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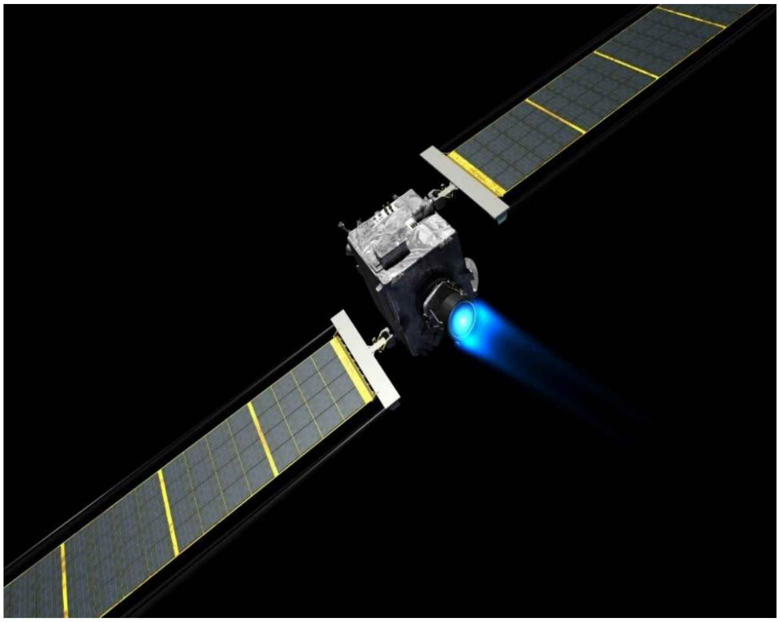
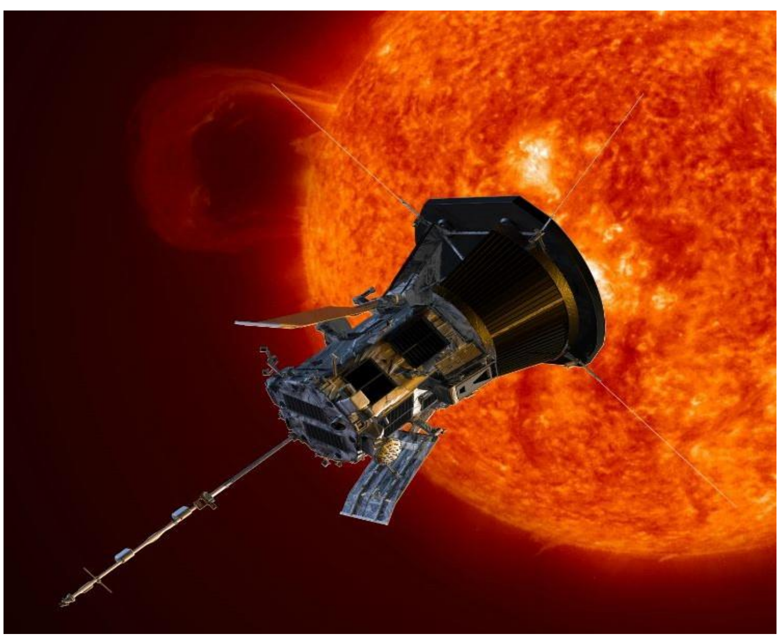
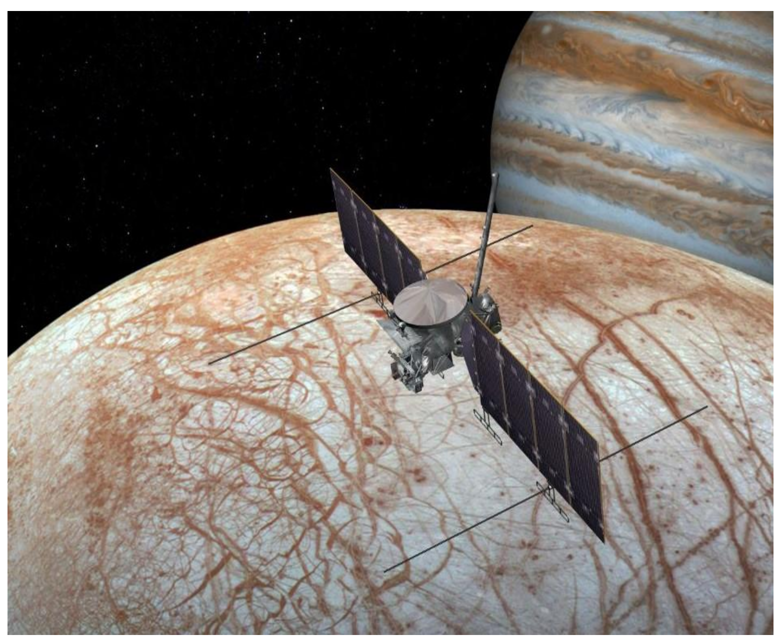



NASA's Management of Its Johns Hopkins University Applied Physics Laboratory Portfolio

September 29, 2022 IG-22-017

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RESULTS IN BRIEF

NASA's Management of Its Johns Hopkins University Applied Physics Laboratory Portfolio

September 29, 2022 IG-22-017 (A-21-016-00)

WHY WE PERFORMED THIS AUDIT

The Johns Hopkins University Applied Physics Laboratory (APL), founded in 1942, has provided important scientific instruments and contributed to space science, spacecraft design and fabrication, and mission operations over its 80-year history. As the scientific and engineering research and development division of Johns Hopkins University, APL is headquartered in Laurel, Maryland, and has six field offices located around the country. The U.S. Department of the Navy sponsors APL as the nation's largest University Affiliated Research Center—a not-for-profit entity primarily funded by the U.S. government to address technical needs that cannot be met as effectively by existing government or contractor resources.

As of February 2022, NASA activities constituted 19 percent of APL's total work, which includes such projects as the Double Asteroid Redirection Test mission, which will test technologies for defending Earth against hazardous asteroids, and Dragonfly, which will sample and examine sites around Saturn's moon Titan. NASA manages two indefinite-delivery, indefinite-quantity (IDIQ) Agency-wide contracts with APL for robotic space missions and supporting research. In 2006 NASA awarded the first Aerospace Research, Development, and Engineering Support Services contract (ARDES I), and in 2020 awarded the follow-on ARDES II contract. The combined potential value of both contracts, with options, is not to exceed $3.8 billion.

In this audit, we evaluated 16 APL project task orders and assessed NASA's management of the ARDES I and II contracts and associated task orders to determine if the Agency's contract administration is effective, efficient, and in compliance with federal law and NASA policy. In addition, we examined APL's management of its portfolio of NASA projects relative to cost and schedule performance. To complete this work, we reviewed NASA documents, federal acquisition regulations, and ARDES I and II contract terms and conditions; interviewed NASA, APL, and Navy officials; and evaluated responses to questionnaires we sent to Agency officials on the 16 NASA projects.

WHAT WE FOUND

Based on our review of 16 NASA projects at APL, we found the Laboratory is appropriately managing its NASA portfolio. Although 8 of the projects experienced cost increases and 11 of the projects experienced schedule delays, APL was not the primary factor for any cost or schedule performance issues experienced on those projects. Specifically, APL's performance was considered a factor but not the primary cause for 3 projects' cost increases and 2 projects' schedule delays. For the remaining projects we reviewed, there were no cost increases or the cost commitment by which to measure cost performance had not yet been established. Overall, several of the 16 projects had schedule delays and cost increases attributable to the COVID-19 pandemic.

Apart from project management, we found that NASA's decision to move two existing tasks from the ARDES I to ARDES II contract was unnecessary and costly. Marshall procurement officials decided to end the Dragonfly and GUSTO—Galactic/Extragalactic ULDB [Ultralong-Duration Balloon] Spectroscopic Terahertz Observatory—task orders on ARDES I and awarded task orders for the remaining in-scope work on the ARDES II contract. Rather than the 4.1 percent fixed-fee rate charged for projects under the ARDES I contract, NASA paid the ARDES II rate of 6.5 percent, resulting in cost increases of at least $3.88 million in ARDES II contract fees for the same scope of work originally covered by the ARDES I contract. In addition, the decision increased the likelihood that the ARDES II contract's maximum value will be reached sooner. Procurement officials based their decision on guidance from the Marshall Space Flight Center's (Marshall) Office of Chief Counsel that responded to Marshall procurement officials request to extend the ARDES I ordering period and increase the IDIQ contract's ceiling amount. Instead, we believe procurement officials should have used the authority granted in the ARDES I contract to keep all active task orders on that contract. Federal Acquisition Regulation (FAR) guidance and policies, precedents related to deviations from FAR requirements, and a previous Government Accountability Office protest decision regarding contract modifications that expressly provided the government latitude in making changes to research and development contracts all provided NASA the flexibility to modify and add value to its existing task orders instead of the costly shifting of the work to the ARDES II contract.

WHAT WE RECOMMENDED

To help ensure NASA does not pay more than required on IDIQ contracts and task orders, we recommended the Assistant Administrator for Procurement document this occurrence as a lessons learned and provide supplemental guidance to NASA procurement officials that, in the absence of prohibitive regulation or direction, the FAR provides them the authority to encourage business process innovations to ensure efficient contract actions. We also recommended the Marshall Center Director require the Marshall Procurement Office to document a process to periodically compare the total cost estimate for awarded APL tasks to the established maximum and take timely action to modify the contract or request a deviation from the FAR to exclude a maximum for ARDES II and any future ARDES-type IDIQ contracts for APL.

We provided a draft of this report to NASA management who partially concurred with our recommendations and described planned actions to address them. We consider the proposed actions responsive and will close the recommendations upon completion and verification.

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Acronyms

AO	Announcement of Opportunity
APL	Applied Physics Laboratory
ARDES	Aerospace Research, Development, and Engineering Support Services
DART	Double Asteroid Redirection Test
DAVINCI	Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging
DCAA	Defense Contract Audit Agency
ESA	European Space Agency
EZIE	Electrojet Zeeman Imaging Explorer
FAR	Federal Acquisition Regulation
FY	fiscal year
GAO	Government Accountability Office
GUSTO	Galactic/Extragalactic ULDB [Ultralong-Duration Balloon] Spectroscopic Terahertz Observatory
IDIQ	indefinite-delivery, indefinite-quantity
IMAP	Interstellar Mapping and Acceleration Probe
JAXA	Japan Aerospace Exploration Agency
JOFOC	Justification for Other than Full and Open Competition
JPL	Jet Propulsion Laboratory
KDP	Key Decision Point
LRO	Lunar Reconnaissance Orbiter
MEGANE	Mars-moon Exploration with GAmma rays and Neutrons
Mini-RF	Miniature Radio Frequency
MLTI	mesosphere, lower thermosphere, and ionosphere
MMX	Martian Moons Exploration
NFS	NASA FAR Supplement
NRA	NASA Research Announcement
OIG	Office of Inspector General
PEP-Hi	Particle Environment Package-Hi
STEREO	Solar Terrestrial Relations Observatory
TIMED	Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics
UARC	University Affiliated Research Center

INTRODUCTION

Founded in 1942 during World War II, the Johns Hopkins University Applied Physics Laboratory (APL or the Lab) was established to work on one of America's most closely guarded wartime secrets—the radio proximity fuse. Radar-like radio senders and receivers in the fuse increased artillery effectiveness by detonating anti-aircraft shells based on their proximity to the target, in this case fast-moving enemy aircraft. After the war and over its 80-year history, APL has provided important scientific instruments to NASA missions and significantly contributed to space science, spacecraft design and fabrication, and mission operations. Recent examples include:

- the Double Asteroid Redirection Test (DART) mission, which launched in November 2021 and will test technologies for defending Earth against hazardous asteroids, and
- Dragonfly, planned to launch in June 2027, which will sample and examine sites around Titan—Saturn's richly organic, icy moon—to advance the search for the building blocks of life in the universe.

NASA manages two Agency-wide contracts with APL for robotic space missions and supporting research: Aerospace Research, Development, and Engineering Support Services or ARDES, which for the purposes of this report we refer to as the first ARDES contract or "ARDES I," awarded in 2006, and the follow-on ARDES II contract awarded in 2020. The estimated value of both contracts, with options, is not to exceed $3.8 billion. In this audit, we examined APL's management of its portfolio of NASA projects relative to cost and schedule performance and assessed NASA's management of the ARDES contracts and associated task orders. See Appendix A for further details on our scope and methodology.

Background

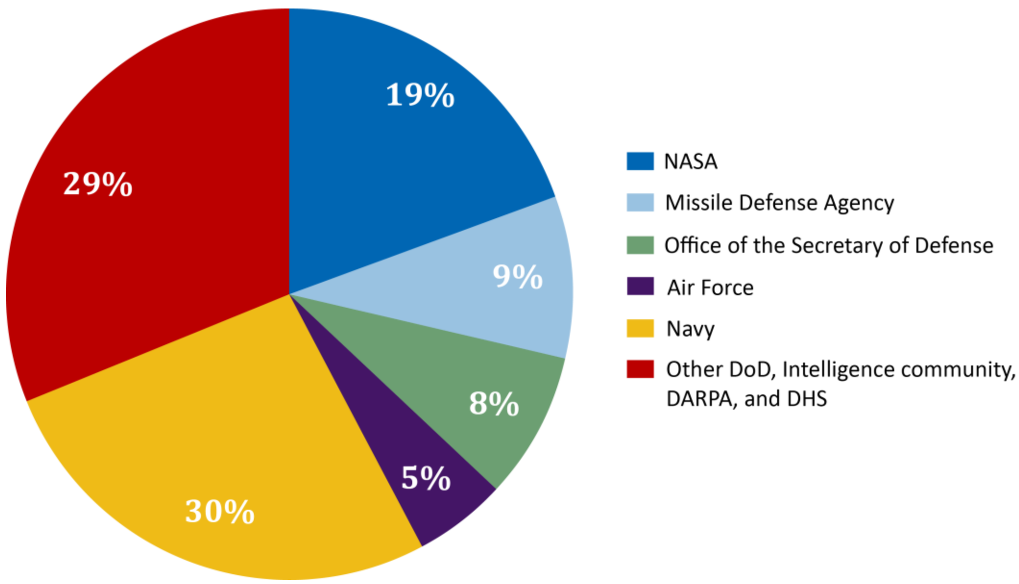
APL, the scientific and engineering research and development division of Johns Hopkins University, is headquartered in Laurel, Maryland, on a 461-acre campus with more than 20 major buildings (see Figure 1).

