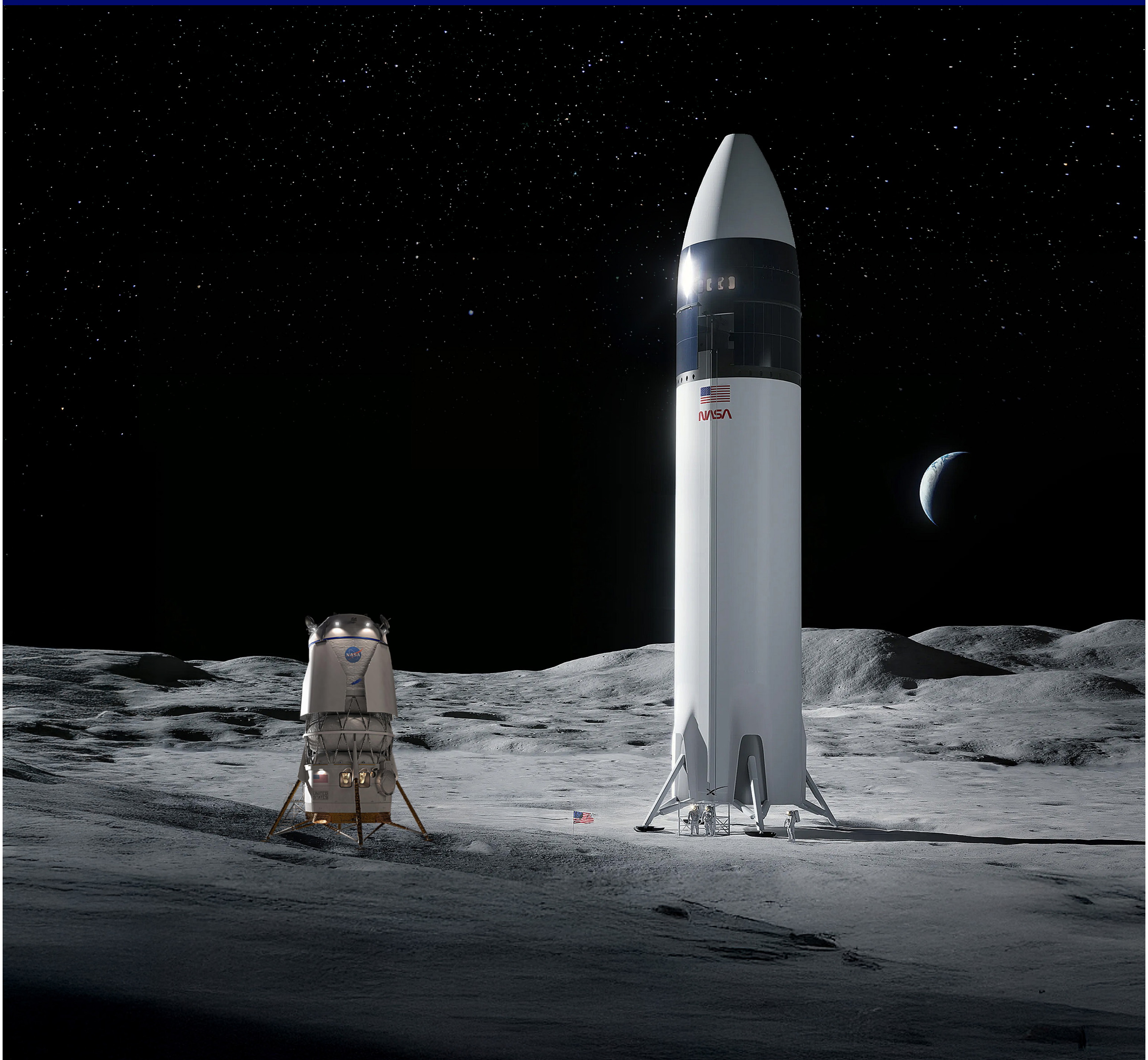
NASA

Office of Inspector General

NASA's Management of the Human Landing System Contracts



March 10, 2026

IG-26-004

RESULTS IN BRIEF

NASA's Management of the Human Landing System Contracts

March 10, 2026 IG-26-004 (A-24-09-00-HED)

WHY WE PERFORMED THIS AUDIT

NASA's Artemis campaign aims to return astronauts to the Moon for the first time since Apollo 17 and establish the framework for a sustainable lunar presence. The Human Landing System (HLS)—which will enable crew to descend to the lunar surface, temporarily live and work there, and ascend back to lunar orbit—is a key component to that endeavor. To this end, NASA awarded firm-fixed-price contracts to SpaceX and Blue Origin for the rapid development and demonstration of each company's unique HLS.

Since the HLS Program's inception in 2019, NASA has obligated $6.9 billion for HLS development and estimates it will spend $18.3 billion through fiscal year 2030. NASA is utilizing a tailored program management approach, giving the HLS providers significant latitude to implement their own project management practices while allowing for a reduced number of Agency-required reviews and data submissions. However, to gain visibility into the providers' development work and ensure they are meeting safety and operational requirements, the HLS Program is employing an insight/oversight model. Given NASA's significant financial investment and the high stakes of returning astronauts to the Moon's surface, it is essential the Agency maintains sufficient awareness into the risks associated with these new technologies and the authority to require system and operational changes to ensure the safety of the crew.

In this audit, we evaluated (1) the extent to which the HLS providers are meeting cost, schedule, and performance goals; (2) the HLS Program's implementation of the insight/oversight model; and (3) the Program's identification and mitigation of risks to astronaut safety. To complete this work, we interviewed HLS Program officials, including program management, contracting officers, contracting officer representatives, safety officials, and systems engineering personnel, among others, as well as officials from SpaceX and Blue Origin. We also examined SpaceX and Blue Origin contract files, data from NASA's financial systems, Agency review milestones and provider deliverables, risk assessments, and technical requirements. Additionally, we reviewed and analyzed HLS Program and provider schedule data.

WHAT WE FOUND

NASA's acquisition approach for the lunar landers has been effective in controlling contract costs, with the SpaceX and Blue Origin contracts having only increased by 6 percent and less than 1 percent, respectively. This was due in part to NASA negotiating mutually beneficial contract changes at no cost to the government. However, both SpaceX and Blue Origin have experienced schedule delays and face technical and integration challenges that have the potential to further impact lander costs and delivery schedules. In particular, SpaceX's lander will not be ready for a June 2027 lunar landing. To accelerate lander development to meet a 2028 lunar landing date, NASA is assessing proposals from both SpaceX and Blue Origin, but it is too early to determine the technical feasibility, financial implications, and schedule impacts of these proposals.

The HLS Program's use of insight and collaborations has shown to be an effective management approach to gain visibility and participatory involvement into lander development and data. However, both insight and collaborations are not without financial costs to the Agency. The HLS Program has insight into more than 1,100 focus areas between SpaceX and Blue Origin, with increased insight into engine development, cryogenic fluid management, and crew training. As the providers continue development and approach critical milestones, increases in insight will likely require additional NASA resources to conduct analyses, reviews, and tests. NASA is also collaborating with SpaceX and Blue Origin by providing requested expertise and knowledge in technical areas such as engineering or safety through the increasing use of NASA personnel and support contractors. While we found the work beneficial to HLS development, it comes at no cost to the providers and is dependent on NASA resources.

Furthermore, while the providers' use of Government Task Agreements (GTA) to access specialized NASA facilities and services has proven to be successful, we found the HLS Program does not have a formal process outlining how to manage GTAs submitted at contract proposal that have since been canceled or unfulfilled, or new GTAs requested after contract award, which are the financial responsibility of the providers. This lack of guidance led to confusion and a pause in GTA work in early 2025. As a result, the HLS Program went through a reconciliation process authorizing NASA to decrement $1.5 million from SpaceX's contract in 2026. The Agency determined a decrement to Blue Origin's contract was not warranted.

We noted NASA is proactively taking measures to mitigate and prevent hazards associated with the landers, such as requiring lunar ascent tests as part of the providers' uncrewed demonstration missions. However, despite these efforts, and considering the lunar landers carry the highest probability of crew loss, gaps still exist in the Agency's risk reduction methodology. For instance, while HLS Program officials believe the Program is following Agency Test Like You Fly guidance, we found key missed opportunities to apply these principles to the SpaceX and Blue Origin uncrewed demonstration missions. Additionally, NASA and SpaceX disagree on whether the provider is meeting the intent of the Agency's manual control requirement. Incorporating the manual control capability is a key element of HLS's human-rating certification and part of an essential crew survival strategy. Key decisions on Blue Origin's manual control design have yet to be made.

We also observed limitations in the Agency's approach to crew survival analyses—the evaluation of available crew survival capabilities to counter a catastrophic event—due to functional constraints and the availability of resources. Since the analyses typically mature later in the landers' design cycle, the decision packages used to recommend new or enhanced capabilities that improve the likelihood of crew survival are limited to capturing resultant risks rather than preemptively driving risk reduction. Moreover, the analyses do not account for extended crew survival once an immediate threat is over. While NASA is taking steps to prevent catastrophic events from occurring, ultimately, should the astronauts encounter a life-threatening emergency in space or on the lunar surface, NASA does not have the capability to rescue the stranded crew.

What We Recommended

To improve management of government-spent funds and enhance crew safety and survival during the Artemis missions, we recommended NASA officials: (1) ensure an approach for managing GTAs that have been canceled, unfulfilled, modified, or realigned is formalized in HLS Program policy; (2) ensure an approach for decrementing costs for GTAs submitted after contract proposal, including a timeline for recovery, is formalized in HLS Program policy; (3) update the Use of Government Resources clause in both the SpaceX and Blue Origin contracts to reflect GTA policy changes; (4) consult with the Commercial Crew Program to review post-variance acceptance risk assessment findings related to its manual control waiver for lessons that can be applied prior to HLS certification; and (5) update crew survival analyses, including decision packages, to include strategies for extended crew survival.

We provided a draft of this report to NASA management who concurred with Recommendations 1, 2, 4, and 5 and partially concurred with Recommendation 3. We consider management's comments and described planned actions responsive; therefore, the recommendations are resolved and will be closed upon completion and verification of the proposed corrective actions.

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Acronyms

CDR	Critical Design Review
DRD	data requirements description
ECLSS	Environmental Control and Life Support System
EP	equivalent personnel
GTA	Government Task Agreement
HAATS	High-Altitude Army National Guard Aviation Training Site
HLS	Human Landing System
NextSTEP	Next Step Technologies for Exploration Partnerships
NRHO	Near-Rectilinear Halo Orbit
OIG	Office of Inspector General
PDR	Preliminary Design Review
RCS	Reaction Control System

INTRODUCTION

NASA's Artemis campaign aims to return astronauts to the Moon for the first time since Apollo 17 and establish the framework for a sustainable lunar presence. Key to these endeavors is the development of lunar landing system technologies that will enable crew to descend to the lunar surface, temporarily live and work there, and ascend back to lunar orbit. To this end, NASA awarded firm-fixed-price contracts to SpaceX and Blue Origin for the rapid development and demonstration of each company's unique Human Landing System (HLS).

Since the HLS Program's inception in 2019, NASA has obligated $6.9 billion for HLS development and estimates it will spend $18.3 billion through fiscal year 2030. To facilitate rapid development, encourage innovation, and reduce costs, NASA has given its HLS providers significant latitude to implement their own project management practices with reduced Agency-required reviews and data submissions. NASA is using a tailored insight/oversight model to gain visibility into broad aspects of the providers' development work and ensure they are meeting the Agency's safety and operational requirements. Given NASA's significant financial investment and the high stakes of returning astronauts to the Moon's surface, it is essential the Agency maintains sufficient awareness into the risks associated with these new technologies and the authority to require system and operational changes to ensure the safety of the crew.

In this audit, we examined NASA's management of the HLS contracts. Specifically, we evaluated (1) the extent to which HLS providers are meeting cost, schedule, and performance goals; (2) the HLS Program's implementation of the insight/oversight model; and (3) the HLS Program's identification and mitigation of risks to astronaut safety. See Appendix A for details of the audit's scope and methodology.

Background

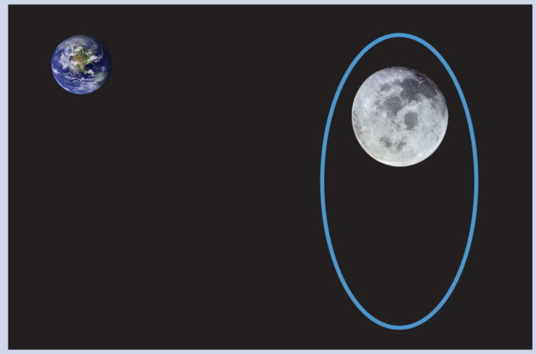
While the Apollo Program set out to prove NASA could land humans on the Moon and return them safely to Earth, the Artemis campaign aims to establish a sustainable human presence that will allow astronauts to live and work on the lunar surface.[1] Further, Artemis hopes to lay the foundation for future crewed missions to Mars. The crew will collect samples, perform science experiments, test new technologies, and observe the Moon's environment. To meet mission needs, the Agency is working with U.S. industry to develop lunar landers. SpaceX's Starship lander and Blue Origin's Blue Moon lander will not just deliver astronauts to the lunar surface but will also serve as living quarters for them while they are on the Moon.

[1] The Apollo Program was the first time humans left Earth's orbit and visited another celestial body. Through the Apollo Program, NASA made 11 crewed space flights (out of 17 space flights in total), and 12 astronauts walked on the Moon. The first crewed Apollo flight to lunar orbit occurred in 1968 (Apollo 8), the first Moon landing in 1969 (Apollo 11), and the last Moon landing in 1972 (Apollo 17).

Artemis Missions

Following two Artemis flight test missions to lunar orbit—the uncrewed Artemis I flight completed in December 2022 and the crewed Artemis II flight planned for April 2026—the Artemis III mission will put humans on the Moon's surface for the first time in more than 50 years.[2] Artemis III will serve as the first integrated mission of the Space Launch System heavy-lift rocket; the Orion Multi-Purpose Crew Vehicle (Orion); the Exploration Ground Systems used to process, launch, and recover NASA spacecraft; the HLS; and the Agency's next-generation spacesuit for exploring the lunar surface. For this mission, SpaceX's Starship will dock with Orion in Near-Rectilinear Halo Orbit (NRHO). Two crewmembers will then transfer from Orion to the lander for transportation to the Moon's surface for a 6.5-day stay. On the Moon, they will use next-generation spacesuits to conduct moonwalks to survey the South Pole region, retrieve samples, and collect other data to meet scientific objectives. Upon completion of the lunar surface mission, the HLS will return to NRHO and dock with Orion for crew transfer and return to Earth.

