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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2023 Defense Advanced Research Projects Agency **Date:** April 2022

<b>Appropriation/Budget Activity</b> 0400: <i>Research, Development, Test &amp; Evaluation, Defense-Wide</i> / BA 3: <i>Advanced Technology Development (ATD)</i>	<b>R-1 Program Element (Number/Name)</b> PE 0603287E / <i>SPACE PROGRAMS AND TECHNOLOGY</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	144.463	181.524	81.888	-	81.888	103.364	119.458	125.291	120.790	-	-
SPC-01: <i>SPACE PROGRAMS AND TECHNOLOGY</i>	-	144.463	181.524	81.888	-	81.888	103.364	119.458	125.291	120.790	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

**A. Mission Description and Budget Item Justification**

The Space Programs and Technology program element is budgeted in the Advanced Technology Development budget activity because it addresses high payoff opportunities to dramatically reduce costs associated with advanced space systems and provides revolutionary new system capabilities for satisfying current and projected military missions.

A space force structure that is robust against attack represents a stabilizing deterrent against adversary attacks on space assets. This program element will examine concepts and architectures that move the U.S. away from a dependence on monolithic, ultra-capable, vulnerable, and unsustainably costly assets; replacing them with disaggregated assets that are agile, affordable, and easily replaced. Ready access to space requires the delivery of capabilities, replenishment of supplies into orbit, and rapid manufacturing of affordable space capabilities. In addition, developing space access and spacecraft servicing technologies will lead to reduced ownership costs of space systems and new opportunities for introducing technologies for the exploitation of space.

Systems development is also required to increase the interactivity and functionality of space systems, space-derived information, and services with terrestrial users. Studies under this program element include technologies and systems that will enable satellites and microsatellites to operate more effectively by increasing maneuverability, survivability, and situational awareness, and precision control of multi-payload systems. Studies will actively seek to take advantage of new commercial developments which may enable both rapid constitution/reconstitution of assets, and agility/functionality not previously available for military systems.

**B. Program Change Summary (\$ in Millions)**

	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	151.439	101.524	0.000	-	0.000
Current President's Budget	144.463	181.524	81.888	-	81.888
Total Adjustments	-6.976	80.000	81.888	-	81.888
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	80.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	-2.100	0.000			
• SBIR/STTR Transfer	-4.876	0.000			
• Adjustments to Budget Year	-	-	81.888	-	81.888

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

**Project:** SPC-01: *SPACE PROGRAMS AND TECHNOLOGY*

Congressional Add: *Hypersonic Risk Reduction (Blackjack) - Congressional Add*

Congressional Add: *Hypersonic Risk Reduction (Robotic Servicing of Geosynchronous Satellites) - Congressional Add*

Congressional Add Subtotals for Project: SPC-01

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	-	55.000
	-	25.000
	-	80.000
	-	80.000

**Change Summary Explanation**

FY 2021: Decrease reflects reprogrammings and SBIR/STTR transfer.

FY 2022: Increase reflects a Congressional add for Hypersonic risk reduction.

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

**C. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2021	FY 2022	FY 2023
<b>Title:</b> Demonstration Rocket for Agile Cislunar Operations (DRACO)	33.000	37.000	57.501
<b>Description:</b> Maintaining U.S. interests in cislunar space requires a leap-ahead propulsion technology. Current space propulsion includes electric (high efficiency but low thrust) and chemical (high thrust but low efficiency). The Demonstration Rocket for Agile Cislunar Operations (DRACO) program is developing and demonstrating a High-Assay Low-Enriched Uranium (HALEU) nuclear thermal propulsion (NTP) system on orbit by 2025. The NTP technology demonstrated by DRACO achieves thrust similar to chemical systems, but with 2-5 times the efficiency. The enhanced performance afforded by NTP will allow the U.S. to lead operations in the cislunar volume, a volume that is in danger of being defined by the adversary.			
<b>FY 2022 Plans:</b>			
<ul style="list-style-type: none"> <li>- Conduct conceptual design of the demonstration system (DS) spacecraft.</li> <li>- Conduct system requirements review for operational system (OS) and DS spacecraft concepts.</li> <li>- Conduct subsystem requirements review for NTP demonstration reactor.</li> <li>- Demonstrate designs of NTP fuel elements in representative test environments.</li> <li>- Conduct baseline design review for NTP demonstration reactor.</li> <li>- Conduct technology maturation plan for DS spacecraft concept.</li> </ul>			
<b>FY 2023 Plans:</b>			
<ul style="list-style-type: none"> <li>- Begin detailed design of the NTP demonstration reactor.</li> <li>- Begin fabrication of long lead components for the NTP demonstration reactor.</li> <li>- Begin fabrication of long lead components for the demonstration system NTP spacecraft.</li> </ul>			

