

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Air Force **Date:** February 2020

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>
--	--

COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	140.247	170.973	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
632480: <i>Aerospace Fuels</i>	-	2.028	2.386	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
633035: <i>Aerospace Power Technology</i>	-	32.926	39.670	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
634921: <i>Aircraft Propulsion Subsystems Int</i>	-	18.961	18.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
634922: <i>Space & Missile Rocket Propulsion</i>	-	33.383	53.256	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
635098: <i>Advanced Aerospace Propulsion</i>	-	29.913	18.814	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
63681B: <i>Advanced Turbine Engine Gas Generator</i>	-	23.036	38.831	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program develops and demonstrates technologies to achieve enabling and revolutionary advances in turbine, advanced-cycle, rocket, and space propulsion as well as electrical power, thermal management, and fuels. The program has six projects, each focusing on technologies with a high potential to enhance the performance of existing and future Air Force weapon systems. The Aerospace Fuels project develops and demonstrates improved hydrocarbon fuels and advanced propulsion systems, including those for air-breathing, high-speed/hypersonic flight. The Aerospace Power Technology project develops and demonstrates adaptive power and thermal management components, controls, and systems for high-power payloads and aircraft as part of energy-optimized aircraft development. The Aircraft Propulsion Subsystems Integration project develops demonstrator engines by integrating the engine cores demonstrated in the Advanced Turbine Engine Gas Generator project with low-pressure components. The Space and Missile Rocket Propulsion project develops and demonstrates innovative rocket propulsion technologies, propellants, and manufacturing techniques. The Advanced Aerospace Propulsion project develops the scramjet propulsion cycle to a technology readiness level appropriate for in-flight demonstration and for full integration with other engine cycles (including turbine and rocket based). The Advanced Turbine Engine Gas Generator project develops and demonstrates core turbine engine technologies for current and future aircraft propulsion systems.

Portions of the Aerospace Fuels, Aircraft Propulsion Subsystems Integration, and Advanced Turbine Gas Generator projects support adaptive cycle technology demonstrations, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

Projects in this program have been coordinated through the Department of Defense (DoD) Science and Technology (S&T) Executive Committee process to harmonize efforts and eliminate duplication.

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Air Force		Date: February 2020
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	
<p>In FY 2021, the efforts and activities under Project 632480, Aerospace Fuels, will be transferred from PE 0603216F, Aerospace Propulsion and Power Technology to PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology, in order to consolidate Aerospace Fuel research for increased transparency for Congress.</p> <p>In the FY 2021, the Air Force is consolidating its existing thirteen Advanced Technology Development (ATD), Research Development Test and Evaluation (RDT&E), Budget Activity 03 (BA 03) PEs into five new capability focused RDT&E BA 03 PEs to better align with the Air Force Science and Technology (S&T) Strategy signed by the SECAF in April 2019. This consolidation will improve and accelerate delivery of integrated transformational, multidisciplinary, collaborative technology solutions necessary to enable new Air Force warfighting capabilities that support of the National Defense Strategy. This new structure will provide the Air Force and Congress with a clearer understanding and increased transparency of integrated technology solutions and demonstrations key to enabling the Air Force future force design.</p> <p>In FY 2021, the entirety of Project 633035, Aerospace Power Technology; Project 634922, Space & Missile Rocket Propulsion; Project 635098, Advanced Aerospace Propulsion, and Project 63681B, Advanced Turbine Engine Gas Generator, will be transferred from PE 0603216F, Aerospace Propulsion and Power Technology, to PE 0603033F, Next Gen Platforms Dev/Demo.</p> <p>In FY 2021, Project 634921, Aircraft Propulsion Subsystems Int, non-Vanguard efforts and activities will be transferred from PE 0603216F, Aerospace Propulsion Subsystems Int, to PE 0603033F, Next Gen Platforms Dev/Demo. Skyborg Vanguard activities under this Project will be consolidated and transferred in FY 2021 from PE 0603216F, Aerospace Propulsion and Power, to PE 0603032F, Future AF Integrated Technology Demos, Project 630320, Air Force Vanguard.</p> <p>All these transfers detailed above are part of the Air Force RDT&E BA 03 PE consolidation in order to realign technology areas to better support the National Defense Strategy, Air Force Future Operating Concept and Air Force S&T Strategy, April 2019. This is an administrative realignment and not a new start. This work will continue to be executed by the Air Force Research Laboratory Aerospace Systems Technology Directorate located in either Wright Patterson Air Force Base, Ohio or Edwards Air Force Base, California.</p> <p>This program element may include necessary civilian pay expenses required to manage, execute, and deliver science and 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, 0602202F, 0602203F, 0602204F, 0602602F, 0602605F, 0602788F, 1206601SF, and 0602298F.</p> <p>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.</p>		

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Air Force **Date:** February 2020