Near-Rectilinear Halo Orbit (NRHO)



Starting with Artemis III, the HLS will dock with Orion, and later Gateway, in NRHO. With a 6.5-day orbital period, vehicles in NRHO are under the influence of both Earth and lunar gravity. NRHO is characterized by large variations in distances to the Moon, from an average of 1,000 miles at its closest to as far as 43,000 miles. There are about 55 opportunities for landers to descend from NRHO to the lunar surface in a year and it takes the HLS approximately 19 hours from leaving NRHO to landing on the Moon.

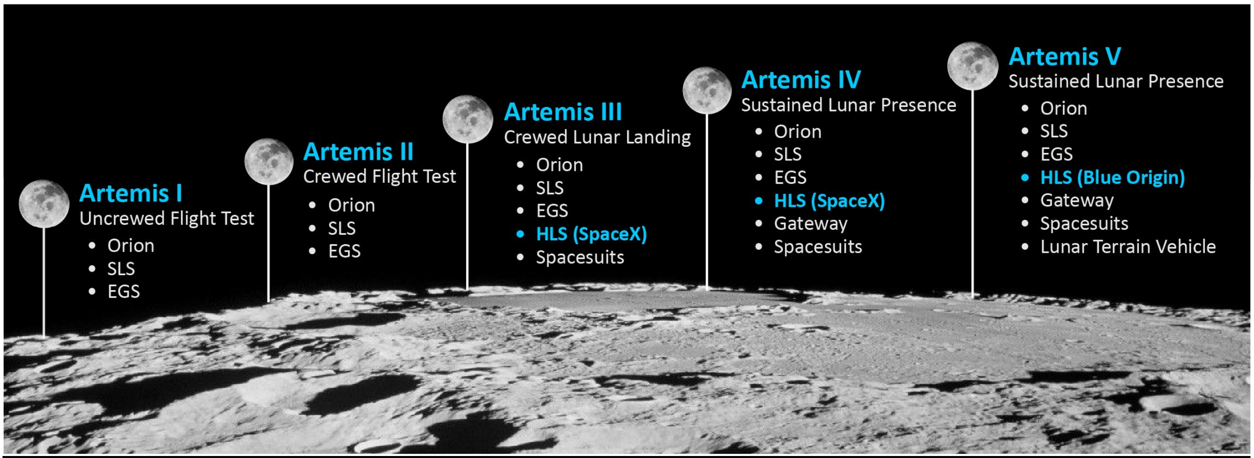
Source: NASA.

Artemis IV will be NASA's first sustaining Artemis mission and will introduce the Gateway—a small space station that will orbit the Moon and serve as a staging location for lunar missions and deep space operations.[3] Unlike Artemis III, both Orion and Starship will dock with Gateway in NRHO rather than directly with one another. Crew will transfer from Orion to Gateway and then to Starship for transportation to and from the lunar surface. Upon return to Gateway, the crew will board Orion and return to Earth. Artemis V will continue Artemis sustaining operations with a concept of operations similar to Artemis IV but will introduce Blue Origin's Blue Moon lander for the first time. Figure 1 depicts the increasing complexity of the Artemis missions.

[2] Subsequent to the completion of our audit work, NASA announced changes to its Artemis campaign approach, including the addition of a new Artemis mission to low Earth orbit prior to a lunar surface mission. For the purposes of this report, we use the Artemis mission numbering under which the HLS providers are currently contracted to perform lunar surface missions—SpaceX's Starship lander for Artemis III and IV and Blue Origin's Blue Moon lander for Artemis V.

[3] Five space agencies—NASA, the European Space Agency, the Japan Aerospace Exploration Agency, the Canadian Space Agency, and the Mohammed Bin Rashid Space Centre—are contributing to the development of Gateway.

Figure 1: Major Artemis Systems by Mission



Source: NASA Office of Inspector General (OIG) presentation of Agency information.

Note: Space Launch System (SLS) and Exploration Ground Systems (EGS).

HLS Contract Approach

NASA's contracting approach for the landers is relatively new in that the Agency is pursuing multiple HLS providers who will design, build, and own the landers. This approach is a departure from the Agency's traditional government-owned hardware model, such as for the Space Launch System. NASA will purchase the landers as services under firm-fixed-price, indefinite-delivery, indefinite-quantity contracts that utilize performance-based milestone payments.[4] The Agency's intent is to increase competition, provide cost control, and support a regular cadence of lunar landings. Under this approach, the HLS Program sets high-level requirements but relies on the providers' innovation to develop and demonstrate the landers. The providers only receive payment after NASA determines that they have successfully achieved a milestone as defined in the contract.

In September 2019, NASA issued a solicitation for the development and demonstration of an initial lander under the second Next Step Technologies for Exploration Partnerships (NextSTEP-2).[5] Five companies submitted proposals, and in May 2020, Blue Origin, Dynetics, and SpaceX were awarded firm-fixed-price contracts to begin designing and developing a lander. Blue Origin received over $480 million, Dynetics nearly $240 million, and SpaceX nearly $135 million for the 10-month base period of the NextSTEP-2, Appendix H contract. In July 2021, NASA awarded SpaceX a firm-fixed-price contract with a potential value of approximately $3 billion to further develop and demonstrate its lunar lander for Artemis III, including an uncrewed demonstration mission to the lunar surface prior to the crewed

4 A firm-fixed-price contract places full responsibility on the contractor to control costs while imposing a minimum administrative burden. An indefinite-delivery, indefinite-quantity contract allows the government to order a minimum quantity of supplies or services.

5 NextSTEP-2 is a NASA public-private partnership model for commercial development of new capabilities for crewed missions in deep space. The initial NextSTEP Broad Agency Announcement was released in 2014 with selections made in 2015. NextSTEP-2 solicited additional proposals to continue NASA's development of space exploration technologies, capabilities, and concepts.

Artemis III mission. This contract is known as Appendix H, Option A.[6] In November 2022, NASA exercised Option B—with a potential contract value of approximately $1 billion—on SpaceX's existing Appendix H contract to further develop its lander for Artemis IV and to meet NASA's sustaining requirements for recurring astronaut transportation services to the Moon.[7] In total, the potential value for SpaceX's Appendix H contract was approximately $4.3 billion.[8]

To maximize competition and provide redundancy in NASA's ability to transport astronauts to the lunar surface, in September 2022, NASA issued an HLS Sustaining Lunar Development solicitation under NextSTEP-2, Appendix P. In May 2023, NASA awarded Blue Origin approximately $3.1 billion to provide a lunar lander for the Artemis V mission.[9] Similar to the Appendix H contract, the Appendix P firm-fixed-price contract includes an uncrewed demonstration mission of the lander. See Figure 2 for an overview of the HLS contract structure at contract award.

Figure 2: HLS Contract Structure under NASA's NextSTEP-2 Contract Award

"Initial" HLS (Artemis III)		"Sustaining" HLS (Artemis IV and Beyond)	
APPENDIX H BASE PERIOD Early design and development	**APPENDIX H OPTION A** SpaceX Artemis III mission including an uncrewed demonstration	**APPENDIX H OPTION B** SpaceX Artemis IV mission	**APPENDIX P** Blue Origin Artemis V mission including an uncrewed demonstration
2020 to 2021	Awarded in 2021	Awarded in 2022	Awarded in 2023

Source: NASA OIG presentation of Agency information.

[6] NASA had expected to award at least two companies a contract for development and demonstration of their landers; however, in fiscal year 2021, the Agency received just 28 percent of the requested funding for the HLS Program and was only able to select one company.

[7] For the purposes of this audit, the potential contract value excludes contract line item numbers for the Human-Class Delivery Lander—also known as the cargo lander—portion of the contract. This lander is being developed to deliver cargo from Earth to the lunar surface and will not provide transportation of crew.

[8] For the purposes of this audit, the total potential contract value for SpaceX's Appendix H contract is calculated including the value of all base, Option A, and Option B exercised and unexercised options as well as the maximum value available for indefinite-delivery, indefinite-quantity task/delivery orders.

[9] For the purposes of this audit, the total potential contract value for Blue Origin's Appendix P contract is calculated including the value of all base, exercised, and unexercised options as well as the maximum value available for indefinite-delivery, indefinite-quantity task/delivery orders. Additionally, the potential contract value excludes contract line item numbers for the cargo lander portion of the contract.

Lunar Lander Providers

Space X

For the Artemis III and IV missions, SpaceX is developing its Starship lander. Standing about 171 feet tall, Starship will launch from Earth on SpaceX's Super Heavy booster. Both the lander and booster utilize SpaceX's Raptor engines, which are fueled by liquid oxygen and liquid methane, collectively referred to as propellant. SpaceX intends to utilize three configurations of the Starship concept to support Artemis missions to the Moon. While the Starship lander will deliver astronauts to the lunar surface, the Starship tanker will deliver propellant to low Earth orbit where it will be stored in the Starship storage depot before being distributed to the Starship lander.

Prior to the Artemis III and IV missions, SpaceX will launch the Starship storage depot to low Earth orbit, which will be followed by more than 10 Starship tankers carrying propellant. Each tanker will rendezvous with, dock to, and transfer propellant to the storage depot—also known as propellant aggregation. Propellant aggregation begins more than 200 days prior to crew launching to allow for sufficient schedule margin. SpaceX is targeting to launch one tanker flight every 6 days until sufficient propellant is aggregated. The fleet of Starship tankers will launch from both SpaceX's Starbase facility in Texas and NASA's Kennedy Space Center in Florida; the depot can launch from either location.

When there is sufficient propellant in the Starship storage depot, an uncrewed Starship lander will lift off from Kennedy Space Center to rendezvous and dock with the depot in low Earth orbit where it will refuel before continuing to NRHO. Once in NRHO, the lander will undergo a full checkout of its systems—known as the Lunar Orbit Checkout Review—to verify they are operating properly before the crew launches from Earth on the integrated Space Launch System/Orion.[10] The fueled lander can loiter up to 100 days awaiting the arrival of Orion before delivering and returning astronauts to and from the lunar surface. At the end of the mission, Orion will return the astronauts to Earth and the HLS will transfer to an alternate orbit for either disposal or reuse. See Figure 3 for the Artemis III concept of operations. Artemis IV will follow a similar mission profile; however, instead of docking with Orion directly, the Starship lander will dock with Gateway to retrieve the astronauts, take them to the lunar surface, and return them to the station.

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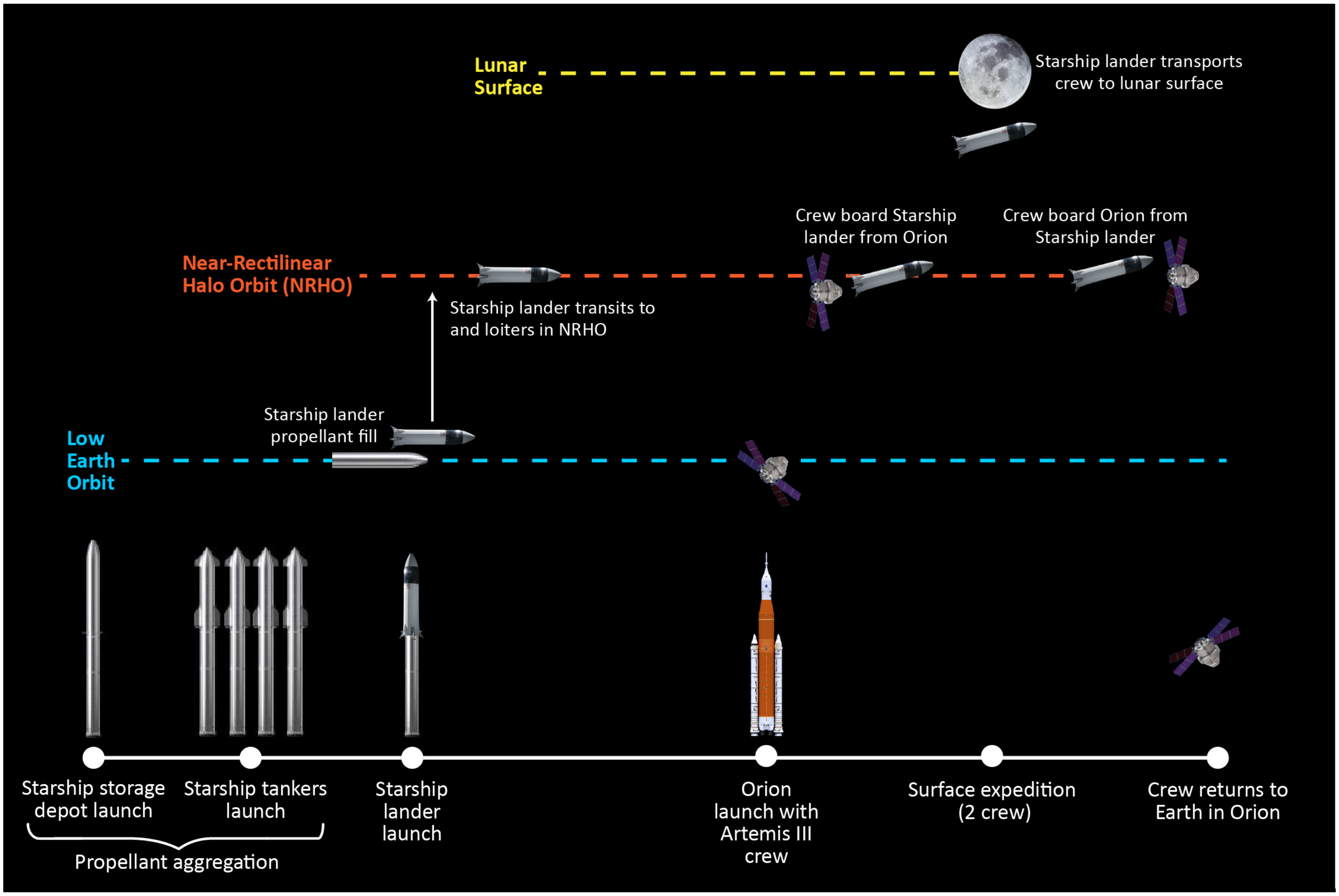
[10] The Lunar Orbit Checkout Review is a critical milestone that assesses the readiness of a lander to perform its mission, ensuring it is capable of a successful lunar landing and return. This review is conducted prior to NASA's approval to approach and dock with Orion or Gateway in NRHO for the purpose of crew transfer.

Figure 3: Artemis III Concept of Operations



Source: NASA OIG representation of SpaceX information.

SpaceX maximizes its in-house capabilities to control quality, cost, and schedule. As a result, the Starship and Super Heavy booster are primarily manufactured, integrated, and tested internally. SpaceX also follows a continuous integration process where components, systems, and individual vehicle stages undergo testing at key stages of manufacturing and integration.