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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2021</b>	<b>FY 2022</b>	<b>FY 2023</b>
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- Conduct preliminary design of the NTP demonstration reactor.
- Begin detailed design of the NTP demonstration reactor.
- Conduct preliminary design review (PDR) for the demonstration system.

**FY 2022 to FY 2023 Increase/Decrease Statement:**  
The FY 2023 increase reflects program focus shift from design to fabrication of long lead components for the NTP demonstration reactor and demonstration system NTP spacecraft.

**Title:** Blackjack

**Description:** The Blackjack program is developing space technologies demonstrating a proliferated smallsat constellation capability in Low Earth Orbit (LEO). Capabilities demonstrated will provide constant custody of very large numbers of concurrent targets; target identification, tracking, and characterization; tactical communications; architectural resilience via massive proliferation; and rapid on-orbit technology refresh and experimentation. Blackjack will leverage commercial industry plans to build constellations in LEO to provide global commercial broadband internet service. Key efforts include low size, weight, power, and cost (SWaP-C) multi-modality smallsat sensor payloads, algorithms for autonomous payload and architecture command and control, algorithms for satellite on-board processing and data fusion, and advanced manufacturing for military payload mass production. A Memorandum of Agreement (MOA) documents the partnership with U.S. Space Force and Air Force. The anticipated transition partners are the U.S. Space Force, Air Force and Space Development Agency. Blackjack will progress through design and build of 2 satellites with tactical communications and Intelligence, Surveillance, and Reconnaissance (ISR) payloads, and then build and launch 2 satellites with missile warning/defense payloads, then an additional 8 tactical communications/ISR satellites for the full Blackjack demonstration of a proliferated LEO constellation.

**FY 2022 Plans:**

- Conduct operations of laser communications demonstration satellites.
- Complete assembly, integration, and testing of full demonstration satellites.
- Launch full demonstration satellites to support autonomous constellation control.
- Launch and conduct check-out and early operations of first two ISR/Radio Frequency (RF) satellites.

**FY 2023 Plans:**

- Launch and conduct check-out and early operations of first two Overhead Persistent InfraRed (OPIR) satellites.
- Final Blackjack constellation demonstration payload and bus integration.
- Launch and deploy full Blackjack constellation demonstration.

**FY 2022 to FY 2023 Increase/Decrease Statement:**

	64.634	42.019	10.887
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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2021</b>	<b>FY 2022</b>	<b>FY 2023</b>
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The FY 2023 decrease reflects a shift from spacecraft assembly, integration, testing, and launch to on-orbit operations.			
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<b>Title:</b> Robotic Servicing of Geosynchronous Satellites (RSGS)	43.329	19.005	10.000
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**Description:** A large number of national security and commercial space systems operate at geosynchronous earth orbit (GEO), providing persistence and enabling ground station antennas to point in a fixed direction. Technologies for servicing of GEO spacecraft would involve a mix of highly automated and remotely operated (from Earth) robotic systems. The Robotic Servicing of Geosynchronous Satellites (RSGS) program will establish the capability to provide robotic services in GEO suitable for a variety of potential servicing tasks, in full collaboration and cooperation with existing satellite owners and national security space operators, and with sufficient propellant for several years of follow-on capability. Key RSGS challenges include robotic tool/end effector requirements, efficient orbital maneuvering of a servicing vehicle, robotic arm systems, automation of certain spacecraft operations, and development of the infrastructure for coordinated control between the servicer and client spacecraft operations teams. The transition agreement is with a commercial partner who will provide the satellite to carry the robotic payload and who will operate the robotic servicer. To support the development of a broadly accepted satellite servicing capability, DARPA is using the Consortium for Execution of Rendezvous and Servicing operations (CONFERS) approach to bring together experts from the private sector and Government to research, develop and publish nonbinding, consensus-based standards for safe operational approaches to on-orbit servicing.

**FY 2022 Plans:**

- Complete payload flight software qualification.
- Complete payload structures fabrication.
- Complete build and test of robotic arms.
- Complete integration of robotic payload.
- Start testing and space qualification of integrated robotic payload.
- Initiate partner training and detailed demonstration planning.
- Convene CONFERS fourth general assembly and Global Satellite Servicing Forum.
- Publication of CONFERS revised technical standards document inclusive of lessons learned from on-going commercial and government activity.

**FY 2023 Plans:**

- Complete testing and space qualification of integrated robotic payload.
- Deliver integrated and tested robotic payload for integration to spacecraft.
- Complete partner training and detailed demonstration planning.

**FY 2022 to FY 2023 Increase/Decrease Statement:**

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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	FY 2021	FY 2022	FY 2023
The FY 2023 decrease reflects shift from completion of robotic payload fabrication, testing and space qualification to spacecraft integration.			
<b>Title:</b> Advanced Space Technology Concepts	3.500	3.500	3.500
<b>Description:</b> Studies conducted under this program will examine and evaluate emerging technologies and concepts with the potential to provide substantial improvement in efficiency, effectiveness, and resilience of operations in space. This includes the degree and scope of potential impact and improvements to military operations, mission utility, and warfighter capability. Studies are also conducted to analyze emerging threats along with possible methods and technologies for countermeasures. The feasibility of achieving potential improvements, in terms of resources, schedule, and technological risk, is also evaluated. The results from these studies are used, in part, to formulate future programs or refocus ongoing work. Topics of consideration include applying artificial intelligence to low earth orbit constellation operations to enable collaboration between space, air, maritime, and ground platforms in anti-access/area denial (A2/AD) theaters; robust architectures for precision navigation and timing; enabling operations in Cislunar space; and on-orbit software environments.			
<b>FY 2022 Plans:</b>			
- Initiate studies of new concepts and novel approaches for precision navigation and timing systems.			
- Examine the use of new technologies to enable operation in novel orbital domains.			
<b>FY 2023 Plans:</b>			
- Initiate studies of novel approaches for reconfigurable satellite systems and payloads.			
<b>Accomplishments/Planned Programs Subtotals</b>	144.463	101.524	81.888

	FY 2021	FY 2022
<b>Congressional Add:</b> Hypersonic Risk Reduction (Blackjack) - Congressional Add	-	55.000
<b>FY 2022 Plans:</b> - Build all ISR/RF & OPIR payloads, buses and Pit Bosses.		
- Complete assembly, integration, and testing of first two and initiate eight additional ISR/RF satellites to support autonomous constellation demonstration.		
<b>Congressional Add:</b> Hypersonic Risk Reduction (Robotic Servicing of Geosynchronous Satellites) - Congressional Add	-	25.000
<b>FY 2022 Plans:</b> - Complete flight software integration and test.		
- Integrate flight avionics, tools and robotic arms on spacecraft structure and test.		
- Conduct space qualification testing and deliver robotic payload components to commercial partner.		

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	FY 2021	FY 2022
- Initiate partner training and detailed demonstration planning.		
<b>Congressional Adds Subtotals</b>	-	80.000

**D. Other Program Funding Summary (\$ in Millions)**

N/A

**Remarks**

**E. Acquisition Strategy**

N/A