Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Air Force											Date: May 2021	
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*							
COST ($ in Millions)	**Prior Years**	**FY 2020**	**FY 2021**	**FY 2022 Base**	**FY 2022 OCO**	**FY 2022 Total**	**FY 2023**	**FY 2024**	**FY 2025**	**FY 2026**	**Cost To Complete**	**Total Cost**
Total Program Element	-	148.176	164.426	163.032	0.000	163.032	-	-	-	-	-	-
622401: *Structures*	-	37.043	82.400	51.546	0.000	51.546	-	-	-	-	-	-
622403: *Flight Controls and Pilot-Vehicle Interface*	-	49.297	0.000	39.790	0.000	39.790	-	-	-	-	-	-
622404: *Aeromechanics and Integration*	-	28.595	0.000	29.941	0.000	29.941	-	-	-	-	-	-
622405: *High Speed Systems Technology*	-	33.241	62.578	38.103	0.000	38.103	-	-	-	-	-	-
622406: *Aerospace Power & Flight Control Technology*	-	0.000	19.448	0.000	0.000	0.000	-	-	-	-	-	-
625172: *NUCLEAR SYSTEM TECHNOLOGY*	-	0.000	0.000	3.652	0.000	3.652	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This program investigates, develops, and analyzes aerospace vehicle technologies in the primary areas of high speed systems, flight control technologies, aeromechanics, structure systems and nuclear system technology. The effort has five projects, each focusing on a technology area critical to the Department of the Air Force. The High Speed Systems Technology project develops high speed/hypersonic aerospace vehicles as well as high-speed air breathing propulsion engines to include combined cycle, ramjet, and hypersonic scramjet technologies to enable revolutionary propulsion capability for the Department of the Air Force. The Flight Controls and Pilot-Vehicle Interface project develops technologies that enable maximum affordable capability from manned, remotely-piloted and autonomous aerospace vehicles. The Aeromechanics and Integration project designs advanced aerodynamic vehicle configurations that are developed and analyzed through simulations, experiments, and multi-disciplinary analyses. It also develops design techniques, incorporating vehicle, inter-vehicle, and intra-vehicle control systems. The Structures project develops and exploits new materials, and fabrication processes. The Nuclear System Technology project provides science and technology to preserve nuclear deterrence for future generations.

Funds in this PE may be used to investigate specified technology advancements in air, space and/or cyber domains.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver science & technology capabilities. The use of program funds in this PE would be in addition to the civilian pay expenses budgeted in program elements 0601102F, 0602102F, 0602201F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.

Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Air Force	Date: May 2021
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*

In FY 2022, the seismic technologies efforts of PE 1206601SF, Space Technology, Project 621010, Space Survivability & Surveillance were transferred to Appropriation 3600, Research, Development, Test & Evaluation, Air Force, PE 0602201F, Aerospace Vehicles Technologies, Project 625172, Nuclear System Technology, from Appropriation 3620, Budget Activity (BA) 02 due to the creation of a new Appropriation for Space Force.

This program is in Budget Activity 2, Applied Research because this budget activity includes studies, investigations, and non-system specific technology efforts directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters.

B. Program Change Summary ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	157.724	349.225	357.519	0.000	357.519
Current President's Budget	148.176	164.426	163.032	0.000	163.032
Total Adjustments	-9.548	-184.799	-194.487	0.000	-194.487
• Congressional General Reductions	0.000	-0.300			
• Congressional Directed Reductions	0.000	-1.200			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	10.000	23.000			
• Congressional Directed Transfers	0.000	-206.299			
• Reprogrammings	0.297	0.000			
• SBIR/STTR Transfer	-4.675	0.000			
• Other Adjustments	-15.170	0.000	-194.487	0.000	-194.487