Since April 2023, SpaceX has performed 11 integrated flight tests of the Starship and Super Heavy booster.[11] On Flight 3, SpaceX completed an in-space propellant transfer demonstration between two tanks within the Starship vehicle. Flight 4 saw the first successful controlled landings of the Starship and booster, while Flight 5 demonstrated the provider's ability to "catch" the booster at the launch pad using the launch tower arms. The first six flights were all conducted using the first version of Starship, with Flight 7 introducing a new version. Flights 7, 8, and 9 all experienced mishaps resulting in loss of the

[11] SpaceX's Flight 1 launched on April 20, 2023; Flight 2 on November 18, 2023; Flight 3 on March 14, 2024; Flight 4 on June 6, 2024; Flight 5 on October 13, 2024; Flight 6 on November 19, 2024; Flight 7 on January 16, 2025; Flight 8 on March 6, 2025; Flight 9 on May 27, 2025, Flight 10 on August 26, 2025, and Flight 11 on October 13, 2025.

Starship vehicle.[12] With each mishap, the Federal Aviation Administration, which is responsible for regulating commercial space flight launch and reentry activities, reviews SpaceX's internal mishap investigation findings and must make a determination on whether they approve of corrective actions taken before the next flight test can occur.[13] Most recently, SpaceX completed Flights 10 and 11 of the integrated Starship, which each saw both the Starship and Super Heavy booster splashdown as planned. Flight 11 served as the final test of Starship's second version. SpaceX's upcoming flight tests include plans to perform a vehicle-to-vehicle propellant transfer demonstration mission in 2026, which will utilize a third version of the Starship.

Blue Origin

For the Artemis V mission, Blue Origin is developing its Blue Moon lander. Standing 52 feet tall, Blue Moon will launch on Blue Origin's reusable New Glenn heavy-lift rocket from Cape Canaveral Space Force Station in Florida. The lander will utilize Blue Origin's BE-7 engines, which are fueled by liquid oxygen and liquid hydrogen. Prior to the Artemis V mission, Blue Origin will launch a transporter to low Earth orbit, essentially serving as a propellant depot. From there a fleet of refuelers will launch, rendezvous with the transporter, and transfer propellant. The Blue Moon lander will then launch to low Earth orbit to receive fuel from both a refueler and the transporter before traveling to NRHO to dock with Gateway for the Lunar Orbit Checkout Review. The transporter, left in low Earth orbit, will receive additional propellant there before traveling to a higher "stairstep" orbit for final propellant aggregation.[14] Once the transporter has traveled to NRHO, Blue Moon will undock with Gateway to receive its final propellant transfer and then dock with Gateway a second time. Next, Orion will deliver the astronauts to Gateway, who will then transfer to Blue Moon for transit to the lunar surface and back to the station. At the end of the mission, Orion will return the astronauts to Earth and the lander will transition to another orbit for disposal or later reuse. See Figure 4 for the Artemis V concept of operations.

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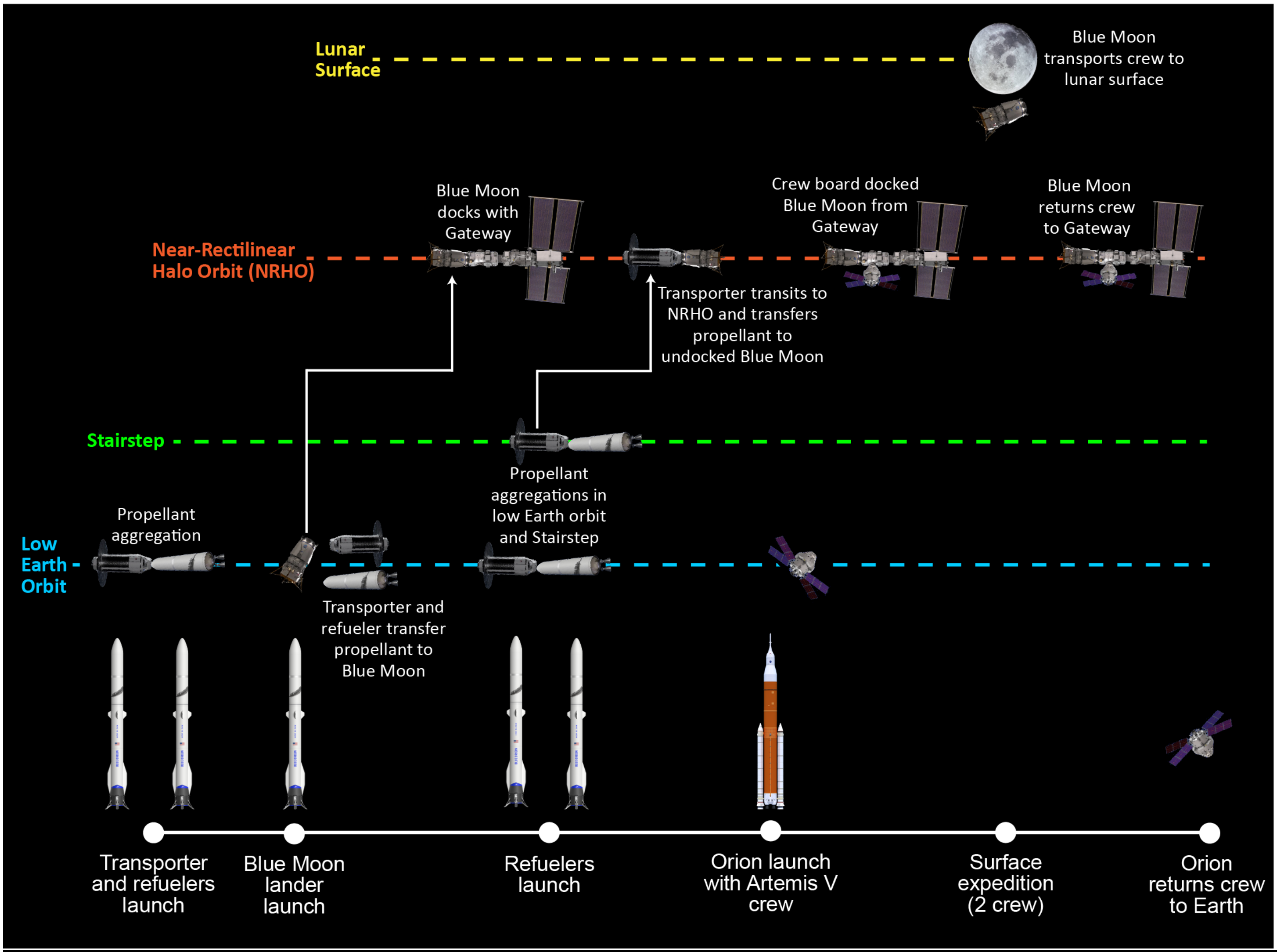
[12] Additionally, while undergoing testing in preparation for Flight 10, the Starship exploded during static fire testing. A static fire test is a prelaunch test in which a rocket's engines are briefly ignited while the vehicle remains anchored to the ground.

[13] The required Federal Aviation Administration mishap investigations for Flights 7, 8, and 9 have been closed.

[14] "Stairstep" refers to refueling at multiple altitudes. For the Artemis V mission, stairstep refueling will occur at an altitude above low Earth orbit.

Figure 4: Artemis V Concept of Operations



Source: NASA OIG representation of Blue Origin information.

Blue Origin is leading a coalition of companies known as the National Team to assist with Blue Moon's design, development, testing, and verification. However, since contract award, Blue Origin has restructured its National Team, allowing the provider to utilize common components it developed for the Blue Moon lander and New Glenn rocket.[15] For instance, Blue Origin altered its transporter design by moving some tank development and manufacturing in-house, allowing the provider to leverage the work they have done on the lander for the transporter.

[15] Initially, the National Team was composed of Astrobotic Technology, The Boeing Company, Draper, Honeybee Robotics, and Lockheed Martin Corporation to assist Blue Origin with its HLS development. Later, Blue Origin determined that greater efficiencies could be gained by downsizing Lockheed Martin's scope on the transporter.

Blue Origin follows a block upgrade philosophy where new capabilities are added to each successive lander. Prior to its uncrewed demonstration mission, Blue Origin plans to conduct two missions using the Mark 1 variant of its Blue Moon lander—a smaller cargo and science payload lander—which will land on the Moon and demonstrate several critical subsystems and operations to buy down risk, including propulsion, cryogenic fluid management, and precision landing. Blue Origin will then test its Mark 2 variant—designed to carry astronauts—on an uncrewed demonstration mission before use on the Artemis V crewed mission. Blue Origin also plans to fly its New Glenn rocket multiple times on commercial and refueling missions prior to flying the HLS lander. In 2025, Blue Origin completed two flight tests of the New Glenn rocket—in January, the rocket achieved orbit on its first launch attempt, and in November, the reusable first stage of the rocket successfully landed on a barge in the Atlantic Ocean.

Human Landing System Program Management

The HLS Program is managed at Marshall Space Flight Center under the Moon to Mars Program Office within the Exploration Systems Development Mission Directorate. The Mission Directorate defines and manages systems development for programs critical to NASA's Artemis campaign and plans the Agency's Moon to Mars exploration approach.

NASA is utilizing a tailored program management approach for the HLS Program—modeled after the Commercial Crew Program—to streamline typical program management processes.[16] NASA's program and project management policy dictates certain requirements for oversight, life-cycle reviews, and other programmatic matters, while providing the flexibility to adjust those requirements to fit the unique needs of a program or project. Instead of using the standard series of technical milestones for major acquisitions, the HLS Program's approach relies on a reduced number of reviews and data submissions to encourage innovation and reduce costs. However, each provider will participate in the Preliminary Design Review (PDR) and Critical Design Review (CDR).[17] PDR is a checkpoint in the design life cycle before hardware manufacturing can begin, while CDR demonstrates the design is appropriately mature to support proceeding with full-scale fabrication, assembly, integration, and testing.

While the providers are responsible for developing the landers utilizing their own designs and operational approaches and processes, NASA maintains ultimate responsibility for assuring crew safety and mission success. The HLS Program uses various mechanisms to ensure the providers' launch systems and spacecraft meet Agency safety and operational requirements.

Insight/Oversight

As part of the transition to a service-based acquisition strategy where contractors develop systems for NASA's end use, the HLS contracts are structured to allow the Agency various degrees of insight and oversight of system development. Since NASA will neither build the landers nor own them, the appropriate level of monitoring, control, and acceptance is critical to ensure the providers' products and services meet NASA's needs and objectives. NASA incorporated the concept of insight into the

[16] NASA's Commercial Crew Program spurred the development of a U.S. commercial crew space transportation capability for providing access to and from the International Space Station in low Earth orbit.

[17] For SpaceX's Artemis III HLS, the HLS Program did not conduct a formal PDR but rather a series of alternate reviews to show the provider met the intent of a PDR. Both SpaceX's Artemis IV HLS and Blue Origin's Artemis V HLS will also undergo Key Decision Point C that produces an Agency Baseline Commitment, which sets the cost, schedule, and technical baselines that form the basis for NASA's commitment to the Office of Management and Budget and Congress.

Commercial Crew Program's contracts as a way of monitoring the performance of their providers, and the HLS Program built upon this concept for SpaceX and Blue Origin. The HLS Program uses risk-based insight depth levels to determine the level of insight required. While level 0 requires no activity and levels 1 and 2 consist of reviewing provider documentation—often in a limited capacity—levels 3 through 5 require NASA to conduct their own analyses, simulations, and testing of provider activities. Compared to insight, oversight is the government's formal review and concurrence or nonconcurrence with a contractor's activity, such as through PDR and CDR. Essentially, insight is a monitoring activity whereas oversight is an exercise of authority by NASA.

The HLS Program also expanded on the government insight and government resource clauses of the Commercial Crew Program's contracts to include the option to provide NASA subject matter experts to assist the providers—also known as collaborations. Additionally, the HLS Program included Government Task Agreements (GTA) to allow the providers use of on-site NASA resources. See Table 1 for a summary of the various mechanisms NASA uses to integrate with the HLS providers. For additional details on insight, oversight, collaborations, and GTAs, see Appendix B.

Table 1: Coordination between NASA and the HLS Providers

Mechanism for Integration	Description
Insight	Insight is a monitoring activity where NASA gains an understanding of the contractor's activities and data. NASA uses risk-based insight to assign a depth level (0 to 5) to individual focus areas. Areas with increased insight allow NASA to analyze, test, and simulate contractor data.
Oversight	Oversight is NASA's exercise of authority by formally reviewing contractor-provided documents and either concurring or nonconcurring with deliverables. NASA assigns a type (1 to 5) to individual data requirements descriptions—or contractually required data deliverables.
Collaboration	NASA is making its uniquely qualified personnel and subject matter experts available to both providers as support. The providers are allotted a certain number of NASA civil servants and support contractors, collectively known as equivalent personnel (EP).
Government Task Agreement	GTAs allow the providers to use on-site NASA resources—like facilities, assets, and services uniquely available to NASA—to further their lander development. Both providers can request GTAs at any time during contract performance, but the terms must be negotiated.

Source: NASA OIG representation of HLS Program information.

Cross-Program Integration

The HLS Program is responsible for the overall integration of the landers with the other Artemis campaign systems that are concurrently in development, including Orion, next-generation spacesuits, and Gateway. Each system has its own requirements that the other integrated systems must also meet. The HLS Program has various mechanisms in place to facilitate integration, including agreements between the various programs, cross-program integration teams, and regular meetings.

Risk Management

NASA engages in a systematic process to identify, analyze, score, and respond to risks. The Agency combines risk-informed decision-making and continuous risk management to create a comprehensive framework for managing risks. This approach fosters proactive management of risk items, informs better decision-making, and allows NASA to manage risk-related activities and actions more effectively. The HLS Program determines the best approach for addressing these risks, while also taking into consideration cost, schedule, technical, performance, and safety concerns. The Program also establishes the strategy for handling these identified risks, up to and including acceptance. However, despite the Agency's best efforts, unanticipated and unexpected hazards may still occur.

Likewise, SpaceX and Blue Origin each identify, mitigate, and track risks in their respective risk systems. The HLS Program determines which provider risks to track in the Program's risk management database based on developed criteria. Additionally, if NASA concludes a provider-identified risk severely affects their ability to meet program goals, certification, or safety expectations, the HLS Program may intervene and implement corrective action.

In 2023, the HLS Standing Review Board found the HLS Program may have been underutilizing the formal risk process to highlight its key risks.[18] The Board recommended the Program reevaluate its risk philosophy and communications approach to provide a more comprehensive snapshot of the Program's risk posture. In response, the HLS Program simplified its risk process and established multiple forums to work with the technical teams to identify and elevate risks.

