United States Government Accountability Office

Report to Congressional Committees

September 2023

SPACE LAUNCH SYSTEM

Cost Transparency Needed to Monitor Program Affordability

GAO-23-105609

GAO Highlights

Highlights of GAO-23-105609, a report to congressional committees

September 2023

SPACE LAUNCH SYSTEM

Cost Transparency Needed to Monitor Program Affordability

Why GAO Did This Study

The SLS is the world's most powerful rocket and will enable NASA to return humans to the moon. NASA requested $11.2 billion in the fiscal year 2024 president's budget request to fund the program through fiscal year 2028, in addition to the $11.8 billion spent developing the initial capability. In November 2022, NASA successfully demonstrated SLS Block 1 during its Artemis I flight test. NASA intends to fly a series of increasingly difficult missions, including Artemis II—a crewed test flight—and Artemis III—a crewed lunar landing.

GAO's April 2023 high-risk report noted that NASA needed to improve transparency into the long-term costs and affordability of human spaceflight programs, including by establishing cost and schedule baselines for additional SLS capabilities.

A House report to an appropriations bill included a provision for GAO to review NASA's human exploration programs, including the SLS program. GAO assessed the extent to which (1) NASA has established plans to measure the SLS program costs post-Artemis I, and (2) the program has made progress with its plans to reduce projected SLS costs. GAO reviewed NASA documents and plans and interviewed agency officials.

What GAO Recommends

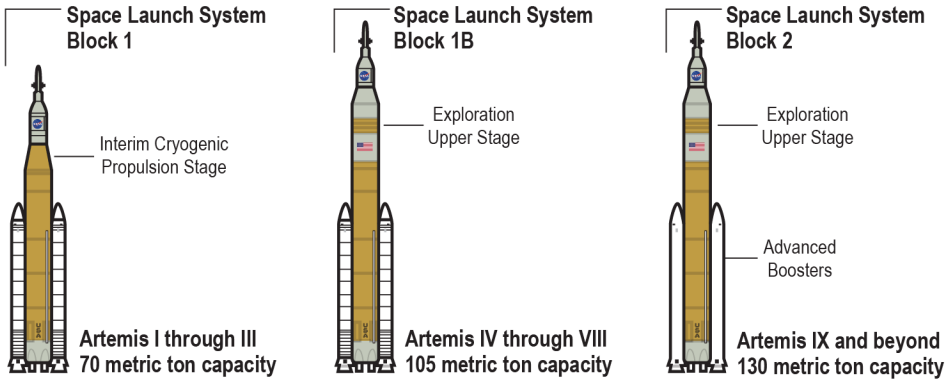
GAO has made three past recommendations in this area—two of which GAO considers priority recommendations. GAO maintains that implementing these recommendations would provide necessary insight to improve program affordability.

View GAO-23-105609. For more information, contact William Russell at (202) 512-4841 or RussellW@gao.gov.

What GAO Found

The National Aeronautics and Space Administration (NASA) does not plan to measure production costs to monitor the affordability of its most powerful rocket, the Space Launch System (SLS). After SLS's first launch, Artemis I in November 2022, NASA plans to spend billions of dollars to continue producing multiple SLS components, such as core stages and rocket engines, needed for future Artemis missions. The program is also concurrently producing hardware for more capable versions of the SLS, the Block 1B and Block 2, for use on later missions.

Space Launch System Planned Block Upgrades



Source: GAO presentation of National Aeronautics and Space Administration images and information. | GAO-23-105609

Because the original SLS version's cost and schedule commitments, or baselines, were tied to the launch of Artemis I, ongoing production and other costs needed to sustain the program going forward are not monitored. Instead, NASA created a rolling 5-year estimate of production and operations costs to ensure that the costs fit within NASA's overall budget. However, neither the estimate nor the annual budget request track costs by Artemis mission or for recurring production items. As a result, the 5-year estimate and the budget requests are poor measures of cost performance over time. In 2014, GAO recommended that NASA develop a cost baseline that captures production costs for the missions beyond Artemis I that fly SLS Block I. NASA intends to fly SLS Block I for Artemis II, planned for 2024, and Artemis III, planned for 2025. NASA partially concurred, but has not yet implemented this recommendation. A cost baseline would increase the transparency of ongoing costs associated with SLS production and provide necessary insights to monitor program affordability.

Senior NASA officials told GAO that at current cost levels, the SLS program is unaffordable. The SLS program developed a roadmap outlining short-term and long-term cost-saving strategies for future missions. For example, NASA plans to use contract types that shift cost risk from the government to the contractors and that achieve manufacturing efficiencies, but it is too early to determine the effects of such strategies. NASA is also considering long-term options, including purchasing future SLS launches and payload capabilities from a contractor who would own, operate, and integrate the SLS rocket.

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Abbreviations

EGS	Exploration Ground Systems
EUS	Exploration Upper Stage
KDP	key decision point
NASA	National Aeronautics and Space Administration
OIG	Office of Inspector General
Orion	Orion Multi-Purpose Crew Vehicle
SLS	Space Launch System

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

September 7, 2023

The Honorable Jeanne Shaheen
Chair
The Honorable Jerry Moran
Ranking Member
Subcommittee on Commerce, Justice, Science, and Related Agencies
Committee on Appropriations
United States Senate

The Honorable Hal Rogers
Chair
The Honorable Matt Cartwright
Ranking Member
Subcommittee on Commerce, Justice, Science, and Related Agencies
Committee on Appropriations
House of Representatives

The National Aeronautics and Space Administration's (NASA) Space Launch System (SLS) is the world's most powerful rocket and will enable NASA's efforts to return humans to the moon. Since 2011, NASA has spent $11.8 billion to develop the initial SLS capability. The president's budget request for fiscal year 2024 includes an additional $11.2 billion for fiscal years 2024 through 2028 to further develop and produce the SLS.

In November 2022, NASA successfully demonstrated the initial capability of the SLS Block 1 during a flight test referred to as Artemis I. NASA intends to fly a series of increasingly difficult missions using SLS Block 1. These missions will include Artemis II—a crewed test flight planned for 2024—and Artemis III—a crewed lunar landing planned for 2025. At the same time, NASA is developing additional SLS capabilities for later Artemis missions. The SLS Block 1B will increase the amount of cargo NASA can deliver to the moon. The SLS Block 2 will lift even heavier payloads into space to support the agency's ambitious Artemis goals.

The SLS program is the first time NASA has produced and operated a human-rated space launch vehicle since the Space Shuttle program ended in 2011. Production and operation of the SLS to support the Artemis missions represents a complex technical and programmatic endeavor. While Artemis I was ultimately a successful launch, the SLS program has faced a variety of challenges, which led to significant cost growth and years of delays to that launch.

GAO has designated NASA's management of acquisitions as a high-risk area for over three decades. In our April 2023 high-risk report, we found that, to make human spaceflight programs more affordable, NASA needed to provide more information about long-term program costs and take actions to reduce those costs. This included establishing cost and schedule baselines for additional SLS capabilities.[1]

The House Report accompanying H.R. 4505, Commerce, Science, Justice, and Related Agencies Appropriations Bill, 2022 included a provision for GAO to review NASA's human exploration programs, including the SLS program.[2] Our review assesses the extent to which (1) NASA has established plans to measure the SLS program's costs following completion of Artemis I and (2) the program has made progress executing its plans to reduce projected SLS costs.

To assess the extent to which NASA has established plans to measure the program's costs following the completion of Artemis I, we reviewed current SLS program documentation to identify the program's current activities and future plans, including efforts by the program to establish cost or schedule baselines. We also reviewed prior and current versions of policies governing NASA's space flight programs and discussed these policies with NASA officials. In addition, we reviewed past GAO reports and reports by the NASA Office of Inspector General (OIG) related to SLS program management or cost and schedule baselines.

To determine the extent to which the program has made progress executing its plans to reduce projected SLS costs, we assessed the NASA SLS roadmap of short-term and long-term affordability and sustainability goals. We interviewed agency officials about how the SLS program office planned to achieve the stated goals. We reviewed contracts and their incentive structures, and interviewed agency officials, to determine steps the SLS program has taken or plans to take to implement cost saving strategies.

We conducted this performance audit from December 2021 to September 2023 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

[1]GAO, *High-Risk Series: Efforts Made to Achieve Progress Need to Be Maintained and Expanded to Fully Address All Areas*, GAO-23-106203 (Washington, D.C.: Apr. 20, 2023).

[2]H.R. Rep. No. 117-97. 134 (2021).

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.

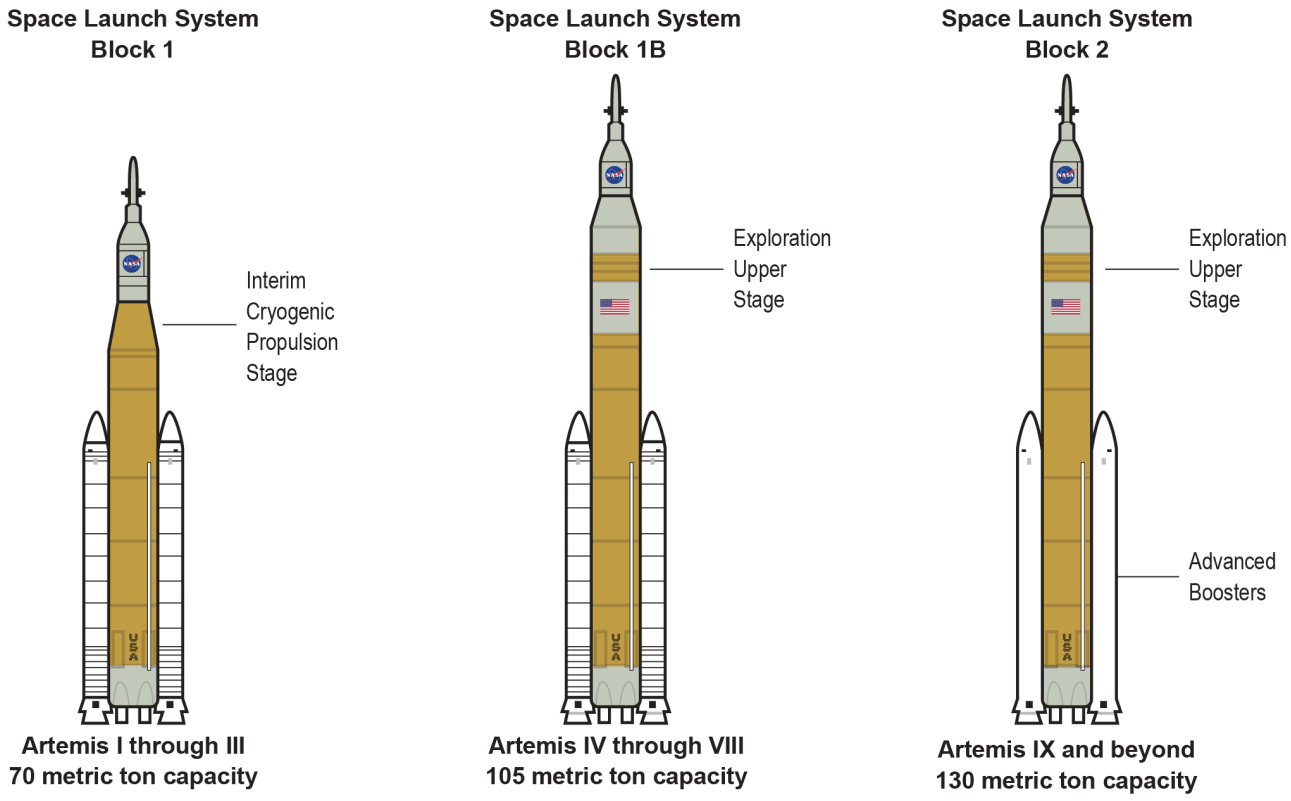
Background

The SLS program evolved from NASA's Constellation program—the human exploration effort intended to succeed the Space Shuttle. NASA cancelled the Constellation program in 2010 due to a number of factors including cost and schedule growth and funding gaps. The NASA Authorization Act of 2010 directed NASA to develop a space launch system.[3] To fulfill this direction, NASA formally established the SLS program in 2011. In accordance with the direction contained in the act, NASA used legacy or existing systems, designs from the Space Shuttle program, and contracts from the Constellation program as the basis for building the initial SLS capability.

NASA plans to incrementally develop three progressively larger SLS launch vehicles capable of carrying payloads of 70-, 105-, and 130-metric tons. This block upgrade approach will allow NASA to accomplish U.S. policy and a presidential space policy directive to reach the moon and eventually Mars. This approach will phase out legacy systems as they are replaced by newly developed ones. Figure 1 shows the three planned block upgrades of SLS.

[3]Pub. L. No. 111-267, § 302.

Figure 1: Space Launch System Planned Block Upgrades

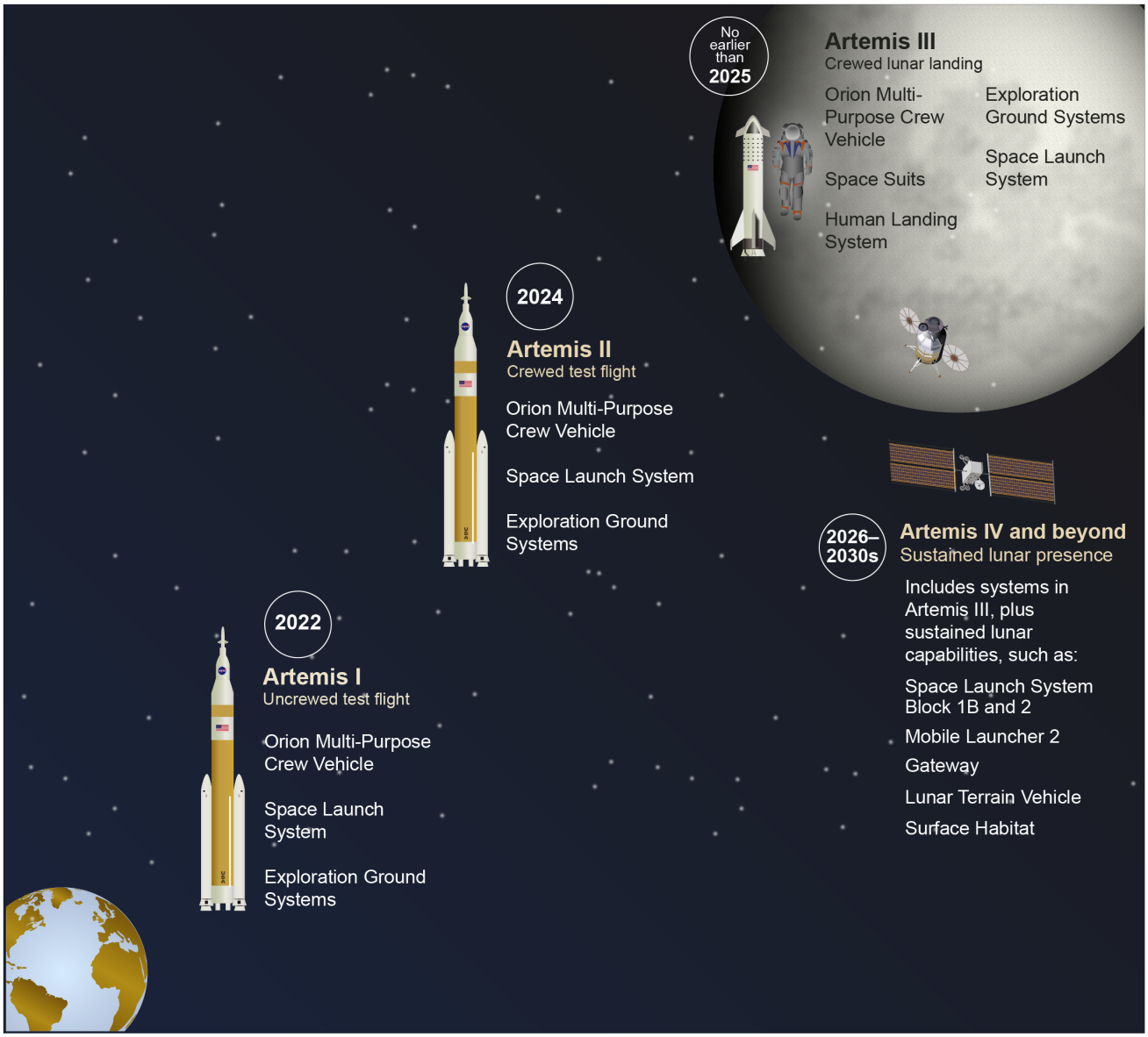


Source: GAO presentation of National Aeronautics and Space Administration images and information. | GAO-23-105609

Key Elements of NASA's Planned Return to the Moon

The goal of NASA's Artemis missions is to return U.S. astronauts to the moon, including a sustained lunar presence and ultimately human exploration of Mars. To do so, NASA programs are developing multiple highly complex and interdependent systems that will need to be integrated to support individual Artemis missions. Artemis I and II are the first planned uncrewed and crewed demonstration missions, respectively, of the SLS, Orion Multi-Purpose Crew Vehicle (Orion), and associated ground systems known as Exploration Ground Systems (EGS). Artemis III incorporates additional programs, such as those developing space suits and a landing system to put humans on the surface of the moon. See figure 2 for the programs needed to accomplish the Artemis missions.

Figure 2: Artemis Missions and the Programs Needed to Accomplish Each Mission



Source: GAO presentation of National Aeronautics and Space Administration images and information. | GAO-23-105609

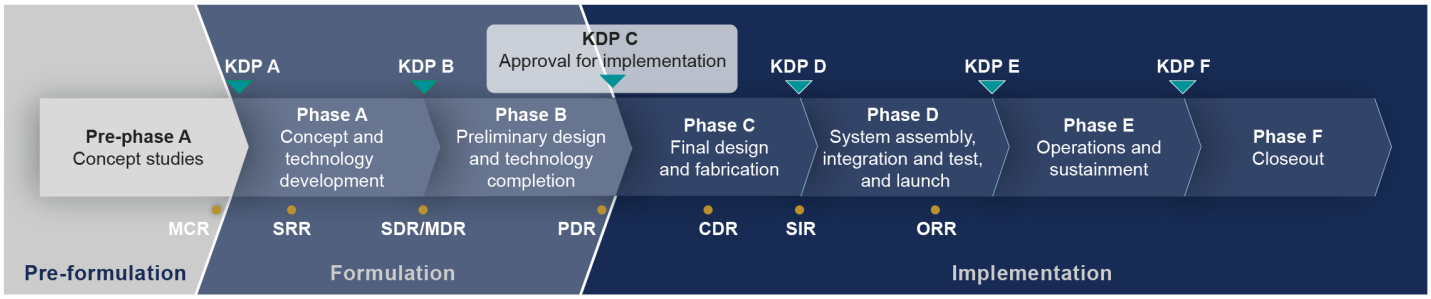
To support planned future Artemis missions, the SLS program must continue producing key elements from the SLS Block 1 while also developing several significant upgrades for future blocks. For all future Artemis missions, the SLS program will need to produce all of these

components: a core stage, which includes four RS-25 engines; two solid rocket boosters; a second stage; and a stage adapter. At the same time, the program is developing a more powerful second stage, the Exploration Upper Stage (EUS) needed for SLS Block 1B and the advanced boosters which, when paired with the EUS, comprise SLS Block 2.

NASA Acquisition Life Cycle

The life cycle for NASA space flight projects consists of two phases: (1) formulation, which takes a project from concept development to preliminary design; and (2) implementation, which includes activities like building, launching, and operating the system. NASA further divides formulation and implementation into phases A through F. Figure 3 depicts NASA's life cycle for space flight projects.

Figure 3: NASA's Life Cycle for Space Flight Projects



Management decision reviews

KDP = key decision point

Technical reviews

- MCR = mission concept review
- SRR = system requirements review
- SDR/MDR = system definition review/mission definition review
- PDR = preliminary design review
- CDR = critical design review
- SIR = system integration review
- ORR = operational readiness review

Source: GAO presentation of National Aeronautics and Space Administration images and information. | GAO-23-105609

Major projects must get approval from senior NASA officials at key decision points (KDP) before they can enter each new phase. The SLS program has moved through most of these phases and is in the latter phases. Specifically, the SLS program held a KDP E review in April 2022

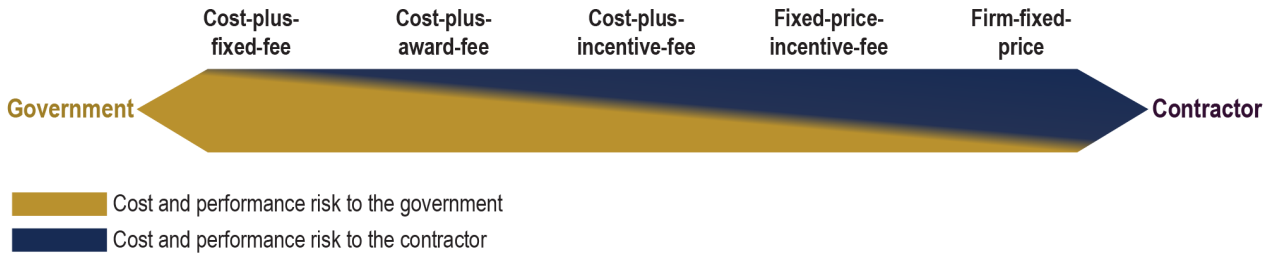
to evaluate the readiness of the systems for operations. The program is in Phase E where it will continue to conduct ongoing production.

Contract Types

NASA uses contractors to develop SLS capabilities, build SLS components, and assemble the rocket. The primary contract types described by the Federal Acquisition Regulation, as supplemented by the NASA Federal Acquisition Regulation, fall into two broad categories—fixed-price and cost-reimbursement.[4] Furthermore, agencies can use these contract types in combination, with both fixed-price and cost-reimbursable contract line item numbers, unless otherwise prohibited.

The balance of performance and cost risk between the government and the contractor varies by contract type. Under a cost-plus-fixed-fee contract, the contractor has minimal responsibility for cost increases and performance risks (i.e., meeting contract requirements) and the negotiated fee (profit) is fixed. Under a firm-fixed-price contract, the contractor has full responsibility for the cost of performance and resulting profit (or loss). Figure 4 shows the correlation of risk and cost responsibility to contract types.

Figure 4: Cost and Performance Risk Related to Contract Types



Source: GAO analysis of Federal Acquisition Regulation documentation. | GAO-23-105609

[4]Fixed-price contracts are defined in Federal Acquisition Regulation subpart 16.2 and further implemented by NASA in NASA Federal Acquisition Regulation subpart 1816.2, and cost-reimbursement contracts are defined in Federal Acquisition Regulation subpart 16.3 and further implemented by NASA in NASA Federal Acquisition Regulation subpart 1816.3.

Prior GAO and NASA OIG Reports

We and the NASA OIG have raised concerns with and made recommendations regarding NASA's approach for estimating SLS program costs and establishing cost baselines.

- In May 2014, we recommended that NASA establish a separate cost and schedule baseline for work required to support the SLS program through Artemis II and that if NASA decided to fly the SLS Block 1 for additional missions, it should also establish a separate cost and schedule baseline for those efforts, to include funding for production.[5] We also recommended that NASA establish separate cost and schedule baselines for each additional capability that encompass all costs, including production costs, because NASA intends to use the increased capabilities of the SLS well into the future and has chosen to estimate costs associated with achieving the capabilities. In 2015 we identified these recommendations as warranting priority attention by the agency and continue to track them.[6]

  As part of the latter recommendation, we stated that, when NASA could not fully specify costs due to lack of well-defined missions or flight manifests, the agency instead should forecast a cost estimate range—including production costs—having minimum and maximum boundaries and report these baselines or ranges annually to Congress via the agency's budget submission.[7]

  In its comments on our 2014 report, NASA partially concurred with these two recommendations, asserting that much of what it had already done or expected to do would address them. For example, the agency stated that establishing the SLS program as a separate effort from the other human spaceflight programs with individual cost and schedule commitments met GAO's intent, as would NASA's plans to track and report development, operations, and sustainment costs in its budget to Congress as the capabilities evolved. In our response, we acknowledged that NASA's prior establishment of separate human spaceflight programs lends some insight into expected costs and

[5]A baseline establishes and documents an integrated set of project requirements, cost, schedule, and technical content that forms the basis for NASA's commitment to the external entities of OMB and Congress.

[6]GAO, *Priority Open Recommendations: National Aeronautics and Space Administration*, GAO-23-106496 (Washington, D.C.: May 3, 2023).

[7]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).

schedule at the broader program level. However, we stated that it does not meet the intent of the two recommendations because cost and schedule identified at that level is unlikely to provide the detail necessary to monitor the progress of each SLS block against a baseline.

- In October 2017, we found that NASA had still not established an expected total life-cycle cost estimate that included production costs for the SLS program. We raised the issue to Congress for its consideration.[8] Specifically, we restated our earlier recommendations and suggested that Congress consider requiring NASA to establish separate cost and schedule baselines for work required to support SLS for Artemis II, and establish separate cost and schedule baselines for each additional capability that includes production costs.[9] In its comments on the report, NASA reiterated that its position had not changed and remained consistent with both agency policy and direction in prior authorization acts.

  The House Committee on Appropriations included language in a House Report accompanying a Commerce, Justice, Science, and Related Agencies Appropriations Bill, 2020 directing NASA to establish cost and schedule baselines for SLS and associated ground systems for Artemis II. If additional development efforts occur outside the scope of Artemis II, then it directed NASA to establish separate cost and schedule baselines for each additional capability of SLS that encompasses all life-cycle costs, to include operation and sustainment costs.[10]

  Since that time, NASA has not yet established a baseline for the SLS program for Artemis II. NASA does plan to establish separate cost and schedule baselines for additional SLS capabilities. For example, NASA plans to establish a separate cost and schedule baseline for the SLS Block 1B, but as of July 2023, it has not yet done so.

- In December 2019, we found that NASA did not plan to develop a cost estimate for the Artemis III mission, which will rely on several NASA

[8]A life-cycle cost estimate is a structured accounting of all labor, material, and other efforts required to develop, produce, operate and maintain, and dispose of a program.

[9]GAO, *NASA Human Space Exploration: Integration Approach Presents Challenges to Oversight and Independence*, GAO-18-28 (Washington, D.C.: Oct. 19, 2017).

[10]Commerce, Justice, Science, and Related Agencies Appropriations Bill of 2020, H.R. Rep. No. 116-101 (2019).

programs, including SLS.[11] At the time, the NASA Administrator had stated that the mission could cost between $20 billion and $30 billion. We recommended that NASA develop a life-cycle cost estimate for the Artemis III mission, with which NASA agreed. At the time, NASA said that it would provide a preliminary cost estimate for the Artemis III mission by the end of calendar year 2020—after the agency had achieved certain milestones for several of the programs required for the mission, including signing the SLS production contracts. As of May 2023, NASA was continuing to work toward achieving those milestones and has not yet established a life-cycle cost estimate for the Artemis III mission.

- The NASA OIG has also raised concerns with the SLS program's approach during this time period. For example, in April 2022, the NASA OIG found that NASA's decision to categorize the SLS program as a capability demonstration would affect how the agency continues to classify the production costs of the program's deliverables that do not directly support Artemis I.[12] Specifically, the OIG reported that it disagreed with NASA's approach because all ongoing or future production efforts would not be included in any agency commitments or external cost or schedule performance reports to Congress.

NASA Does Not Plan to Measure Production Costs for SLS Program

NASA does not plan to measure production costs to monitor the affordability of the SLS program. After SLS's first launch, Artemis I in November 2022, NASA plans to spend billions of dollars to continue producing multiple SLS components, such as core stages and rocket engines, needed for future Artemis missions. These ongoing production costs to support the SLS program for Artemis missions are not captured in a cost baseline, which limits transparency and efforts to monitor the program's long-term affordability.

This is important because the production and other costs for the SLS program account for more than one third of NASA's budget request for programs required to return to the moon. For example, in the president's budget submission for fiscal year 2024, NASA requested $6.8 billion for the five programs that will be required for Artemis III. The SLS program accounted for about $2.5 billion, or 37 percent of that request. NASA is creating annual production and operations cost estimates for SLS, but

[11]GAO, *NASA Lunar Programs: Opportunities Exist to Strengthen Analyses and Plans for Moon Landing*, GAO-20-68 (Washington, D.C.: Dec. 19, 2019).

[12]NASA, Office of Inspector General, *NASA's Cost Estimating and Report Practices for Multi-Mission Programs,* IG-22-011 (Washington, D.C.: Apr. 7, 2022).

these estimates do not track costs by Artemis mission or for recurring production items.

NASA tailored its existing policy requirements when the SLS program set its original baseline in August 2014 and only required the program to capture the cost and schedule commitments to demonstrate the SLS's initial capability. The baseline did not include future hardware production costs, which include multiple core stages, boosters, and engines, needed to support Artemis II and beyond. In August 2021, NASA further revised its policy and no longer required any program that has unspecified end points and plans for ongoing production, like SLS, to develop life-cycle cost estimates that include production costs. Instead, these programs develop a cost and schedule baseline only for the work required to support the initial capability.[13] After these programs demonstrate their initial capability, the policy requires them to develop an estimate of production and operation costs for the next 5 years and to update and document the estimate annually. NASA officials told us they plan to monitor production costs and affordability of the SLS program via the 5-year production and operations cost estimate.

In accordance with the revised policy, the SLS program produced one 5-year production and operations cost estimates in April 2022. This estimate was based on fiscal year 2021 budget assumptions, captured the projected cost of the program over the next 5 years, and demonstrated that it fit within NASA's overall budget. Since April 2022, the program has annually released a 5-year funding profile in the President's budget requests.

Neither the 5-year production and operation cost estimate nor the annual budget requests are a substitute for a cost baseline, and are poor tools to measure cost performance over time. As of July 2023, the program has not updated its 5-year production and operations cost estimate to reflect the current expected costs for the SLS program. Without regular updates, cost estimates lose their usefulness as predictors of likely outcomes and as benchmarks for meaningfully tracking progress. As a result, it is unclear what the current estimates are to produce SLS hardware covered by the fiscal year 2024 budget request.

[13]NASA, *NASA Space Flight Program and Project Management Requirements*, Procedural Requirements 7120.5F (Aug. 3, 2021).

Similarly, the budget does not delineate costs needed to produce SLS hardware from other expenses such as initial development of the SLS block 1B upgrade, or the impact of changes to mission dates. Some NASA officials told us that changes to Artemis mission dates should not affect the SLS program's cost estimate; other officials noted that the program's cost estimate would be expected to increase to account for the delay to the Artemis IV mission, which shifted from 2026 to 2028. These officials also told us that funds spent on flight hardware for Artemis missions do not equate to fiscal years, and that they will continue to annually produce a 5-year production and operation cost estimate that uses the budget process and is based on the most up-to-date program information.

As the program is spending billions of dollars to produce hardware for future Artemis missions, some of the concerns raised in our past reports are now occurring. For example, NASA has awarded a contract which includes costs up to nearly $2 billion to be reimbursed for production of the core stages needed for Artemis III and Artemis IV. Based on our analysis of the contract, the cost to produce successive core stages is increasing over time. Additional delays to an Artemis mission date could also further increase expected costs. Without a way to capture and monitor these production costs against a baseline, it will be difficult to measure any cost growth related to these efforts. We previously found that NASA's approach to track costs through its budget submission was unlikely to provide the detail necessary to monitor the progress.[14] As a result, our prior recommendation for NASA to establish a cost and schedule baseline that captures these production costs for the SLS program continues to be important and timely.

Similarly, as NASA continues to take steps to implement our recommendation to develop a life-cycle cost estimate for Artemis III, it will need to identify the costs that stem from each of the five programs that are required for the mission, including the SLS program. NASA cannot produce a life-cycle cost estimate for the Artemis III mission without identifying the costs to produce the SLS hardware required for the mission. Implementing our prior recommendations to establish cost and schedule baselines that capture these ongoing, recurring production costs would begin to improve transparency into the program. Further, understanding the full cost of the SLS program will help decision-makers

[14]GAO-14-385.

monitor program performance and assess the long-term affordability of the program.

NASA Is Taking Steps to Improve Affordability, but It Is Too Early to Assess Their Effect on Future Costs

NASA recognizes the need to improve the affordability of the SLS program and is taking steps to do so. Senior agency officials have told us that at current cost levels the SLS program is unsustainable and exceeds what NASA officials believe will be available for its Artemis missions. With input from NASA management, the SLS program has developed a roadmap outlining short-term and long-term strategies that it hopes will result in future cost savings. The program's short-term strategies are to: (1) stabilize the flight schedule, (2) achieve learning curve efficiencies, (3) encourage innovation, and (4) adjust acquisition strategies to reduce cost risk. NASA, however, has not yet identified specific program-level cost-saving goals which it hopes to achieve. NASA has made some progress toward implementing these strategies, but it is too early to fully evaluate their effect on cost.

Stabilize the Flight Schedule. NASA has made significant progress in stabilizing its planned flight schedule. Changing aspects of the flight schedule, including the date, planned SLS version, and mission, affect the program's cost and schedule. We reported in December 2020 that repeated changes—four changes over 10 months—to the SLS program's flight schedule contributed to uncertainty within the program and affected the program's ability to plan program activities efficiently.[15] For example, we found that NASA made several changes for the SLS EUS, shifting between different trajectory and cargo or crew requirements that were affecting the design and therefore the program's schedule. In February 2022, NASA officials stated that the program expects that a stable flight schedule will result in significant cost savings in future years. While there have been changes to the flight schedule since we issued that report, such as shifts in the mission dates, the hardware required by the SLS program has not changed.