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2020	FY 2021
Project: 622404: *Aeromechanics and Integration*		
Congressional Add: *Program increase - secure UAV technologies*	0.000	0.000
Congressional Add: *Program increase - advanced battery technology for directed energy*	0.000	0.000
Congressional Add Subtotals for Project: 622404	0.000	0.000
Project: 622405: *High Speed Systems Technology*		
Congressional Add: *Program increase - modeling and testing of high temperature aero vehicle*	0.000	4.000
Congressional Add: *Program increase - hypersonic research and education*	0.000	4.000
Congressional Add: *Program increase - hypersonic vehicle structures*	10.000	0.000
Congressional Add: *Program increase - secure UAV technologies*	0.000	10.000
Congressional Add: *Program increase - advanced battery technology for directed energy*	0.000	5.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Air Force	Date: May 2021
Appropriation/Budget Activity 3600: *Research, Development, Test & Evaluation, Air Force* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2020	FY 2021
Congressional Add Subtotals for Project: 622405	10.000	23.000
Congressional Add Totals for all Projects	10.000	23.000

Change Summary Explanation

Decrease in FY 2022 of 194.487 million is due to Congressional reversal of program element restructure, higher Department of the Air Force priorities, and transformational activities.

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force			Date: May 2021
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*	Project (Number/Name) 622401 / *Structures*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
622401: *Structures*	-	37.043	82.400	51.546	0.000	51.546	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This project develops advanced structures concepts to exploit new materials and fabrication processes and investigates new concepts and design techniques. New structural concepts include low cost design and fabrication techniques, incorporating subsystem hardware items and adaptive mechanisms into the aerospace structures and/or skin of the platform.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Aircraft Service Life Technologies	13.384	29.771	18.615
Description: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring technologies. ***FY 2021 Plans:*** Complete demonstration of Aircraft Digital Twin models and tools on legacy fleet aircraft. Continue lifing methods for durability and damage tolerance of aging composite structures on legacy fleet aircraft. Complete development of digital maintenance models and virtual and augment reality maintenance tools. ***FY 2022 Plans:*** Continue lifing methods for durability and damage tolerance of aging structures on legacy fleet aircraft. Initiate digital engineering systems analysis on a low cost attritable unmanned aircraft system. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by $11.156 million. Funding decrease due to reduced emphasis on aircraft service life technologies.			
Title: Vehicle Design Technologies	12.170	27.072	16.937
Description: Develop methodologies to reduce the cost and time involved from design to full-scale testing of structural concepts and aerospace systems. ***FY 2021 Plans:*** Continue the development of advanced high fidelity aircraft design analysis tools. Continue the development of integrating cost, mission effectiveness, and affordable manufacturing methods into aircraft design analysis tools. Complete the development of control effector designs for supersonic tailless aircraft. Continue new design techniques to quantify and trade risk impacts against			

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622401 / *Structures*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
performance in aircraft designs. Initiate the development of new design methods that link vehicle system requirements to mission operation performance. ***FY 2022 Plans:*** Continue the development of advanced high fidelity aircraft design analysis tools. Continue the development of integrating cost, mission effectiveness, and affordable manufacturing methods into aircraft design analysis tools. Continue new design techniques to quantify and trade risk impacts against performance in aircraft designs. Continue the development of new design methods that link vehicle system requirements to mission operation performance. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by $10.135 million. Funding decrease due to reduced emphasis on vehicle design technologies.			
Title: Structural Concepts ***Description:*** Develop design methods, processes, and lightweight, adaptive, and multifunctional structural concepts to capitalize on new materials, multi-role considerations, and technology integration into aircraft systems. ***FY 2021 Plans:*** Complete development and verification of low cost attritable airframe concepts and manufacturing methods. Continue development of innovative structural design methods to dramatically reduce weight and complexity of aircraft structures. Continue development of fail-safe technologies for bonded unitized composite structures applicable to Mobility aircraft. Initiate validation of impact damage analysis and methods for advanced fail-safe composite structures applicable to Mobility aircraft. ***FY 2022 Plans:*** Continue development of innovative structural design methods to dramatically reduce weight and complexity of aircraft structures. Continue development of fail-safe technologies for bonded unitized composite structures applicable to Mobility aircraft. Continue validation of impact damage analysis and methods for advanced fail-safe composite structures applicable to Mobility aircraft. Initiate new low cost design and manufacturing structural concepts for attritable vehicles. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by 9.562 million. Funding decrease due to reduced emphasis on structural concepts.	11.489	25.557	15.994
Accomplishments/Planned Programs Subtotals	37.043	82.400	51.546