Figure 1: APL Campus

Source: APL.

APL also maintains six field offices in various locations around the country.[1] The Lab employs approximately 8,000 people, 80 percent of whom are technical professionals, across all locations with a diversified portfolio of more than 600 programs. APL is the nation's largest University Affiliated Research Center (UARC) and serves as a technical advisor to its government sponsors.[2] The U.S. Department of the Navy sponsors APL's UARC status, and the Lab supports multiple other federal agencies including NASA. As of February 2022, 30 percent of APL's work was for the Department of the Navy and 19 percent for NASA, with much of the remaining work defense related as shown in Figure 2.

Figure 2: APL Sponsors by Percentage of Work as of February 2022



Source: NASA OIG analysis of APL data.

Note: DoD is U.S. Department of Defense; DARPA is Defense Advanced Research Projects Agency; and DHS is U.S. Department of Homeland Security.

First efforts linking APL to space research began in the 1940s with a team led by Dr. James Van Allen who set out to make measurements of the Earth's upper atmosphere and of the Sun using rockets captured from Germany after World War II. In the 1950s, APL developed satellite navigation technology and formed what would become the Lab's Space Exploration Sector. By the mid-1960s, APL was making important contributions to the field of high-precision geolocation that led the Lab to expand its work into space physics, and its focus grew to include civilian space efforts with NASA. Under NASA sponsorship, APL's body of research expanded to investigations of the interplanetary environment supporting the Interplanetary Monitoring Platform missions through the early 1970s, the Active Magnetospheric Particle Tracer Explorers program in the 1980s, the Near Earth Asteroid Rendezvous Shoemaker in the 1990s, and—more recently—NASA's Parker Solar Probe and Van Allen Probes

[1] Field offices are located in Colorado Springs (Colorado), Fort Walton Beach/Eglin Air Force Base (Florida), Hill Air Force Base (Utah), Lexington Park (Maryland), National Security Space (California), and Raleigh (North Carolina).

[2] UARCs are independent, not-for-profit entities sponsored and primarily funded by the U.S. government to address technical needs that cannot be met as effectively by existing government or contractor resources.

missions.[3] The Lab serves as the prime contractor for several NASA missions and tasks and is a subcontractor on others.

NASA Missions and Contract Awards to APL

Mission Directorates (e.g., Science Mission Directorate, Space Operations Mission Directorate, or Space Technology Mission Directorate) create programs and projects with a long-term focus based on the Agency's strategic direction. NASA space flight programs are initiated to accomplish scientific or exploration goals that generally require a collection of mutually supporting projects, which are integrated and managed by the programs. In support of these programs and projects, NASA has multiple avenues from which it may obtain necessary studies, hardware, and services. NASA primarily issues requests for proposal or broad agency announcements such as Announcements of Opportunity (AO) and NASA Research Announcements (NRA) through which a potential offeror may submit a proposal.[4] Unlike a request for proposal containing a defined statement of work or specification, an AO and NRA provide for the submission of competitive project ideas, conceived by the offerors, in one or more program areas of interest.

After evaluating all submitted proposals in response to an issued solicitation and making a final selection, NASA then awards the offeror—in this case APL—a contract or task order. APL's task orders range from scientific studies and analysis to hardware deliverables and the completion of project life-cycle phases for NASA projects.[5] An example of a recent task order for scientific studies and analyses is the Space Weather Science and Observation Gap Analysis where APL was tasked with completing a study to inform NASA how measurements from the Agency's Earth- and space-based observatories will advance weather forecasting. Specifically, the Gap Analysis focused on (1) assessing the current state of NASA's observational capability to address the science of space weather and its capacity

Dragonfly

Dragonfly will attempt to fly a large drone on Titan.

Source: NASA.

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[3] From 1963 to 1973, NASA launched 10 Interplanetary Monitoring Platform satellites to obtain data on the radiation environment of cislunar space. The Active Magnetospheric Particle Tracer Explorers program was a three-nation, three-spacecraft mission launched in August 1984 to study magnetospheric ions and interactions of plasmas in the magnetosphere and solar wind. Launched in February 1996, the Near Earth Asteroid Rendezvous Shoemaker was the first spacecraft to orbit and land on an asteroid. Its primary scientific goals were to measure the asteroid's size, shape, volume, mass, gravity field, and spin state; its surface properties; and internal properties including mass distribution and magnetic field. The Parker Solar Probe and Van Allen Probes mission are described in Appendix B.

[4] AOs are based on a review of proposals by peer scientists or other appropriate technical experts. An AO does not specify the investigations to be proposed but solicits investigator ideas that can contribute to broad, publicly documented objectives. NRAs are used to announce research interests in support of NASA programs, and after a peer or scientific review using factors in the NRA, proposals for funding are selected.

[5] Per NASA Procedural Requirements 7120.5F, *NASA Space Flight Program and Project Management Requirements*, NASA divides the life cycle of its projects into two major phases—Formulation and Implementation—that are further divided into Phases A through F. Formulation consists of Phases A and B, and Implementation is Phases C through F (see Appendix B for a more detailed description). This structure allows managers to assess the progress of their projects at Key Decision Points (KDP) throughout the process. Project cost and schedule commitments are established at KDP-C, the point at which NASA approves the project to proceed to Implementation. Periodic reviews, such as the Preliminary Design Review and Critical Design Review, assess the maturity of the design and determine whether the project is ready to proceed to the next phase.

to provide data that significantly advances forecasting capabilities and (2) identifying high-priority observations at risk or not currently available that are required to significantly advance forecasting capabilities. An example of a task order for the completion of a NASA project life-cycle phase is Dragonfly's Phase B task order. As part of NASA's New Frontiers Program, Dragonfly marks the first time NASA will attempt to fly a multi-rotor vehicle for science on another planet.[6] Under this task order, APL is developing a set of system and associated subsystem preliminary designs, including interface definitions, and overseeing development of the preliminary design of the spacecraft.

In October 1997, prior to the ARDES I and II contracts, NASA awarded APL a contract for research, design, and other services for NASA programs and projects. The contract, which has a maximum value of $1.1 billion, has only one active task order remaining—the New Horizons mission.[7] The contract had been scheduled to end in September 2022; however, in May 2022 NASA approved an extension of the New Horizons mission and, according to the contracting officer, the Agency intends to award a 2-year extension to the existing task order.

More recently—from fiscal year (FY) 2019 through FY 2021—NASA awarded APL $414.7 million through various procurement vehicles including contracts, subcontracts, and grants to support the Agency's programs and research efforts. The primary contractual vehicles for procuring the majority of APL hardware and services are two indefinite-delivery, indefinite-quantity (IDIQ) Agency-wide contracts for robotic space missions and supporting research—ARDES I and ARDES II.[8]

An *IDIQ* contract is a contract for services that does not procure or specify a firm quantity of services (other than a minimum or maximum quantity) and that provides for the issuance of orders for the performance of tasks during the period of the contract. The government places *task orders* for individual requirements.

A *cost-plus-fixed-fee* contract is a cost-reimbursement contract that provides for payment to the contractor of a negotiated fee that is fixed at the inception of the contract.

A *cost-plus-incentive-fee* contract is a cost-reimbursement contract that provides for an initially negotiated fee to be adjusted later by a formula based on the relationship of total allowable costs to total target costs.

A *firm-fixed-price* contract provides for a price that is not subject to any adjustment on the basis of the contractor's cost experience in performing the contract.

ARDES I. NASA awarded the ARDES I contract to APL under a Justification for Other Than Full and Open Competition (JOFOC)—otherwise known as a "sole source" award—on October 1, 2006, as an Agency-wide IDIQ contract with a maximum value of $1.5 billion.[9] NASA obligates funding for ARDES I on cost-plus-fixed-fee and cost-plus-incentive-fee task orders. The scope of the contract is to execute robotic space missions for the Agency through the full mission life cycle—from mission concept and formulation through data analysis. NASA and APL established an

[6] Missions in NASA's New Frontiers Program use medium-class spacecraft to conduct high-science-return investigations that add to our understanding of the solar system.

[7] New Horizons launched in January 2006 to explore Pluto, its moons, and other Kuiper Belt objects. The spacecraft flew by Pluto in July 2015 and the Kuiper Belt object nicknamed Ultima Thule in January 2019.

[8] Marshall Space Flight Center administers the ARDES contracts.

[9] JOFOC stems from Federal Acquisition Regulation (FAR) 6.302-3(a)(2)(ii). For ARDES, NASA used the JOFOC to "establish or maintain an essential engineering, research, or development capability to be provided by an educational or other nonprofit institution or a federally funded research and development center." In an *Other than Full and Open Competition* action, the government enters into a contract without going through the typical competitive process based on one of the exceptions in FAR 6.302. We reviewed the reasonableness of this action and found the solicitation resulted in multiple proposers submitting bids and that NASA conducted appropriate market research to determine that APL was the only contractor able to provide the required engineering capabilities.

initial 5-year ordering period and a 5-year option period in the contract. NASA subsequently extended the ordering period from 2016 through March 2020 and increased the maximum amount of supplies and services that may be ordered to $1.77 billion. As of June 2022, $1.73 billion (98 percent) had been obligated on the contract.

ARDES II. NASA awarded the ARDES II contract to APL on March 30, 2020, under the same JOFOC criteria as ARDES I. ARDES II is a hybrid cost-plus-fixed-fee/firm-fixed-price contract with an initial ordering period through March 2025 and a 5-year option through March 2030. Each 5-year ordering period has a maximum value of $1 billion. As of June 2022, NASA had obligated $378.5 million (38 percent of the first ordering period value) through the award of 44 task orders on the contract. As of August 2022, none of the task orders have been awarded as firm-fixed-price. One example of work awarded on the ARDES II contract is a task order for development of the Mars-moon Exploration with GAmma rays and NEutrons (MEGANE) instrument.[10] Table 1 shows key elements of the ARDES I and II contracts.

Table 1: Key ARDES Contract Elements

Contract Name	Date Awarded	IDIQ Maximum[a]	Contract Type	Ordering Period End Date	Number of Task Orders (as of June 2022)	Obligations (as of June 2022)
ARDES I	October 1, 2006	$1.77 billion	IDIQ	March 31, 2020	185	$1.73 billion
ARDES II	March 30, 2020	$2 billion ($1 billion for initial 5-year ordering period and $1 billion for 5-year option, if exercised)	IDIQ	Initial 5-year ordering period: March 29, 2025 5-year option (if exercised): March 29, 2030	44	$378.5 million

Source: NASA OIG presentation of contract documentation.

[a] The ARDES I contract, under the heading "Estimated Cost," established a "maximum amount of supplies and services that may be ordered." The ARDES II contract established a "maximum potential not-to-exceed (NTE) value."

Task orders. Under the ARDES contracts, "tasks" can be phases within a project or mission, instrument contributions to a project or mission, or technical support and advisory services. All task orders on ARDES I are cost-plus-fixed-fee and receive either a fixed fee of 4.1 percent or the fixed 4.1 percent plus up to an additional 2.5 percent incentive fee for task orders that are competed, have a value equal to or greater than $25 million, and where the deliverable is primarily hardware. ARDES II task orders are either cost-plus-fixed-fee or firm-fixed-price, with cost-plus-fixed-fee task orders receiving a fixed fee of 6.5 percent, and firm-fixed-price task orders receiving a profit rate of 8.0 percent. The determination of which fee percentage(s) will be applied to ARDES II task orders is identified during the negotiation process.

[10] MEGANE is part of the Martian Moons eXploration mission in development by the Japan Aerospace Exploration Agency that will visit the two Martian moons, Phobos and Deimos, land on the surface of Phobos, and collect a surface sample. Plans are for the sample to be returned to Earth in 2029. MEGANE will give the mission the ability to "see" the elemental composition of Phobos, by measuring the energies of neutrons and gamma-rays emitted from the small moon.

Federal Acquisition Regulation and NASA FAR Supplement

The Federal Acquisition Regulation (FAR) is the primary regulation used by executive agencies in the acquisition of supplies and services with appropriated funds. The FAR designates contracting officers and their supporting technical representatives responsibility for the oversight of NASA's contracts. Each contracting officer holds a warrant that allows them to negotiate and bind the government in a contract. Additionally, the FAR provides contracting officers the authority to use sound business judgment when exercising their contract authority in the best interests of the government.[11] The NASA FAR Supplement (NFS) is issued as Chapter 18 of Title 48, Code of Federal Regulations, and follows the same general structure as the FAR by providing regulatory guidance for use in NASA's contracts.

[11] FAR 1.102-4, *Role of the Acquisition Team*.

Review of Select NASA Projects Found that APL Is Appropriately Managing Its NASA Portfolio

Based on our review of selected task order cost and schedule data and survey responses from NASA project officials, we found that APL is appropriately managing its NASA projects. As of January 2022, 55 active ARDES I and ARDES II task orders were awarded to APL, most of which support NASA's Science Mission Directorate, with a total combined value of $1.92 billion. We judgmentally selected 15 of the 55 active task orders for review based on dollar value and the scope of APL's contribution to the respective NASA project. We chose to review project task orders that:

- were awarded on the ARDES I or ARDES II contracts,
- had a total award value of greater than or equal to $1 million, and
- have provided or will provide NASA with a hardware deliverable such as the Parker Solar Probe that was launched in August 2018 and is studying the Sun.

As of January 2022, the 15 task orders accounted for $1.5 billion of $1.92 billion, or 78 percent, of the total value of all active ARDES I and ARDES II task orders. In addition to the 15 project task orders that met the criteria listed above, we also reviewed Europa Clipper, a project on which APL is a subcontractor to NASA's Jet Propulsion Laboratory (JPL) and is providing the propulsion module to NASA.[12] Although APL's Europa Clipper work does not fall under either ARDES contract, we added it to our review due to the significance of the mission as well as the developmental and personnel resource challenges that we identified in an unrelated prior audit.[13] See Appendix B for details on the 16 projects, including APL's contributions, task order values, and overall mission objectives.

