United States Government Accountability Office

Testimony before the Subcommittee on Space and Aeronautics, Committee on Science, Space, and Technology, House of Representatives

For Release on Delivery
Expected at 11 a.m. ET
Tuesday, March 1, 2022

NASA LUNAR PROGRAMS

Moon Landing Plans Are Advancing but Challenges Remain

Statement of W. William Russell, Director, Contracting and National Security Acquisitions

GAO-22-105533

March 1, 2022

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GAO Highlights

Highlights of GAO-22-105533, a testimony before the Subcommittee on Space and Aeronautics, Committee on Science, Space, and Technology, House of Representatives

Why GAO Did This Study

NASA is developing multiple highly complex and interdependent programs to achieve the lunar landing mission, known as Artemis III, as well as longer-term goals to create a sustained lunar presence. In the fiscal year 2022 president's budget request, NASA requested at least $32 billion over the next 5 years to support these efforts.

To land astronauts on the Moon, NASA will need to develop a lunar lander and new space suits. It will also need to execute uncrewed and crewed test flights, planned for spring 2022 and 2024, respectively, of the Orion Multi-Purpose Crew Vehicle and the Space Launch System. NASA has delayed the first test flight multiple times, which places pressure on the schedule for subsequent missions. In prior reports, GAO highlighted progress NASA has made toward these missions, as well challenges the agency faces in managing and integrating these systems and missions. This statement updates NASA's progress and challenges in working towards the first three Artemis missions.

This statement is primarily based on GAO's previously issued work on NASA's lunar programs, as well as its ongoing annual assessment of NASA major projects. GAO updated some areas by following up with NASA through other ongoing work.

What GAO Recommends

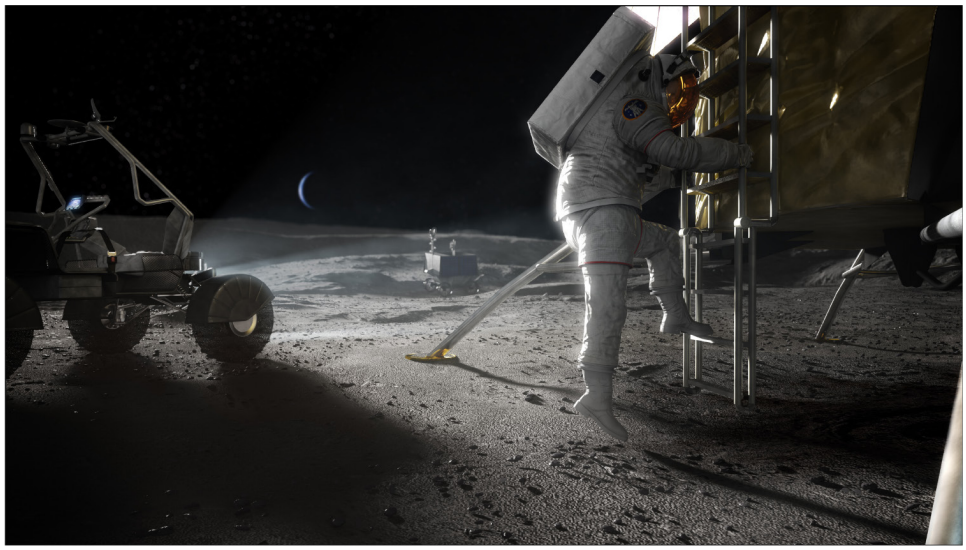
Since 2019, GAO has made 10 recommendations related to improving NASA's management of its Artemis efforts and related programs. NASA generally agreed with these recommendations and plans to take steps to implement them.

View GAO-22-105533. For more information, contact W. William Russell at (202) 512-4841 or Russellw@gao.gov.

What GAO Found

The National Aeronautics and Space Administration (NASA) effort to return U.S. astronauts to the Moon and then travel to Mars—known as Artemis—has made progress. Since GAO's May 2021 report, NASA conducted integration and test events for the Artemis I mission (an uncrewed test flight) and manufactured some hardware for the Artemis II mission (a test flight that will carry crew). NASA also made progress on completing planning activities for the Artemis III moon landing mission, such as reviewing integration efforts across lunar programs.

Artist's Rendition of Artemis Lunar Landing Mission



Source: National Aeronautics and Space Administration. | GAO-22-105533

NASA now plans to conduct the Artemis III moon landing mission no earlier than 2025, a year later than originally planned. While this delay will allow more time for NASA to acquire a lunar lander and new space suit (shown above), Artemis III schedule and costs remain challenging for several reasons, including:

Delays to the lunar lander contract. NASA officials stated they estimated a 7-month delay in working on the lander, subsequent to a bid protest and federal court complaint regarding the award of the lander's contract. The schedule to develop the landing system is ambitious; the program plans to develop and launch the system months faster than other spaceflight programs and needs to mature critical technologies.

Change to spacesuit acquisition strategy. In July 2021, NASA approved a change from developing its new spacesuits in-house to using a contractor, which may affect planned development time frames. Under this strategy, NASA officials stated they will not have the contract awardee's proposed schedule until after the contract is awarded. Officials told GAO the award is planned for spring 2022.

Increasing costs. Key Artemis III programs have experienced cost growth. For example, costs for the Space Launch System and ground systems grew by more than $1 billion in 2020.

March 1, 2022

Chairman Beyer, Ranking Member Babin, and Members of the Subcommittee:

Thank you for the opportunity to discuss the National Aeronautics and Space Administration's (NASA) efforts to return astronauts to the surface of the Moon and ultimately human exploration of Mars through its Artemis missions. In the fiscal year 2022 president's budget request, NASA requested at least $32 billion over the next 5 years to support this ambitious undertaking. NASA is developing multiple highly complex and interdependent programs to achieve the lunar landing mission, known as Artemis III, as well as longer-term goals to create a sustained lunar presence. NASA now plans to conduct the lunar landing mission in 2025 or later. This is a delay of at least a year from earlier plans. NASA has initiated eight lunar programs since 2017 to support lunar landing missions and develop a sustained lunar presence. These new programs include a human landing system to transport crew to the lunar surface and space suits for lunar surface operations. In addition, NASA plans to rely on existing programs, including the Orion Multi-Purpose Crew Vehicle (Orion) and the Space Launch System (SLS) to launch and transport crew from Earth to lunar orbit for the mission.

We have highlighted progress NASA has made toward the lunar landing mission, such as completing some early lunar program development activities, as well as challenges NASA faces in managing and integrating these systems and missions.[1] For example, in December 2019, we reported that NASA had begun making decisions related to requirements, cost, and schedule for individual lunar programs but was behind in taking these steps across the programs to support the overall Artemis III mission. As a result, NASA risked the discovery of integration challenges and needed changes late in the development process. Successfully executing the Artemis III mission will require extensive coordination across lunar programs and with a wide range of contractors to ensure systems operate together seamlessly and safely.

You asked us to testify today on GAO's work examining NASA's lunar programs. My statement focuses on (1) progress NASA has made toward

[1]GAO, *NASA Lunar Programs: Significant Work Remains, Underscoring Challenges to Achieving Moon Landing in 2024*, GAO-21-330 (Washington, D.C: May 26, 2021); and *NASA Lunar Programs: Opportunities Exist to Strengthen Analyses and Plans for Moon Landing*, GAO-20-68 (Washington, D.C.: Dec. 19, 2019).

its first three Artemis missions and (2) challenges the agency faces in conducting Artemis missions.

This statement is based primarily on our previously issued reports on NASA's Artemis efforts, including reports that focus on the lunar programs necessary to support Artemis missions, and our annual assessment of NASA major projects.[2] In addition, we updated some information from our ongoing work.[3] To provide updates, we assessed NASA program acquisition and key decision point documentation, briefings to senior leaders, and information provided for recommendation follow up. The reports cited throughout this statement include detailed information on their scope and methodology.

We are conducting the work on which this statement is based 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.