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622401 / *Structures*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force			Date: May 2021
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*	Project (Number/Name) 622403 / *Flight Controls and Pilot-Vehicle Interface*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
622403: *Flight Controls and Pilot-Vehicle Interface*	-	49.297	0.000	39.790	0.000	39.790	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This project develops technologies that enable maximum affordable capability from manned, remotely-piloted, and autonomous aerospace vehicles. Advanced control technologies are developed for maximum vehicle performance throughout the flight envelope and simulated in virtual environments. Resulting technologies contribute significantly towards the development of reliable autonomous or remotely piloted air vehicles, hypersonic aircraft, and extended-life legacy aircraft.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Advanced Flight Controls Technologies	6.790	0.000	9.168
Description: Develop technologies for advanced control-enabled capabilities, including flight controls, components, integrated vehicle management systems, and software and system certification techniques for both manned/unmanned and remotely piloted aircraft. ***FY 2021 Plans:*** Complete the development, demonstration, and assessment of advanced flight control mechanization technologies for trusted and certifiable operations under adverse and contested environments. Continue the development of trusted autonomy approach, integrating certification processes and autonomy development. Initiate the development, demonstration, and assessment of autonomy capabilities under adverse and contested environments. ***FY 2022 Plans:*** Continue the development of trusted autonomy approach, integrating certification processes and autonomy development. Continue the development, demonstration, and assessment of autonomy capabilities under adverse and contested environments. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 increased by $9.168 million compared to FY 2021. Funding increase due to increased emphasis on advanced flight controls technologies.			
Title: Manned and Unmanned Teaming Technologies	17.644	0.000	23.569
Description: Develop technology for flight control systems that will permit safe interoperability between manned and remotely piloted aircraft and effective teaming in adverse and contested environments. ***FY 2021 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622403 / *Flight Controls and Pilot-Vehicle Interface*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Continue development, demonstration, and assessment of advanced control automation techniques. Complete the development of mixed initiative control techniques for teams of remotely piloted aircraft and/or manned-unmanned teams in contested, dynamic mission environments, as well as for the integration of unmanned systems into controlled airspace and airbase operations. Complete the development of robust, affordable Unmanned Air Systems (UAS) operations in a terminal airspace environment. Continue the development of autonomous behaviors for safe, effective manned-unmanned teams. Initiate the development of tactical autonomy for manned-unmanned teams in contested, dynamic mission environments. ***FY 2022 Plans:*** Continue development, demonstration, and assessment of advanced control automation techniques. Continue the development of autonomous behaviors for safe, effective manned-unmanned teams. Continue the development of tactical autonomy for manned-unmanned teams in contested, dynamic mission environments. Initiate the development of mission management autonomy for manned-unmanned teams. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 increased by $23.569 million compared to FY 2021. Funding increase due to increased emphasis on manned and unmanned teaming technologies.			
Title: Flight Controls Technologies Modeling and Simulation ***Description:*** Develop tools and methods for capitalizing on simulation-based research and development of future aerospace vehicles. ***FY 2021 Plans:*** Continue modeling and simulation efforts to evaluate emerging autonomous and robust flight control technologies and concepts, as well as assess mission level performance of integrated aerospace systems. Continue analyses of manned-unmanned teams in adversarial mission environments. Continue trade studies of vehicle concepts for strike, mobility and reconnaissance. Continue manned-unmanned teaming evaluations including rapid development of new capabilities. Initiate analyses of capability concepts for future advanced development programs. ***FY 2022 Plans:*** Continue modeling and simulation efforts to evaluate emerging autonomous and robust flight control technologies and concepts, as well as assess mission level performance of integrated aerospace systems. Continue analyses of manned-unmanned teams in adversarial mission environments. Continue trade studies of vehicle concepts for strike, mobility and reconnaissance. Continue manned-unmanned teaming evaluations including rapid development of new capabilities. Continue analyses of capability concepts for future advanced development programs. ***FY 2021 to FY 2022 Increase/Decrease Statement:***	5.196	0.000	7.053

