepts leveraging enhanced component/subsystem technologies - Initiate investigation of applicable low-cost, high-volume manufacturing technologies - Continue activities to mature and demonstrate advanced technology solutions, components and sub-system prototypes and models to accomplish successful large-scale widely distributed all-domain warfighter operations (previously executed under WARTECH effort in this program) - Continue activities to explore technologies that support achieving all-domain moving target engagement at scale in challenging operational environments (previously executed under WARTECH effort in this program) - Continue activities exploring production of low-cost and high-speed weapons (previously executed under WARTECH effort in this program) - Continue activities exploring technologies supporting offensive and defensive capabilities (previously executed under WARTECH effort in this program) - Initiate development of target and behavior models using predictive analytics - Initiate technologies providing near-real time situation awareness using data fusion from multi-domain sources - Initiate efforts to integrate data across the Information Environment into a common data fabric providing access to and analysis of all of the data that exists within the AF information environment - Initiate development of artificial intelligence / machine learning - enabled analytic tools and capabilities to automate common tasks, characterize the information battlespace, and assess the effects of information warfare operations			

Exhibit R-2, RDT&E Budget Item Justification: PB 2025 Air Force	Date: March 2024
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603032F / *Future AF Integrated Technology Demos*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2023	FY 2024	FY 2025
- Initiate efforts to link disparate information warfare sub-disciplines to deliberately target and affect human and system behavior; develop integrated information warfare planning tools and capabilities to synchronize information warfare effects - Initiate investments in partnerships and alliances that expand USAF information warfare capabilities and capacity to fulfill information warfare gaps and requirements ***FY 2024 to FY 2025 Increase/Decrease Statement:*** FY 2025 funding increased compared to FY 2024 by $34.112 million. This increase establishes the activities necessary to continue these transformational capability maturation efforts which initiated in FY 2024 under the WARTECH effort within this program.			
Accomplishments/Planned Programs Subtotals	144.712	255.855	248.506

	FY 2023	FY 2024
Congressional Add: Program increase - automated geospatial intelligence detection algorithms ***FY 2023 Accomplishments:*** Conduct Congressionally directed efforts.	0.000	-
Congressional Adds Subtotals	0.000	-

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

Not applicable