Background

Key Elements of NASA's Planned Return to the Moon

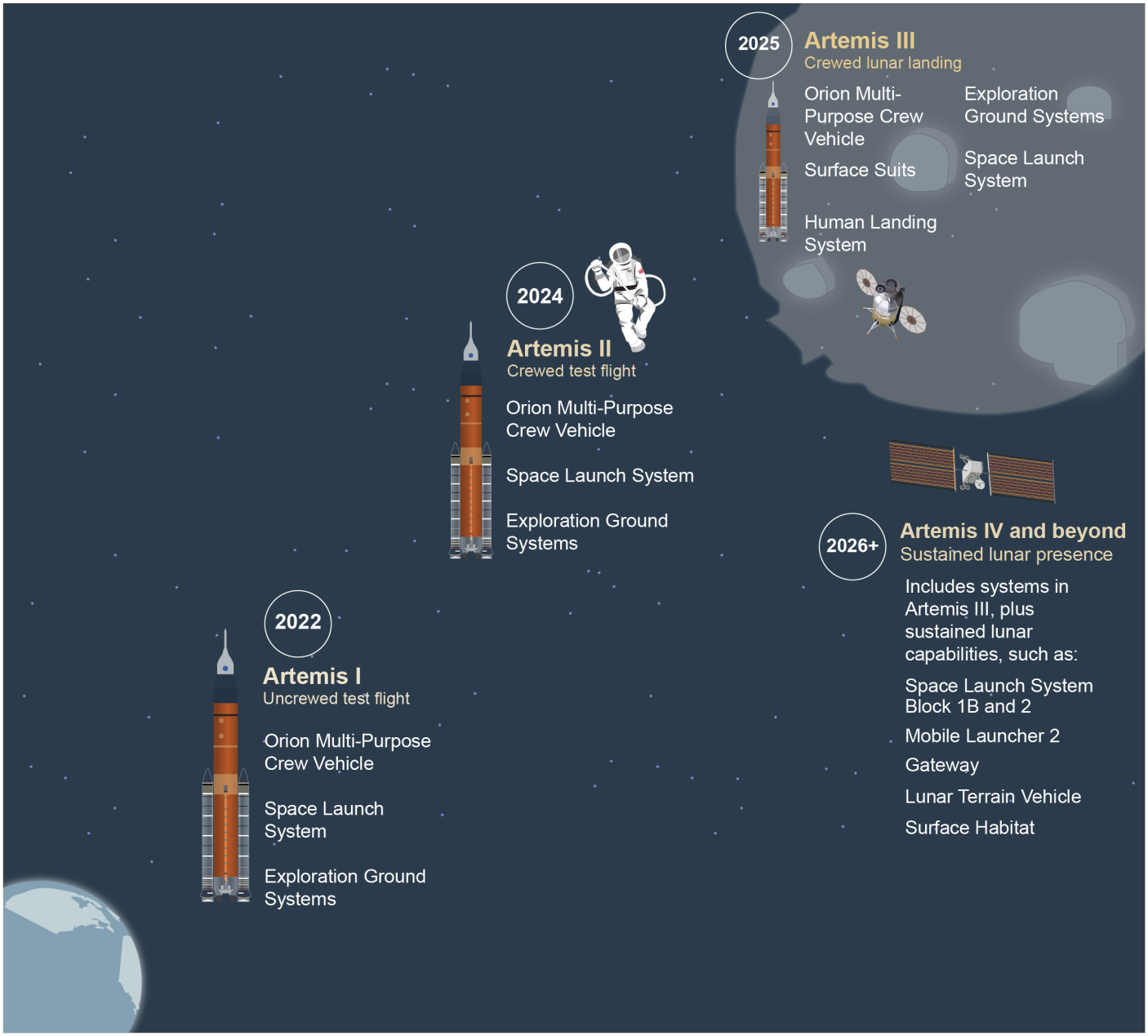
NASA is developing multiple programs to achieve its Artemis III mission and longer-term goals including a sustained lunar presence and ultimately human exploration of Mars.[4] These programs include an outpost orbiting the Moon, a landing system to put humans on the surface of the Moon, and a new launch vehicle and crew capsule. See figure 1 for programs needed to accomplish the Artemis missions.

[2]GAO-21-330; *NASA: Assessments of Major Projects,* GAO-21-306 (Washington, D.C.: May 20, 2021); *NASA Human Space Exploration: Significant Investments in Future Capabilities Require Strengthened Management Oversight*, GAO-21-105 (Washington, D.C.: Dec. 15, 2020); and GAO-20-68.

[3]Our ongoing work includes our annual review of all of NASA's major projects and a review NASA's lunar focused programs.

[4]NASA distinguishes between programs and projects in its policies and guidance. A NASA program has a dedicated funding profile and defined management structure, and may include several projects. Projects are specific investments under a program that have defined requirements, life-cycle costs, schedules, and their own management structure. For the purpose of this statement, we refer to both programs and projects as programs.

Figure 1: Artemis Missions and the Programs Needed to Accomplish Each Mission



Source: GAO analysis of National Aeronautics and Space Administration data (data and images). | GAO-22-105533

Note: NASA also plans to launch the Volatiles Investigating Polar Exploration Rover in 2023. The rover is being designed to investigate volatiles—including water, carbon dioxide, and other chemicals that boil at low temperatures—at the lunar South Pole. NASA could potentially use these volatiles to

support sustained human presence on the lunar surface. Scientific results from the rover that map volatiles on the lunar surface will help to inform the landing site selection for the Artemis III mission.

Prior to the Artemis III lunar landing mission, NASA plans to execute uncrewed and crewed test flights of the Orion crew capsule and the SLS, known as the Artemis I and II missions, respectively. We have previously reported that NASA has experienced delays on the uncrewed test flight, which places pressure on the schedule for future missions.[5]

NASA Acquisition Life Cycle

NASA initiates space flight programs to accomplish its scientific or exploration goals. NASA policy states that programs shall follow their appropriate life cycle. The life cycle for programs consists of two phases:

1. formulation, which takes a program from concept to preliminary design, and
2. implementation, which includes building, launching, and operating the system, among other activities.

Senior NASA officials must approve programs at milestone reviews, known as key decision points (KDP), before they can enter each new phase. The formulation phase culminates in a review at KDP C. This decision point is also known as a confirmation review, at which cost and schedule baselines are established. NASA measures its cost and schedule performance for the program against these baselines.

Throughout the acquisition life cycle, programs also hold reviews to assess the maturity of their systems or evaluate the readiness to move to the next phase of the life cycle. For example:

- Near the end of the formulation phase, programs hold a preliminary design review to assess the maturity of the program's technologies and to determine if the design is mature enough to proceed with the detailed design phase.
- During the implementation phase, programs hold a critical design review to determine if the design is stable enough to support proceeding with the final design and fabrication.

[5]GAO-21-105.

NASA Acquisition Management High Risk Area and Priority Recommendations

Acquisition management has been a long-standing challenge at NASA, although we have reported on improvements the agency has made in recent years.[6] We first designated NASA's acquisition management as a high-risk area in 1990 in view of NASA's history of persistent cost growth and schedule slippage in the majority of its major systems. We have identified management weaknesses that have exacerbated the inherent technical and engineering risks faced by NASA's largest projects, including the Orion, SLS, and Exploration Ground Systems programs. NASA has taken steps to improve its management of major projects, such as embracing tools to support better cost and scheduling practices, but has continued to struggle with major project cost and schedule performance. In our March 2021 High Risk Update, we found that NASA needs to do more to reduce acquisition risk and demonstrate progress, especially with regard to demonstrating sustained improvement in cost and schedule performance for new, large, complex programs, such as NASA's lunar programs.[7]

We have made multiple recommendations to NASA focused on improving transparency into long-term costs and affordability of human spaceflight programs and improving the reliability of data used to inform acquisition decisions. We determined that these recommendations warranted priority attention, and therefore included them in our annual letter to the NASA administrator.[8] This letter provided the overall status of the agency's implementation of our recommendations and identifies open recommendations that should be a priority for implementation. As of December 2021, we identified seven recommendations related to monitoring Artemis program and mission costs and execution as being a priority for implementation.

[6]GAO, *High-Risk Series: Dedicated Leadership Needed to Address Limited Progress in Most High-Risk Areas*, GAO-21-119SP (Washington, D.C.: Mar. 2, 2021).

[7]GAO-21-119SP.

[8]GAO, *Priority Open Recommendations: National Aeronautics and Space Administration,* GAO-21-574PR (Washington, D.C.: Jun. 21, 2021).

NASA Has Made Progress Toward Its Artemis Test Flights and Planning for First Lunar Landing Mission

NASA has made progress toward its first three Artemis missions since we last reported on the status of these missions and programs in May 2021.[9] This progress includes conducting integration and test events for the Artemis I mission and manufacturing some hardware for the Artemis II mission. NASA also has made progress completing documents and activities for Artemis III mission planning, including holding an integration review.

- **Artemis I**. NASA has made progress in final integration and test activities for its Artemis I mission, scheduled for spring 2022. NASA will need to complete important testing for integrated operations and launch. For example, NASA will need to complete the wet dress rehearsal in early 2022. During this test, NASA fills the core stage and interim cryogenic propulsion stage with fuel at the launch pad, conducts a countdown and testing, and then drains the tanks. If any issues occur during the test prior to fueling, NASA officials said they can potentially retest the next day. If issues occur after the propulsion stage is loaded with fuel, it could result in longer delays to completing the test. Officials said the minimum time to retest after fueling depends on their ability to replenish the fuel, the issue, and the corrective action.
- **Artemis II**. NASA is making progress receiving and manufacturing the hardware needed for the Artemis II mission. For example, the European Space Agency delivered the service module, which provides the propulsion and life support systems for crew, to the Kennedy Space Center in October 2021. In addition, in 2021, the SLS program delivered the interim cryogenic propulsion stage to contractor facilities near the Kennedy Space Center, completed the integration of the top part of the core stage, and installed key components of the engine section of the core stage.

  NASA has a number of key activities remaining for Artemis II. These include hardware deliveries, such as the Orion launch abort system and SLS core stage to the Exploration Ground Systems program. Key integration and test events include core stage functional testing, installing avionics on the Orion crew module—which are being reused from the Artemis I crew module—and mating the crew module with the service module, and integrating the entire SLS stack, which includes the engines, boosters, stages, and adapters.

[9]GAO-21-330 and GAO-21-306.

- **Artemis III**. NASA has also made progress completing initial Artemis III planning activities since our May 2021 report. The human exploration mission directorate and the Advanced Exploration Systems (AES) division, which is responsible for managing the Artemis III and later missions, have made progress in baselining several key lunar architecture and requirements documents. For example, the human exploration mission directorate updated its top-level Artemis requirements in March 2021 to better match current planned missions and the AES division baselined its corresponding requirements in June 2021. The division also finalized documents to govern control boards and defined mission concept of operations and risk management processes.[10]

  In December 2019, we recommended that the division define and determine a schedule for synchronization or integration reviews to help ensure that requirements between mission and program levels are reconciled. We found that, without reconciling these requirements, NASA risked discovery of needed design changes late in the acquisition process, which could result in cost or schedule delays.

  NASA concurred with this recommendation and took steps to implement it. The AES division held its first integration review, which focused on the Artemis III mission, in September 2021, and plans to hold these reviews approximately annually. For the first review, the division convened relevant stakeholders, including the programs included in the missions, to confirm that Artemis products, processes, and organizational responsibilities were defined and that systems were properly integrated as part of the architecture, among other things. During the review, NASA officials also reviewed requirements alignment among the mission directorate, division, and programs. AES officials said the next review would include more definition of the lunar lander and how its design affects the overall mission design.

[10]Division and joint-division control boards review and approve cost, schedule, technical, and risk baselines for their portfolio of programs and assigned Artemis missions and any changes to these baselines.

NASA Faces Challenges Related to Artemis Schedule and Cost, Technology Development, and Management

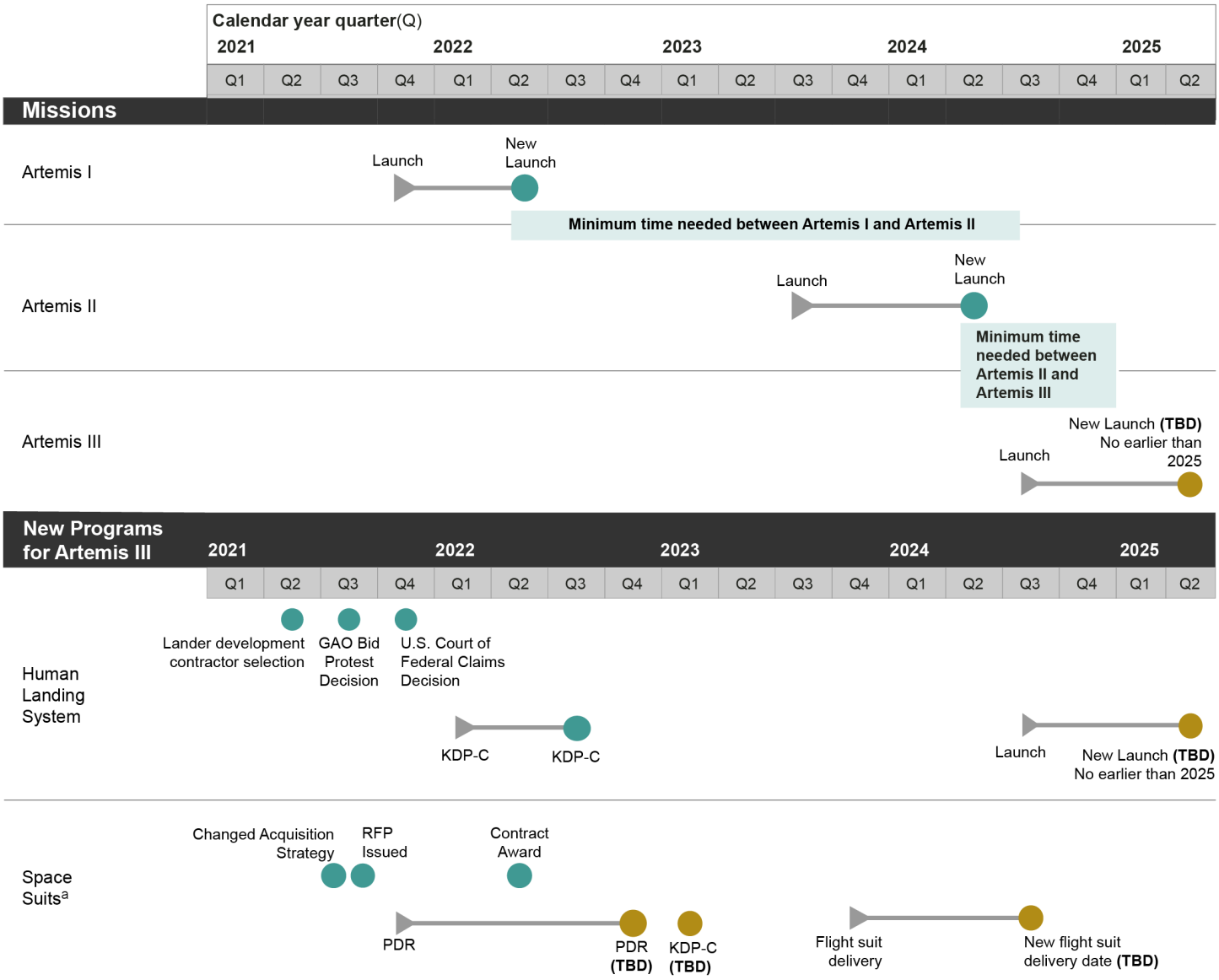
While NASA continues to make progress on its Artemis efforts, the agency still faces a number of challenges. We will continue to follow up on NASA's efforts to address these challenges in our ongoing work.

Artemis III Schedule Remains Challenging

In November 2021, NASA announced that it was no longer working to its goal of an Artemis III mission for the first lunar landing in 2024 and that the mission would be no earlier than 2025. We previously found that the 2024 lunar landing goal was aggressive, and in announcing the delay, senior NASA officials acknowledged that the prior 2024 goal was unrealistic. This delay will allow NASA more time to acquire a new lunar lander and space suits, both of which are required to return humans to the lunar surface.

NASA has also delayed Artemis mission time frames and key program milestones since our May 2021 lunar programs report. The first three Artemis missions are sequentially linked, so a delay to any mission has a ripple effect on the subsequent missions. Figure 2 depicts the changes to key events for the missions.

Figure 2: Artemis Missions I through III and New Program Delays since GAO's May 2021 Lunar Programs Report



Source: GAO analysis of National Aeronautics and Space Administration (NASA) documentation. | GAO-22-105533

[a]Space suit program officials said the schedule for the space suits is uncertain until after NASA awards a contract for the demonstration and production of the suits. The contractor will be required to provide a schedule for all subsequent milestone dates.

While NASA has delayed the Artemis III mission by at least a year, the schedule remains challenging for the following reasons:

- **Further delays to the Artemis I and II missions.** Delays to the Artemis I mission have a cascading effect on the Artemis II and III mission schedules because of the minimum time needed between missions. NASA announced another delay for the Artemis I mission from November 2021 to spring 2022. This is more than 3 years past the original November 2018 launch date.

  Further Artemis I mission delays may occur. The Exploration Ground System program estimated that NASA had an 80 percent likelihood of launching in April 2022. However, as of November 2021, the program was tracking risks that, if realized, could delay the launch past April 2022. These include the risk of potential delays (1) related to Coronavirus Disease 2019 affecting worker availability, and (2) technical challenges related to an anomaly on one of core stage engine controllers, which contains the electronics that operate the engine and communicate with the SLS vehicle. Exploration System Development division officials stated that they resolved the anomaly by removing and replacing the controller in late December 2021, but it resulted in some delays.

  NASA also delayed the Artemis II mission to May 2024, which is a delay of 13 months past the original April 2023 launch date. The new Artemis II date assumes that the Artemis I mission launches no later than April 2022, and delays past this date may result in additional Artemis II mission delays. The Exploration System Development division estimates that NASA needs about 27 months between the Artemis I and II missions. However, division officials said the minimum time needed between the two missions varies on the amount of risk assumed. This timeframe is for the Orion program to refurbish and install some avionics from the Artemis I crew module on the Artemis II crew module, complete the crew and service module, and complete the ground systems prelaunch processing activities.

  Delays to the Artemis II mission could also result in further delays to the Artemis III mission. The Artemis II mission is a crewed test flight to demonstrate the Orion crew capsule's ability to support crew in lunar orbit. The test flight will specifically test out the key life support systems like environmental control, communication systems, and flight software that will be necessary for crew and piloting support. NASA may find issues during the test flight that it would need to address between the Artemis II and III missions. Exploration System Development division officials said that they will need at least 6

months between the Artemis II and III missions for the ground systems to prepare for another SLS launch. However, NASA officials said that more time may be needed for modifications to Orion's life support or docking systems or to implement changes to the launch and processing flow. In addition, officials said that the minimum of 6 months does not include additional schedule risks that may be carried by the Human Landing System (HLS) or space suits programs.

- **Delays to the Human Landing System contract.** In April 2021, NASA announced the selection of SpaceX for the award of the contract to develop the Artemis III lunar lander. After the award, Blue Origin and Dynetics filed bid protests with GAO, which GAO denied in July 2021.[11] Subsequently, in August 2021, Blue Origin filed a complaint with the U.S. Federal Court of Claims, which the court dismissed in November 2021.[12] NASA officials reported that a 7-month delay for the HLS program contributed to delaying the Artemis III mission.

  Moving the Artemis III mission to no earlier than 2025 provides the program with additional time to work on the lunar lander, but the timeframe is still aggressive. Prior to the estimated 7-month delay, in May 2021, we had already found that NASA's planned pace to develop a human landing system was months faster than other spaceflight programs, and a lander is inherently more complex than those programs because it supports human spaceflight.[13]

- **Change to NASA's space suit acquisition strategy.** In July 2021, NASA approved a change in acquisition strategy for the space suits for lunar surface operations, which may affect planned time frames. The new acquisition strategy includes a full and open competition among commercial vendors to, among other things, demonstrate and produce the space suits and associated systems. Officials stated that this commercial approach allows the agency to enable innovative solutions among would-be competitors, drive down cost through competition, and enable a commercial market for space suits. NASA plans to award a contract in spring 2022. While the stated goal in the request for proposals was to have demonstrated the suits' capability

[11]GAO, *Blue Origin Federation, LLC; Dynetics, Inc.-A Leidos Company,* B-419783; B-419783.2; B-419783.3; B-419783.4, July 30, 2021, 2021 ¶ CPD 265 (Washington, D.C.: July 30, 2021).

[12]Blue Origin Fed. LLC v. United States, Fed. Cl., No. 21-1695C (Nov. 4, 2021).

[13]GAO-21-330.

as early as 2024, NASA will not have the contract awardee's proposed schedule until after the contract award.

NASA Has Not Yet Established an Artemis III Mission Cost Estimate

Taking steps to improve cost performance will also be important for NASA to contain cost growth in its human spaceflight programs. Orion, SLS, and the ground systems development efforts are critical for the Artemis missions. In May 2021, we reported that those three programs had cumulatively experienced $4.3 billion in development cost growth since baselines were established, with more than $1 billion of the cost growth occurring in 2020. Since May 2014, we have found that transparency in the long-term costs of these human spaceflight programs could be improved.[14] Specifically, the ground systems and SLS do not have a cost and schedule baseline that covers activities beyond Artemis I. In addition, the Orion program does not have a baseline beyond Artemis II. As a result, NASA is planning to spend billions of dollars for missions that do not yet have cost and schedule baselines against which to assess progress.[15]

In December 2019, we recommended that NASA create an Artemis III mission cost estimate to help NASA effectively monitor total mission costs and to provide Congress with insight into mission or program affordability when making decisions about each year's budget request.[16] NASA concurred with the recommendation and said the agency would create this estimate after establishing cost and schedule baselines for the HLS program, among other things. NASA plans to establish a baseline for the HLS program in August 2022.

NASA Faces Technology Development Knowledge Gaps

In May 2021, we found that NASA lunar programs face additional risk due to the use of immature technologies and the ambitious schedule required to develop such technologies.[17] Our best practices work has shown that maturing technologies to a technology readiness level 6—which includes demonstrating a representative prototype of the technology in a relevant environment that simulates the harsh conditions of space—by preliminary

[14]GAO, *NASA: Actions Needed to Improve Transparency and Assess Long-Term Affordability of Human Exploration Programs,* GAO-14-385 (Washington, D.C.: May 8, 2014).

[15]GAO-21-105.

[16]GAO-20-68.

[17]GAO-21-330 and GAO-21-306.

design review can minimize risks for the systems entering product development.[18] In our prior reports, we identified potential challenges maturing technologies for two lunar programs needed for the Artemis III mission.