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622403 / *Flight Controls and Pilot-Vehicle Interface*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
FY 2022 increased by $7.053 million compared to FY 2021. Funding increase due to increased emphasis on flight controls technologies modeling and simulation.			
Title: Future AF Capabilities Applied Research ***Description:*** Investigate, design, and develop science and technologies supporting future Air Force capabilities to provide compelling advantage to the warfighter. To the greatest extent practical, research efforts will utilize modeling and simulation and cross-discipline systems integration (For example: air and space vehicles, avionics, propulsion, materials, human performance, cybersecurity, command, control, communications, computer and intelligence, sensors, electronic warfare, and conventional/ unconventional weapons). The National Defense Strategy and Air Force Science and Technology (S&T) Strategy will inform investments over the FYDP. ***FY 2021 Plans:*** Starting in FY 2021, this work is performed in PE 0602020F, Future AF Capabilities Applied Research, Project 620200, Enterprise Transformational Applied Research, Transformational Capability Incubator effort. ***FY 2022 Plans:*** Not applicable. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Not applicable.	19.667	0.000	0.000
Accomplishments/Planned Programs Subtotals	49.297	0.000	39.790

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force			Date: May 2021
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*	Project (Number/Name) 622404 / *Aeromechanics and Integration*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
622404: *Aeromechanics and Integration*	-	28.595	0.000	29.941	0.000	29.941	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This project develops aerodynamic configurations of a broad range of revolutionary, affordable aerospace vehicles. It matures and applies modeling and numerical simulation methods for fast and affordable aerodynamics prediction and integrates and demonstrates multi-disciplinary advances in airframe, propulsion, weapon, and air vehicle control integration.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Aerodynamic Systems Technologies	6.407	0.000	6.740
Description: Develop aerodynamic assessment prediction methods centered on expanding the design capabilities of future air vehicles. ***FY 2021 Plans:*** Continue development and assessment of low cost attritable unmanned air vehicle concepts. Initiate an assessment of design options to allow runway independence for low cost attritable unmanned air vehicle concepts. Continue design assessments of distributed propulsion concepts for next generation Mobility. Complete the development of a high fidelity aerodynamic analysis tool for the design of laser turrets applicable to Air Superiority 2030 requirements. Continue the assessment and development of incorporating active flow control techniques into advanced design to enable new aircraft configurations. ***FY 2022 Plans:*** Complete development and assessment of low cost attritable unmanned air vehicle concepts. Complete an assessment of design options to allow runway independence for low cost attritable unmanned air vehicle concepts. Continue design assessments of distributed propulsion concepts for next generation Mobility. Continue the assessment and development of incorporating active flow control techniques into advanced design to enable new aircraft configurations. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 increased compared to FY 2021 by $6.740 million. Funding increase due to increased emphasis on aerodynamic systems technologies.			
Title: Next Generation Aerodynamic Technologies	7.087	0.000	7.445
Description: Develop and assess technologies for the next generation of multi-role large aircraft. ***FY 2021 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622404 / *Aeromechanics and Integration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Continue next generation tanker maturation and assess promising configurations in high and low speed wind tunnels. Complete wind tunnel tests of practical laminar flow treatments and coatings for highly swept wings applicable to Mobility applications. Continue the design of a small, pod-mounted tactical air refueling boom for future Mobility applications. Continue the development of advanced high fidelity aerodynamic analysis tools for aircraft conceptual design. ***FY 2022 Plans:*** Complete next generation tanker maturation and assess promising configurations in high and low speed wind tunnels. Continue the design of a small, pod-mounted tactical air refueling boom for future Mobility applications. Continue the development of advanced high fidelity aerodynamic analysis tools for aircraft conceptual design. Initiate assessment of innovative next generation vehicle concepts. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 increased compared to FY 2021 by $7.445 million. Funding increased due to increased emphasis on next generation aerodynamic technologies.			
Title: Aircraft Integration Technologies	15.101	0.000	15.756
Description: Develop enabling technologies to allow efficient and effective integration of propulsion, weapons, and subsystems into current and future air vehicles. ***FY 2021 Plans:*** Continue development of advanced kinetic and directed energy weapons integration technologies for Air Superiority 2030. Continue integrated full flow path demonstration of a medium bypass embedded engine for next generation mobility and completing the full flow path demonstration design. Complete propulsion integrations component wind tunnels tests for Air Superiority 2030 requirements. Initiate design and analysis methods to allow rapid certification of stores separation for new small weapons on tactical aircraft. ***FY 2022 Plans:*** Continue development of advanced kinetic and directed energy weapons integration technologies for Air Superiority 2030. Continue integrated full flow path demonstration of a medium bypass embedded engine for next generation mobility and completing the full flow path demonstration design. Continue design and analysis methods to allow rapid certification of stores separation for new small weapons on tactical aircraft. Initiate development of hybrid electric distributed propulsion vehicle integration designs for next generation vehicle concepts. ***FY 2021 to FY 2022 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622404 / *Aeromechanics and Integration*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
FY 2022 increased compared to FY 2021 by $15.756 million. Funding increased due to increased emphasis on aircraft integration technologies.			
Accomplishments/Planned Programs Subtotals	28.595	0.000	29.941