To determine whether any cost or schedule issues were attributable to APL performance, we interviewed APL personnel, reviewed data provided by APL and NASA, and sent questionnaires to Agency officials for the sample of 16 APL-involved NASA projects. Specifically, 8 of the 16 NASA projects we reviewed either had no cost increases or had not yet established a cost commitment by which to measure cost performance. Of the 8 that had experienced cost increases, 3 cited APL's performance as a factor but not a primary cause. For example, Europa Clipper experienced an increase in total life-cycle cost from $4.25 billion to $5 billion. According to Agency officials, the cost increase was primarily due to development challenges and the COVID-19 pandemic. Of the 11 projects that had experienced schedule delays, only 2 indicated that APL's performance, though not the primary cause, was a factor in the delay. For example, the Dragonfly project has had cost increases and schedule delays, but they were primarily due to NASA replanning the project schedule to include delaying the launch readiness date. Specifically, due to budget and COVID-19 impacts, a launch vehicle change, and repeated launch readiness date

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[12] JPL is a federally funded research and development center located near Pasadena, California, that NASA tasks with managing many of its planetary science projects. To conduct flybys of Jupiter's moon Europa, the propulsion module comprises two-thirds of the Europa Clipper's main body and will hold propellant to slow the spacecraft into orbit around Jupiter.

[13] NASA Office of Inspector General, *Management of NASA's Europa Mission* (IG-19-019, May 29, 2019).

delays, the Agency delayed Dragonfly's launch by a year and now plans to launch the mission in 2027. As shown in Table 2, Agency officials indicated that most of the 16 projects have had cost or schedule overruns, but APL's performance was not the primary cause of any cost or schedule performance issues experienced on the projects.

Table 2: Cost Increases and Schedule Delays of APL-involved NASA Projects

NASA Project	Cost Increase	Schedule Delay
Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging	Green	Green
Double Asteroid Redirection Test (DART)	Red	Red
Dragonfly	Yellow	Yellow
Electrojet Zeeman Imaging Explorer	Green	Yellow
Europa Clipper	Red	Green
Galactic/Extragalactic ULDB [Ultralong-Duration Balloon] Spectroscopic Terahertz Observatory (GUSTO)	Green	Yellow
Interstellar Mapping and Acceleration Probe	Green	Green
Lunar Reconnaissance Orbiter	Yellow	Yellow
Lunar Vertex	Green	Green
Mars-moon Exploration with GAmma rays and Neutrons (MEGANE)	Green	Yellow
Parker Solar Probe	Green	Green
Particle Environment Package-Hi	Red	Red
Solar Orbiter	Green	Yellow
Solar TErrestrial RElations Observatory	Yellow	Yellow
Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics	Yellow	Yellow
Van Allen Probes	Yellow	Yellow

Source: NASA OIG presentation of Agency data received from Program Executive responses to OIG questionnaires and subsequent correspondence from May to June 2022.

[Green] No cost or schedule overrun.

[Yellow] Cost or schedule overrun, APL not a factor.

[Red] Cost or schedule overrun, APL a factor but not primary cause.

NASA's Decision to Move Existing Tasks to ARDES II Was Unnecessary and Costly

NASA is paying APL more than required for two tasks that were unnecessarily moved from the ARDES I to ARDES II contract. Despite no requirement to do so, NASA procurement officials submitted a JOFOC in September 2021 (after the ARDES I ordering period had expired) requesting to extend the ARDES I ordering period and increase the IDIQ contract's ceiling amount to keep five project task orders under ARDES I until their scope of work was complete. Although the Marshall Space Flight Center (Marshall) Office of Chief Counsel did not support the JOFOC citing "the absence of supporting legal authority," ARDES I contract terms and the FAR gave the contracting officer the authority to increase the dollar amounts of existing task orders without submission of a JOFOC. Nevertheless, NASA moved forward based on the Marshall Office of Chief Counsel's assessment and instead awarded the remaining work for two of the five task orders on ARDES II, the follow-on contract that has a higher fixed-fee rate. NASA decided, however, not to move the other three tasks based on the preliminary results of our audit work and other project-related considerations. NASA's award of the two new task orders on the ARDES II contract resulted in a higher fixed-fee rate—the Agency will spend at least $3.88 million more in fees for the same scope of work—and increased the likelihood that the ARDES II contract's maximum value will be reached sooner than expected.

Moving Tasks from ARDES I to ARDES II will Cost NASA a Minimum of $3.88 Million

The ordering period for ARDES I, including all options and modifications, stretched from October 2006 through March 2020.[14] At the expiration of the ordering period in March 2020, several task orders remained active on ARDES I—meaning work was still being conducted per the task order requirements. The NFS states that the periods of performance for task orders placed within the contract's ordering period can remain active if they comply with the Bona Fide Need rule.[15] Per United States Code 31, Section 1502, the Bona Fide Need rule requires appropriated funds to be used only for expenses for which a need arises during the period of that appropriation's availability for obligation.

A substantial amount of APL's work for NASA is related to a project's life-cycle phases for ongoing development and mission operations. This includes task orders for both the DART and Parker Solar Probe missions—the two highest-valued missions on the ARDES I contract, with values of $228 million and $898 million, respectively. When the ARDES I contract ordering period expired in March 2020, 41 of 185 awarded task orders remained active. According to the contracting officer, NASA intended to close out all 41 of those task orders once their scope of work was complete. Of the 41 task orders, 11 were to complete work in a particular life-cycle phase with additional life-cycle phases required to complete the

[14] FAR 2.101 defines "option" as a unilateral right in a contract by which, for a specified time, the government may elect to purchase additional supplies or services called for by the contract or may elect to extend the term of the contract. Contract modification means any written change in the terms of a contract.

[15] NFS 1816.505-72.

project. For example, following the $134.1 million task order for Dragonfly Phase B formulation activities in which APL provides staff and technical resources for the mission, the Agency planned to award new task orders for future life-cycle phases on the ARDES II contract.

In September 2021, Marshall procurement officials sought to increase the values of five task orders for five different projects on ARDES I to complete the remaining work.[16] Table 3 provides the task order description and corresponding requested increase in value that was sought by Marshall procurement officials.

Table 3: Task Order and Requested Increase in Value as of September 2021

Project	Life-Cycle Phase	Task Order Value Increase Sought in Proposed September 2021 JOFOC
Dragonfly	B	$360 million
GUSTO	C/D	$3.5 million
Parker Solar Probe	E	$2 million
Particle Environment Package-Hi	C/D	$700,000
Solar Orbiter	E	$5.6 million

Source: NASA OIG presentation of Agency data.

Marshall procurement officials decided to submit a JOFOC, 18 months after the ARDES I ordering period expired, to "extend the ARDES contract's performance and ordering period" through April 2028 and "increase the contract's IDIQ ceiling amount" by $375 million.[17] In October 2021, the Marshall Office of Chief Counsel declined to support the JOFOC citing "the absence of supporting legal authority" and NASA's "representations to industry" regarding the transition plan to the ARDES II contract. Although procurement officials at multiple NASA Centers told us that moving a task from one contract to another requires the completion of the existing task order followed by the solicitation and award of a new task order, Marshall procurement officials decided to end the Dragonfly and GUSTO task orders on ARDES I and awarded task orders for the remaining in-scope work—with a total value of $172 million—on the ARDES II contract. The contracting officer subsequently decided to keep the other three task orders on ARDES I based on the preliminary results of our audit that questioned the appropriateness of NASA moving the work to ARDES II, as well as project input, mission phase, number of additional years anticipated for the mission, and additional money needed to complete the mission. The following key procurement events occurred under the ARDES I contract:

- **October 2006:** ARDES I awarded as a 5-year, $750 million contract with an additional 5-year, $750 million option.
- **December 2013:** ARDES I ordering period extended through December 2019.

[16] According to the JOFOC, the task orders required a period of performance extension and value increase to prevent a lapse in performance.

[17] The ARDES I contract establishes an ordering period and a maximum for supplies and services that may be ordered; it does not explicitly establish a "ceiling amount." Further, neither the FAR nor the NFS establishes a definition for "ceiling" amount for IDIQ contracts.

- **December 2019:** ARDES I ordering period extended through March 2020 and the maximum on the contract increased to $1.77 billion with approved JOFOC and deviation.[18]
- **March 2020:** ARDES I ordering period ends.
- **September 2021:** Another JOFOC requested to increase the ARDES I maximum value and reinstate the ordering period; Marshall Office of the Chief Counsel did not support this request.
- **November 2021:** GUSTO task order ended on ARDES I and remaining work—$2.46 million—awarded on ARDES II.
- **March 2022:** Dragonfly task order ended on ARDES I and remaining work—$169.57 million—awarded on ARDES II.

Moving the two tasks from the ARDES I to the ARDES II contract resulted in NASA paying a 6.5 percent fixed-fee rate rather than the 4.1 percent rate on the ARDES I contract.[19] As a result, NASA will, at a minimum, pay an additional $3.88 million in fees to APL due to the re-award of Dragonfly's Phase B and GUSTO's Phase C/D remaining work from ARDES I to ARDES II.[20] We question the necessity of this contract action and the resulting increased cost NASA will incur by this decision.

In December 2019, Marshall procurement officials and Office of the Chief Counsel supported a JOFOC to extend the ARDES I ordering period until March 2020 to facilitate a seamless transition of project requirements from ARDES to ARDES II. However, the transition of the tasks does not appear to be "seamless" and has created administrative burdens for NASA projects, program offices, APL, and NASA procurement officials as they had to manage the renegotiation of new task orders for ARDES II. Specifically, NASA's award of these task orders on ARDES II:

1. created additional administrative costs;
2. subjected the projects to technical, cost, and schedule risks; and
3. increased the likelihood that ARDES II will reach the maximum contract value prior to the expiration of the contract's ordering period.[21]

Moreover, APL officials told us that their preference had been to keep the Dragonfly Phase B task order on ARDES I with the lower fixed-fee rate due to the administrative burdens that would result by re-awarding the remaining in-scope work on ARDES II. Furthermore, the maximum value of the ARDES II contract is closer to being reached because the remaining in-scope work on the Dragonfly's Phase B and GUSTO's Phase C/D task orders is being moved to the contract. As of June 2022, the potential total value of awarded tasks on ARDES II was approximately $637 million, 64 percent of the $1 billion potential award amount for the initial 5-year ordering period. As a result, NASA will likely need to increase the maximum contract value to account for future planned and unplanned work. If procurement officials do not proactively recognize and address this need to increase the maximum

[18] In 2019, NASA received approval to extend the ARDES I "IDIQ contract's performance and ordering periods" through March 2020 and "increase the contract's IDIQ ceiling amount."

[19] Neither task order was receiving the optional 2.5 percent incentive fee available on the ARDES I contract.

[20] NASA will pay additional fees of $3.82 million for Dragonfly's Phase B and $55,000 for GUSTO's Phase C/D.

[21] According to Marshall procurement officials, "If the Dragonfly task order were to be transitioned to the ARDES II contract, NASA would likely incur additional re-proposal costs associated with the transfer. The ARDES II contract has different terms and conditions and deliverables from the ARDES contract. These differing terms and conditions and deliverables would have to be proposed to and implemented in the new task order, which would likely require additional funding and result in an increased procurement lead time."

contract value in a timely manner, they will again be out of options for continuing work under ARDES II once that maximum has been reached.

NASA Failed to Ensure Efficient Contract Administration

The terms of the ARDES I contract allowed for flexibility in administering the contract in the best interest of the government and the FAR supports use of such flexibilities. Notably, in deciding federal contract protest cases, the Government Accountability Office (GAO) has traditionally supported the government's contract actions where the nature and purpose of the contract did not change and has expressly provided the government latitude in making changes to research and development contracts.

Terms and Conditions in the ARDES I Contract

Marshall procurement officials did not use the authority granted in the ARDES I contract to keep all active task orders on the contract. The ARDES I contract includes terms that grant the Agency the authority to adjust existing task order values even if the "maximum amount" has been reached. Specifically, under the heading "Estimated Cost," the contract terms state that reaching the maximum only "precludes the issuance of new orders" and "does not preclude the adjustment to the dollar amounts of existing placed orders for actions that are within the scope of the placed orders, and which are made pursuant to existing contract authority, such as the Changes clause."[22]

Instead of using the authority granted in the contract, Marshall procurement officials submitted a JOFOC to add value to the IDIQ "ceiling" and reinstate the ARDES I ordering period.[23] The contracting officer believed that an increase in the contract's maximum value was needed to add value to individual task orders and was unaware of the relevant contract terms that allow NASA to increase the value of existing placed orders. That allowance meant the contracting officer could have increased the value of existing task orders without submitting a JOFOC and seeking support from the Office of Chief Counsel—an action that would have resulted in the Agency avoiding unnecessary additional costs.[24]

The FAR and NFS Clauses

The FAR requires that an IDIQ contract establish a minimum and maximum of supplies and services that may be ordered, wherein the government's only obligation is to order at least the stated minimum amount of supplies or services.[25] The ARDES I contract established that the minimum amount of supplies or services that shall be ordered during the effective period of the contract was $1 million and the maximum amount of supplies and services that may have been ordered, after exercising the 5-year

[22] FAR 52.243-4(a)(1-4) states, "The Contracting Officer may, at any time, without notice to the sureties, if any, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including changes (1) In the specifications (including drawings and designs); (2) In the method or manner of performance of the work; (3) In the Government-furnished property or services; or (4) Directing acceleration in the performance of the work."

[23] According to the contracting officer, the Marshall Procurement Office did not intend to add any new work to the ARDES contract but could not provide an explanation as to why they requested to reinstate the contract's ordering period.

[24] Counsel did not acknowledge the pertinent ARDES I contract terms in its legal guidance to not support the submitted JOFOC.