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>
--	--

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	148.418	113.973	115.142	0.000	115.142
Current President's Budget	140.247	170.973	0.000	0.000	0.000
Total Adjustments	-8.171	57.000	-115.142	0.000	-115.142
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	57.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-4.674	0.000			
• Other Adjustments	-3.497	0.000	-115.142	0.000	-115.142

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

Project: 633035: Aerospace Power Technology

Congressional Add: *Program increase - silicon carbide research*

Congressional Add: *Program increase - low spool generator capabilities*

Congressional Add Subtotals for Project: 633035

Project: 634922: Space & Missile Rocket Propulsion

Congressional Add: *Program increase - chemical apogee engines*

Congressional Add: *Program increase - upper stage engine maturation*

Congressional Add: *Program increase - space propulsion technologies*

Congressional Add Subtotals for Project: 634922

Project: 63681B: Advanced Turbine Engine Gas Generator

Congressional Add: *Program increase - advanced turbine engine gas generator*

Congressional Add Subtotals for Project: 63681B

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	14.528	10.000
	0.000	5.000
Congressional Add Subtotals for Project: 633035	14.528	15.000
	2.421	5.000
	8.232	18.000
	0.000	2.000
Congressional Add Subtotals for Project: 634922	10.653	25.000
	6.780	17.000
Congressional Add Subtotals for Project: 63681B	6.780	17.000
Congressional Add Totals for all Projects	31.961	57.000

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Air Force		Date: February 2020
Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	
Change Summary Explanation Decrease in FY 2019 of \$3.497 million in Other Adjustments is due to realignment of funds to PE 0602212F to support Research and Development Projects, 10 U.S.C. Section 2358. Decrease in FY 2021 of \$115.142 million is due to the following: 1) Realignment of the entirety of Project 632480, Aerospace Fuels from PE 0603216F, Aerospace Propulsion and Power Technology to PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology to consolidate the Aerospace Fuels research for increased transparency for Congress. 2) Realignment of the entirety of Project 633035, Aerospace Power Technology; Project 634922, Space & Missile Rocket Propulsion; Project 635098, Advanced Aerospace Propulsion; and Project 63681B, Advanced Turbine Engine Gas Generator to PE 0603033F, Next Gen Platforms Dev/Demo. 3) Realignment of Project 634921, Aircraft Propulsion Subsystems Int non-Vanguard efforts and activities to PE 0603033F, Next Gen Platforms Dev/Demo. Skyborg Vanguard activities under this Project will be consolidated and transferred in FY 2021 to PE 0603032F, Future AF Integrated Technology Demos, Project 630320, Air Force Vanguards. These transfers in FY 2021 are part of the Air Force RDT&E BA 03 PE consolidation in order to realign technology areas to better support the National Defense Strategy, Air Force Future Operating Concept and Air Force S&T Strategy, April 2019.		

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force										Date: February 2020		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 632480 / <i>Aerospace Fuels</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
632480: <i>Aerospace Fuels</i>	-	2.028	2.386	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project evaluates and demonstrates improved hydrocarbon fuels, unique special application fuels, alternate fuels and advanced, novel aerospace propulsion technologies for Air Force applications, including high-speed and hypersonic flight and technologies to increase turbine engine operational reliability, durability, mission flexibility, and performance, while reducing weight, fuel consumption, and cost of ownership. The advanced fuel emphasis is on demonstrating new thermally stable, high-heat sink, and controlled chemically reacting fuels for a conventional turbine engine, turbine-based combined cycle engines, and other advanced propulsion systems. The project also evaluates and demonstrates fuel system components that minimize cost, reduce maintenance, and improve performance of future aerospace systems. The advanced propulsion emphasis is on demonstrating concepts for combined cycle, ramjet, and scramjet engines. A portion of this project supports the demonstration of adaptive cycle technologies. This project develops component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

In FY 2021, the efforts and activities under Project 632480, Aerospace Fuels, will be transferred from PE 06030216F, Aerospace Propulsion and Power Technology to PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology to consolidate the Aerospace Fuels research increasing the transparency for Congress. The transferred efforts and activities will continue to be executed by the Air Force Research Laboratory Aerospace Systems Technology Directorate located in Wright Patterson Air Force Base, Ohio. This is an administrative realignment for consolidation, and not a new start.

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

	FY 2019	FY 2020	FY 2021
Title: Fuel-Related Thermal Management	0.607	0.731	0.000
Description: Demonstrate thermally stable fuels and fuel system hardware concepts to enhance cooling capacity (performance), minimize fuel coking, and reduce fuel system maintenance.			
FY 2020 Plans: Continue investigation of fuel heat sink approaches for thermal management of adaptive engines, such as on-board fuel deoxygenation. Initiate investigation of heat exchangers including additive manufactured units. Initiate the development of integrated test rigs to tests these approaches and assess efficiency of these approaches.			
FY 2021 Plans: Starting in FY 2021, this work is performed under the Fuel-Related Thermal Management effort in PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 632480 / <i>Aerospace Fuels</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
FY 2021 decreased compared to FY 2020 by \$0.731 million. Funding decreased due to realignment of Fuel-Related Thermal Management research to PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology, Fuel-Related Thermal Management effort.				
<p>Title: Gas Turbine Combustion, Emissions, and Performance</p> <p>Description: Develop and demonstrate efficacy of low-cost, environmentally friendly fuel approaches to assess and reduce soot/particulate emissions from gas turbine engines.</p> <p>FY 2020 Plans: Continue development of augmentor combustor/simulator to determine fuel effects on augmentor operability under realistic conditions. Initiate study of fuel temperature limitations and use data to validate models.</p> <p>FY 2021 Plans: Starting in FY 2021, this work is performed under the Gas Turbine Combustion, Emissions, and Performance effort in PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 decreased compared to FY 2020 by \$0.621 million. Funding decreased due to realignment of Gas Turbine Combustion, Emissions, and Performance research to PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology, Gas Turbine Combustion, Emissions, and Performance effort.</p>		0.543	0.621	0.000
<p>Title: Fuel Logistics</p> <p>Description: Identify, develop, and demonstrate low-cost approaches to reducing the fuel logistics footprint for the Air Force.</p> <p>FY 2020 Plans: Continue development of fuel composition in-situ sensors to ensure thermal stability throughout platform mission. Continue development of fuel sensors and mitigation products to detect and mitigate fuel bio-contamination.</p> <p>FY 2021 Plans: Starting in FY 2021, this work is performed under the Fuel Logistics effort in PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 decreased compared to FY 2020 by \$0.827 million. Funding decreased due to realignment of Fuel Logistics research to PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology, Fuel Logistics effort.</p>		0.749	0.827	0.000
<p>Title: Alternative Jet Fuels</p>		0.129	0.207	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 632480 / <i>Aerospace Fuels</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Description: Characterize and demonstrate the use of alternative hydrocarbon jet fuel to comply with Air Force certifications and standards for jet fuels.</p> <p>FY 2020 Plans: Complete development of generic alternative fuel specification annexes for commercial jet fuels used by Air Force.</p> <p>FY 2021 Plans: Starting in FY 2021, this work is performed under the Alternative Jet Fuels effort in PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 decreased compared to FY 2020 by \$0.207 million. Funding decreased due to realignment of Alternative Jet Fuels research to PE 0602201F, Aerospace Vehicle Technologies, Project 625330, Aerospace Fuel Technology, Alternative Jet Fuels effort.</p>				
Accomplishments/Planned Programs Subtotals		2.028	2.386	0.000
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force										Date: February 2020		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 633035 / <i>Aerospace Power Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
633035: <i>Aerospace Power Technology</i>	-	32.926	39.670	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates system and subsystem integration to include adaptive architectures, actuation, electrical power, thermal management, and distribution for aerospace applications. This project develops and demonstrates the components, controls and systems required to satisfy the operational needs of current and future aircraft and enables the use of future high-power payloads. This technology enhances reliability and survivability, and reduces vulnerability, weight, and life cycle costs of air platforms. The electrical power system components developed are projected to provide a two-fold to five-fold improvement in aircraft reliability and maintainability, and a reduction in power system weight. This project is integrated into energy optimized aircraft efforts and power and thermal programs.

In FY 2021, the entirety of Project 633035, Aerospace Power Technology, will be transferred to PE 0603033F, Next Gen Platforms Dev/Demo, Project 633035, Aerospace Power Technology, as part of the Air Force RDT&E BA 03 PE consolidation in order to realign technology areas to better support the National Defense Strategy, Air Force Future Operating Concept and Air Force Science and Technology Strategy, April 2019. The Project and associated efforts will continue to be managed by the Air Force Research Laboratory Aerospace Systems Technology Directorate located in Wright Patterson Air Force Base, Ohio. This is an administrative realignment for consolidation, and not a new start.

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

	FY 2019	FY 2020	FY 2021
Title: High Power Aircraft Subsystem Technologies	18.398	24.670	0.000
Description: Develop and demonstrate integrated architecture, controls and components for power generation, conditioning, and distribution; energy storage components; and thermal management and subsystem technologies for integration into high power aircraft.			
FY 2020 Plans: Continue development and demonstration of system and component electrical power, electro-mechanical, and thermal technologies for high-power aircraft. Complete development of actuation technology for applications with power, volume, and thermal limitations. Continue the development of hybrid-cycle power and thermal management system. Continue development of advanced power generation and distribution system. Continue development and demonstration of integrated, adaptive megawatt-class tactical aircraft power and thermal capability. Continue development and demonstration of megawatt class architecture, controls and integration. Continue development and demonstration of robust electrical power systems for megawatt applications. Continue development and demonstration of thermal management systems for megawatt applications. Continue development and demonstration of solid state electrical distribution technology for megawatt applications.			
FY 2021 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 633035 / <i>Aerospace Power Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
For FY 2021 and future years, this work is performed under the High Power Aircraft System effort in PE 0603033F, Next Gen Platform Dev/Demo, Project BPAC 633035, Aerospace Power Technology.				
FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 decreased compared to FY 2020 by \$24.670 million. Funding decreased due to the transfer and realignment of this work to the High Power Aircraft Subsystems Technology effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 633035, Aerospace Power Technology.				
Accomplishments/Planned Programs Subtotals		18.398	24.670	0.000
		FY 2019	FY 2020	
Congressional Add: Program increase - silicon carbide research		14.528	10.000	
FY 2019 Accomplishments: Conducted Congressionally directed efforts				
FY 2020 Plans: Not Applicable				
Congressional Add: Program increase - low spool generator capabilities		0.000	5.000	
FY 2019 Accomplishments: Not Applicable				
FY 2020 Plans: Conduct Congressionally directed efforts.				
Congressional Adds Subtotals		14.528	15.000	
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force										Date: February 2020		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 634921 / <i>Aircraft Propulsion Subsystems Int</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
634921: <i>Aircraft Propulsion Subsystems Int</i>	-	18.961	18.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The Aircraft Propulsion Subsystems Integration (APSI) project includes demonstrator engines for manned systems and efficient small-scale propulsion for remotely piloted aircraft and cruise missile applications. The demonstrator engines integrate the core (high- pressure spool) technology developed under the Versatile Affordable Advanced Turbine Engines (VAATE) project with the engine (low-pressure spool) technology such as fans, turbines, engine controls, mechanical systems, exhaust nozzles, and augmentors. Additionally, this project includes activities to improve propulsion safety and readiness. This project also focuses on integration of inlets, nozzles, engine-to-airframe compatibility, and power and thermal management subsystems technologies. The APSI project provides aircraft with potential for longer range and higher cruise speeds with lower specific fuel consumption, surge power for successful engagements, high sortie rates with reduced maintenance, reduced life cycle cost, and improved survivability, resulting in increased mission effectiveness. Technologies developed are applicable to sustained high-speed vehicles and responsive space launch. The Aircraft Propulsion Subsystems Integration project is focused on improving propulsion capabilities while at the same time reducing the cost of ownership. Anticipated technology advances include turbine engine improvements providing approximately twice the range for a sustained supersonic combat aircraft, doubling the time on station with ten times the power output for surveillance aircraft and propulsion for a high speed supersonic missile with double the range for time sensitive targets. A portion of this project supports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, high power extraction, integrated thermal management, and durability for widely varying mission needs.

In FY 2021, Project 634921, Aircraft Propulsion Subsystems Int, non-Vanguard efforts and activities will be transferred from PE 0603216F, Aerospace Propulsion and Power Technology, to PE 0603033F, Next Gen Platform Dev/Demo. Skyborg Vanguard activities under this Project will be consolidated and transferred in FY 2021 from PE 0603216F, Aerospace Propulsion and Power Technology, to PE 0603032F, Future AF Integrated Technology Demos, Project 630320, Air Force Vanduaards. These transfers are part of the Air Force RDT&E BA 03 PE consolidation in order to realign technology areas to better support the National Defense Strategy, Air Force Future Operating Concept and Air Force S&T Strategy, April 2019. The Project and associated Non-Vanguard efforts and activities will continue to be executed by the Air Force Research Laboratory Aerospace Systems Technology Directorate located in Wright Patterson Air Force Base, Ohio. This is an administrative realignment for consolidation, and not a new start.

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

	FY 2019	FY 2020	FY 2021
Title: Missile/Remotely Piloted Aircraft Engine Performance	11.198	10.674	0.000
Description: Design, fabricate, and test component technologies for limited-life engines to improve the performance, durability, and affordability of missile and remotely piloted aircraft engines.			
FY 2020 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634921 / <i>Aircraft Propulsion Subsystems Int</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Continue risk reduction component testing of a medium-scale efficient core demonstrator. Continue risk reduction testing of components for small expendable turbojet/turbofans (100-900 lbs class). Initiate and complete conceptual and detailed design of a medium-scale high power, high efficiency turboprop. Initiate risk reduction component rig testing and initiate fabrication of components in preparation for engine testing for this turboprop. Initiate and complete conceptual design of a high efficiency medium-scale embedded propulsion concept. Continue development of derivative supersonic turbojet engines for missile and high speed accelerators. Complete design and review of advanced turbine based accelerator with reusable high speed applications. Complete vehicle and propulsion system integration analysis.</p> <p>FY 2021 Plans: For FY 2021 and future years, non-Vanguard work is performed under the Missile/Remotely Piloted Aircraft effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634921, Aircraft Propulsion Subsystems Integration. Skyborg Vanguard activities are performed under the Skyborg effort in PE 0603032F, Next Gen Platform Dev/Demo.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 decreased compared to FY 2020 by \$10.674 million. Funding decreased due to the transfer and realignment of this work to the Missile/Remotely Piloted Aircraft Engine Performance effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634921, Aircraft Propulsion Subsystem Int, and PE 0603032F, Future AF Integrated Technology Demos, Project 630320, Air Force Vanguard, as part of the Air Force RDT&E BA 03 PE consolidation.</p>			
<p>Title: Adaptive Turbine Engine Technologies</p> <p>Description: Design, fabricate, and demonstrate performance, durability, and operability technologies to mature adaptive turbine engine technologies.</p> <p>FY 2020 Plans: Continue to provide subject matter expert support to Adaptive Engine Transition Program. Complete hardware fabrication for an adaptive engine for utilization as an integrated power and thermal management engine demonstrator. Initiate and complete conceptual design review of adaptive engine core technologies and initiate technology rig tests to decrease risk in core technology testing. Initiate detailed design, fabrication and testing of component technology rig for an adaptive core demonstrator. Initiate conceptual design of fully adaptive architectures and mature critical technologies for future weapon systems.</p> <p>FY 2021 Plans: For FY 2021 and future years, this work is performed under the Adaptive Turbine Engine Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634921, Aircraft Propulsion Subsystems Integration.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement:</p>	7.763	7.342	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634921 / <i>Aircraft Propulsion Subsystems Int</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
FY 2021 decreased compared to FY 2020 by \$7.342 million. Funding decreased due to the transfer and realignment of this work to the Adaptive Turbine Engine Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634921, Aircraft Propulsion Subsystems Int as part of the Air Force RDT&E BA 03 PE consolidation.			
Accomplishments/Planned Programs Subtotals	18.961	18.016	0.000

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force										Date: February 2020		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 634922 / <i>Space & Missile Rocket Propulsion</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
634922: <i>Space & Missile Rocket Propulsion</i>	-	33.383	53.256	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates advanced and innovative low-cost rocket turbo-machinery and components, and low-cost space launch propulsion technologies. Additionally, this project develops technologies for the sustainment of strategic systems (including solid rocket motor boosters and missile propulsion, post boost control, and aging and surveillance efforts) and tactical rockets. Characteristics such as environmental acceptability, affordability, reliability, responsiveness, reduced weight, and reduced operation and launch costs are emphasized. Increased life and performance of propulsion systems are key goals. Technology areas investigated include ground demonstrations of compact, lightweight, advanced propulsion technologies, higher efficiency energy conversion systems (derived from an improved understanding of combustion fundamentals), and high-energy propellants. Technological advances in this project could improve the performance of expendable payload capabilities by approximately twenty to fifty percent and reduce launch, operations, and support costs by approximately thirty percent. Responsiveness and operability of propulsion systems will be enhanced for reusable launch systems. Aging and surveillance thrusts for solid rocket motors could reduce lifetime prediction uncertainties for individual motors by fifty percent, enabling motor replacement for cause. The efforts in this project contribute to the sustainment of the rocket propulsion industry, providing rocket propulsion technology for the entire Department of Defense (DoD) and National Aeronautics and Space Administration (NASA). The efforts in this project are part of the Rocket Propulsion 21 (RP21) program. The efforts in this project are reviewed by a DoD level steering committee annually for relevance to DoD missions and achievement of technical goals defined by the RP21 program.

In FY 2021, the entirety of Project 634922, Space & Missile Rocket Propulsion, will be transferred from PE 0603216F, Aerospace Propulsion & Power Technology, Project 634922, Space & Missile Rocket Propulsion to PE 0603033F, Next Gen Platform Demo, Project 634922, Space & Missile Rocket Propulsion, as part of the Air Force RDT&E BA 03 PE consolidation in order to realign technology areas to better support the National Defense Strategy, Air Force Future Operating Concept and Air Force Science and Technology Strategy, April 2019. The Project and associated efforts will continue to be executed by the Air Force Research Laboratory Aerospace Systems Technology Directorate located in Edwards Air Force Base, California. This is an administrative realignment for consolidation, and not a new start.

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

	FY 2019	FY 2020	FY 2021
Title: Liquid Rocket Propulsion Technologies	15.002	15.258	0.000
Description: Develop liquid rocket propulsion technology for current and future space launch vehicles.			
FY 2020 Plans: Complete study for next generation liquid propulsion technology demonstration effort focused on modularity and cost reduction. Complete testing of hydrocarbon engine components. Initiate modular engine feasibility demonstration.			
FY 2021 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634922 / <i>Space & Missile Rocket Propulsion</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>In FY 2021, this work is performed under the Liquid Rocket Propulsion Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634922, Space & Missile Rocket Propulsion.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 decreased compared to FY 2020 by \$15.258 million. Funding decreased due to the transfer and realignment of this work to the Liquid Rocket Propulsion Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634922, Space & Missile Rocket Propulsion, as part of the Air Force RDT&E BA 03 PE consolidation.</p>				
<p>Title: On-Orbit Propulsion Technologies</p> <p>Description: Develop solar electric, electric, and monopropellant propulsion technologies for existing and future satellites, upper stages, orbit transfer vehicles, and satellite maneuvering.</p> <p>FY 2020 Plans: Continue to develop and transition experimental, modeling and simulation, and theoretical efforts geared towards advanced thruster development with additional emphasis on understanding thrust scale-up. Continue to extend capability to study next generation of hypergolic fuels, including propellant characterization, drop-in testing, and lab-scale thruster demonstration. Continue analysis and development of multi-mode propulsion opportunities to combine high efficiency and high thrust capabilities on a common propellant. Continue thrust scale-up effort for advanced non-toxic mono-propellant thrusters. Initiate electric propulsion thruster effort utilizing advanced non-toxic mono-propellant.</p> <p>FY 2021 Plans: In FY 2021, this work is performed under the On-Orbit Propulsion Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634922, Space & Missile Rocket Propulsion.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 decreased compared to FY 2020 by \$3.391 million. Funding decreased due to the transfer and realignment of this work to the On-Orbit Propulsion Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634922, Space & Missile Rocket Propulsion, as part of the Air Force RDT&E BA 03 PE consolidation.</p>		1.364	3.391	0.000
<p>Title: Ballistic Missile Technologies</p> <p>Description: Develop and demonstrate missile propulsion and post-boost control systems technologies for ballistic missiles.</p> <p>FY 2020 Plans:</p>		3.637	5.934	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634922 / <i>Space & Missile Rocket Propulsion</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Continue technology maturation and demonstration efforts for post-boost technologies and tactical missile technologies. Initiate motor component modeling & simulation tool development efforts geared towards reducing cost and schedule of new developments.</p> <p>FY 2021 Plans: In FY 2021, this work is performed under the Ballistic Missile Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634922, Space & Missile Rocket Propulsion.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 decreased compared to FY 2020 by \$5.934 million. Funding decreased due to the transfer and realignment of this work to the Ballistic Missile Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634922, Space & Missile Rocket Propulsion, as part of the Air Force RDT&E BA 03 PE consolidation.</p>			
<p>Title: Strategic System Motor Surveillance</p> <p>Description: Develop and demonstrate aging and surveillance technologies for strategic systems to reduce lifetime prediction uncertainty for individual motors, enabling motor replacement for cause.</p> <p>FY 2020 Plans: Continue to apply next generation of chemical and aging mechanism modeling, simulation, and analysis tools, sensor schemes and tools, and non-destructive analysis tools. Continue advanced sensor analysis development efforts to further improve data acquisition and reduce uncertainty in ballistic missile life predictions. Continue to improve the fidelity and precision of non-destructive evaluation tools to increase the capability to determine flaw size, orientation, and location. Continue to support the transition of previous tools, models, data management system to user. Continue long-term validation of tools through long-term aging of sub-scale motors. Continue sub-scale motors dissection to validate the sensor and analytical analysis of each motor. Continue maturation and demonstration of advanced sensor, non-destructive evaluation, modeling and supporting technology development efforts to detect and explain phenomena to further improve data acquisition and reduce uncertainty in ballistic and tactical missile solid rocket motor life predictions.</p> <p>FY 2021 Plans: In FY 2021, this work is performed under the Strategic System Motor Surveillance effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634922, Space & Missile Rocket Propulsion.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement:</p>	2.727	3.673	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 634922 / <i>Space & Missile Rocket Propulsion</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
FY 2021 decreased compared to FY 2020 by \$3.673 million. Funding decreased due to the transfer and realignment of this work to the Strategic System Motor Surveillance effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 634922, Space & Missile Rocket Propulsion, as part of the Air Force RDT&E BA 03 PE consolidation.			
Accomplishments/Planned Programs Subtotals	22.730	28.256	0.000

	FY 2019	FY 2020
Congressional Add: Program increase - chemical apogee engines <i>FY 2019 Accomplishments:</i> Conducted Congressionally directed efforts. <i>FY 2020 Plans:</i> Conduct Congressionally directed efforts	2.421	5.000
Congressional Add: Program increase - upper stage engine maturation <i>FY 2019 Accomplishments:</i> Conducted Congressionally directed efforts. <i>FY 2020 Plans:</i> Conduct Congressionally directed efforts	8.232	18.000
Congressional Add: Program increase - space propulsion technologies <i>FY 2019 Accomplishments:</i> Not Applicable <i>FY 2020 Plans:</i> Conduct Congressionally directed efforts	0.000	2.000
Congressional Adds Subtotals	10.653	25.000