	FY 2020	FY 2021
Congressional Add: Program increase - secure UAV technologies ***FY 2020 Accomplishments:*** Not Applicable. ***FY 2021 Plans:*** Conduct Congressionally directed efforts.	0.000	0.000
Congressional Add: Program increase - advanced battery technology for directed energy ***FY 2020 Accomplishments:*** Not applicable. ***FY 2021 Plans:*** Conduct Congressionally directed efforts.	0.000	0.000
Congressional Adds Subtotals	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force			Date: May 2021
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*	Project (Number/Name) 622405 / *High Speed Systems Technology*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
622405: *High Speed Systems Technology*	-	33.241	62.578	38.103	0.000	38.103	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This effort investigates, analyzes, and develops high speed/hypersonic aerospace vehicle technologies. Advanced high temperature structures concepts are explored and developed to exploit new materials, fabrication processes, and design techniques. Advanced aerodynamic vehicle configurations are developed and analyzed through simulations, experiments, and multi-disciplinary analyses. Advanced flight control technologies are developed and simulated for hypersonic vehicles. These technologies will enable future high speed weapons; intelligence, surveillance, and reconnaissance systems; and space access vehicles.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: High Speed Systems Technology	13.511	23.008	22.123
Description: Develop design analysis methods and technologies for high speed systems at extreme flight conditions. ***FY 2021 Plans:*** Continue to mature critical technologies for high speed/ hypersonic flight with greater emphasis on longer range flight and heavier payloads. Continue maturation of innovative structural concepts, analytical methods, service life predictions, and thermal management techniques for structures. Continue development of design/analysis techniques/tools and experimental approaches to enable enhanced high-speed air induction system starting, operability, and performance for propulsion integration concepts over a wide range of flight conditions. Continue development of high speed system concepts that provide revolutionary capabilities. Continue investigation of aeromechanic technologies to reduce drag and enable robust stability and control at all flight conditions. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental ground and flight testing. Continue assessment of engagement, mission, and campaign-levels of effectiveness for promising high speed systems and refine concept designs to incorporate needed capabilities. ***FY 2022 Plans:*** Continue to mature critical technologies for high speed/ hypersonic flight with primary emphasis on longer range flight and heavier payloads. Continue maturation of innovative structural concepts, analytical methods, service life predictions, airframe/engine integration, and thermal management techniques for structures. Complete development of design and analysis techniques and tools as well as experimental approaches to enable enhanced high-speed air induction system starting, operability, and performance for propulsion integration concepts over a wide range of flight conditions. Continue development of high speed system concepts that provide revolutionary capabilities including affordable expendable systems and robust reusable systems. Continue investigation of aeromechanic technologies to reduce drag and enable robust stability and control at all flight conditions. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed			