[25] FAR 16.504(a)(1) states, "The contract must require the Government to order and the contractor to furnish at least a stated minimum quantity of supplies or services. In addition, if ordered, the contractor must furnish any additional quantities, not to exceed the stated maximum. The contracting officer should establish a reasonable maximum quantity based on market research, trends on recent contracts for similar supplies or services, survey of potential users, or any other rational basis."

option and contract modifications, was $1.77 billion. The NFS states that a task or delivery order contract's ordering period may be for any period up to 5 years, but the period may be extended pursuant to an option or contract modification. The NFS further states that the ordering period may not exceed a total of 10 years unless approved by the Senior Procurement Executive.[26]

The FAR requires that an IDIQ contract must include a specific clause which establishes a deadline for deliveries by the contractor.[27] NASA included the FAR clause in the ARDES I contract, but instead of providing a date, NASA inserted "TBD," thereby not establishing an end to the period of delivery for the orders in the contract. A FAR clause is incorporated by reference, stating that "the quantities of supplies and services specified in the Schedule are estimates only and are not purchased by this contract, adding that "the contract shall govern the Contractor's and Government's rights and obligations with respect to that order to the same extent as if the order were completed during the contract's effective period." However, the parties did not establish a delivery or period of performance deadline that would apply to all awarded task orders in the IDIQ contract. Further, another FAR clause in the ARDES I contract provides that unless an order is returned with written notice stating the Contractor's intent to not ship the item(s), "the Contractor shall honor any order exceeding the maximum order limitations."

In October 2021, the Marshall Office of Chief Counsel stated that it was unable to support the JOFOC because "there is no legal authority that permits a federal agency to revive or retroactively extend an IDIQ contract's expired performance and ordering period and increase its cost ceiling." It also suggested that approving the actions proposed in the JOFOC would be treated as "the noncompetitive creation of a new contractual relationship." However, the Marshall Office of Chief Counsel did not cite any United States Code, FAR and NFS requirements, or ARDES I contract terms that prohibited adding value to active in-scope task orders. Additional justifications to not support the JOFOC included the length of the ARDES I contract, and counsel suggested that NASA negotiate with APL to accept the 4.1 percent fixed-fee rate from ARDES I for the task orders that were planned to transition to ARDES II.

Although the Marshall Office of Chief Counsel did not cite United States Code, the FAR, or the NFS, the FAR outlines procurement policies and procedures that are used by members of the Acquisition Team in the absence of specific policy or procedure in the FAR. The FAR's Statement of Guiding Principles for the Federal Acquisition System states that if a procurement action is neither specifically addressed in the FAR nor prohibited by law, it should be interpreted as permitting the team to innovate and utilize sound

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[26] NFS 1816.505-71(a) states, "10 U.S.C. 2304a establishes limitations on the ordering period of a task or delivery order contract awarded by NASA. The statute specifies that the ordering period may be for any period up to five years. This period may be subsequently extended for one or more successive periods pursuant to an option or contract modification. In no case may the ordering period exceed a total of ten years unless approved by the Senior Procurement Executive." NASA Procurement Notice, PN 04-12 states, "Senior Procurement Executive" means the Assistant Administrator or Deputy Assistant Administrator for Procurement, Office of Procurement, NASA Headquarters.

[27] FAR 52.216-22, "Indefinite Quantity," states, "Any order issued during the effective period of this contract and not completed within that period *shall* be completed by the Contractor within the time specified in the order. The contract *shall* govern the Contractor's and Government's rights and obligations with respect to that order to the same extent as if the order were completed during the contract's effective period; *provided*, that the Contractor *shall* not be required to make any deliveries under this contract after _______________ *[insert date]."*

business judgment in the best interest of the government.[28] Despite this FAR principle, Marshall Procurement Officials did not utilize such a strategy.

Further, the FAR does not prohibit adding value to task orders after the IDIQ ordering period has expired. In addition to the lack of prohibiting language in the FAR and the ARDES I contract terms that allow for the adjustment of task order values even after the maximum of the base contract is reached, the NFS provides guidance to limit the use of numerous task orders. To reduce the administrative burden and transactional costs of issuing numerous task orders, the NFS requires the contracting officer to consider "adding the new requirement into an existing task or delivery order if the requirement fits within the scope of an existing task or delivery order." Further, the NFS states that contracting officers shall consider avoiding the use of task orders solely to track funding.

Lastly, per the FAR, "the contracting officer should establish a reasonable maximum quantity based on market research, trends on recent contracts for similar supplies or services, survey of potential users, or any other rational basis."[29] While the contracting officer can make a reasonable determination based on historical and current mission data as to what the IDIQ maximum should be, they cannot predict with any certainty what work may be added to the contract resulting from future selections of the contractor under announcements of opportunity. In this regard, the FAR allows for deviations from its requirements, including the requirement to even establish a maximum for an IDIQ contract.[30] For example, in March 2022 a General Services Administration Senior Procurement Executive approved a class deviation from the FAR requirement to establish a maximum quantity for an indefinite-quantity contract for one of their programs.[31] The result of the deviation was that the program contract only required a stated minimum quantity of supplies or services. NASA procurement officials could not find documentation to identify whether the Agency has used a similar deviation in the past.[32]

Precedent in Federal Contract Protest Cases

In further support of modifying and adding value to active task orders, a GAO protest decision determined that contract modifications of this nature do not trigger competition requirements and therefore would not subject the government to a viable protest from industry. In deciding a 2006 bid protest related to the modification of a research and development contract at the U.S. Army Space and

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[28] Per the FAR's Statement of Guiding Principles for the Federal Acquisition System, "If a policy or procedure, or a particular strategy or practice, is in the best interest of the Government and is not specifically addressed in the FAR, nor prohibited by law (statute or case law), Executive order or other regulation, Government members of the Team should not assume it is prohibited. Rather, absence of direction should be interpreted as permitting the Team to innovate and use sound business judgment that is otherwise consistent with law and within the limits of their authority. Contracting officers should take the lead in encouraging business process innovations and ensuring that business decisions are sound."

[29] FAR 16.504.

[30] FAR 1.403 states that "Individual deviations affect only one contract action, and, unless 1405(e) is applicable, may be authorized by the agency head. The contracting officer must document the justification and agency approval in the contract file." FAR 1.405(e) provides guidance to civilian agencies, other than NASA, on deviations pertaining to treaties and executive agreements.

[31] FAR 1.404 states that "class deviations affect more than one contract action." FAR 1.404(e) states that "for NASA, class deviations shall be controlled and approved by the Assistant Administrator for Procurement. Deviations shall be processed in accordance with agency regulations."

[32] A procurement official noted that until recently there has not been a central database to capture and track actions, such as deviation approvals, to NASA Headquarters, and instead actions would be sent directly to an assigned analyst who would file the documentation themselves. The Division Director sent a message to all analysts to request whether a deviation has been used for the maximum quantity of an IDIQ contract, and no approved deviations were identified.

Missile Defense Command, GAO stated that "…additional latitude for changing a contract may exist where the contract is for research and development, noting that the scope of such contracts is often flexible because of unanticipated changes due to the lack of definitiveness of the government's requirements."[33] The scenario described in the GAO decision is similar to the issue NASA faced with the ARDES I contract. Specifically, the Agency delayed the launch date for the Dragonfly project, which is managed by APL. That delay required Dragonfly project managers to replan cost and schedule milestones for the mission. As a result of that replan, NASA identified that the Phase B task order for Dragonfly needed additional money, although the task order's scope of work would remain the same. Instead of modifying and adding value to the existing Phase B task order, an action supported by GAO precedence, NASA ended the Phase B work on ARDES I and awarded the remaining work on ARDES II, resulting in $3.82 million in additional—and avoidable—costs to NASA.

[33] GAO, *DOR Biodefense, Inc.; Emergent BioSolutions* (B-296358.3 and B-296358.4, January 31, 2006).

OTHER MATTERS OF INTEREST: DCAA BACKLOG OF INCURRED COST AUDITS

Although the period of performance for the ARDES I contract expired in March 2020, 41 active task orders with periods of performance extend beyond the contract period. The ARDES I contract cannot be closed out because of these active tasks; however, the NFS requires that expired tasks be closed within 90 days. For an IDIQ contract such as ARDES I, each task order must be closed separately as if it were a stand-alone contract. The determination of final indirect costs is central to the closeout of cost type contracts and task orders.[34] The resulting determination may require an adjustment to the final obligated amount of the contract. The Defense Contract Audit Agency (DCAA) is responsible for performing incurred cost audits for NASA.[35]

As of May 25, 2022, NASA had a backlog of 81 ARDES tasks awaiting closeout, some of which expired as long ago as 2008.[36] The 81 task orders had total obligations of approximately $171 million, of which $177,664 is yet to be disbursed to APL. Approximately 67 percent of these backlogged task orders are attributed to delays in DCAA completing incurred cost audits which are required before APL can provide NASA documentation for closeout.[37] According to NASA's closeout contractor, the final actual rates between APL and DCAA have been processed only through 2016.[38] APL cannot submit its final invoice until it has received the finalized audits from DCAA, and therefore, NASA is unable to close out the task. Both the NASA contracting officer and the closeout contractor indicated they have no authority to compel DCAA to perform the incurred cost audits in a timelier manner.

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[34] Indirect costs are not directly identified with a single final cost objective but are the percentage or dollar factor that expresses the ratio of indirect expense incurred in a given period to direct labor cost, manufacturing cost, or another appropriate base for the same period.

[35] Incurred cost audits assess the accuracy of a contractor's annual costs to determine whether the costs are allowable, reasonable, and allocable to the contract in accordance with contract terms, cost accounting standards, and government laws or regulations.

[36] The physical completion dates of these tasks range from 2008 to 2022. They have been submitted to the closeout support but have not been administratively closed.

[37] The reasons for the remaining percentage of backlogged task orders could be attributable to the contractor not submitting all deliverables, reports, or invoices, or the contracting officer not completing closeout checklist actions or physically transferring the file to the closeout contractor.

[38] Settlement rates are the final rates determined after the end of a contractor's fiscal year.

CONCLUSION

Overall, we found that APL was appropriately managing its NASA projects. Specifically, during our review of 15 projects—with task orders valued at $1.5 billion—as well as the Europa Clipper project, we found that APL was not the primary cause of cost or schedule overruns for the 12 projects that experienced such increases.

However, we found that NASA is paying APL more than required for two tasks that were unnecessarily moved from the ARDES I to ARDES II contract even though neither the FAR nor ARDES I contract terms prohibited increasing the dollar amounts of task orders after an IDIQ ordering period has expired. Specifically, NASA moved $172 million of remaining in-scope work for Dragonfly and GUSTO from the ARDES I contract to the ARDES II contract. By awarding these task orders on ARDES II, the Agency subjected itself to a higher fixed-fee rate that will result in NASA paying $3.88 million more in fees for the same scope of work. We question the necessity and cost NASA incurred resulting from this decision. Furthermore, NASA's action created additional administrative costs, subjected the projects to risks, did not align with APL's preferences, and increased the likelihood that the ARDES II contract will reach its maximum value sooner than expected. Finally, while NASA has made strides in improving contract closeout efforts the last several years, continued delays in DCAA completing required incurred cost audits is impacting these efforts on the ARDES contracts.

RECOMMENDATIONS, MANAGEMENT'S RESPONSE, AND OUR EVALUATION

To help ensure NASA does not pay more than required on IDIQ contracts and task orders, we recommended the Assistant Administrator for Procurement:

1. Document this occurrence as a lessons learned, as well as provide supplemental guidance to NASA procurement officials that, in the absence of prohibitive regulation or direction, the FAR provides them the authority to take the lead in encouraging business process innovations to ensure efficient contract actions.

In addition, we recommended the Marshall Space Flight Center Director require the Marshall Procurement Office:

2. Document a process to periodically assess and compare the total cost estimate for awarded APL tasks to the established maximum and take timely action to modify the contract or request a deviation from the FAR to exclude a maximum for ARDES II and any future ARDES-type IDIQ contracts for APL.

We provided a draft of this report to NASA management who partially concurred with our recommendations and described planned actions to address them. However, the Agency disagreed with our finding that two task orders were unnecessarily moved from the ARDES I to ARDES II contract, stating in part that the ARDES I contract had expired, its maximum value reached, and therefore any modifications adding value to the task order that would exceed the ARDES I maximum was not authorized. We disagree with this argument because the ARDES I contract terms state that reaching the maximum only "precludes the issuance of new orders" and "does not preclude the adjustment to the dollar amounts of existing placed orders for actions that are within the scope of the placed orders, and which are made pursuant to existing contract authority, such as the Changes clause." Nevertheless, we consider the proposed actions responsive and will close the recommendations upon completion and verification.

Management's comments are reproduced in Appendix D. Technical comments provided by management and revisions to address them have been incorporated as appropriate.

Major contributors to this report include Raymond Tolomeo, Science and Aeronautics Research Audits Director; Sarah Beckwith and Diane Choma, Project Managers; Theresa Becker; Erin Cooke; Derek Gainsboro; Greg Lokey; and Matt Ward.

If you have questions about this report or wish to comment on the quality or usefulness of this report, contact Laurence Hawkins, Audit Operations and Quality Assurance Director, at 202-358-1543 or laurence.b.hawkins@nasa.gov.

PAUL MARTIN

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Paul K. Martin
Inspector General

APPENDIX A: SCOPE AND METHODOLOGY

We performed this audit from September 2021 through August 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

In this report, we assessed NASA's management of the contracts and portfolio of Agency projects being developed by APL. Additionally, we sent questionnaires to NASA Program Executives of 16 projects and used the responses to evaluate any cost overruns or schedule delays to determine whether the issues were attributable to APL performance (see Appendix B for more details on our project selection). We also assessed NASA's management of the ARDES contracts and associated task orders to determine if NASA's contract administration is effective, efficient, and in compliance with federal law and NASA policy.