- **Human Landing System.** At the time of our May 2021 review, we found that while NASA planned to avoid extensive technology development for its lunar landers by asking the HLS contractors to include mature technologies in their proposed designs, the initial HLS contractor proposals included technologies with relatively low maturity levels.[19] Our analysis of HLS critical technologies data for all three contractors showed that the contractors proposed only four mature technologies out of a total of 11 critical technologies at the time of the base contract award. In addition, NASA noted in its April 2021 source selection statement for the Option A contract, which NASA awarded to SpaceX, that SpaceX had several propulsion sub-systems that would require substantial maturation.[20] The source selection statement also stated that SpaceX's proposal acknowledged the risks introduced due to the complexity of its system, coupled with the level of development and testing activities that must occur with relatively little schedule margin available, and proposed an approach to help mitigate this risk. Maturing these technologies may require either (1) additional time to develop or (2) for NASA and the contractor to make trade-offs to use more mature technologies.
- **Space suits.** Also in May 2021, we found that NASA had not planned to mature two of its three critical technologies for its lunar surface suits for the Artemis III mission by preliminary design review.[21] However, since then, the project changed its acquisition strategy, as noted above. Program officials said that after award they will provide data on the government's design and technology development efforts to date, and that the contractor can use these data if it chooses. If the contractor plans to use immature technologies, it may require more

[18]GAO, *Technology Readiness Assessment Guide: Best Practices for Evaluating the Readiness of Technology for Use in Acquisition Programs and Projects,* GAO-20-48G (Washington, D.C; Jan. 2020).

[19]GAO-21-330.

[20]We have not yet reviewed the HLS program contract with SpaceX for technology maturity of critical technologies after the resolution of the GAO bid protest and U.S. Court of Federal Claims complaint.

[21]GAO-21-306.

time to mature the technologies. We plan to determine the status of critical technologies and their corresponding levels of maturity in ongoing work.

NASA may face mission delays if it does not mature critical technologies for these two programs in time to develop, integrate, and test the various systems needed for the mission. Our technology best practices have found that if a program's design does not have a solid technical basis, the program is at risk for having a design that is less likely to remain stable.[22]

NASA Continues to Develop its Artemis Management and Integration Functions for the First Lunar Landing Mission

The human exploration mission directorate and the AES division needs to complete the process of establishing a solid foundation for mission management and integration. For example:

- In May 2021, we found that NASA had assigned Artemis mission roles and responsibilities to specific divisions, but had not yet finalized the documentation of roles, responsibilities, and authorities. In September 2021, NASA announced a reorganization of its human exploration mission directorate. The reorganization splits the directorate into two, with one directorate focused on space operations and the second on systems development. NASA is still in the process of implementing the reorganization, and it is too soon to know how these changes will affect NASA's governance of Artemis missions or programs.
- In May 2021, we also found that the agency had not clearly documented how it determined what key programmatic and technical tools it plans to use to guide mission decision-making.[23] For example, the agency plans to apply some program and technical management practices and tools found in program management and systems engineering policy and guidance to the Artemis III mission, such as creating a mission integrated master schedule, but not other practices and tools, such as holding mission-level key decision point reviews. Without documenting this decision-making process, NASA cannot ensure that it has the appropriate processes in place to track how the missions will achieve objectives and address risks at the mission level. We recommended that the AES division document the process used to determine the program and technical management practices and tools that it will apply to the Artemis III and later missions.

  NASA concurred with this recommendation. NASA officials said that officials reviewed the set of products the AES division plans to use to

[22]GAO-20-48G.

[23]GAO-21-330.

govern the Artemis III mission at its September 2021 integration review. The agency continues to evaluate the structure within its two new mission directorates, including the execution and operation of the Artemis missions. We plan to continue to assess NASA's implementation of the recommendation.

In summary, NASA has made important progress on its Artemis efforts, but completing the lunar landing mission remains challenging. NASA is undertaking a complex series of missions that rely on the success of each individual program and on the agency to effectively manage and integrate the programs. NASA has experienced significant cost growth and schedule delays on the programs needed for the Artemis I and II missions. If these test flights are further delayed, or if major system updates are needed, the planned schedule for Artemis III will be delayed. NASA and SpaceX will also need to develop the human landing system at an unprecedented pace, and NASA will need to select a space suits contractor to mature, develop, and produce lunar surface suits. Lastly, to improve oversight of the Artemis missions, NASA needs to continue to take steps to implement our prior recommendations to determine mission and program costs, and to further mature its integration and management functions for the Artemis III and later missions.

Chairman Beyer, Ranking Member Babin, and Members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

GAO Contact and Staff Acknowledgments

If you or your staff have any questions about this testimony, please contact W. William Russell, Director, Contracting and National Security Acquisitions at (202) 512-4841 or russellw@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. GAO staff who made key contributions to this statement include Kristin Van Wychen, Assistant Director; Erin Kennedy, Analyst-in-Charge; Erin Cohen; Laura Greifner; Natalie Logan; Sylvia Schatz; Alyssa Weir; and Robin Wilson.

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