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622405 / *High Speed Systems Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
component technologies through ground and flight testing. Complete assessment of engagement, mission, and campaign-levels of effectiveness for promising high speed systems and refine concept designs to incorporate needed capabilities. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by 0.795 million. Funding decreased described in plans above.			
Title: High Speed Vehicle Aeromechanics and Integration ***Description:*** Develop new and improved components, concepts, and designs for sustained flight of high-speed/hypersonic expendable and re-useable vehicles. Conduct analyses of high speed/hypersonic vehicles to enable revolutionary capabilities. ***FY 2021 Plans:*** Continue to mature critical technologies for high speed/ hypersonic flight with greater emphasis on longer range flight and heavier payloads. Continue development of design/analysis techniques/ tools and experimental approaches to enable enhanced high-speed air induction system starting, operability, and performance for propulsion integration concepts over a wide range of flight conditions. Continue development of high speed system concepts that provide revolutionary capabilities. Continue investigation of aeromechanic technologies to reduce drag and enable robust stability and control at all flight conditions. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental ground and flight testing. Continue assessment of engagement, mission, and campaign levels of effectiveness for promising high speed systems and refine concept designs to incorporate needed capabilities. Continue assessment of campaign level benefits of preferred high speed weapon alternatives. ***FY 2022 Plans:*** Continue to mature critical technologies for high speed/hypersonic flight with primary emphasis on longer range flight, heavier payloads, and high speed deployment. Continue development of design and analysis techniques and tools as well as experimental approaches to enhance high-speed engine inlet performance over a wide range of flight conditions. Continue development of high speed system concepts that provide revolutionary capabilities. Continue investigation of aeromechanic technologies to reduce drag, evaluate uncertainty, improve instrumentation accuracy, enable payload deployment, and achieve robust stability & control at all flight conditions. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through ground and flight testing. Continue assessment of engagement, mission, and campaign level effectiveness for promising high speed system concepts and refine concept designs to incorporate needed capabilities. Complete assessment of campaign level benefits of preferred high speed weapon alternatives. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by 0.590 million. Funding decreased described in plans above.	9.730	16.570	15.980
Accomplishments/Planned Programs Subtotals	23.241	39.578	38.103

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622405 / *High Speed Systems Technology*