Our assessment of the processes and practices included review of NASA documents and interviews with NASA officials from the Office of Procurement, Science Mission Directorate, NASA Office of JPL Management and Oversight (formerly the NASA Management Office), Office of Chief Counsel, and NASA Shared Services Center. We also interviewed Department of the Navy and APL officials. Our primary criteria for assessing the aforementioned practices and procedures were the FAR, NASA FAR Supplement, and the ARDES I and ARDES II contract terms and conditions.

Use of Computer-Processed Data

We only utilized computer-processed data in the identification of our sample. We did not validate the reliability of any computer processed data, as no computer-processed data was used to support the findings of this report. All findings identified were internal control process weaknesses, and any inaccuracies in computer-processed data would not substantively change the findings of this report.

Review of Internal Controls

We assessed internal controls and compliance with laws and regulations as they relate to contract administration. We focused specifically on whether NASA procurement officials administered procurement actions in compliance with federal acquisition regulations. We identified control weaknesses with NASA's procurement practices that are addressed in the findings. Our recommendations, if implemented, will ensure compliance with cited federal statutes and correct the control weaknesses identified in this report.

Prior Coverage

During the last 5 years, the NASA Office of Inspector General and GAO have issued 12 reports and testimony of significant relevance to the subject of this report. Reports can be accessed at https://oig.nasa.gov/audits/auditReports.html and http://www.gao.gov.

NASA Office of Inspector General

2021 Report on NASA's Top Management and Performance Challenges (MC-2021, November 15, 2021)

COVID-19 Impacts on NASA's Major Programs and Projects (IG-21-016, March 31, 2021)

2020 Report on NASA's Top Management and Performance Challenges (MC-2020, November 12, 2020)

NASA's Planetary Science Portfolio (IG-20-023, September 16, 2020)

Management of NASA's Europa Mission (IG-19-019, May 29, 2019)

NASA's Engineering and Technical Services Contracts (IG-19-014, March 26, 2019)

NASA Cost and Schedule Overruns: Acquisitions and Program Management Challenges (CT-18-002, June 14, 2018)

Government Accountability Office

NASA: Assessments of Major Projects (GAO-22-105212, June 23, 2022)

NASA: Lessons from Ongoing Major Projects Could Improve Future Outcome (GAO-22-105709, February 9, 2022)

Federal Contracting: Senior Leaders Should Use Leading Companies' Key Practices to Improve Performance (GAO-21-491, July 27, 2021)

NASA: Assessments of Major Projects (GAO-21-306, May 20, 2021)

NASA: Assessments of Major Projects (GAO-20-405, April 29, 2020)

APPENDIX B: APL PROJECT SUMMARIES

We judgmentally selected 16 project task orders based on the scope of APL's contribution to the respective project. Specifically, we chose to review projects with active task orders that (1) were awarded on the ARDES I or ARDES II contracts, (2) had a total award value of greater than or equal to $1 million, and (3) have provided or will provide NASA with a hardware deliverable. In addition to the 15 projects that met the criteria listed, we also reviewed Europa Clipper, where APL is a sub-contractor to JPL and is providing the propulsion module to NASA. Although APL's Europa Clipper work does not fall under either ARDES contract, we added it to our review due to the significance of the mission (see Table 4 for task order values by project). Task orders support projects at a variety of NASA Centers including Ames Research Center (Ames), Glenn Research Center (Glenn), Goddard Space Flight Center (Goddard), Johnson Space Center (Johnson), JPL, Kennedy Space Center (Kennedy), Langley Research Center (Langley), and Marshall.

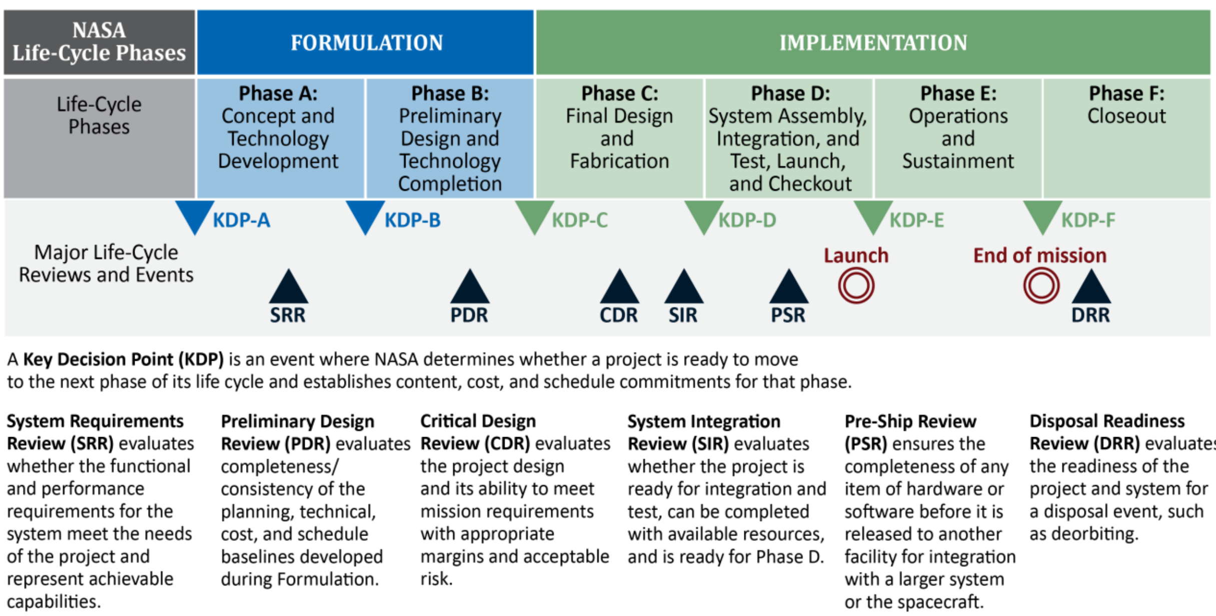
Table 4: Task Order Values for Selected Projects as of January 2022

Project	Task Order Value (in millions)
Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging	$1.3
Double Asteroid Redirection Test (DART)	$194.1
Dragonfly	$134.1
Electrojet Zeeman Imaging Explorer	$3.7
Europa Clipper	$98.6
Galactic/Extragalactic ULDB [Ultralong-Duration Balloon] Spectroscopic Terahertz Observatory (GUSTO)	$12.9
Interstellar Mapping and Acceleration Probe	$70.4
Lunar Reconnaissance Orbiter	$6.2
Lunar Vertex	$28.0
Mars-moon Exploration with GAmma rays and Neutrons (MEGANE)	$21.5
Parker Solar Probe	$898.3
Particle Environment Package-Hi	$40.9
Solar Orbiter	$11.9
Solar Terrestrial Relations Observatory	$28.2
Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics	$6.2
Van Allen Probes	$57.8

Source: NASA OIG presentation of Agency data.

NASA's project life cycle is divided into two phases—Formulation and Implementation—that are further divided into Phases A through F (see Figure 3).[39] The Formulation Phase is divided into Phases A and B during which time project teams identify how their mission supports NASA's strategic goals and develop technological and preliminary project designs. A project must pass through Key Decision Point (KDP) C to receive management approval to proceed with the start of Implementation, which includes an assessment of the preliminary design, a determination of whether the project is sufficiently mature, and the establishment of cost and schedule baselines—the Management Agreement and Agency Baseline Commitment. The Management Agreement is regarded as a contract between the Agency and project manager and provides the parameters and authorities over which the project manager is accountable. The Agency Baseline Commitment contains the cost and schedule parameters NASA submits to the Office of Management and Budget and Congress. Implementation is divided into Phases C through F and is where project development—Phases C and D—and operations—Phase E—plans are executed. Implementation concludes with the completion of Phase F.

Figure 3: NASA Project Life Cycle



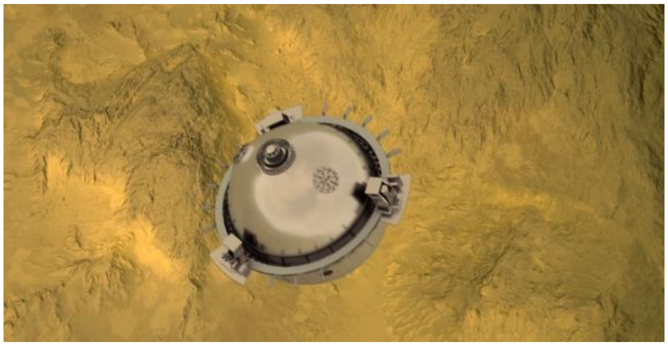
Source: NASA OIG presentation of Agency information.

For readability in this Appendix, Status is given as Formulation and Implementation, with a distinction made for Operations & Sustainment (Primary vs. Extended Operations). When a project is still in Formulation and baselines have not been established, schedules and life-cycle costs are given as estimates and ranges, respectively. For those projects in Implementation, Agency Baseline Commitment costs and schedule are provided as planned first flights/launches and life-cycle costs.

[39] NASA Procedural Requirements 7120.5F and NASA/SP-2014-3705, *NASA Space Flight Program and Project Management Handbook* (September 2014).

Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging (DAVINCI)

Probing Venus's dense atmosphere
Preliminary Launch Date Estimate: June 2029



Source: Goddard visualization by CI Labs.

Snapshot

Science Mission Directorate, Planetary Science Division

NASA Centers: Goddard, JPL

Preliminary Life-Cycle Cost Estimate: $1.2 to 1.6 billion

Planned Mission Duration: 2 years

Project Life-Cycle Phase: Formulation. Because this project is in Formulation, cost and launch dates are preliminary estimates; the Agency uses these estimates for planning purposes only, and it has not yet committed to a cost or schedule.

The Deep Atmosphere Venus Investigation of Noble gases, Chemistry, and Imaging (DAVINCI) will measure the composition of Venus's atmosphere. The mission aims to develop an understanding of how Venus formed and evolved, as well as whether it had an ocean. In doing so, DAVINCI will make precise measurements of noble gases and elements to help determine reasons for the planet's inhospitable nature. Following launch, DAVINCI will conduct two flybys of Venus to study the atmosphere and map the surface composition. Approximately 2 years after launch, a probe will be released into the planet's atmosphere. The probe will descend for about an hour before landing on Venus, taking critical measurements as it descends to the surface.

APL's Role

APL is supporting the project in multiple capacities, including conducting risk reduction activities to address data rates. APL will also provide the critical Descent Sphere communication system to enable the return of the science data. APL will provide science support for instruments that will test Venus's atmosphere as well as engineering support. The estimated costs of APL's contributions to DAVINCI are $23 million.

Work in Progress and Key Milestones

The project is continuing in the Formulation Phase of the project life cycle, which includes the performance of risk reduction activities conducted by APL. DAVINCI is projected to conduct its Preliminary Design Review in June 2025, followed by KDP-C in August 2025. System Requirements Reviews for the various instruments and subsystems are expected to take place throughout 2023, with Preliminary Design Reviews following in 2024, and Critical Design Reviews taking place in 2025.

Mission Challenges and COVID-19 Impacts

DAVINCI falls within NASA's Discovery Program, which launches smaller missions using fewer resources and shorter development times than larger "flagship" missions. Agency officials noted that the funding profile needed to meet the launch readiness date of June 2029 is not supported by the Discovery Program FY23 budget request. The project is working with the Planetary Science Division and Discovery Program to rephase mission funds, which will not increase the mission cost estimate. NASA project officials stated that there have been no COVID-19 impacts to date.

Double Asteroid Redirection Test (DART)

Defending Earth from hazardous asteroids
Launched November 24, 2021

Source: NASA/APL.

Snapshot

Science Mission Directorate, Planetary Science Division

NASA Centers: Glenn, Goddard, Johnson, JPL, Langley

Projected Life-Cycle Cost: $330.6 million

Planned Mission Duration: 10 months

Project Life-Cycle Phase: Primary Operations

DART is the first-ever test mission for planetary defense and will test technologies for defending Earth against potential asteroid hazards by deflecting the asteroid through kinetic impact. DART's target is the Didymos binary asteroid system, consisting of Didymos, about a half-mile across, and a smaller companion called Dimorphos. The mission launched aboard a SpaceX Falcon 9 rocket from Vandenberg Space Force Base in California in November 2021. After 10 months in orbit, DART will target Dimorphos, which, at roughly 500-feet in diameter, is a good representation of asteroids that could pose the most frequent significant threat to Earth. The impact is intended to change the asteroid's orbit speed and will be observed and measured using telescopes on Earth.

APL's Role

APL has leadership and project management responsibility for DART. Additionally, APL built and is managing the DART spacecraft as well as coordinating the investigation teams. The Lab is responsible for $263 million of the total $330 million associated with DART's life-cycle costs.

Work in Progress and Key Milestones

DART transitioned to Phase E of its project life cycle on January 1, 2022, and the spacecraft continues its trajectory towards Dimorphos as it prepares for impact on September 26, 2022. APL will command and control the spacecraft from its Mission Operations Center in Maryland. Following impact, the APL-led DART Investigation Team will collect observations through March 2023. The project is planned to complete all activities by the end of September 2023.

Mission Challenges and COVID-19 Impacts

During the terminal phase of approaching the Didymos system, DART will have to autonomously navigate to and impact the asteroid 6.8 million miles from Earth. To meet this daunting challenge, the project developed the Small-body Maneuvering Autonomous Real-Time Navigation system to guide the spacecraft and handle a range of variations it may encounter when it arrives at Didymos. Further, the project faced challenges with the design of the spacecraft's critical, high-resolution camera. To reduce risk of failure in flight, the camera's main mirror mount was redesigned late in the Integration and Testing Phase, which was one reason launch slipped from July 2021 to November 2021. COVID-19 was a major factor in the delays of testing and delivering DART's solar arrays and their eventual delivery. The delays from the solar arrays played a role in the 4-month launch postponement. Additionally, according to GAO, DART officials had to develop a modified testing plan with a CubeSat contractor, as representatives from the Italian Space Agency were unable to travel to the United States for testing of the device due to COVID-19.

Dragonfly

Science drone on Saturn's icy moon Titan
Preliminary Launch Date Estimate: June 2027

Source: NASA/APL.