Human-Rating Requirements and Certification

While SpaceX and Blue Origin own their respective HLS vehicles, NASA is responsible for the overall safety of the Artemis missions and crew. Toward that end, the Agency utilizes a comprehensive approach to ensure the safety and success of crewed space missions. Human-rating focuses on the integration of the human into the system and the prevention of catastrophic events that impact the safety of the crew. Its concept encompasses design, processes, certification, and an ongoing commitment to crew safety throughout the life cycle of a space system. The process for achieving a human-rated vehicle involves human safety risk identification, reduction, control, visibility, and program management acceptance criteria. Prior to the first crewed flight, the NASA Administrator must grant a formal authorization allowing the HLS Program Manager to operate the HLS vehicles within the prescribed parameters. Additionally, this certification must be maintained throughout the system's lifetime.

[18] A Standing Review Board conducts continuous independent assessments and oversees program-level reviews, with insight into lower-level reviews.

NASA Is Controlling HLS Contract Costs but Lander Development Challenges Have Delayed Planned Artemis Mission Dates

NASA's acquisition approach for the lunar landers has been effective in controlling contract costs, with the SpaceX and Blue Origin contracts only increasing by 6 percent and less than 1 percent, respectively. This cost control has been due in part to NASA negotiating mutually beneficial contract changes with the providers at no cost to the government. However, both SpaceX and Blue Origin have experienced schedule delays and face technical and integration challenges that have the potential to further impact lander costs and delivery schedules. In particular, SpaceX's lander will not be ready for a lunar surface mission by June 2027.[19] NASA is assessing proposals from both SpaceX and Blue Origin for accelerating lander development to meet a 2028 lunar landing date, but it is too early to determine the technical feasibility, financial implications, and schedule impacts of these proposals.

HLS Contract Costs Have Remained Stable through Early Development Milestones

NASA's acquisition approach for the HLS contracts has been effective at controlling costs to the government. As of December 2025, the SpaceX and Blue Origin contracts have collectively increased by $266 million. SpaceX's potential contract value has increased by 6 percent—roughly $253 million—from the original potential contract value of $4.3 billion. Blue Origin's potential contract value has increased by less than 1 percent—$13 million—from the original potential contract value of $3.1 billion. For both SpaceX and Blue Origin, these increases were due in part to government-driven changes associated with interface requirements from other Artemis systems.

One key feature of NASA's cost control efforts is the Agency's negotiation of mutually beneficial contract changes at no cost to the government. In particular, NASA leveraged provider-requested schedule delays to negotiate additional tests, reviews, and data requirements. For example, in 2023, in exchange for permitting a schedule delay requested by SpaceX, the provider added a lunar ascent test, including Starship liftoff from the lunar surface and engine relight, as a primary objective for its uncrewed demonstration mission. NASA negotiated a similar modification with Blue Origin in 2024 that permitted a schedule delay of the provider's CDR in exchange for formalizing a lunar ascent test during their uncrewed demonstration mission and for providing NASA additional insight. This approach contrasts with development efforts using cost-plus contracts, where schedule delays typically result in contract cost increases due to NASA paying for the provider's ongoing labor costs.

[19] Subsequent to the completion of our audit work, NASA announced changes to its Artemis campaign architecture, including the addition of a new Artemis mission to low Earth orbit prior to a lunar surface mission. For the purposes of this report, we use the Artemis mission numbering under which the HLS providers are currently contracted.

HLS Schedule Delays Driven by Technical Challenges and Unsettled Designs

SpaceX Schedule Delays for Artemis III

Since award of the Appendix H, Option A contract in July 2021, SpaceX's development of the Artemis III Starship has been delayed at least 2 years, with additional delays expected. In 2023, SpaceX requested a 15-month delay to the June 2025 Artemis III delivery date to accommodate additional time needed for Starship development and the impact of evolving NASA requirements changes.[20] NASA approved this request, extending the Starship's contractual delivery date to September 2026. Then in December 2024, NASA announced that it would push the launch date for Artemis III to no later than June 2027, effectively extending Starship's delivery time frame by an additional 9 months.[21] Even with these extended time frames, SpaceX will be challenged to complete required milestones ahead of the Artemis III mission, starting with Starship's next major milestone—a large-scale, vehicle-to-vehicle cryogenic propellant transfer test. This test was planned for March 2025 but has been delayed 12 months to March 2026.

The HLS Program considers demonstrating cryogenic propellant transfer to be one of the most significant technical challenges facing the provider. Cryogenic fluid management is the ability to store, transfer, and measure ultra cold fluids, such as those used for propellants in space exploration. SpaceX's concept of operations requires the provider to successfully load, transfer, and store cryogenic propellant in space. However, the technologies and processes being used are entirely new and have never been done vehicle-to-vehicle.

NASA is tracking a top risk that some of the cryogenic technologies and capabilities SpaceX is developing will not be adequately mature ahead of the Artemis III mission, impacting the HLS Program's ability to verify and validate the provider's architecture and resulting in the potential for mission delays. Moreover, given that SpaceX has yet to demonstrate the required 12- to 24-day turnover of its launch pad, there is a risk that the provider's planned launch cadence of propellant aggregation ahead of the Artemis III mission will not be met.

Further compounding the schedule pressure, the vehicle-to-vehicle cryogenic propellant transfer test will use a new, third version of Starship. Since SpaceX upgraded from its first version of Starship (used in Flights 1 through 6) to its second version (beginning with Flight 7), three of the five subsequent flight tests (Flights 7, 8, and 9) underperformed, with each flight test ending with a loss of the Starship vehicle. According to HLS Program management, with each mishap, there is an estimated 1- to 3-month impact to the schedule. While the next two flight tests (Flights 10 and 11) performed successfully, in November 2025, the Starship booster for the subsequent flight test (Flight 12)—the first flight test that will use the third version of the lander—experienced an anomaly during ground testing.

[20] In July 2021, Blue Origin and Dynetics protested the SpaceX award to the Government Accountability Office, which denied both protests. Shortly thereafter, Blue Origin, in effect, appealed this decision by filing a bid protest lawsuit with the U.S. Court of Federal Claims, which caused NASA and SpaceX to halt work on SpaceX's HLS demonstration contract. In November 2021, this protest was also denied. As a result of the contract protests, in December 2021, Starship's delivery date under the Appendix H, Option A contract was delayed 6 months from December 2024 to June 2025.

[21] NASA's decision to delay the Artemis III, IV, and V missions was based on the time needed to mitigate technical challenges, including investigating Orion's heat shield performance during the Artemis I mission. The delay also allowed the Agency additional time to address issues with Orion's circuitry related to its Environmental Control and Life Support System before the Artemis II launch, which was pushed from September 2025 to April 2026.

The expected schedule slips leave little margin for error in completing the remaining work to flight certification ahead of Artemis III. CDR, which will determine if the Starship's design is appropriately mature to continue with final design and fabrication, has been delayed to August 2026, leaving less than 6 months between the vehicle-to-vehicle cryogenic propellant transfer test and CDR. There is also limited time—4 months—between CDR and the uncrewed demonstration mission, which is expected to slip to the end of 2026. With a June 2027 launch date for Artemis III, this leaves roughly 6 months between the uncrewed demonstration mission and the crewed lunar landing. Given these time frames, should SpaceX experience any technical issues commonly encountered during development and testing of new technologies or any additional flight test mishaps, the resulting schedule delays could impact the Artemis III launch date.

Accelerating Artemis III Lander Development

Given the schedule delays and technical challenges associated with SpaceX's Starship lander, NASA is exploring options for accelerating lander development for Artemis III. In fall 2025, SpaceX notified the HLS Program that they would potentially not be able to meet the Artemis III planned launch date of June 2027. According to the HLS Program, SpaceX needs additional time to complete development of Starship's third version. As a result, in October 2025, the HLS Program issued task orders to both SpaceX and Blue Origin for proposals on how each provider could accelerate their lander development to meet a 2028 Artemis III launch date. These proposals were due to the Agency in December 2025, and the HLS Program anticipates making a decision on them in spring 2026. At the time of this writing, it is too early to determine the technical feasibility, financial implications, and schedule impacts of these proposals.

SpaceX Schedule Delays for Artemis IV

SpaceX's development of the Artemis IV lander has also experienced delays of at least 6 months from March 2027 to October 2027.[22] However, as announced in December 2024, NASA is working toward a December 2028 Artemis IV launch date. The HLS Program and SpaceX anticipate Artemis IV's next major milestone reviews—PDR and CDR—will each be delayed at least one year to August 2026 and June 2027, respectively. Given that the path to the Artemis IV sustaining lander capability lies through the success of Artemis III, any delays to the Artemis III lander have the potential to impact the Artemis IV lander.

Blue Origin Schedule Delays for Artemis V

Since award of the contract in May 2023, Blue Origin's development of the Artemis V lander has been delayed at least 8 months from April 2028 to December 2028 to accommodate additional time for CDR. However, in December 2024, NASA announced the Artemis V launch date had been pushed to no later than March 2030, giving the provider an additional 15 months to complete remaining milestones and deliver its lander. While Blue Origin is making progress toward its next milestone, CDR, it is still working to address shortcomings with its design and technical margins identified at PDR. For example, Blue Origin needed to mature its propulsion system, reduce mass, and improve propellant margins. As of August 2025—more than a year after PDR was held—nearly half of the official requests for action from the PDR remain open. These requests reflect issues raised during the review that must be corrected, agreed upon by NASA and the provider, and formally closed by the HLS Program.

[22] At the same time SpaceX requested the delay for Artemis III in 2023, the provider requested a delay for Artemis IV.

The HLS Program anticipates that an additional 11-month delay to CDR is likely, pushing the milestone to July 2026. This delay is in addition to an 8-month delay NASA and Blue Origin negotiated in 2024 as part of a no cost contract modification that pushed CDR from December 2024 to August 2025 in exchange for codifying additional tests, reviews, and data requirements. In line with the CDR delays, Blue Origin has also experienced delays to its uncrewed demonstration mission, which will demonstrate the provider's cryogenic propellant transfer capabilities. The Agency currently anticipates the mission will occur in February 2029, roughly one year before the planned Artemis V mission.

Like SpaceX, one of Blue Origin's most significant technical challenges is cryogenic fluid management. Key elements of Blue Origin's concept of operations are the ability to store cryogenic propellants in space, minimize or eliminate the evaporation of the fluids, and perform in-space fluid transfer operations to the transporter and lander in low Earth orbit, the higher stairstep orbit, and NRHO. Given that the provider's cryogenic fluid management storage system depends upon developing multiple components and integrated technologies, delays in this development may adversely impact the integrated storage capability. Moreover, since Blue Origin's architecture is dependent on the ability to transfer cryogenic propellants, there is a risk that the technology will not be sufficiently mature, adversely impacting the aggregation schedule. Although NASA's Artemis V launch delay provided Blue Origin with additional time, any issues commonly encountered during development and testing of new technologies have the potential to impact the Artemis V lander schedule.

Cross-Program Integration Interdependencies Could Further Impact HLS Cost and Schedule

Successful development of the HLS landers is in part dependent on the concurrent development of the various systems required for the Artemis missions—Orion, Gateway, and next-generation spacesuits. However, each of these systems, including the landers, are at different stages of development. As the development of the landers and these other systems progresses, design and operations changes to one system can impact the design and development of other systems. These changes can require additional analyses, modeling, working groups, and interface requirements updates that are not only the financial responsibility of the government, but also have the potential to impact each provider and their mission schedules.

As discussed earlier, cost increases to the SpaceX contract have been driven in part by interface requirements changes from the other Artemis systems. For example, changes to lander-spacesuit interface requirements resulted in a $26.2 million increase to the SpaceX contract in 2023. Although Blue Origin has not experienced any contract cost increases due to interface requirements changes as of March 2025, the HLS Program is anticipating modifications to the contract to account for interface requirements changes from Orion and the spacesuits.

Blue Origin has faced significant design challenges stemming from coordinating with other Artemis V systems that are prioritizing nearer-term Artemis missions. For instance, NASA has directed the spacesuit provider to focus its efforts on Artemis III. Blue Origin had started to develop a don/doff station—used to put on and remove the spacesuits—inside the lander airlock based on a government reference spacesuit design; however, Blue Origin later learned the spacesuit provider was using a different don/doff connection. According to Agency officials, these changes were due to the rapid evolution of the lander and spacesuit design for Artemis III. Although the Agency provided Blue Origin with a spacesuit compatibility document and an interface requirements document in 2024, according to NASA officials, these documents did not provide sufficient details that could have prevented interface changes. For the spacesuit to be compatible with the Blue Moon lander, Blue Origin must either make significant changes to their crew module airlock layout or develop their own don/doff station hardware to support the spacesuit design. This increase in scope could result in schedule delays as well as contract cost increases.

NASA Is Effectively Collaborating with HLS Providers Although Constraints Exist

The HLS Program's use of insight and collaborations has been effective at gaining visibility and participatory involvement into lander development and data. However, both insight and collaborations are not without financial costs to the Agency. Furthermore, while the providers' use of Government Task Agreements (GTA) to access specialized NASA facilities has proven to be successful, we found that the contracts and HLS Program policies do not address how to handle canceled or otherwise unfulfilled GTAs and how to ensure timely recovery of Agency funds spent on GTAs. This lack of guidance led to assumptions that ultimately paused GTA work while a reconciliation process occurred.

Insight Demonstrates an Effective Management Approach for Visibility into HLS Provider Development Efforts

In our assessment, the HLS Program's use of insight to gain visibility into lander development has been an effective management approach for both NASA and its HLS providers. As of November 2025, NASA had spent over half a billion dollars performing insight into the development of the landers.[23] As of July 2025, 59 percent of the HLS Program's civil service workforce were performing insight across the Program's offices. In total, the HLS Program has insight into more than 1,100 focus areas at various depth levels between the two providers (see Table 2). The amount of work and analyses performed by NASA are dependent on the depth level of insight assigned, with levels 0 through 2 requiring none or limited activity on NASA's part and levels 3 through 5 permitting NASA to conduct their own analyses, reviews, or tests of contractor activities. See Appendix B for more details on insight activities and levels.

Table 2: Fiscal Year 2025 Focus Areas and Insight Depth Levels Across HLS Program Offices for Both Providers

Program Office	Number of Focus Areas with Insight Depth Levels 0 to 2	Number of Focus Areas with Insight Depth Levels 3 to 5	Total Focus Areas by Program Office
Systems Engineering and Integration	259	135	**394**
Crew Compartment	116	32	**148**
Space Vehicle Systems	270	123	**393**
Chief Safety Officer	59	12	**71**
Lander Ground Operations	4	0	**4**
Lander Flight Operations	156	10	**166**
Total Focus Areas by Insight Depth Level	**864**	**312**	**1,176**

Source: NASA OIG representation of HLS Program data.

[23] This figure includes insight performed during the early lander studies and risk reduction efforts through NASA's most recent sustaining lunar development procurement and cargo variants.