Achieve Learning Curve Efficiencies. The program plans to reduce costs by achieving manufacturing efficiencies. For example, NASA officials stated that the program plans to or has already structured the production and operation contracts to encourage the contractors to become more efficient with recurring hardware production. However, the program is still too early in production to know if this strategy has resulted

[15]GAO, *NASA Human Space Exploration: Significant Investments in Future Capabilities Require Strengthened Management Oversight*, GAO-21-105 (Washington, D.C.: Dec. 15, 2020).

in cost savings. For example, officials told us that there was a 49 percent reduction in nonconformances, that is, the number of components not meeting requirements, between the production of core stage 1 and core stage 2. Core stage 1 was a development program and a "first time build" during which the program experienced significant challenges and delays. The program may be able to identify cost savings once it is able to compare efficiencies observed in core stage 2 build to core stage 3 and core stage 4, which are still in pre-production, to determine if the rate of improvement continues.

Encourage Innovation. Similarly, NASA has reported that the program has made some progress in reducing program costs by encouraging contractors to pursue innovative manufacturing techniques or tools to streamline production. For example, the RS-25 engine restart contract states that the contractor should use modern manufacturing and fabrication techniques, such as additive manufacturing. NASA officials told us that this will reduce the time and cost to build the engines, compared to historical manufacturing, while still maintaining the integrity of the RS-25 certified design baseline.

Adjust Acquisition Strategies. NASA plans to implement acquisition strategies that will shift cost risk from the government to the contractor.

- First, NASA has taken steps to shift away from cost-plus-award-fee type contracts to fixed-price type contracts, which officials told us will help them reduce program costs. For example, NASA is transitioning to fixed-price contract types for future SLS booster flight sets. NASA awarded a contract for, among other things, the development and production of the first three flight sets under a cost-plus-incentive-fee contract. The government generally bears the risk of an increase in performance cost on this type of contract.[16] For later booster flight sets beginning with Artemis IV, when the system design is stable and the contractor has demonstrated manufacturing processes, NASA is

[16]These types of contracts are often used for the development of systems generally when circumstances do not allow the agency to define its requirements sufficiently and specifically when the work to be performed is such that it is neither feasible nor effective to devise predetermined objective incentive targets applicable to cost, schedule, or technical performance.

using fixed-price-incentive-fee contracts. On this type of contract, the contractor generally assumes the risk of cost, over the ceiling price.[17]

- Second, where feasible, NASA aims to procure some SLS elements as commercial items, which officials also believe will reduce costs. For example, according to program officials, in 2016, NASA awarded a commercial item contract for RL-10 engines for use on the EUS. According to NASA officials, procuring several quantities of a commercial item can be cost efficient if there are multiple buyers outside the agency, rather than the government being the sole buyer. NASA officials explained that the higher rates of production and economies of scale associated with a robust commercial market for a product can result in lower costs.

To improve the long-term affordability of the SLS program, NASA has developed a long term affordability and sustainability initiative. Under this initiative, officials told us that they are exploring different operating models moving forward, such as a joint venture or a consolidated contract that provides a launch services operating model. Under a launch services model, the government would award a contract to procure from a contractor future launches and payload capabilities. In essence, NASA would purchase future SLS launches and payload capabilities from a contractor who would own, operate, and integrate the SLS vehicle. The officials told us the agency is still reviewing its future strategy in advance of releasing a request for proposals to support an eventual contract award.

Agency Comments

We provided a draft of this report to NASA for its review and comment. NASA provided technical comments, which we incorporated as appropriate.

We are sending copies of the report to the appropriate congressional committees and the NASA Administrator. In addition, the report will be available at no charge on GAO's website at http://www.gao.gov.

[17]A fixed-price incentive contract is a fixed-price contract that provides for adjusting profit and establishing the final contract price by application of a formula based on the relationship of total final negotiated cost to total target cost. The final price is subject to a price ceiling, negotiated at the outset. Federal Acquisition Regulation 16.403.

If you or your staff have any questions about this report, please contact me 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 report. GAO staff who made major contributions to this report are listed in appendix I.

W. William Russell
Director, Contracting and National Security Acquisitions

Appendix I: GAO Contact and Staff Acknowledgments

GAO Contact

W. William Russell, (202) 512-4841 or RussellW@gao.gov

Staff Acknowledgments

In addition to the contact named above, Kristin Van Wychen (Assistant Director); John Warren (Analyst-in-Charge); Dan Chandler; Lorraine Ettaro; Genesis Galo; Laura Greifner; Tonya Humiston; Sylvia Schatz; Tanya Waller; and Alyssa Weir made significant contributions to this report.

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