Snapshot

Science Mission Directorate, Planetary Science Division

NASA Centers: Ames, Glenn, Goddard, JPL, Kennedy, Langley, Marshall

Preliminary Life-Cycle Cost Estimate: $2.1 to $2.5 billion

Planned Mission Duration: 10 years

Project Life-Cycle Phase: Formulation. Because this project is in Formulation, cost and launch dates are preliminary estimates; the Agency uses these estimates for planning purposes only, and it has not yet committed to a cost or schedule.

Dragonfly is an 8-bladed rotorcraft that will sample and examine sites around Titan—Saturn's richly organic, icy moon—to advance NASA's search for the building blocks of life in the universe. The mission falls within the Agency's New Frontiers Program, which aims to accomplish exploration goals identified by the planetary science community while containing cost and development time.

APL's Role

APL is providing project management and the principal investigator for the project, and will design, build, and operate the Dragonfly rotorcraft-lander. Additionally, APL will contribute two of the four instruments on the spacecraft: a gamma-ray and neutron spectrometer to measure Titan's surface composition, and geophysical and meteorological sensors to measure the wind speed, pressure, and temperature in the moon's atmosphere.

Work in Progress and Key Milestones

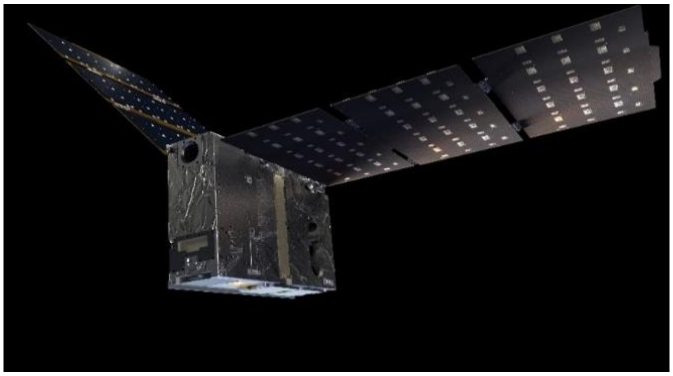
Dragonfly is conducting preliminary design, technology completion, and risk reduction activities. The project planned to undergo testing in April 2022 at Langley's Wind Tunnel Testing Facility, but facility recommissioning issues delayed testing until late summer 2022 at the earliest. Throughout 2022 and into 2023, Dragonfly will complete subsystem and instrument-level Preliminary Design Reviews in preparation for its mission-level Preliminary Design Review, which is expected to occur no earlier than October 2022. The project is expected to reach KDP-C and enter the Implementation Phase of its life cycle in January 2023.

Mission Challenges and COVID-19 Impacts

Dragonfly's primary challenges have been supply-chain issues, test delays at Langley's Transonic Dynamics Tunnel, and reducing lander mass. Dragonfly was originally scheduled to launch in 2026, but NASA moved the launch readiness date to 2027 in part because of the impact of COVID-19 on the overall Planetary Science Division's budget. The June 2027 launch date will require a heavy-class launch vehicle which in turn will speed up transit to Titan; NASA has not yet selected the launch vehicle for Dragonfly. Additionally, COVID-19 work restrictions impacted the project's day-to-day operations due to positive cases and exposures among project staff. The entirety of COVID-19 impacts to Dragonfly are still being assessed.

Electrojet Zeeman Imaging Explorer (EZIE)

Small satellites studying Earth's space weather
Launch Readiness Date: March 2026



Source: NASA/APL/Steve Gribben.

Snapshot

Science Mission Directorate, Heliophysics Division	**NASA Centers:** Goddard, JPL
Projected Life-Cycle Cost: $68.4 million	**Planned Mission Duration:** 16 months
Project Life-Cycle Phase: Implementation	

The Electrojet Zeeman Imaging Explorer (EZIE) will study electric currents in Earth's atmosphere. These currents link aurora to the magnetosphere, which is one piece of Earth's complicated space weather system that responds to solar activity and other factors. The spacecraft will use three small satellites to test mission hypotheses on how electrojets form and evolve.

APL's Role

APL is managing the EZIE mission, providing end-to-end mission development, systems engineering, mission assurance, and science operations.

Work in Progress and Key Milestones

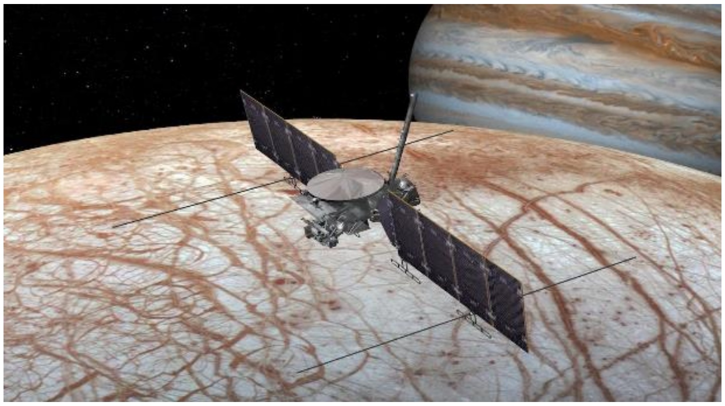
In late July 2022, EZIE passed KDP-C and was confirmed to proceed into the Implementation Phase of its project life cycle. Spacecraft and instrument Critical Design Reviews are planned for January 2023, with the overall mission Critical Design Review set for March 2023. Additionally, the project plans to conduct instrument flight model integration and testing from March to September 2023 before holding KDP-D in November 2023.

Mission Challenges and COVID-19 Impacts

NASA project officials noted two main challenges. The first is the potential for cost growth if additional requirements for testing and inspections are imposed on the project. Second, COVID-19 led to the project's approximately 2.5-month delay on conducting its Preliminary Design Review and KDP-C. However, according to project officials, the delay did not impact the projected launch readiness date.

Europa Clipper

Orbiter investigating a subsurface ocean
Launch Readiness Date: October 2024



Source: NASA/JPL.

Snapshot

Science Mission Directorate, Planetary Science Division

NASA Centers: Goddard, JPL, Kennedy, Langley, Marshall

Projected Life-Cycle Cost: $5 billion

Planned Mission Duration: 3.5 years

Project Life-Cycle Phase: Implementation

Europa Clipper will conduct detailed reconnaissance of Jupiter's ice-covered moon Europa. The mission will launch from Kennedy aboard a SpaceX Falcon Heavy rocket and in 2030 will enter orbit around the Jovian moon, where it will perform repeated close flybys to collect data in pursuit of the hypothesis that a subsurface ocean could harbor conditions suitable for life.

APL's Role

Europa Clipper is managed by JPL, which partnered with APL for mission development. Representatives from both organizations are included in the mission's management, engineering, and science teams. APL is providing the propulsion module and working on instruments that will study the density, temperature, and flow of plasma; produce high-resolution color and stereoscopic images; and map the frozen elements on the crust of the moon.

Work in Progress and Key Milestones

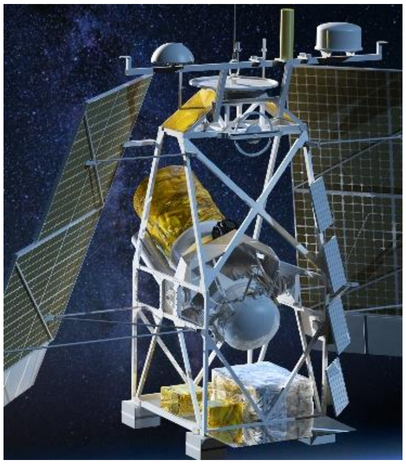
Key activities for 2022 and 2023 include the completion and delivery of all spacecraft subsystems and instruments for integration and testing. Validation and Verification activities will continue to conduct testing, analysis, inspections, and demonstrations to complete requirements verification.

Mission Challenges and COVID-19 Impacts

The main challenges facing the project are the scope and complexity of Validation and Verification activities, completion and delivery of the avionics subsystem, completion and delivery of the solar arrays, and shifting hardware delivery dates in integration and testing to maintain progress and preserve schedule margins. The primary risk posed by these challenges is use of project reserves to overcome any problems that arise. Overall impacts from COVID-19 amounted to $104 million in cost increases and also led to the project shutting down from March to May in 2020. Though the project was approved for required on-site activities in May 2020, restarts were slow, and some tasks did not resume until July 2020.

Galactic/Extragalactic ULDB Spectroscope Terahertz Observatory (GUSTO)

Balloon mission studying phases of the stellar life cycle
Launch Readiness Date: December 2023



Source: NASA/APL.

Snapshot	
Science Mission Directorate, Astrophysics Division	**NASA Center:** Goddard
Projected Life-Cycle Cost: $47.2 million	**Planned Mission Duration:** Approximately 75 days
Project Life-Cycle Phase: Implementation	

GUSTO's mission is to shed light on the complexities of the cosmic material found between stars, known as interstellar medium. Data collected by the balloon-based observatory will also allow scientists to map out large sections of the Milky Way Galaxy and the Large Magellanic Cloud. The 2-ton GUSTO gondola, the structure that will connect the instrument and telescope to the balloon, will be carried nearly 21 miles above Earth's atmosphere, where water vapor can prevent ground-based telescopes from making detailed observations. Part of NASA's Astrophysics Explorers program, GUSTO will be launched on a zero-pressure long duration balloon from McMurdo, Antarctica, in December 2023.

APL's Role

APL is responsible for project management for the mission. The Lab is also responsible for designing and building the gondola.

Work in Progress and Key Milestones

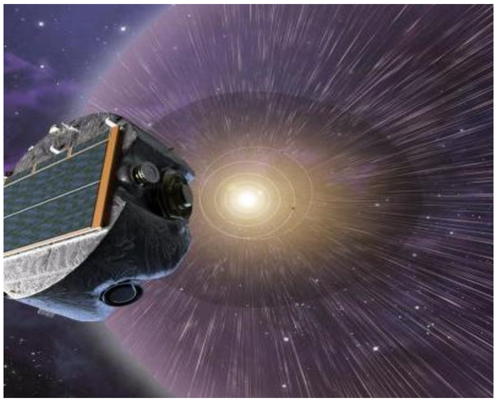
The project is currently working to resolve problems with instrumentation so that the payload can be ready for delivery to APL for observatory Integration and Testing and prepare for a December 2023 launch. Additionally, if GUSTO is approved to proceed, APL will complete the gondola for receipt of the working instrument payload.

Mission Challenges and COVID-19 Impacts

GUSTO's main challenges are resolving instrument payload problems to ensure the necessary science requirements are met while also resolving instrument problems within cost and the replanned schedule. The project must also successfully integrate the payload instrument onto the gondola. Due to COVID-19, the National Science Foundation, which manages U.S. science investigations in Antarctica, canceled the 2021 and 2022 Austral Summer Antarctica science and field season, which included long-duration balloon campaigns. Additionally, personnel at APL had restrictions on working in their labs, and an international instrument component vendor, SRON, had delays in delivery to the payload team.

Interstellar Mapping and Acceleration Probe (IMAP)

Examining the heliosphere
Launch Readiness Date: February 2025



Source: APL.

Snapshot

Science Mission Directorate, Heliophysics Division

NASA Centers: Goddard, JPL, Kennedy

Projected Life-Cycle Cost: $781.8 million

Planned Mission Duration: 2 years

Project Life-Cycle Phase: Implementation

The Interstellar Mapping and Acceleration Probe (IMAP) mission will further our understanding of the heliosphere, the protective bubble around the solar system created by the Sun's magnetic field. The spacecraft will carry 10 science instruments, will launch from Cape Canaveral Space Force Station in Florida aboard a Falcon 9 rocket, and will orbit the Sun at the L1 Lagrange point, approximately 1 million miles from Earth, directly between the Earth and the Sun—an ideal location for solar observation.

APL's Role

APL is responsible for project management and systems engineering. The Lab will also provide flight software and autonomous capabilities; conduct design, assembly, integration, and testing for the observatory; and contribute an instrument to capture images of energetic neutral atoms produced just outside the solar system. Mission operations will be managed by APL.

Work in Progress and Key Milestones

IMAP is currently completing critical design work, fabricating engineering models for instruments and subsystems, and testing major components. A Critical Design Review is planned for December 2022, a Systems Integration Review is scheduled for June 2023, and KDP-D is estimated for July 2023.

Mission Challenges and COVID-19 Impacts

IMAP recently completed structural modifications of the spacecraft's bus and adjusted the design of one instrument's pivot platform to meet response frequencies; this work has had an impact on the schedule margin. COVID-19 led to workforce inefficiencies and supplier disruptions during the Formulation Phase of the project's life cycle. Initially scheduled for February 2021, the mission Preliminary Design Review was completed in May 2021. Subsequently, the launch readiness planning date was also postponed from October 2024 to February 2025. These delays resulted in an additional $22.8 million increase in the mission life-cycle cost. At KDP-C in July 2021, NASA's Science Mission Directorate approved adding $25 million to the project-held reserves to account for future COVID-19 impacts.

Lunar Reconnaissance Orbiter (LRO)

Robotic mission focused on mapping the Moon's surface
Launched June 18, 2009

Source: NASA/Goddard Science Visualization Studio.

Snapshot

Science Mission Directorate, Planetary Science Division

NASA Centers: Goddard, JPL, Marshall

Projected Life-Cycle Cost: $919 million

Planned Mission Duration: 1 year

Project Life-Cycle Phase: Extended Operations

LRO is a robotic mission that has focused on collecting data that supports the identification of potential sites for safe future robotic and human lunar missions. LRO has made groundbreaking observations and discoveries that have resulted in a deeper understanding of the Moon as a dynamic and complex body. The data collected by LRO also helps pave the way for a safe human return to the Moon and future exploration of the solar system. The mission was developed under NASA's former Exploration Systems Mission Directorate before being transferred to the Science Mission Directorate in September 2010 following the completion of LRO's initial exploration goals. The LRO mission has been extended to continue pursuing lunar science and exploration and recently received approval to continue operations through September 2025.

APL's Role

APL provided the Miniature Radio Frequency (Mini-RF) instrument for LRO and currently manages the instrument. Mini-RF is a synthetic aperture radar that helps to map the Moon's surface, measure its surface roughness, and searches for water and ice near the poles. The Mini-RF instrument was developed as a technology demonstration for LRO with significant investments coming from the U.S. Department of Defense. The instrument satisfied all technology demonstration objectives during LRO's primary operations and mission. Mini-RF completed over 1,000 science data collection events and mapped two-thirds of the lunar surface. The Mini-RF transmitter is non-operating (last functioned in December 2010) and currently runs in bi-static mode using a transmitter from Earth.

Work in Progress and Key Milestones

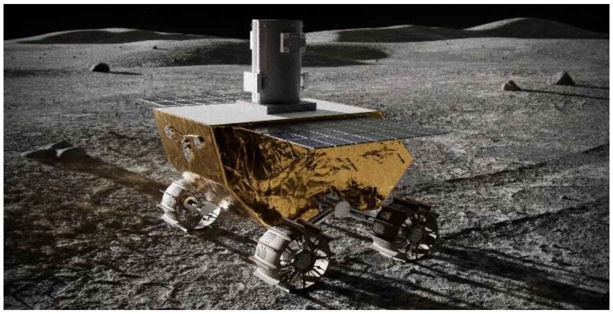
Mini-RF is engaged in answering how the presence of volatiles affects the lunar surface and how silicic materials inform crustal processes and magma generation on planetary bodies without plate tectonics.

Mission Challenges and COVID-19 Impacts

The loss of the Mini-RF transmitter limits operation of the radar to near-side targets and makes the instrument dependent on Earth-based transmitters, not directly under the LRO projects management. This poses risk to data acquisition. However, the science questions that LRO strives to answer involve multiple instruments, and the mission is resilient with respect to the loss of any one instrument. COVID-19 led to all instrument teams on LRO being shifted to remote work with minimal impact on the project, including Mini-RF. This was possible since the instrument teams do not directly control their instruments but send commanding requests to the LRO Mission Operations Center.

Lunar Vertex

Lunar lander instrument and rover
Preliminary Launch Date: April 2024



Source: APL/Lunar Outpost/Ben Smith.

Snapshot

Science Mission Directorate, Planetary Science Division

NASA Center: Marshall

Preliminary Life-Cycle Cost Estimate: $33.6 million

Planned Mission Duration: 13 days

Project Life-Cycle Phase: Formulation

Lunar Vertex is a lander instrumentation and rover mission, slated for delivery to *Reiner Gamma*, a distinctive geographical feature known as a lunar swirl located in *Oceanus Procellarum* in the northwest region of the Moon's near side. Lunar Vertex will collect surface and orbital measurements of the Moon's magnetic field to help scientists understand how lunar swirls form and provide insight into the Moon's interior and core.

APL's Role

The principal investigator for this project is located at APL, and the science team is primarily composed of APL scientists. Additionally, APL manages the subcontracts for delivery of instruments and is delivering two instruments of their own: the Vector Magnetometer-Lander and Vector Magnetometer-Rover. Once on the surface, the Lander will measure the strength and direction of the magnetic field while the Rover will measure the ambient lunar surface field.

Work in Progress and Key Milestones

APL is working to finalize subcontracts and develop the magnetometers while providing oversight of all subcontractor work related to instrument development. APL is also coordinating with a contractor—Intuitive Machines—to develop and finalize lander-payload interfaces and interface control documents. Lunar Vertex successfully completed its Preliminary Design Review, and APL plans to deliver the completed rover to Intuitive Machines for final preparation in August 2023, approximately 9 months prior to the launch. Intuitive Machines will use the lander instrument to complete research, science investigations, and a technology demonstration as part of NASA's Commercial Lunar Payload Services initiative and the Artemis program. Lunar Vertex will be one of four investigations delivered to *Reiner Gamma*.

Mission Challenges and COVID-19 Impacts

APL is working with a disparate group of subcontractors for delivery of instruments that must be ready for launch in a relatively short amount of time. In addition, the challenge of unknown lunar lander interface issues presents risks to the project. Specifically, the possibility of mismatched or last-minute requirement changes presents technical, cost, and schedule risks.

Mars-moon Exploration with Gamma rays and Neutrons (MEGANE)

Spectroscopy instrument supporting JAXA mission to Mars' moons
Launch Readiness Date: September 2024

Source: Institute of Space and Aeronautical Science/JAXA.

Snapshot

Science Mission Directorate, Planetary Science Division	**NASA Centers:** Ames, Marshall
Projected Life-Cycle Cost: $48.1 million	**Projected Instrument Delivery Date:** March 2023
Project Life-Cycle Phase: Implementation	**Planned Mission Duration:** 45 months

The Martian Moons Exploration (MMX) mission, led by the Japanese Aerospace Exploration Agency (JAXA), will aim to reveal the origin of Mars' two moons, Phobos and Deimos. NASA is contributing a spectroscopy instrument to the mission: MEGANE—the Mars-moon Exploration with Gamma rays and Neutrons instrument—will measure the elemental composition of Phobos and help determine whether the moon is a captured asteroid or the result of a larger body hitting Mars. The MMX mission will also include an effort to collect a sample from Phobos and return the sample to Earth.

APL's Role

MEGANE's principal investigator and project management team are housed at APL; the Lab will build and test the instrument.

Work in Progress and Key Milestones

The MEGANE team is working to complete environmental and full functional testing of an integrated engineering model of the instrument. Once this is complete, MEGANE will be delivered to JAXA for testing of electromagnetic interference and electromagnetic compatibility. Prior to the project's planned August 2022 KDP-D review and transition to Phase D of the project life cycle, MEGANE will conduct a System Integration Review, Test Readiness Review, and a Pre-Environmental Review. The results of these reviews will be presented at the KDP-D review. The project also plans to conduct flight model testing prior to the end of FY 2022. The instrument will be delivered to JAXA in June 2023.

Mission Challenges and COVID-19 Impacts

The main challenge is the immaturity of the MMX spacecraft compared to the MEGANE instrument. JAXA is late in providing design information, interface definition, and environmental test conditions. This has resulted in some schedule impacts for intermediate deliverables. There is substantial risk that a late change to the MMX design or interface after the MEGANE Flight Model is mostly assembled could occur as JAXA completes its Critical Design Review and engineering model testing. This could result in cost and schedule impacts. APL noted that MEGANE's schedule and funding are structured to mitigate these risks. For example, MEGANE still retains more than 70 days of funded margin on the Flight Model critical path, which exceeds both NASA and institutional guidelines for this stage of the project. The project did not identify any impacts to MEGANE's cost or schedule caused by COVID-19.

Parker Solar Probe

Studying the Sun up close
Launched August 12, 2018

Source: NASA.

Snapshot

Science Mission Directorate, Heliophysics Division

NASA Center: Goddard

Projected Life-Cycle Cost: $1.4 billion

Planned Mission Duration: 7 years

Project Life-Cycle Phase: Primary Operations

The Parker Solar Probe will come closer to the Sun than any previous spacecraft, collecting data on solar activity and contributing to our ability to forecast major space-weather events that impact life on Earth. The primary science goals are to understand how the Sun's corona is heated and how solar wind is accelerated. The probe will fly by Venus 7 times over its 7-year mission to gradually shrink its orbit around the Sun; it will eventually come as close as 3.83 million miles to the Sun, well within the orbit of Mercury and about 7 times closer than any spacecraft has come before—while moving at approximately 430,000 miles per hour, making it the fastest spacecraft ever. As of February 2022, the spacecraft had flown by Venus 5 times and made 11 passes at the Sun. NASA announced that the Parker Solar Probe became the first spacecraft to enter the Sun's corona at about 8 million miles from the Sun's surface during its 8th pass in April 2021.

APL's Role

The Parker Solar Probe was designed, built, and is now operated by APL as part of NASA's Living with a Star program. APL is responsible for project management, systems engineering, mission operations, science data management, and for leading the science investigation teams. The Lab also designed, developed, and tested the Thermal Protection System—an 8-foot-diameter carbon-foam shield that defends the spacecraft against the intense heat and energy of the Sun.

Work in Progress and Key Milestones

For the rest of 2022, the Parker Solar Probe will fly past the Sun 3 more times. Between 2023 and the planned end of mission in 2025, the spacecraft will make another 10 close passes of the Sun.

Mission Challenges and COVID-19 Impacts

The Parker Solar Probe will make ever increasingly close passes through the Sun's corona, subjecting the spacecraft to high levels of heat, dust, and charged particles. The top risk is the impact of dust on the spacecraft cooling system. The visible imaging camera also picks up bits of material expelled from the spacecraft's structures after impact with those dust grains. The spacecraft team has noticed that occasionally the star-tracking cameras used as part of the guidance and control system see reflected light from dust and shattering particles that can momentarily disrupt their ability to see stars. Project officials noted, however, that this does not compromise the safety of spacecraft or instrument operations, and the star trackers are not the spacecraft's only method of controlling where it points. The guidance and control software uses data from the star trackers in tandem with an inertial measurement unit and solar-limb sensors to keep the Thermal Protection System—the heat shield—pointed toward the Sun. The project reported no significant impacts from COVID-19.

Particle Environment Package-Hi (PEP-Hi)

Sensors for ESA Mission to Jupiter
Launch Readiness Date: April 2023

Source: NASA/JPL/ESA/ATG medialab/DLR/University of Arizona/University of Leicester.

Snapshot

Science Mission Directorate, Planetary Science Division

NASA Center: Marshall

Projected Life-Cycle Cost: $50.4 million

Planned Mission Duration: At least 3 years after expected arrival in 2029

Project Life-Cycle Phase: Implementation

The European Space Agency's (ESA) Jupiter Icy Moons Explorer mission will study Jupiter and three of its largest moons—Ganymede, Callisto, and Europa—each of which scientists believe hosts a liquid water ocean beneath an icy surface. APL is contributing two particle-detection instruments, known as the Particle Environment Package-Hi (PEP-Hi), which will help to uncover details about the radiation environment around the Jovian system and the planet's interactions with its moons.

APL's Role

APL developed and built two sensors for the PEP-Hi package. The Jupiter Energetic Neutrals and Ions sensor will image neutral atoms that form from interactions between the plasma and neutral gases from the moons with Jupiter's intense radiation environment. The Jovian Energetic Electrons sensor will use 3D-printed collimators to map the processes responsible for making Jupiter the solar system's largest particle accelerator.

Work in Progress and Key Milestones

APL delivered the two sensors to ESA in February 2021. APL will continue to provide project management and technical personnel for the PEP-Hi team, which is led by the Swedish Institute of Space Physics.

Mission Challenges and COVID-19 Impacts

Currently, the main challenge for the project is avoiding contamination to the Jupiter Energetic Neutrals and Ions High Voltage Deflection Assembly during spacecraft dynamics testing. In response to this challenge, the project designed and installed a soft cover for the sensor. Travel and access restrictions caused by COVID-19 impacted the project's ability to build and test various parts of both sensors; COVID-19 also led to increased costs and delayed the delivery of PEP-Hi to ESA.

Solar Orbiter

Studying the inner workings of the Sun
Launched February 9, 2020

Source: NASA.

Snapshot

Science Mission Directorate, Heliophysics Division

NASA Center: Goddard

Projected Life-Cycle Cost: $323 million

Planned Mission Duration: 7 years

Project Life-Cycle Phase: Primary Operations

The Solar Orbiter is a NASA/ESA collaboration that will investigate how the Sun creates and controls the heliosphere—an 11-billion-mile-wide protective bubble of charged particles and magnetic field lines surrounding the solar system. Currently traveling inside the orbit of Mercury, the spacecraft will create a picture of the Sun's atmosphere and inner workings and how they can affect the space environment farther out in the solar system. The Suprathermal Ion Spectrograph, designed and built at APL, is one of four sensors in an instrument suite that will determine the composition of energetic electrons, protons, and heavy ions flooding from the Sun. The Spectrograph is a highly sensitive mass spectrometer that can identify elements from helium to iron by measuring how long it takes a particle to fly through the instrument.

APL's Role

APL is responsible for the Spectrograph's instrument operations and data analysis.

Work in Progress and Key Milestones

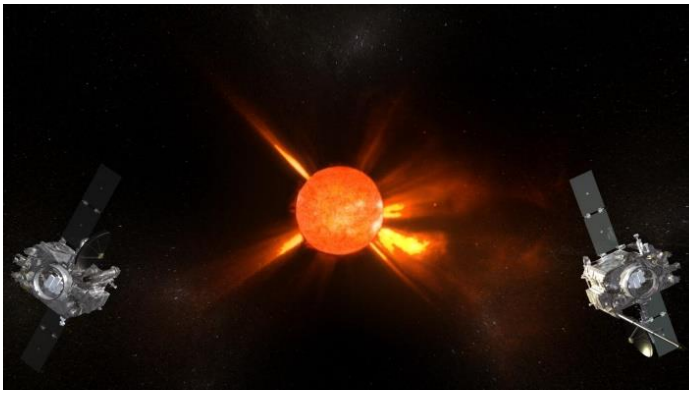
The Solar Orbiter is now in its main science phase. In 2022, the Solar Orbiter will be close to within 48 million kilometers of the Sun's surface.

Mission Challenges and COVID-19 Impacts

The mission's biggest challenge is workflow and communication with the Solar Orbiter project for spacecraft and instrument operation. APL has reported slow communication between the flight operations team and requests through the primary investigator at Alcala University in Madrid, Spain, that are not being handled in a timely fashion and could potentially introduce risk to the instrument. The project reported no significant impacts from COVID-19.

Solar Terrestrial Relations Observatory (STEREO)

Studying the Sun from Earth's orbit
Launched October 25, 2006



Source: NASA.

Snapshot

Science Mission Directorate, Heliophysics Division

NASA Center: Goddard

Projected Life-Cycle Cost: $588.4 million

Planned Mission Duration: 2 years

Project Life-Cycle Phase: Extended Operations

The Solar Terrestrial Relations Observatory, or STEREO, has been studying the Sun and its atmosphere since 2006. Composed of two nearly identical observatories—one ahead of Earth in its orbit (STEREO A), the other trailing behind (STEREO B)—STEREO traced the flow of energy and matter from the Sun to Earth, with specific attention to coronal mass ejections and the structure of solar wind. The mission has been in extended operations since 2009. Contact with STEREO B was lost in October 2014 due to multiple hardware anomalies affecting control of the spacecraft; it was reestablished in August 2016 briefly until it was lost again in September 2016 due to spacecraft orientation. STEREO A is still performing as expected.

APL's Role

APL designed, built, and is operating the twin observatories. The Lab is responsible for providing system engineering, spacecraft development, mission integration and testing, mission design and navigation, launch vehicle interface, spacecraft and associated ground support equipment, observatory integration and testing, and mission operations.

Work in Progress and Key Milestones

In addition to normal science operations and observations, the operating STEREO spacecraft also provides support to the Parker Solar Probe and Solar Orbiter missions. The mission is currently preparing for the 2023 Senior Review of Heliophysics operating missions.

Mission Challenges and COVID-19 Impacts

The spacecraft and instruments are well in excess of their design life. After losing contact with the spacecraft, NASA ended operations with STEREO B in October 2018. The STEREO-A spacecraft remains healthy, aside from the loss of the primary inertial measurement unit and degradation of the backup inertial measurement unit. Significant engineering analysis went into mitigations to perform operations without use of the inertial measurement units for rate measurements, and the spacecraft is no longer dependent on them. The risk to the mission therefore remains low. While most instruments continue to operate nominally, there are some long-standing instrument issues that still require resolution. The program reported no significant impacts from COVID-19.

Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED)

Observing Earth's upper atmosphere
Launched December 7, 2001

Source: NASA/APL.

Snapshot

Science Mission Directorate, Heliophysics Division

NASA Center: Goddard

Projected Life-Cycle Cost: $284.5 million

Planned Mission Duration: 2 years

Project Life-Cycle Phase: Extended Operations

NASA's Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED) mission observes one of the least understood regions of Earth's atmosphere: the upper regions, composed of the mesosphere, lower thermosphere, and ionosphere—known as the MLTI—ranging from 40 to 110 miles above Earth's surface. TIMED investigates how energy is transferred into and out of the MLTI, where the Sun's energy first enters Earth's environment. The mission seeks to categorize upper atmospheric response to solar storms and explain the fundamental behavior of carbon dioxide in the atmosphere; TIMED increases the understanding on how solar wind affects changes in the chemical composition of Earth's atmosphere and its effects on Earth's weather. The mission has been in extended operations since 2004.

APL's Role

APL designed, built, and is operating the TIMED spacecraft, and is also leading the project's science effort. The Lab provides mission operations services including the mission operations center, ground station, mission data center, and management of the major payload communications and science activity planning and assessment.

Work in Progress and Key Milestones

NASA has approved TIMED to continue as an extended mission, and TIMED will be invited to the 2023 Heliophysics Senior Review. All of TIMED's instruments are still producing data, enabling continuing studies of the upper atmosphere. The mission is planning a ground system refresh in the FY 2022 to FY 2023 timeframe as well as contingency procedure improvements to add the capability to review assessment reports from home. Despite nearly 20 years on orbit, TIMED is still able to routinely produce most of its original data products as well as some additional ones that have been added during the mission. The number of TIMED-related, peer-reviewed publications continues to be high, exceeding 160 per year. The majority of publications have been by first-time authors from outside of the mission team.

Mission Challenges and COVID-19 Impacts

While the TIMED spacecraft and instruments are in operating condition overall, Global Ultraviolet Imager—a spectrograph that is measuring the composition and temperature profiles of the MLTI region—continues to be limited to its spectrographic mode due to a failure of the scanning mechanism. Also, successful steps were taken to recover from a reaction wheel failure and to build resilience in case of another wheel failure. The program reported no significant impacts from COVID-19.

Van Allen Probes

Twin probes studying space weather in Earth's radiation belts
Launched August 30, 2012; End of Operations October 18, 2019

Source: NASA/APL.

Snapshot

Science Mission Directorate, Heliophysics Division	**NASA Center:** Goddard
Actual Life-Cycle Cost: $708.9 million	**Planned Mission Duration:** 2 years
Mission Closeout: November 2021	

The Van Allen Probes were two identical spacecraft that helped scientists understand the radiation belts surrounding Earth and informed better designs for spacecraft that can survive the rigors of space. With instruments measuring electromagnetic fields and charged particles, the probes made discoveries about the architecture of the radiation belts and the forces shaping them.

APL's Role

APL built the twin spacecraft and managed mission operations. The Lab also designed, developed, and tested the spacecraft and ground system, and managed the science instrument teams and their associated sub-contracts. APL also provided project management support for the Radiation Belt Storm Probes Ion Composition Experiment instrument, which helped determine how space weather creates what is called the "storm-time ring current" around Earth and understand how the inner magnetosphere changes during geomagnetic storms.

Work in Progress and Key Milestones

Closeout was completed in November 2021. There is no further work on this project.

Appendix C: Schedule of Questioned Costs with Dollar-Related Findings

Table 5 summarizes the questioned costs identified during our audit and discussed in this report. Questioned costs related to an increased fixed-fee percentage were due to the decision to end two active task orders which were expected to remain on ARDES I and to award new task orders for the remaining work on ARDES II, as detailed in the report.

Table 5: Schedule of Questioned Costs

Issue	Recommendation Number	Questioned Costs[a]
Increased fixed-fee costs associated with awarding new task orders for remaining ARDES I work on ARDES II	1	$3,876,979
Total		**$3,876,979**

Source: NASA OIG analysis.

[a] Questioned Costs are expenditures that are questioned by the OIG because of alleged violation of law, regulation, or contractual requirement governing the expenditure of funds; costs that are not supported by adequate documentation at the time of our audit; or are unallowable, unnecessary, or unreasonable.

APPENDIX D: MANAGEMENT'S COMMENTS

National Aeronautics and Space Administration

Mary W. Jackson NASA Headquarters
Washington, DC 20546-0001

September 27, 2022

Reply to Attn of: Office of Procurement

TO: Assistant Inspector General for Audits
THRU: Associate Administrator for Science Mission Directorate
Director, Marshall Space Flight Center

FROM: Assistant Administrator for Procurement

SUBJECT: Agency Response to OIG Draft Report, "NASA's Management of its Johns Hopkins University Applied Physics Laboratory Portfolio" (A-21-016-00)

The National Aeronautics and Space Administration (NASA) appreciates the opportunity to review and comment on the Office of Inspector General (OIG) draft report entitled, "NASA's Management of its Johns Hopkins University Applied Physics Laboratory Portfolio" (A-21-016-00), dated August 29, 2022.

In the draft report, the OIG makes two recommendations addressed to NASA to help ensure that the Agency does not pay more than required on indefinite-delivery, indefinite-quantity (IDIQ) contracts and task orders.

Specifically, the OIG recommends the following:

To ensure NASA does not pay more than required on IDIQ contracts and task orders, the OIG recommends the Associate Administrator for Procurement:

Recommendation 1: Document this occurrence as a lessons learned, as well as provide supplemental guidance to NASA procurement officials that, in the absence of prohibitive regulation or direction, the FAR provides them the authority to take the lead in encouraging business process innovations to ensure efficient contract actions.

Management's Response: NASA partially concurs.

The OIG interpretation is based upon the statement in section B of the Aerospace, Research, Development, and Engineering Support Services (ARDES) I contract that the maximum contract value "does not preclude adjustments to the dollar amounts of existing placed orders, for actions that are within the scope of the placed orders, and which are made pursuant to existing contract authority, such as the Changes clause." Accordingly, had the Agency followed this contract language and allowed the new Dragonfly and Galactic/Extragalactic ULDB [Ultralong-Duration Balloon] Spectroscopic Terahertz

Observatory (GUSTO) task order work to continue under ARDES I, the OIG alleges NASA could have saved $3.88M. However, Office of Procurement (OP) and Marshall Space Flight Center (MSFC) respectfully disagree for the following reasons:

MAXIMUM CONTRACT VALUE:
Section B of the ARDES I contract does not authorize an increase to the task order value without a corresponding modification to increase the maximum contract value. Any other interpretation is inconsistent with 10 U.S.C.A. §3403(e), which provides that "[a] task or delivery order may not increase the scope, period, or maximum value of the task or delivery order contract under which the order is issued. The scope, period, or maximum value of the contract may be increased only by modification of the contract."

EXPIRED CONTRACT:
An expired contract cannot be modified or reinstated. The ARDES I contract had expired 18 months before the contemplated actions to the Dragonfly task order were identified. Therefore, modification of the maximum contract value was not possible because the ARDES I contract had expired.

SCOPE OF WORK:
Contemplated modification actions must be "within the scope of the placed orders." With respect to the competitively awarded Dragonfly task order, the contemplated actions included a complete replan of the Dragonfly task order that would have (1) changed the proposed launch vehicle to a heavy-class launch vehicle, (2) nearly tripled the task order value (i.e., by adding $360M), and (3) increased the maximum IDIQ contract value by 20 percent. The magnitude of such a change is well outside the scope of the changes contemplated by section B of the ARDES I contract.

CHANGES CLAUSE:
The Changes clause does not provide the authority to make a bilateral change of the magnitude contemplated here. The Changes clause contemplates relatively minor changes within scope that can be unilaterally directed by the contracting officer. The contractor can assert a right to adjustment if changes constitute a price change (usually increase) to the contract or task order. (Note: The clause cited in footnote 22 of the OIG's report (i.e., FAR 52.243-4) is not contained in the contract.)

CONTRACTING OFFICER JUDGMENT:
Transferring the work to the new and updated ARDES II contract as soon as possible was in the overall best interest of the Government. When compared to the ARDES I contract, ARDES II provides NASA with greater program management control and oversight, more comprehensive data requirements descriptions for NASA deliverables, more favorable technical data license rights, and protections against counterfeit items and contract funding flowing into China and Russia. Further, the ARDES II contract was negotiated based on the NASA-structured approach for determining profit or fee objectives (see NASA FAR Supplement 1815.404-70), which evaluates cost, technical, and management risk and was determined to be fair and reasonable by the contracting officer for a cost-plus-fixed-fee completion task order contract. As for the three remaining task orders on the ARDES I contract (i.e., Parker Solar Probe, Suprathermal

Ion Spectrograph, and Particle Environmental Package), their estimated cost of performance was accounted for in the ARDES I contract negotiated $1.77B maximum value ceiling.

OP will assess whether supplemental guidance is required in the management of IDIQ contracts relative to the information provided in this report and the circumstances detailed above. NASA guidance specifically addresses modification to structured profit/fee approach for nonprofit organizations (NASA FAR Supplement (NFS) 1815.404-70 and NFS 1815.404-71-1). Guidance further advises the Contracting Officer to analyze and document profit or fee objectives. NASA Form 634 was used in both ARDES I and II in determining the appropriate fee. Additionally, OP will also reinforce current FAR and NFS regulatory guidance to assist the workforce in documenting risk and normative values when fee is determined for university-affiliated research centers, for-profit entities, and for-nonprofit organizations to ensure efficient contract actions.

Estimated Completion Date: June 30, 2023

Additionally, the OIG recommends the MSFC Director require the Marshall Procurement Office:

Recommendation 2: Document a process to periodically assess and compare the total cost estimate for awarded APL tasks to the established maximum and take timely action to modify the contract or request a deviation from the FAR to exclude a maximum for ARDES II and any future ARDES-type IDIQ contracts for APL.

Management's Response: NASA partially concurs. MSFC and OP will ensure the process for assessments comparing the total cost estimate for awarded APL tasks to the established maximum is documented. MSFC uses multiple tools, such as 533 financial report analysis and Planning, Programming, Budgeting, and Execution (PPBE) spending projections, to track and compare task order values and expenditures to the maximum contract value and will take timely action to modify the contract, if required and authorized. Numerous task order awards and/or options exercises will be made over the course of the ARDES II contract, and each time, procurement officials will conduct proper analysis consistent with current practice. Going forward, the Contracting Officer will document the process for tracking total cost estimates against the established maximum contract value and provide quarterly tracking updates to the MSFC Procurement Officer to maintain proper awareness. OP will assess the appropriateness of deviations on a case-by-case basis relative to future ARDES or ARDES-type IDIQ contracts and the timelines necessary to address changes in maximum contract value.

Estimated Completion Date: June 30, 2023

We have reviewed the draft report for information that should not be publicly released. As a result of this review, we have not identified any information that should not be publicly released.

Once again, thank you for the opportunity to review and comment on the subject draft report. If you have any questions or require additional information regarding this response, please contact Debrina Harrell at (202) 358-0982.

Karla Jackson

Digitally signed by Karla Jackson
Date: 2022.09.27 14:58:11 -04'00'

Karla Smith Jackson

APPENDIX E: REPORT DISTRIBUTION

National Aeronautics and Space Administration

Administrator
Deputy Administrator
Associate Administrator
Deputy Associate Administrator
Chief of Staff
Associate Administrator for Science Mission Directorate
Assistant Administrator for Procurement
Director, Marshall Space Flight Center

Non-NASA Organizations and Individuals

Office of Management and Budget
    Deputy Associate Director, Climate, Energy, Environment and Science Division

Government Accountability Office
    Director, Contracting and National Security Acquisitions

Congressional Committees and Subcommittees, Chairman and Ranking Member

Senate Committee on Appropriations
    Subcommittee on Commerce, Justice, Science, and Related Agencies

Senate Committee on Commerce, Science, and Transportation
    Subcommittee on Science and Space

Senate Committee on Homeland Security and Governmental Affairs

House Committee on Appropriations
    Subcommittee on Commerce, Justice, Science, and Related Agencies

House Committee on Oversight and Reform
    Subcommittee on Government Operations

House Committee on Science, Space, and Technology
    Subcommittee on Investigations and Oversight
    Subcommittee on Space and Aeronautics

(Assignment No. A-21-016-00)