As noted in Table 2, the HLS Program has increased insight (levels 3 through 5) into more than 300 focus areas associated with SpaceX's development of Starship and Blue Origin's development of Blue Moon. According to the HLS Program's Technical Management Plan, the levels of insight are commensurate with the net level of risk to the focus area.[24] Risk reports generated by both NASA and the providers play a critical role in deciding which focus areas require deeper insight, and therefore, some of the HLS Program's highest risks closely align with areas of increased insight into lander development. For example, NASA is tracking several risks related to engine development, cryogenic fluid management, and crew training. As a result, from fiscal years 2024 to 2025, the HLS Program increased the number of propulsion-related focus areas for SpaceX; increased the insight depth level of Blue Origin's overall engine performance, including their cryocoolers; and increased the insight depth level of lunar landing skills for both providers to the highest level.[25]

The HLS Program's use of insight to monitor and manage the providers' lander development continues to improve upon the insight/oversight model first defined by the Commercial Crew Program during the Agency's initial shift toward commercialization. For example, NASA and the Commercial Crew Program, along with The Boeing Company, formed several teams to investigate the failures that transpired during the June 2024 Boeing Starliner Crew Flight Test to the International Space Station.[26] Some of the general findings concluded that insight data was difficult to access—taking time and critical engineering resources to collect—and the Reaction Control System (RCS) thruster data was not readily accessible to NASA engineers as insight data.[27] Recognizing RCS to be a high-risk area within HLS development, the HLS Program has increased insight into over a dozen focus areas related to the providers' RCS development.

According to the fiscal year 2025 Insight Plan, the HLS Program had level 5 insight—the highest depth level of insight—into three focus areas. Two of the three focus areas involve lunar landing skills for both SpaceX and Blue Origin, which is a high-level risk area that NASA is tracking.[28] Specifically, crew are required to safely monitor vehicle performance and be capable of performing a manual landing. However, the lack of adequate training and preparation facilities for mastering these skills increases the chance of a crash landing, resulting in a loss of crew and loss of mission.

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[24] The net risk picture, a combination of NASA-identified and provider-identified risk statements, allows the HLS Program to increase its insight depth level in a given area as a risk mitigation measure to better understand the perceived risk. NASA HLS-PLAN-016, Revision E, *Human Landing System Program Technical Management Plan* (May 12, 2025).

[25] Cryocoolers act like heat exchangers for large propellant tanks to mitigate boiloff when combined with innovative tank insulation systems.

[26] Shortly before docking to the International Space Station on June 6, 2024, NASA and Boeing identified helium leaks and issues with the spacecraft's reaction control thrusters. After weeks of in-space and ground testing and Agency review, NASA returned the Starliner to Earth without its crew on September 6, 2024. After a 9-month stay on the Station, the two astronauts returned to Earth on March 18, 2025, onboard a Crew Dragon capsule as part of the SpaceX Crew-9 mission.

[27] The RCS uses thrusters to control a spacecraft's attitude, altitude, and speed.

[28] NASA also has level 5 insight into one provider's passive thermal control system focus area, which maintains component temperatures without using powered equipment.

As part of this increased level of insight into the lunar landing skills focus area, the HLS Control Board approved additional mitigation strategies, including use of the High-Altitude Army National Guard Aviation Training Site (HAATS) in Colorado to ensure adequate training for lunar landing skills.[29] Using debriefs and lessons learned from crew training during the Apollo era, HAATS trains pilots, including astronauts, on crew communications and visual environments—like brownouts and lunar dust—similar to those Apollo astronauts encountered on the lunar surface.[30]

High-Altitude Army National Guard Aviation Training Site (HAATS) in Colorado

Since 2021, HAATS has been building a partnership with NASA, training astronauts on flight controls, power management, and visual illusions. Charlie Duke, Apollo 16 astronaut, is seen being briefed on NASA training and offering insights from his own experience.

Source: Colorado Army National Guard.

Throughout our audit work, both NASA and the providers conveyed the importance of insight not only in terms of overseeing developmental progress but also for more effective communications between all parties. For example, NASA has access to SpaceX databases obtainable only through insight, granting the Agency access to real-time information, data, and models that enable proactive discussions in weekly insight meetings with the provider. For Blue Origin, NASA conducted insight meetings related to crew radiation and provided limited independent analysis that helped the provider understand crew radiation modeling and vehicle design considerations. As a result, NASA gained additional insight into Blue Origin's vehicle design and expected crew radiation dose.

The HLS Program regularly assesses the focus areas to determine the level of insight needed, and as the HLS providers continue development and approach critical milestones, increases in insight will likely require additional NASA resources to conduct analyses, reviews, and tests.

NASA Is Increasing Allowable Collaborations with HLS Providers

NASA is further collaborating with the HLS providers by providing expertise and knowledge through increasing use of full-time NASA employees and support contractors, collectively known as equivalent personnel (EP).[31] At any time, and at no cost to the providers, SpaceX and Blue Origin can request a "collaboration" and use of EPs, up to a contractually set limit, to support work on a specific technical area such as engineering or safety. NASA has the sole authority in determining whether to provide any

[29] The HLS Control Board is the decision-making entity relating to the initiation, planning, formulation, implementation, and evaluation of the HLS Program. This includes authority in areas such as establishing and/or approving changes to the Program's baseline (budget, schedule, requirements, technical content, and risks), HLS risk posture, and schedule milestones.

[30] A "brownout" is when dust particles blow around the outside of an aircraft making visual landing difficult. Apollo astronauts reported that lunar dust obscured their vision when landing the Lunar Module and that it became increasingly severe as the altitude decreased. The Apollo 12 crew observed the Surveyor 3—the second in the Surveyor robotic lunar landing series to make a soft landing on the Moon—covered in a fine coating of brown dust that was later determined to be from when the Lunar Module landed 163 meters away.

[31] EPs are made up of a mixture of both full-time equivalent, or NASA civil servants, and work-year equivalent, or contractor personnel.

portion of the providers' collaboration requests and retains the right to modify the number of EPs, the type of assistance provided, and the duration of the EPs at any time, including ending the collaboration.

Initially, NASA's base period contracts with SpaceX and Blue Origin—awarded in May 2020—allowed the providers to request up to 50 EPs per fiscal year. The Agency later increased this number to 60 in July 2021 for SpaceX and in May 2023 for Blue Origin. In February 2025, NASA increased the number to 80 EPs for SpaceX and Blue Origin to meet the continued demand from both providers. The allotted EPs are an average total over the fiscal year and can fluctuate throughout the year.

As of November 2025, NASA EPs have supported more than 200 collaborations between SpaceX and Blue Origin across eight NASA centers, amounting to a cost of nearly $66 million outside of the contracts. For example, NASA EPs helped the providers with engineering expertise including landing site selection and hazard detection, designing manual controls, and developing propellant gauges in low gravity. Additionally, to address top risks within the HLS Program, both providers are utilizing collaborations with NASA's highly specialized expertise in cryogenic fluid management—to include aspects of designing, modeling, and testing. According to NASA officials, managing cryogenic fluids, such as cooling, storing, and transferring, are key technologies both providers will need to mature before a successful lunar landing. Overall, we found the use of collaborations and EPs to be beneficial to HLS development. Looking forward, however, the trend of increasing allotted EPs could strain NASA resources.

NASA Lacks a Formal Process to Manage Evolving Government Task Agreements

Although NASA and the providers utilize the GTA process outlined in the HLS contracts, the HLS Program does not have a formal process outlining how to manage GTAs submitted at contract proposal that have since been canceled or unfulfilled or new GTAs requested after contract award whose costs need to be decremented from the provider. GTAs allow SpaceX and Blue Origin to utilize specialized NASA facilities and services they otherwise would not have access to for the development of their landers, such as the Neutral Buoyancy Laboratory at Johnson Space Center and engine testing facilities at Marshall Space Flight Center. Each of the providers' contracts includes a Use of Government Resources clause, which lists two distinct categories of GTAs—those submitted at contract proposal and those requested after contract award. For proposal GTAs, NASA assessed their costs as part of the total evaluated price of the proposed contract during the contract selection process. These costs were not included in the cost of the firm-fixed-price contract. Conversely, new GTAs requested after contract award are the financial responsibility of the provider.

Ames Research Center's Vertical Motion Simulator

As the world's largest flight simulator, the Vertical Motion Simulator can move 60 feet vertically and 40 feet horizontally within its 10-story building at NASA's Ames Research Center. With 6 degrees of freedom motion and computer-generated images that can simulate various environments, the simulator offers the highest fidelity preflight training experience. NASA has made this unique asset available to both HLS providers as they prepare to put humans on the Moon for the first time since 1972.

Source: NASA.

At contract proposal, both providers requested a combined total of over 130 GTAs with an estimated value of $282 million. Examples of GTAs requested at proposal include hypervelocity impact testing at Johnson Space Center, wind tunnel testing at Ames Research Center, and use of the Vertical Motion Simulator at Ames to develop lunar environment visuals and test manual controls. Both providers also requested use of spacecraft communications support from NASA's Deep Space Network.

Since contract award, we found that both providers requested new GTAs and NASA spent funds toward executing these GTAs.[32] New GTAs include use of NASA's WB-57 aircraft—a high altitude airborne platform capable of flying above 60,000 feet—to provide aerial imaging of early Starship flight tests, as well as use of Marshall Space Flight Center subject matter experts and facilities to conduct cryogenic storage and engine testing and Langley Research Center for plume surface interaction testing.

NASA's WB-57 Aircraft

The WB-57 aircraft can fly for approximately 6.5 hours, has a range of approximately 2,500 miles, and can carry up to 8,800 pounds of payload. Two crewmembers fly onboard in a pilot station and a sensor equipment operator station. SpaceX utilized this unique NASA asset during early flight tests to conduct airborne imaging of the Starship from liftoff to maximum dynamic pressure and booster landing.

Source: NASA.

The HLS contracts make clear the delineation between GTAs requested at proposal and GTAs requested after contract award. However, the contracts and HLS Program policies lack specific instructions on how to (1) ensure timely recovery of Agency funds spent on new GTAs through the decrement of a future contract milestone payment and (2) handle proposal GTAs that were canceled or not fully executed.

Of the new GTAs identified during our review, NASA had not yet decremented any of its incurred costs from either provider. The work associated with the earliest of these GTAs dates back to 2022. Although several GTAs have periods of performance that stretch multiple years, according to NASA, the work agreed to in the GTA does not need to be complete before a decrement can occur. However, neither the Use of Government Resources contract clause nor HLS Program policies define when a decrement should occur. Moreover, NASA intends to decrement based on the agreed upon estimated value of the GTA regardless of whether the incurred costs are above or below the estimate, a decision that is also not outlined in the Use of Government Resources contract clause nor in HLS Program policies.

This lack of specificity in the contracts also extends to the proposal GTAs. Specifically, NASA and one provider—Blue Origin—operated under the assumption that if a proposal GTA was canceled or otherwise not fulfilled, the estimated value of that GTA could be applied against new GTAs at no cost to the provider. However, there is no language in the Use of Government Resources contract clause addressing cancellation of proposal GTAs by either NASA or the provider or specifying proper recourse for the provider. This confusion led to a pause in GTA work in early 2025 while a broader discussion began on how to reconcile the value associated with the canceled or unfulfilled proposal GTAs with the estimated costs of new GTAs.

[32] The total number of new GTAs was revised by NASA as the Agency determined that some new GTAs were modified or realigned from proposal GTAs.

During the course of our audit, NASA acknowledged and took steps to address shortcomings with the GTA process. In July 2025, the HLS Program issued an internal memorandum outlining the GTA reconciliation process with Blue Origin. As part of this process, NASA examined new GTAs, proposal GTAs that were canceled or otherwise unfulfilled, and GTAs that, while initially listed as new GTAs, were in fact modified or realigned from proposal GTAs and thus should not be considered "new" or subject to contract price adjustments. NASA concluded that the estimated value of canceled, unfulfilled, and realigned GTAs exceeded the estimated value of NASA's revised assessment of Blue Origin's new GTAs. Therefore, the Agency determined it did not need to decrement any money from the provider's contract. Going forward, NASA and Blue Origin have agreed that any new GTAs will need to have an agreed upon decrement prior to GTA approval; however, this agreement has not been formalized.

Additionally, in July 2025, the Agency drafted a contract modification reducing a milestone payment to account for new GTAs SpaceX requested post-award. While execution of the contract modification was delayed due to a government shutdown, both parties reached agreement in December 2025, and a future milestone payment to SpaceX in 2026 will be decreased by $1.5 million.[33]

Without clearer and well-documented guidance and decisions on how to move forward, we have concerns that a reconciliation process could repeat itself should additional proposal GTAs be canceled or otherwise not fulfilled, the value of which could be used once again to offset new GTAs or result in a request for equitable adjustment.[34]

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[33] Federal government agencies were shut down or operating at reduced staffing levels during a lapse in appropriations from October 1, 2025, through November 12, 2025.

[34] Any contractor may submit a request for equitable adjustment to the government for payment when unforeseen or unintended changes occur within the contract causing an increase in contract costs, such as government modification of the contract, differing site conditions, defective or late-delivered government property, or issuance of a stop work order. Federal Acquisition Regulation 43.103, *Types of Contract Modifications (*2025).

NASA Incorporates Astronaut Safeguards into Landers but Operational and Resource Constraints Limit Risk Mitigation and Crew Survival Efforts

Of the numerous systems required to choreograph the Artemis missions, the HLS carries the highest probability of crew loss. To avoid a catastrophic event, NASA is proactively taking measures to mitigate and prevent hazards associated with the landers. Despite these efforts, gaps exist in NASA's risk reduction methodology, including in its testing posture and crew survival approach. Furthermore, there are emergency scenarios that NASA will be unable to mitigate during the early crewed Artemis missions. Ultimately, should a catastrophic event occur, NASA does not currently have the capability to rescue a stranded crew from space or the lunar surface.

NASA Is Addressing Key Vehicle Safety Risks

The HLS Program and providers are tracking and mitigating top risks, including those related to landing or lander system constraints, missed ascent from the lunar surface, and a failed return docking with Orion or Gateway. NASA utilizes a strategy to control these threats as its primary method for minimizing hazards and risks.[35] The intent is to prevent their occurrence or reduce them to an acceptable level. Typical approaches for protecting against hazards include eliminating the hazard through the lander's design, minimizing the likelihood or severity of the hazard, incorporating safety devices, and implementing special procedures.

NASA also relies on human-rating requirements to design, evaluate, and provide assurance that a crewed system can safely conduct the required missions. Human-rated systems—such as the landers—must accommodate astronaut needs, utilize human capabilities, control hazards with sufficient certainty, and provide—to the maximum extent practical—for the safe recovery of the crew from hazardous situations. Additionally, human-rating incorporates design features and capabilities that accommodate human interaction with the system to enhance overall safety and mission success. This approach ensures missions operate at an acceptable level of risk to the humans involved. Risk posture—the agreed upon limits of risk an organization is willing to accept to achieve its objectives—is the key factor for making decisions throughout the mission's life cycle. Using these tools, NASA is working with the providers to address key risks related to the Artemis landers.