	FY 2020	FY 2021
Congressional Add: Program increase - modeling and testing of high temperature aero vehicle ***FY 2020 Accomplishments:*** Not Applicable. ***FY 2021 Plans:*** Conduct Congressionally directed efforts.	0.000	4.000
Congressional Add: Program increase - hypersonic research and education ***FY 2020 Accomplishments:*** Not Applicable. ***FY 2021 Plans:*** Conduct Congressionally directed efforts.	0.000	4.000
Congressional Add: Program increase - hypersonic vehicle structures ***FY 2020 Accomplishments:*** Conduct Congressionally directed efforts ***FY 2021 Plans:*** Not applicable.	10.000	0.000
Congressional Add: Program increase - secure UAV technologies ***FY 2020 Accomplishments:*** Not applicable. ***FY 2021 Plans:*** Conduct Congressionally directed efforts. This effort will be executed in PE 0602201F Aerospace Vehicle Technologies, Project 622404 Aeromechanics and Integration.	0.000	10.000
Congressional Add: Program increase - advanced battery technology for directed energy ***FY 2020 Accomplishments:*** Not applicable. ***FY 2021 Plans:*** Conduct Congressionally directed efforts. This effort will be executed in PE 0603216F, Aerospace Propulsion and Power Technology, Project 633035 Aerospace Power Technology.	0.000	5.000
Congressional Adds Subtotals	10.000	23.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force			Date: May 2021
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*	Project (Number/Name) 622406 / *Aerospace Power & Flight Control Technology*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
622406: *Aerospace Power & Flight Control Technology*	-	0.000	19.448	0.000	0.000	0.000	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This project develops integrated electrical and thermal management components, controls and systems for military aerospace applications. Power component technologies are developed to increase reliability, maintainability, commonality, affordability, and supportability of aircraft and flight line equipment. Research is conducted in energy storage and hybrid power system technologies to enable special purpose applications. Electrical power and thermal management technologies enable future military megawatt level power and thermal management needs. Controls and system integration technologies ensure the interoperability of aircraft, power, thermal, engine and other systems and subsystems. This project supports development of electrical power and thermal management components, controls and systems suitable for applications to legacy and future aircraft platforms including strike and mobility concepts. Lightweight power systems suitable for other aerospace applications are also developed. This project develops technologies that enable maximum affordable capability from manned, remotely-piloted and autonomous aerospace vehicles. Advanced control technologies are developed for maximum vehicle performance throughout the flight envelope and simulated in virtual environments. Resulting technologies contribute significantly towards the development of reliable autonomous or remotely piloted air vehicles, hypersonic aircraft, and extended-life legacy aircraft.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: High Power System Technologies	0.000	8.000	0.000
Description: Develop integrated system architecture, controls, and component technologies to provide for the large amounts of electrical power needed, and concurrent thermal mitigation required, by current and future manned and unmanned systems. ***FY 2021 Plans:*** Continue development of system and component electrical power, electro-mechanical, and thermal technologies for high-power applications. Continue development of hybrid approaches to power generation, storage, and application as well as thermal management. Continue testing of subsystems hardware in conjunction with continued platform level tip-to-tail modeling and simulation energy optimization. Continue development of advanced, safe energy storage, power distribution, and management systems to include Silicon Carbide applications and batteries. Continue power and thermal development toward demonstration of tactical aircraft high-power payload capability, e.g. laser weapon system. Continue analysis and development of adaptive power and thermal control systems for high-power aircraft. Continue weapon system contractor support for platform integration of advanced power and thermal system architectures. Initiate medium-scale propulsion, power and thermal system studies and development. ***FY 2022 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622406 / *Aerospace Power & Flight Control Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Not applicable. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by $8 million. In FY 2022, this work will be performed in PE 0602203F Aerospace Propulsion, Project 623145 Aerospace Power Technology.			
Title: Advanced Flight Control Technologies ***Description:*** Develop technologies for advanced control-enabled capabilities, including flight controls, components, integrated vehicle management systems and software and system certification techniques for both manned/unmanned and remotely piloted aircraft. ***FY 2021 Plans:*** Complete the development, demonstration, and assessment of advanced flight control mechanization technologies for trusted and certifiable operations under adverse and contested environments. Continue the development of trusted autonomy approach, integrating certification processes and autonomy development. Initiate the development, demonstration, and assessment of autonomy capabilities under adverse and contested environments. ***FY 2022 Plans:*** Not applicable ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by $2.624 million. In FY 2022, this work will be performed in PE 0602201F, Project 622402 Flight Controls and Pilot-Vehicle Interface.	0.000	2.624	0.000
Title: Manned and Unmanned Teaming Technologies ***Description:*** Develop technology for flight control systems that will permit safe interoperability between manned and remotely piloted aircraft and effective teaming in adverse and contested environments. ***FY 2021 Plans:*** Continue development, demonstration, and assessment of advanced control automation techniques. Complete the development of mixed initiative control techniques for teams of remotely piloted aircraft and/or manned-unmanned teams in contested, dynamic mission environments, as well as for the integration of unmanned systems into controlled airspace and airbase operations. Complete the development of robust, affordable Unmanned Air Systems (UAS) operations in a terminal airspace environment. Continue the development of autonomous behaviors for safe, effective manned-unmanned teams. Initiate the development of tactical autonomy for manned-unmanned teams in contested, dynamic mission environments. ***FY 2022 Plans:***	0.000	6.817	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 622406 / *Aerospace Power & Flight Control Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Not applicable. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by $6.817 million. In FY 2022, this work will be performed in PE 0602201F, Project 622402 Flight Controls and Pilot-Vehicle Interface.			
Title: Flight Controls Technologies Modeling and Simulation ***Description:*** Develop tools and methods for capitalizing on simulation-based research and development of future aerospace vehicles. ***FY 2021 Plans:*** Continue modeling and simulation efforts to evaluate emerging autonomous and robust flight control technologies and concepts, as well as assess mission level performance of integrated aerospace systems. Continue analyses of manned-unmanned teams in adversarial mission environments. Continue trade studies of vehicle concepts for strike, mobility and reconnaissance. Continue manned-unmanned teaming evaluations including rapid development of new capabilities. Initiate analyses of capability concepts for future advanced development programs. ***FY 2022 Plans:*** Not applicable. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 decreased compared to FY 2021 by $2.007 million. In FY 2022, this work will be performed in PE 0602201F, Project 622402 Flight Controls and Pilot-Vehicle Interface.	0.000	2.007	0.000
Accomplishments/Planned Programs Subtotals	0.000	19.448	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force			Date: May 2021
Appropriation/Budget Activity 3600 / 2	R-1 Program Element (Number/Name) PE 0602201F / *Aerospace Vehicle Technologies*	Project (Number/Name) 625172 / *NUCLEAR SYSTEM TECHNOLOGY*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
625172: *NUCLEAR SYSTEM TECHNOLOGY*	-	0.000	0.000	3.652	0.000	3.652	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This project provides sustaining S&T to preserve nuclear deterrence for future generations, develops complimentary projects to inform future systems, establishing inter-agency partnerships for Modeling & Simulation (M&S) and test platforms, and coordinates with existing programs for next generation strategic systems development and test platforms.