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

N/A

Remarks

D. Acquisition Strategy

Not Applicable

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force										Date: February 2020		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 635098 / <i>Advanced Aerospace Propulsion</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
635098: <i>Advanced Aerospace Propulsion</i>	-	29.913	18.814	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates, via ground and flight tests, the scramjet propulsion cycle to a technology readiness level appropriate for full integration with other engine cycles (including turbine and rocket-based) to provide the Air Force with transformational military capabilities. The primary focus is on the hydrocarbon-fueled, scramjet engine. Multi-cycle engines will provide the propulsion systems for possible application to support aircraft and weapon platforms operating up to Mach 7. Efforts include: scramjet flow-path optimization to enable operation over the widest possible range of Mach numbers; active combustion control to assure continuous positive thrust (even during mode transition); robust flame-holding to maintain stability through flow distortions; and maximized volume-to-surface area to minimize the thermal load imposed by the high-speed engine. Thermal management plays a vital role in scramjet and combined cycle engines, including considerations for protecting low speed propulsion systems (e.g., turbine engines) during hypersonic flight.

In FY 2021, the entirety of Project 635098, Advanced Aerospace Propulsion, will be transferred from PE 0603216F, Aerospace Propulsion & Power Technology, Project 635098, Advanced Aerospace Propulsion to PE 0603033F, Next Gen Platform Demo, Project 635098, Advanced Aerospace Propulsion, as part of the Air Force RDT&E BA 03 PE consolidation in order to realign technology areas to better support the National Defense Strategy, Air Force Future Operating Concept and Air Force Science and Technology Strategy, April 2019. The Project and associated efforts will continue to be managed by the Air Force Research Laboratory Aerospace Systems Technology Directorate located in Wright Patterson Air Force Base, Ohio. This is an administrative realignment for consolidation, and not a new start.

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

	FY 2019	FY 2020	FY 2021
Title: Scramjet Technologies	29.913	18.814	0.000
Description: Develop and demonstrate technologies for a hydrocarbon-fueled scramjet with robust operation up to Mach 7.			
FY 2020 Plans: Complete scramjet combustor maturation efforts for flight-compliant designs based on results from direct connect testing of medium scale engine components at Aerodynamic and Propulsion Test Unit. Continue development and demonstration of tactically compliant subsystems, including scramjet engine start system, fuel system, and active engine controls. Continue development of scramjet technologies to enhance operability including robust operation during maneuvers. Continue accelerated development and demonstration of tactically- relevant long range high speed strike scramjet engine technologies including ground and flight demonstrations needed for potential follow-on acquisition program.			
FY 2021 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 635098 / <i>Advanced Aerospace Propulsion</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
For FY 2021 and future years, this work is performed under PE 0603033F, Next Gen Platform Dev/Demo, Project 635098, Advanced Aerospace Propulsion, Scramjet Technologies effort.				
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> FY 2021 decreased compared to FY 2020 by \$18.814 million. Funding decreased due to the transfer and realignment of this work to the Scramjet Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 635098, Advanced Aerospace Propulsion, as part of the Air Force RDT&E BA 03 PE consolidation.				
Accomplishments/Planned Programs Subtotals		29.913	18.814	0.000
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force										Date: February 2020		
Appropriation/Budget Activity 3600 / 3					R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>				Project (Number/Name) 63681B / <i>Advanced Turbine Engine Gas Generator</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
63681B: <i>Advanced Turbine Engine Gas Generator</i>	-	23.036	38.831	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project develops and demonstrates technology to increase turbine engine operational reliability, durability, mission flexibility, and performance while reducing weight, fuel consumption, and cost of ownership. The objective is to provide continuous evolution of technologies into an advanced gas generator in which the performance, cost, durability, repairability, and maintainability can be assessed in a realistic engine environment. The gas generator, or core, is the basic building block of the engine and nominally consists of a compressor, a combustor, a high-pressure turbine, mechanical systems, and core subsystems. Experimental core engine demonstration validates engineering design tools and enhances rapid, low-risk transition of key engine technologies into engineering development, where they can be applied to derivative and/or new systems. These technologies are applicable to a wide range of military and commercial systems including aircraft, missiles, land combat vehicles, ships, and responsive space launch. Component technologies are demonstrated in a core (sub-engine). This project also assesses the impact of low spool components such as; inlet systems, fans, low pressure turbines, exhaust systems, and system level technologies such as; integrated power generators and thermal management systems on core engine performance, and durability in ground demonstrations of engine cores. The core performances of this project are validated on demonstrator engines in the Aircraft Propulsion Subsystem Integration Project of this program. A portion of this project supports the demonstration of adaptive cycle technologies, which develop component technology for an adaptive cycle engine architecture that provides optimized performance, fuel efficiency, and durability for widely varying mission needs.

In FY 2021, the entirety of Project 63681B, Advanced Turbine Engine Gas Generator, will be transferred from PE 0603216F, Aerospace Propulsion & Power Technology, Project 63681B, to PE 0603033F, Next Gen Platform Demo, Project 63681B, Advanced Turbine Engine Gas Generator, as part of the Air Force RDT&E BA 03 PE consolidation in order to realign technology areas to better support the National Defense Strategy, Air Force Future Operating Concept and Air Force Science and Technology Strategy, April 2019. The Project and associated efforts will continue to be managed by the Air Force Research Laboratory Aerospace Systems Technology Directorate located in Wright Patterson Air Force, Ohio. This is an administrative realignment for consolidation, and not a new start.

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

	FY 2019	FY 2020	FY 2021
Title: Core Engine Technologies	6.958	9.188	0.000
Description: Design, fabricate, and demonstrate performance predictions in core engines, using innovative engine cycles and advanced materials for turbofan and for turbojet engines.			
FY 2020 Plans: Complete detailed design of medium-scale efficient core demonstrator. Continue risk reduction component tests for medium-scale engine advanced fan and core. Continue build of medium-scale engine. Complete conceptual design of large-scale adaptive core concepts. Complete design of bladed disks and bearing systems components for small cruise missile size engine. Complete			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020		
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 63681B / <i>Advanced Turbine Engine Gas Generator</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
development of small cruise missile engine demonstrator test plans to improve life prediction capability for bladed disks and bearing systems. FY 2021 Plans: In FY 2021, this work is performed under the Core Engine Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 63681B, Advanced Turbine Engine Gas Generator. FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 decreased compared to FY 2020 by \$9.188 million. Funding decreased due to the transfer and realignment of this work to the Core Engine Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 63681B, Advanced Turbine Engine Gas Generator, as part of the Air Force RDT&E BA 03 PE consolidation.				
Title: High Pressure Ratio Core Engine Technologies Description: Design, fabricate, and demonstrate high overall pressure ratio engine cores to provide increased durability and affordability with lower fuel consumption for turbofan and for turboshaft engines. FY 2020 Plans: Complete several key risk reduction testing of components for small engines (200-800 lbs class). Initiate conceptual and preliminary design of small engine technology: Identify innovative architecture, critical technologies and component designs for efficient, recuperated turbo shaft engines. Continue assembly of advanced concept additive manufacturing heat exchanger for small core engines. Continue fabrication of recuperator for demonstration of increased core efficiency in small core engines. FY 2021 Plans: In FY 2021, this work is performed under the High Pressure Ratio Core Engine Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 63681B, Advanced Turbine Engine Gas Generator. FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 decreased compared to FY 2020 by \$3.456 million. Funding decreased due to the transfer and realignment of this work to the High Pressure Ratio Core Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 63681B, Advanced Turbine Engine Gas Generator, as part of the Air Force RDT&E BA 03 PE consolidation.		2.524	3.456	0.000
Title: Adaptive Turbine Engine Core Technologies Description: Design, fabricate, and demonstrate adaptive turbine engine cores to provide increased durability and affordability with lower fuel consumption for turbofan and for turboshaft engines. FY 2020 Plans:		6.774	9.187	0.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Air Force		Date: February 2020
Appropriation/Budget Activity 3600 / 3	R-1 Program Element (Number/Name) PE 0603216F / <i>Aerospace Propulsion and Power Technology</i>	Project (Number/Name) 63681B / <i>Advanced Turbine Engine Gas Generator</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Complete conceptual design of adaptive engine technology and initiate technology rig tests to decrease risk in core technology testing. Continue component tests of advanced variable turbine and innovative compression rear block designed to accept flow variations caused by variable turbine operation.			
<i>FY 2021 Plans:</i> In FY 2021, this work is performed under the Adaptive Turbine Engine Core Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 63681B, Advanced Turbine Engine Gas Generator.			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> FY 2021 decreased compared to FY 2020 by \$9.187 million. Funding decreased due to the transfer and realignment of this work to the Adaptive Turbine Core Engine Technologies effort in PE 0603033F, Next Gen Platform Dev/Demo, Project 63681B, Advanced Turbine Engine Gas Generator, as part of the Air Force RDT&E BA 03 PE consolidation.			
Accomplishments/Planned Programs Subtotals	16.256	21.831	0.000

	FY 2019	FY 2020
<i>Congressional Add:</i> Program increase - advanced turbine engine gas generator	6.780	17.000
<i>FY 2019 Accomplishments:</i> Conducted Congressionally directed efforts		
<i>FY 2020 Plans:</i> Conduct Congressionally directed efforts		
Congressional Adds Subtotals	6.780	17.000

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

N/A

Remarks

D. Acquisition Strategy

N/A