[35] A hazard is a state or set of conditions, internal or external to a system, that have the potential to cause harm. Risks are the combination of the probability that a space system will experience an undesired event and the magnitude of the consequences if the undesired event occurs.

Lander Engineering Design Constraints

All landers have engineering design constraints related to the size and characteristics of potential hazards that they can overcome during a lunar landing. NASA selected the lunar South Pole for the Artemis missions due to the unprecedented opportunity for scientific discovery. Landing at this location, however, poses many challenges and introduces constraints not experienced during the Apollo missions—all of which occurred near the Moon's equator. For example, a multitude of geological features, including rugged and uneven terrain strewn with rocks in excess of 65 feet in diameter and deep craters dominate the landscape, unlike the large plains visited by the Apollo missions. Shackleton Crater—a prevalent feature of the lunar South Pole—is more than two times deeper than the Grand Canyon. Understanding this environment is crucial for ensuring the safety of the crew and enabling mission success.

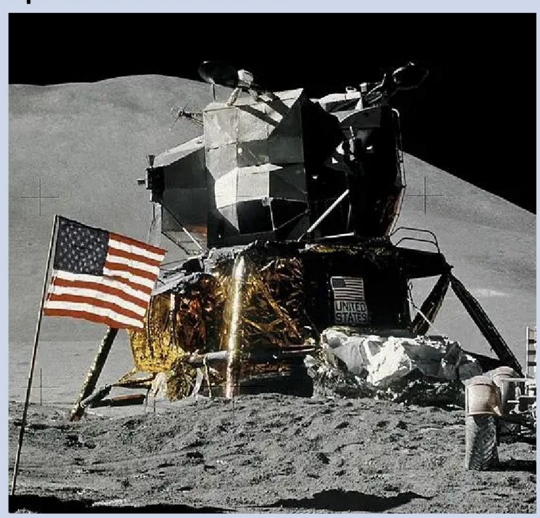
Landers may also encounter hazards such as boulders or mounds that are too large or depressions that are too deep for the landing legs and stability design. For example, steep slopes of up to 20 degrees on the lunar South Pole present navigation and landing challenges. Given Starship's height of 171 feet—about the equivalent of a 14-story tall commercial building—there is a risk that its momentum will continue after landing causing it to tip over. Blue Moon—standing at 53 feet tall—also faces landing risks, including exceeding the lander's tilt tolerance for safe and effective execution of critical crew functions. Surpassing the tilt tolerance for either lander, which NASA established as not to exceed 8 degrees to support all post-landing crew activities, could impact the operation of equipment such as the hatch used by the crew to exit and enter the vehicle. By comparison, the Apollo Lunar Module stood 23 feet tall. See Figure 5 for a relative comparison of lander heights.

Historic Lunar Landing Attempts

Of the 59 crewed and uncrewed robotic lunar landings attempted since 1958, only 28 have been successful, with recent events highlighting the challenges of landing on the Moon's South Pole. For example, in March 2025, an uncrewed Intuitive Machines lander tipped over inside a crater shortly after touchdown on the Moon's surface. This mission was the closest that any spacecraft has ventured to the lunar South Pole and the second Intuitive Machines lander to reach the area. Intuitive Machines' first lander broke a leg during landing and continued to operate for 7 days before depleting its power.

Source: Intuitive Machines.

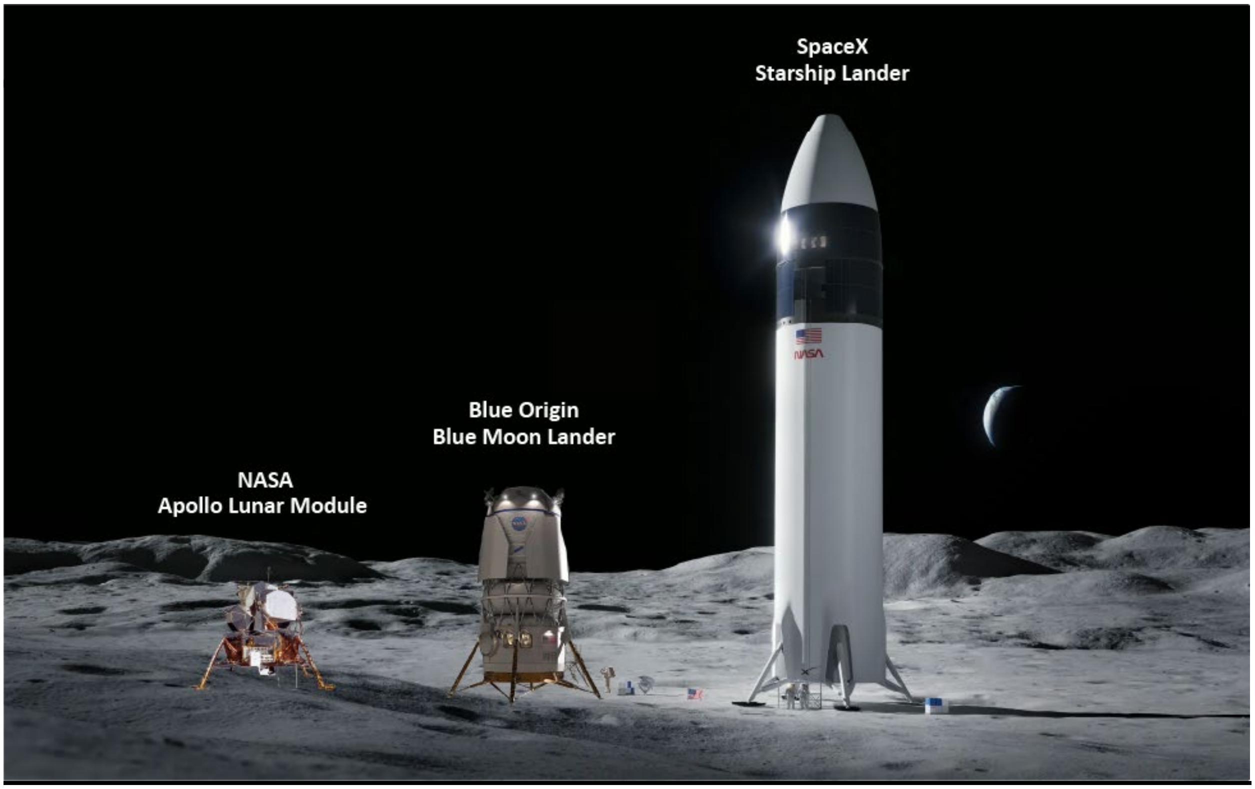
Apollo 15 Lunar Module



During the Apollo 15 mission, the Lunar Module settled on a crater slope at an approximate 11-degree tilt angle, very nearly violating the limit for a safe ascent. Previously, the Apollo 14 crew reported their module's slant impacted their ability to sleep due to an uncomfortable feeling that it was tipping over.

Source: NASA.

Figure 5: Comparison of Apollo Lunar Module, Blue Origin Blue Moon, and SpaceX Starship



Source: NASA OIG presentation of Agency, Blue Origin, and SpaceX information.

Starship is not like the traditional landers of the past. Given its height, one unique attribute is its use of an elevator to carry crew, equipment, and samples to and from the lunar surface. Starship's elevator sits just below the crew compartment and is approximately 115 feet above the ground—a height taller than the Statue of Liberty from her heel to the top of her head. Currently, there is no other method for the crew to enter the vehicle from the lunar surface in the event of an elevator failure.

The HLS Program requires at least single failure tolerance to catastrophic events, meaning the ability of a system to sustain a single failure and not have it affect the design goal. SpaceX is focused on building a robust standard elevator design with redundant mechanisms. However, the HLS Program is tracking the elevator as a top risk and is actively working with SpaceX to develop alternate means of vehicle ingress should the elevator become stuck or fail while the crew is on the lunar surface. Comparatively, Blue Moon—like the Apollo Lunar Modules—uses stairs that are approximately 6 feet above the ground as the primary access method for the vehicle. See Figure 6 for the Apollo, Starship, and Blue Moon access methods.

Figure 6: Apollo, Starship, and Blue Moon Access Methods

Left photo: Apollo astronaut descending the steps of the Lunar Module. Center photo: NASA astronauts testing Starship's elevator concept. Right photo: Blue Moon access testing in NASA's Neutral Buoyancy Laboratory.

Source: NASA, SpaceX, and Blue Origin.

Vehicle Manual Control

The ability of the crew to bypass automation to control the lander's flight path is a fundamental element of crew survival and mission success. NASA's human-rating certification requires vehicles provide the capability for crew to take manual control during all phases of flight, especially during critical phases such as descent and landing on the lunar surface.[36] If there are issues with the automated guidance system, such as failures or unexpected performance, manual control enables the protection of the crew and mission. Notably, of the Apollo Program's seven planned crewed lunar landings, astronauts engaged the backup manual control method during every mission.[37] More recently, the crew of Boeing's Starliner flight test demonstrated the importance of spacecraft manual control in June 2024 when manual control was the only way to maintain the position and attitude of the vehicle on its approach to the International Space Station after multiple thruster failures.[38] Ultimately, contravening the manual control requirement could adversely impact the crew's ability to intervene, potentially leading to the loss of the crew or mission.

There is disagreement between NASA and SpaceX on whether the provider's current proposed approach for landing meets the intent of the Agency's manual control requirement. Despite the provider's stated acknowledgment and commitment to meeting this requirement, NASA's tracking of SpaceX's manual control risk indicates a worsening trend. If NASA and SpaceX do not reach a concrete solution prior to CDR, it may lock in automation as the only available landing method or result in significant late design

[36] NASA HLS-RQMT-001, Revision E, *Human Landing System (HLS) Program System Requirements Document (PSRD)* (April 24, 2023).

[37] On Apollo 10, the crew manually regained control of the Lunar Module to rendezvous and dock with the Command and Service Module due to a rendezvous misconfiguration. During the Apollo 11, 12, 14, 16, and 17 lunar landings, the commander took over manual control due to hazardous terrain at the computer's targeted landing site. On Apollo 13, an oxygen tank explosion led to a major power-down of the Lunar Module requiring manual crew control of the spacecraft. During Apollo 15, the commander took over semiautomatic manual control to land in the preselected landing target area.

[38] NASA's Boeing Crew Flight Test mission was the first flight of the Starliner spacecraft to the International Space Station with astronauts as part of the Agency's Commercial Crew Program.

changes and increased schedule risk. In our judgement, this further increases the potential that SpaceX could request a waiver to the manual control requirement to meet the schedule.[39]

NASA, under the Commercial Crew Program, granted a similar manual control waiver to SpaceX for its Dragon spacecraft, which transports crewmembers to the International Space Station.[40] This decision was due in part to Dragon's prior flight history transporting cargo to the Station. However, Starship will not have the same level of proven flight heritage in the actual operating environment for its crewed lunar missions. Incorporating this system capability is a key element of HLS's human-rating certification and part of an essential crew survival strategy. Key decisions on Blue Origin's manual control design have yet to be made. As of November 2025, neither provider had requested a waiver to the manual control requirement.

Lunar Plume Surface Interaction

The interaction between the HLS rocket engines' exhaust plumes and the lunar surface can impact precision landings and negatively affect landing navigation sensor performance. As the descent continues, the interaction becomes increasingly more complex, with the plumes vigorously kicking up lunar dust, soil, and rocks. For instance, the Apollo missions experienced regolith ejections that obscured views of the landing site during final approach and touchdown.[41]

The HLS Program is actively pursuing risk reduction activities related to the new landers' plume surface interactions. Current models rely on Apollo flight reconstructions; however, without direct HLS measurements, the predictions are largely uncertain. For instance, potential risks can vary with the lander's configuration, operations concept, and specific landing site. Both SpaceX and Blue Origin utilize single-stage HLS designs, meaning they use the same vehicle to descend to the Moon's surface and ascend back to orbit. Further, the HLS vehicles are significantly larger in size than the dual-stage Lunar Modules flown during the Apollo missions, likely resulting in different induced hazards.

Addressing the risks associated with lunar plume surface interaction requires validation and model improvements. Toward that end, the Agency is conducting ground testing to gather data. Additionally, as part of its Commercial Lunar Payload Services initiative, NASA installed the Stereo Cameras for Lunar-Plume Surface Studies instrument on Firefly Aerospace's Blue Ghost commercial lander.[42] The instrument captured around 3,000 high-resolution images during Blue Ghost's descent and landing in March 2025.[43] These pictures will aid in the creation of models to predict lunar regolith erosion. SpaceX is also planning to add instrumentation to its uncrewed demonstration mission vehicle to build interaction models that will include raw images, as well as vehicle and calibration data. Blue Origin's

[39] A waiver is a documented authorization releasing a project from meeting a requirement where NASA documents and accepts a certain level of risk.

[40] Dragon became the first crewed space vehicle without a manual control mode or backup system independent of its primary flight computer. This is contrary to NASA's human-rating requirements and in opposition to a human space flight history that underscores the importance of having a backup capability.

[41] Regolith collectively refers to lunar dust, soil, and rocks.

[42] NASA is working with several American companies to deliver science and technology to the lunar surface under the Commercial Lunar Payload Services initiative.

[43] The Stereo Cameras for Lunar-Plume Surface Studies' stereo photogrammetry combines overlapping images to create 3D digital elevation maps of the lunar surface, providing more accurate before-and-after plume surface interaction comparisons.

uncrewed demonstration mission will further measure plume surface interactions to aid in the development of precision landing sensors.

NASA Is Not Adhering to Test Like You Fly Principles for the HLS Uncrewed Flight Demonstrations

SpaceX and Blue Origin are conducting uncrewed demonstration missions of their landers; however, these tests will not be in configurations fully representative of their planned crewed vehicles. NASA performs key risk reduction activities by requiring providers to conduct ground testing and flight demonstrations. Demonstrating a vehicle in a flight-like configuration—known as Test Like You Fly—is a key risk reduction activity that helps to minimize the likelihood of mission failures by identifying and correcting hardware, software, and mission design flaws before a system's deployment.[44]

Test Like You Fly calls for the configuration of the tested system to be as close as practical to its final operational configuration. Additionally, the evaluation should occur as near as possible to the expected operational environment using the final processes and procedures in which the integrated system will operate. Test Like You Fly encompasses both system-to-system testing, as well as end-to-end testing of the complete operational system. As a result, tests and simulations should accurately reflect the planned mission profile. To Test Like You Fly, the HLS Program examines the applicable mission and flight characteristics to determine the extent they can apply them on the ground, including through a combination of testing and analysis. When ground testing is not possible, flight testing can serve as an acceptable mitigation.

While HLS Program officials believe the Program is following Agency guidance on Test Like You Fly, we found key missed opportunities to apply these principles to the uncrewed demonstration missions. For these missions, NASA required the providers to demonstrate precision landing on the lunar surface, transmit the landers' state-of-health for 2 hours after landing, and subsequently ascend from the lunar surface. The Agency, however, did not require demonstration of crew systems such as the Environmental Control and Life Support System (ECLSS), airlocks, or elevator.[45] The exclusion of systems means the weight of the test vehicles will not be representative of the crewed mission vehicles. This, in turn, reduces the number of propellant tanker flights required to support the demonstrations; therefore, end-to-end propellant aggregation will not be fully flight tested prior to the first crewed missions. Likewise, in our judgement, not including an elevator on Starship's uncrewed demonstration mission eliminates the opportunity to test its ability to operate in the actual lunar environment under possible surface tilt conditions.

Additionally, although some systems require crewmember presence to fully function during a lunar mission, NASA will be unable to observe the impact of operational sequences and the lunar environment on the equipment itself prior to the first crewed Starship and Blue Moon flights. For example, NASA is forfeiting the opportunity to examine the effects of lunar dust on the ECLSS components. As experienced during the Apollo era, dust can degrade a system's performance by adhering to seals and clogging filters. NASA officials told us the decision to exclude ECLSS was a careful choice based on risk, cost, and schedule.

[44] NASA HLS-PLAN-005, Revision B, *Human Landing System (HLS) Verification & Validation (V&V) Plan* (February 8, 2024).

[45] ECLSS provides clean air and water to crewmembers through artificial means. It manages air and water quality, waste, atmospheric parameters, and emergency response systems.

To further define the dust environment, the HLS Program is conducting two ground tests in fiscal year 2026. A primary obstacle to executing flight-like tests on the ground, however, is that many space flight attributes are impossible to recreate on Earth. For example, during the Artemis I flight test, Orion's heat shield experienced unexpected material loss during reentry into Earth's atmosphere. Despite extensive ground testing prior to the mission, this issue did not fully reveal itself until the vehicle experienced the extreme heat of reentry—a flight condition that cannot be adequately replicated on Earth.

The landers' ability to lift off and ascend from the lunar surface is also essential for crew survival as the ascent phase contains some of the highest risk events. Once the crew completes the mission on the lunar surface, they prepare for ascent by performing required vehicle reconfiguration and system checkouts prior to using the HLS to return to the orbiting Orion or Gateway in NRHO. The ascent phase begins with liftoff from the lunar surface, continues through the time spent loitering in low lunar orbit, and ends when the lander enters NRHO. Ascending from the surface of the Moon will kick up debris that could damage the vehicle or its engines, the engines could fail to ignite, or the propellant burns needed to return to NRHO could malfunction.

Although NASA did not initially require ascent tests in its contracts with the providers, to the Agency's credit, these tests were later added. However, the Agency still did not require the providers to demonstrate an end-to-end ascent, return, and docking with either Orion or Gateway in NRHO. SpaceX's ascent test will include lifting off the lunar surface and relighting of the Raptor engines. This brief engine relight is critical for demonstrating main stage combustion to buy down risk for the crewed ascent and observing the lunar plume surface interaction with the engines. Blue Origin's ascent test will include lifting off from the lunar surface as well as an ascent to either low lunar orbit or NRHO.

NASA's Crew Survival Analyses Limited by Functional Restrictions and Resource Considerations

Crew survival analyses are tools employed by NASA to capture the survival posture of any given Artemis mission. The HLS Program uses the crew survival analysis process to evaluate available survival capabilities that can effectively counter a catastrophic event—such as a fire—and provide crewmembers an opportunity to reach a safe state or place. If the analysis reveals there are no confirmed capabilities to safely extract astronauts from the immediate hazard, then a crew survival gap exists. If left unaddressed, these scenarios will result in the loss of the crew. Once a crew survival gap is identified, the HLS Program may choose to accept the risk or generate a decision package for elevation through the Moon to Mars Program Office. Decision packages are the mechanism used to identify recommendations for new or enhanced capabilities that improve the likelihood of crew survival. They assist Moon to Mars Program Office leadership in making risk-informed decisions on the inclusion or exclusion of these capabilities, as well as in the acceptance of any residual risk.

The intent of the crew survival analysis process is to influence requirements and designs early enough in the vehicle's development to have the greatest impact on crew survival. However, there are limitations due to functional constraints and the availability of resources. For example, because the analyses typically mature later in the design cycle, the decision packages are limited to capturing resultant risks rather than preemptively driving risk reduction. As a result, the lander design may be too advanced to institute meaningful change or require a significant impact to the schedule. Moreover, funds may already be depleted. Additionally, crew survival analyses are limited to considering a single catastrophic event at a time and do not address the occurrence of multiple simultaneous events. This logic assumes that when the crew is safe from the catastrophic event, all systems will perform normally to return them to safety after the initial incident. The analyses also do not account for extended crew survival once the immediate threat is over since the crew may be in a compromised situation for several days.

Given that many HLS design decisions rely on meeting safety thresholds, the identification of catastrophic hazards and crew survival gaps are crucial considering the lander is the top loss of crew contributor for the Artemis III and IV lunar missions. These results are based on the risk of failures in Starship's avionics, main engines, lander propulsion, landing legs, and electrical power. The Agency's loss of crew threshold is 1 in 40 for lunar operations and 1 in 30 for the Artemis missions overall.[46] Current estimates for Artemis III and IV show Starship in compliance with the Agency's established thresholds. The top loss of crew risk contributors for the Artemis V mission are still under development according to NASA officials.

Further driving survival concerns is the introduction of multiple new systems during the early crewed Artemis missions, including the landers, next-generation spacesuits, Gateway, and elements of Orion. This will also be the first time NASA will (1) have Orion and the lander operate in NRHO, (2) dock the landers with Orion or Gateway, and (3) land and return humans from the Moon's South Pole. Unknown-unknowns and underestimated risks are more prevalent with early flights because of the lack of data about how an integrated system behaves in the actual flight environment.[47] This is evidenced by comparing risk estimates to early launch vehicle failure rates. For example, the Space Shuttle Program thought they were operating at a 1 in 100 loss of crew threshold, but years later determined the actual number was 1 in 10 for the early flights.[48] Similarly, during Apollo, the risk of loss of crew was also 1 in 10.

NASA Ruled Out Crew Rescue Capabilities for the Early Crewed Artemis Missions

While NASA is taking steps to prevent catastrophic events from occurring during the Artemis missions, at some point in the future, astronauts will likely encounter a life-threatening emergency in space. Despite NASA having in-space rescue plans for its Skylab missions in the 1970s and for the Space Shuttle missions following the loss of Columbia and its crew in 2003, the Agency has not required in-space crew rescue capabilities since the Shuttle's retirement in 2011.[49] Without a rescue capability for the Artemis missions, the crew will be lost should the HLS become disabled on the lunar surface or be unable to dock with the awaiting Orion or Gateway in NRHO.

[46] By comparison, the loss of crew threshold for a Commercial Crew Program mission to the International Space Station is 1 in 500 for ascent and entry and 1 in 200 for a 210-day stay at the Station.

[47] Unknown-unknowns are future situations that are impossible to predict.

[48] The Space Shuttle Program flew from 1981 to 2011 and consisted of reusable spacecraft that carried crew and cargo to space and back to Earth.

[49] With a total of three crewed missions between 1973 and 1974, Skylab was America's first space station and proved humans could live and work in space for an extended period of time.

Agency officials noted several challenges to requiring a crew rescue capability. Crew rescue would require additional consumables, as well as an ability to assemble and launch an Orion or lander in a matter of months.[50] To make a crew rescue attempt, the crew must also be able to shelter in a safe haven until a rescue can be executed. Otherwise, the scenario would result in the loss of the crew. Additionally, it can be prohibitively expensive to have a second Orion standing by to launch and rescue the crew or to have a spare HLS resting on the lunar surface should the primary lander fail.

[50] Consumables are commodities that support the conduct of a given mission. Examples include food, water, oxygen, propellant, power, and operational supplies.

ADDENDUM: FEBRUARY 2026 UPDATES TO ARTEMIS CAMPAIGN APPROACH

Subsequent to the completion of our audit work, NASA announced changes to its Artemis campaign approach in late February 2026. Specifically, the Agency's new goals include standardizing the Space Launch System vehicle configuration, adding an additional Artemis mission in 2027, and undertaking at least one lunar surface landing every year thereafter. To this end, the Artemis III mission is now projected to serve as a flight test to low Earth orbit to test systems and operational capabilities in preparation for an Artemis IV lunar landing in 2028. The new Artemis III mission plans include Orion rendezvousing and docking with one or both of the SpaceX and Blue Origin landers; in-space testing of the docked vehicles; integrated checkout of life support, communications, and propulsion systems; and potential testing of the next-generation spacesuits. The Agency plans to further define the Artemis III low Earth orbit flight test after completing detailed reviews between NASA and its Artemis partners. Given the timing of this announcement and additional decisions that still need to be made, we did not evaluate the cost, schedule, or technical impact this shift will have on the HLS Program or lander providers.

CONCLUSION

Establishing a long-term human presence on and in orbit around the Moon and conducting the first crewed mission to the surface of Mars will be among the most challenging technical feats in NASA's history. In accordance with the Agency's plans, the Moon provides an opportunity to revive human activities in deep space and develop the infrastructure necessary to support repeatable missions that grow in duration and complexity in preparation for the crewed exploration of Mars. Key to achieving this goal is the successful development of the HLS vehicles that will need to safely ferry astronauts to and from the lunar surface.

With the development of the lunar landers and building upon lessons learned from the Commercial Crew Program, NASA has continued its move toward commercialization where the Agency is buying a service from a contractor. We found that the Agency's contract approach has been effective at controlling costs and provided the HLS Program with insight into SpaceX's and Blue Origin's development of their lunar landers. The providers have also been able to utilize the Agency's subject matter expertise and unique capabilities and facilitates to advance their lander development.

Nonetheless, SpaceX's lander will not be ready to land astronauts on the lunar surface in June 2027. While NASA is working with the providers to accelerate lunar lander development to meet a 2028 lunar surface mission, it is too early to determine the technical, financial, and schedule implications of such proposals. Whatever the case, while the providers are responsible for developing the lunar landers and delivering them by their contractually agreed to dates, NASA is responsible for ensuring the safety of the crew. Although NASA is proactively taking measures to mitigate and prevent hazards associated with the landers, there are currently gaps in the Agency's approach, including in its testing posture and crew survival analyses. Moreover, should a catastrophic event occur, NASA does not have the capability to rescue stranded crew from space or the lunar surface.

Recommendations, Management's Response, and Our Evaluation

To improve management of government-spent funds, we recommended the HLS Program Manager, in conjunction with the Assistant Administrator for Procurement:

1. Ensure an approach for managing GTAs that have been canceled, unfulfilled, modified, or realigned is formalized in HLS Program policy.
2. Ensure an approach for decrementing costs for GTAs submitted after contract proposal, including a timeline for recovery, is formalized in HLS Program policy.
3. Update the Use of Government Resources clause in both the SpaceX and Blue Origin contracts to reflect GTA policy changes.

To enhance crew safety and survival during the Artemis missions, we recommended the HLS Program Manager:

4. Consult with the Commercial Crew Program to review post-variance acceptance risk assessment findings related to its manual control waiver for lessons that can be applied prior to HLS certification.
5. Update crew survival analyses, including decision packages, to include strategies for extended crew survival.

We provided a draft of this report to NASA management who concurred with Recommendations 1, 2, 4, and 5 and partially concurred with Recommendation 3. We consider management's comments and described planned actions responsive; therefore, the recommendations are resolved and will be closed upon completion and verification of the proposed corrective actions.

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

Major contributors to this report include Deanna Lee, Human Exploration Audits Assistant Director; Sarah McGrath, Assistant Director; Tyler Mitchell; Dimitra Tsamis; Daniel Fenzau; Lauren Suls; and Shani Dennis.

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

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Robert H. Steinau
NASA OIG Senior Official

APPENDIX A: SCOPE AND METHODOLOGY

While we performed this audit from July 2024 through December 2025, it was temporarily suspended during the government shutdown. The audit was performed in accordance with generally accepted government auditing standards, which 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.

The scope of this audit included examining NASA's management of the HLS contracts. Specifically, we evaluated (1) the extent to which HLS providers are meeting cost, schedule, and performance goals; (2) the HLS Program's implementation of the insight/oversight model; and (3) the HLS Program's identification and mitigation of risks to astronaut safety.

To determine the extent to which the HLS providers are meeting cost, schedule, and performance goals, we reviewed contract data using NASA's Enterprise Procurement Data Warehouse, SpaceX and Blue Origin contract files, financial data from NASA's financial systems, and NASA review milestones and contractor deliverables. We also reviewed and analyzed HLS Program and contractor schedule data and cross-referenced this with the overall Artemis schedule goals. We interviewed HLS Program officials including program management, contracting officers, and contracting officer representatives, among others, as well as officials from SpaceX and Blue Origin.

To assess the implementation of the insight/oversight model and other collaboration efforts, we interviewed HLS Program officials, including the insight discipline leads, as well as SpaceX and Blue Origin officials. We also reviewed 2 years of insight planning documents from across the HLS Program to determine NASA's level of insight for both SpaceX and Blue Origin. Additionally, we reviewed GTAs—requested at proposal and those requested after contract award—to determine the scope of work being provided to both providers. We also examined the collaborations requested by both providers including the number of EP assigned to the collaborations. We analyzed both GTA and collaboration costs and obligations through NASA's financial accounting system.

To evaluate the HLS Program's identification and mitigation of risks to astronaut safety, we reviewed concept of operations documents for Artemis III, IV, and V; technical and risk management criteria; safety and mission assurance plans; and various risk assessments and program presentations to identify HLS safety concerns. Further, we interviewed technical and programmatic officials from the HLS Program, SpaceX, and Blue Origin. We also interviewed NASA officials from the offices of Safety and Mission Assurance; Chief Engineer; Systems Engineering and Integration; Space Vehicle Systems; and Program, Planning, and Control.

Assessment of Data Reliability

We used computer-processed data to perform this audit, and that data was used to inform our findings and conclusions. We reviewed and analyzed NASA program and contract cost data in the Agency's financial accounting systems for the HLS Program. The systems from which we derived this data have been tested through the Data Act report. Additional assurances were obtained by reviewing the derived data for erroneous information and comparing it to other sources. We also reviewed and analyzed contractor-provided schedule data. While we did not perform direct validation of data as we relied on the HLS Program's processes for obtaining and reporting this data, we determined the data was sufficiently reliable for our purposes.

Review of Internal Controls

We assessed internal controls and compliance with requirements related to NASA's management of the HLS contracts. The control weaknesses we found were identified and discussed in this report. Our recommendations, if implemented, will improve the identified control weaknesses. However, because our review was limited to these internal control components and underlying principles, it may not have disclosed all internal control deficiencies that may have existed at the time of this audit.

Prior Coverage

During the last 5 years, the NASA Office of Inspector General and Government Accountability Office have issued nine reports of significant relevance to the subject of this report. Reports can be accessed at https://oig.nasa.gov/audits/ and https://www.gao.gov, respectively.

NASA Office of Inspector General

NASA's Management of the Artemis Missions (IG-22-003, November 15, 2021)

Government Accountability Office

NASA: Assessments of Major Projects (GAO-24-106767, June 20, 2024)

Commercial Space Transportation: FAA's Oversight of Human Spaceflight (GAO-24-106184, February 21, 2024)

NASA Artemis Programs: Lunar Landing Plans Are Progressing but Challenges Remain (GAO-24-107249, January 17, 2024)

NASA Artemis Programs: Crewed Moon Landing Faces Multiple Challenges (GAO-24-106256, November 30, 2023)

NASA: Assessments of Major Projects (GAO-23-106021, May 31, 2023)

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

NASA Lunar Programs: Significant Work Remains, Underscoring Challenges to Achieving Moon Landing in 2024 (GAO-21-330, May 26, 2021)

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

APPENDIX B: INSIGHT, OVERSIGHT, COLLABORATIONS, AND GOVERNMENT TASK AGREEMENTS

Insight

NASA is relying heavily on risk-based insight into the providers' development progress. According to NASA, insight is the government gaining an understanding of a contractor's activities and data with the goal of achieving final flight certification. NASA gains insight through various methods including, but not limited to, attending insight meetings with the provider, site visits, database queries, milestone reviews, and various data requirements descriptions (DRD)—that is, contractually required data deliverables—that the contractor provides NASA.

Six offices within the HLS Program perform insight: Program, Planning, and Control; Systems Engineering and Integration; Crew Compartment; Lander Flight Operations; Lander Ground Operations; and Space Vehicle Systems. Additionally, the HLS Program's Technical Authorities—which include teams from the offices of the Chief Engineer, Safety and Mission Assurance, and the Chief Health and Performance Officer—perform insight as well.[51] Each of the offices have multiple disciplines that fall within their purview and within each discipline are focus areas from which insight can be obtained. For example, propulsion is one of the disciplines within the Space Vehicle Systems office, and within this discipline, there are more than 100 focus areas between both providers, including main engines, cryocoolers, and thrusters. Each office is assisted by insight teams that include Lead System Engineers, Mission Segment Leads, and multiple Discipline Leads.[52]

There are different levels of insight that the HLS Program can determine it needs into the focus areas. Levels 0 and 1 require none or very limited activity, and levels 2 and 3 are limited to the provider allowing NASA access and attendance at meetings and listening to NASA's questions—also known as "observing." The providers are not required to resolve or address the NASA insight team's findings within these depths. Levels 4 and 5—or "doing"—allows NASA to conduct their own analyses, reviews, and tests of contractor activities. As such, these levels of insight may not only disrupt the provider's normal tempo but could also require the provider to dedicate additional resources to address the insight team's results. See Table 3 for the HLS Program's insight depth levels. While NASA's default depth of insight is 2, the HLS Program—with approval from the HLS Control Board—can adjust the insight depth level based on the risk assessments of each provider.

[51] The Technical Authority process ensures the engineering, safety, and health communities have an independent, influential role in providing alternative perspectives during the decision-making process. It also ensures that programs and projects have collectively contemplated the risks, discussed data-based dissent, and decided that the risks are worth taking.

[52] A Lead System Engineer's focus is on one provider and ensures the progress of the NASA insight team. A Mission Segment Lead's focus is on one mission segment—like launch, landing, and ascent—and performs insight into integration activities. A Discipline Lead's focus is on a single engineering discipline, including its design, performance, and verification and validation.

Table 3: Insight Depth Levels

Level	Description
0	No activity.
1	Monitor a very limited amount of the provider's documentation associated with a particular activity.
2	Review provider documentation associated with a particular activity.
3	Perform limited analysis, modeling, testing, and simulations as a reality check or as a comparison to results from heritage systems, relying largely on provider assumptions.
4	Perform partial independent analysis, modeling, testing, simulations, or other insight activities.
5	Perform complete independent analysis, modeling, testing, simulations, or other insight activities.

Source: NASA HLS-PLAN-016.

NASA tailored their insight approach based on a model developed by the U.S. Air Force and its management of the National Security Space Launch program. The space launch program, now managed by the U.S. Space Force, procures launch services from commercial providers to provide critical space-lift capability in support of the U.S. Department of Defense and other national security missions.[53] Using firm-fixed-price contracts, this acquisition approach leverages the U.S. commercial launch industry, helping to reduce costs, promote competition, and sustain assured access to space.

Oversight

Oversight is the government's formal review and documentation of either concurrence or nonconcurrence with a provider's products and activities. NASA's oversight management consists mainly of assessing and providing critical reviews of provider DRDs at major milestones, such as Certification Baseline Review, PDR, and CDR.[54] For each of these milestones, the HLS Program assigns a DRD, its data type, and the frequency of its submittal. For example, the System Safety Assessment Report, which identifies and determines methods to control hazards and supports the overall risk management process, is a Type 1 DRD for both providers. NASA's approval is mandatory for this and all other Type 1 DRDs. See Table 4 for all oversight data types.

[53] Under National Security Space Launch Phase 3, which covers launches in fiscal years 2025 to 2029, the Space Force is splitting procurement into two lanes. Lane 1 will be open to all qualified bidders for lower-risk payloads encouraging new entrants and innovation in the growing commercial launch market whereas lane 2 will require the highest levels of mission assurance for national security missions.

[54] During the Certification Baseline Review, NASA examines the progress of each provider toward the design of their HLS and established design, construction, safety, health, and medical standards for each system. The PDR evaluates the completeness of the planning, technical, cost, and schedule baselines developed during the formulation phase. The CDR determines if the design is appropriately mature to continue with the final design and fabrication phase.

Table 4: Oversight Data Types for Data Requirements Descriptions

Data Type	Description
1	NASA approval is mandatory and required.
2	NASA has 30 days to disapprove in writing any issues and interim changes to those issues.
3	Delivered by the contractor but does not require NASA approval.
4	Delivered by the contractor only if NASA requests it in writing.
5	Delivery is not required but the government shall have access if needed.

Source: NASA OIG representation of HLS Program data.

Collaborations

NASA also uses collaboration teams to assist the providers. Collaboration occurs when the contractor requests NASA "in-line" technical support on an area that NASA has expertise in and subject matter experts who can provide resources to the providers. NASA engineers providing support to a contractor work as a fully embedded member on that provider's team. NASA supplies both full-time civil servants and contractor support under the umbrella term "equivalent personnel." The number of EPs the providers can request on certain collaborations are outlined in both HLS contracts.

Government Task Agreements

The HLS Program furthers its collaborative approach by allowing the providers access to uniquely available on-site NASA resources that are not available commercially. Executed via a GTA, NASA and the provider must negotiate and sign the terms of the agreement.[55] The HLS contracts separate GTAs into two sections—those submitted with the provider's proposal and those requested during the provider's performance of the contract. While GTAs submitted at proposal were not included in the overall contract price, they were considered as part of the total evaluated price of the proposal. After award of the contract, both the HLS Program and the providers may agree to execute additional—or new—GTAs during contract performance. Under the terms of the contracts, the providers are responsible for the cost of new GTAs.[56]

[55] Each GTA form includes the name and location of the NASA resource/facility, the overall task objective, tasks to be performed by the government and contractor, an agreed upon schedule for use of the NASA resources, and total cost data. Each GTA is signed by both NASA and the provider.

[56] According to the SpaceX and Blue Origin contract clauses, the parties shall effectuate new GTAs and corresponding contract price adjustments pursuant to Federal Acquisition Regulation 52.243-1, *Changes-Fixed-Price (Alternative I)* (January 17, 2025).

Appendix C: Management's Comments

National Aeronautics and Space Administration

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

March 2, 2026

Reply to Attn of: Exploration Systems Development Mission Directorate

TO: Deputy Assistant Inspector General for Audits

FROM: Acting Associate Administrator for Exploration Systems Development Mission Directorate

SUBJECT: Agency Response to OIG Draft Report, "NASA's Management of the Human Landing System Contracts" (A-24-09-00-HED)

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 the Human Landing System (HLS) Contracts" (A-24-09-00-HED), dated January 22, 2026.

NASA is working closely with its commercial partners as they develop critical hardware elements for the Artemis missions that will return American astronauts to the Moon by 2028 to assert American leadership in space, lay the foundations for lunar economic development, prepare for the journey to Mars, and inspire the next generation of American explorers. Leveraging NASA's unique and historic experience in lunar exploration, paired with the speed and innovation of industry, the HLS Program is providing the key lunar landing capability for Artemis to achieve a long-term human presence in deep space. NASA shares its knowledge and expertise and maintains oversight of safety while the commercial partners develop, test, and mature their lander designs.

NASA acknowledges that due to technical challenges and emergent designs, the partners' schedules have experienced delays. The Agency is actively implementing mitigation measures, such as increased collaboration with experts to monitor and manage the partners' lander development while implementing lessons learned to minimize further impact. NASA dedicates in-house resources for risk mitigation and technology development applicable to the program at large. Additionally, NASA is actively working with both partners to accelerate lander development. Final determinations on technical feasibility, financial impacts, and schedule adjustments will follow as implementation advances. Safety remains the top priority for the Agency and its partners as they develop these elements.

The Artemis program emphasizes the importance of safety in all spaceflight operations, including the use of historical data and experience to continuously improve vehicle requirements and medical guidance. While the Test Like You Fly process is an integral part of NASA's mission assurance and operational practices, commercial partners can have alternative approaches to flight tests. For example, SpaceX's approach is a continuous loop that integrates testing and development into a single process, allowing for early detection of anomalies, accelerated iteration cycles, and improved data correlation. This methodology is essential for reducing cycle times, enabling more frequent testing, and ensuring that every test contributes to mission success.

NASA undertakes challenges that no other organization, agency, or nation can achieve. NASA is committed to working to deliver the safest and most effective outcomes, continuously learning to replicate what works and avoid past missteps—an essential discipline for preserving the Agency's integrity and legacy.

The OIG makes five recommendations, three of which are addressed to the HLS Program Manager, in conjunction with the Assistant Administrator for Procurement, to improve management of Government-spent funds, and two of which are addressed to the HLS Program Manager to enhance crew safety and survival during the Artemis missions.

Specifically, the OIG recommends the HLS Program Manager, in conjunction with the Assistant Administrator for Procurement:

Recommendation 1: Ensure an approach for managing Government Task Agreements (GTA) that have been canceled, unfulfilled, modified, or realigned is formalized in HLS Program policy.

> **Management's Response:** NASA concurs with this recommendation. The requests for GTAs and the Government's ability to meet requests have evolved over time, which is not unexpected under a complex, development program. The HLS Program is developing an Organizational Work Instruction (OWI) to clearly document execution and management of the GTA process.
>
> **Estimated Completion Date:** September 30, 2026.

Recommendation 2: Ensure an approach for decrementing costs for GTAs submitted after contract proposal, including a timeline for recovery, is formalized in HLS Program policy.

> **Management's Response:** NASA concurs with this recommendation. NASA will demonstrate the implementation of this recommendation with the release of the HLS Program GTA OWI.
>
> **Estimated Completion Date:** September 30, 2026.

Recommendation 3: Update the Use of Government Resources clause in both the SpaceX and Blue Origin contracts to reflect GTA policy changes.

> **Management's Response:** NASA partially concurs with this recommendation. The HLS Program will conduct a thorough review and assessment of Program policies and updated procedures and afterwards will determine if a contract clause update is appropriate. NASA will demonstrate implementation of this recommendation by

providing OIG with the results of the assessment. If an update is appropriate, the HLS Program, in coordination with the Office of Procurement, will incorporate a revised clause through bilateral agreement with the commercial partners and will align with the next anticipated modification.

Estimated Completion Date: September 30, 2026.

In addition, the OIG recommends that NASA's HLS Program Manager:

Recommendation 4: Consult with the Commercial Crew Program (CCP) to review post-variance acceptance risk assessment findings related to its manual control waiver for lessons that can be applied prior to HLS certification.

Management's Response: NASA concurs with this recommendation. The HLS Program works closely with the CCP to learn from their past experiences. For example, the Crew HLS Interface for Piloting Working Group includes members that also support CCP and shares lessons learned about CCP manual piloting. The HLS Program and CCP have established working groups and will continue to operate to help inform HLS certification. The HLS Program will continue to engage with CCP to understand best practices that could be applied to HLS certification.

Estimated Completion Date: May 31, 2026.

Recommendation 5: Update crew survival analyses, including decision packages, to include strategies for extended crew survival.

Management's Response: NASA concurs with this recommendation. The HLS Crew Survival Analysis Report was updated in September 2025 to revision B with the latest identification of crew survival gaps. The HLS Program has developed two decisional packages addressing (1) Elevator Failure Backup Method and (2) Depression Crew Cabin Transfer, which will be presented to the HLS Control Board in calendar year 2026.

Estimated Completion Date: August 30, 2026.

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 Christine Solga at (202) 358-1238.

Lori Glaze Digitally signed by Lori Glaze Date: 2026.03.02 09:25:49 -05'00'

Dr. Lori S. Glaze
Associate Administrator for Exploration Systems Development Mission Directorate (Acting)

cc:
Associate Administrator for Space Operations Mission Directorate/Mr. Bowersox
Assistant Administrator for Procurement/Mr. Horne (Acting)
Program Manager, Human Landing System/Mr. Creech

APPENDIX D: REPORT DISTRIBUTION

National Aeronautics and Space Administration

Administrator
Associate Administrator
Chief of Staff
Acting Associate Administrator for Exploration Systems Development Mission Directorate
Acting Assistant Administrator for Procurement
HLS Program Manager

Non-NASA Organizations and Individuals

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

Government Accountability Office
    Director, Contracting and National Security Acquisitions

Blue Origin
    Senior Vice President, Lunar Permanence

SpaceX
    Program Manager, Starship Human Landing System

Congressional Committees and Subcommittees, Chair and Ranking Member

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

Senate Committee on Commerce, Science, and Transportation
    Subcommittee on Aviation, Space, and Innovation
    Subcommittee on Science, Manufacturing, and Competitiveness

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 Government Reform
    Subcommittee on Government Operations

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

(Assignment No. A-24-09-00-HED)