In FY 2022, the seismic technologies efforts of PE 1206601SF, Space Technology, Project 621010, Space Survivability & Surveillance were transferred to Appropriation 3600, Research, Development, Test & Evaluation, Air Force, PE 0602201F, Aerospace Vehicles Technologies, Project 625172, Nuclear System Technology, from Appropriation 3620, Budget Activity (BA) 02 due to the creation of a new Appropriation for Space Force.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Seismic Technologies	0.000	0.000	3.652
Description: Develop seismic technologies to support national requirements for monitoring nuclear explosions with special focus on regional distances less than 2,000 kilometers from the sensors. ***FY 2021 Plans:*** Not applicable ***FY 2022 Plans:*** Continue to test new algorithms on high performance computing capabilities with special focus on automation of seismic event discrimination and characterization, improving earth structure models, and developing analysis methods for emerging detection technologies. Continue to exercise earth models in use in high-performance computing modeling and simulation codes for operational expert analysis of difficult-to-discriminate earthquakes and explosions. Continue to test specific algorithms for application of big data heuristics to more quickly characterize seismic events. Continue to further develop new statistical approaches to the behavior of discriminants for local and regional seismic events. Initiate refinement of distributed acoustic sensing methodology to provide a new detection solution for seismic explosion monitoring. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** FY 2022 increased compared to FY 2021 by $3.652 million. Funding increased due to the transfer and realignment of the work in the Seismic Technologies effort in PE 1206601SF, Space Technology, Project 621010, Space Survivability & Surveillance,			

Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force		Date: May 2021
Appropriation/Budget Activity 3600 / 2	**R-1 Program Element (Number/Name)** PE 0602201F / *Aerospace Vehicle Technologies*	**Project (Number/Name)** 625172 / *NUCLEAR SYSTEM TECHNOLOGY*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
to Appropriation 3600, Research, Development, Test & Evaluation, Air Force, PE 0602201F, Aerospace Vehicle Technologies, Project 625172, Nuclear System Technology due to the creation of a new Appropriation for Space Force.			
Accomplishments/Planned Programs Subtotals	0.000	0.000	3.652

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable