NASA
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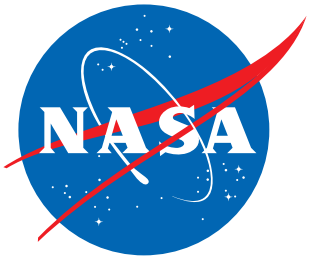
NASA's Management of the Mobile Launcher 2 Project

August 27, 2024

IG-24-016



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RESULTS IN BRIEF

NASA's Management of the Mobile Launcher 2 Project

August 27, 2024 IG-24-016 (A-23-14-00-HED)

WHY WE PERFORMED THIS AUDIT

Development of the mobile launcher is key to NASA's Artemis campaign, which seeks to return astronauts to the Moon and send crewed missions to Mars. The mobile launcher is the ground structure NASA uses to assemble, process, transport, and launch the integrated Space Launch System heavy-lift rocket and Orion Multi-Purpose Crew Vehicle system. The Agency is developing a second mobile launcher (ML-2) at Kennedy Space Center to support larger variants of the Space Launch System that will be used for missions beginning with Artemis IV, scheduled to launch in September 2028. Bechtel National, Inc. (Bechtel), the prime contractor for the ML-2 project, is responsible for ML-2 project management, architectural and engineering designs, technical integration, fabrication, construction, testing, commissioning, and quality control.

The ML-2 contract was awarded in June 2019 for $383 million, with Bechtel scheduled to deliver the launcher to NASA in March 2023. By August 2022, the contract value had increased to over $1 billion and the delivery delayed to May 2026, with more recent estimates from NASA and Bechtel showing further cost increases and schedule delays. We previously reported on ML-2 cost and schedule overruns in a June 2022 report, which were primarily attributed to Bechtel's performance. Despite progress since our last report, NASA has struggled to develop a reliable cost and schedule estimate for the ML-2 project and incentivize significant improvement in contractor performance. Given the importance of ML-2 for future Artemis missions, it is critical that NASA effectively manage the project to control cost increases and avoid further schedule delays.

In this audit, we examined NASA's management of the ML-2 project to include both Bechtel's contract performance and NASA's overall project cost and schedule management. To complete this work, we reviewed ML-2 contract modifications, Bechtel's monthly financial reports, project risk documentation, award fee performance evaluation reports, Contracting Performance Assessment Reporting System reports, schedule analyses, and key milestone documentation. We also interviewed officials from NASA, the Defense Contract Management Agency, and Bechtel.

WHAT WE FOUND

NASA projects the ML-2 will cost over three times more than planned. In 2019, NASA estimated the entire ML-2 project from design through construction would cost under $500 million with construction completed and the ML-2 delivered to NASA by March 2023. In December 2023, NASA estimated the ML-2 project would cost $1.5 billion, including $1.3 billion for the Bechtel contract and $168 million for other project costs, with delivery of the launcher to NASA in November 2026. In June 2024, NASA established the Agency Baseline Commitment (ABC)—the cost and schedule baseline committed to Congress against which a project is measured—for a ML-2 project cost of $1.8 billion and a delivery date of September 2027. Even with the establishment of the ABC, NASA intends to keep Bechtel accountable to the cost and schedule agreed to in December 2023.

Despite the Agency's increased cost projections, our analysis indicates costs could be even higher due in part to the significant amount of construction work that remains. Specifically, our projections indicate the total cost could reach $2.7 billion by the time Bechtel delivers the ML-2 to NASA. With the time NASA requires after delivery to prepare the launcher, we project the ML-2 will not be ready to support a launch until spring 2029, surpassing the planned

September2028 Artemis IV launch date. NASA officials disagree with our analysis and expect cost growth to lessen over time now that Bechtel has started construction of the launcher. The Agency believes this is an area of expertise for the contractor. While progress has been made with the beginning of construction of the ML-2, it is still too early to determine the impact on the contract's continued cost growth and whether Bechtel can achieve and sustain an improved level of performance throughout the construction phase.

Until NASA established the ABC, the Agency lacked a cost and schedule estimate, or official baseline, for the ML-2 project. Cost and schedule estimates from NASA and Bechtel have changed several times and increased significantly over time, making it difficult for NASA to identify its funding needs, be accountable to Congress and other stakeholders, and accurately measure project and contractor performance. The Agency's history of increasing the ML-2's cost estimate over time also contributes to our assessment that costs will be higher than what the Agency currently projects in its ABC.

We also found that Bechtel's performance drove the significant cost increases and schedule delays to the design and development of the ML-2. The current contract value of $1.1 billion includes $594 million of Bechtel overruns. Further, Bechtel's monthly cost reports show the company's continued underestimation of the ML-2 project's scope and complexity resulted in cost increases in several categories, including labor, equipment, and administrative expenses.

Although Bechtel has made progress on the ML-2 project since construction began in August 2023, the company faces technical challenges that risk further cost increases and schedule delays. This includes steel fabrication and delivery issues that impacted the construction start date, as well as potential changes to the ML-2's structure that could add to the launcher's weight and increase costs. To its credit, NASA has taken steps to better manage the Bechtel contract, including removing 6 of 11 umbilicals from the contract and instead providing them to Bechtel as government-furnished equipment, minimizing requirements changes, and improving contract management and visibility into costs.

Nevertheless, the Agency has few options—with award fees remaining the primary tool—to incentivize better contractor performance. In the nine award fee periods from contract inception in July 2019 through September 2023, NASA awarded Bechtel approximately $11.2 million out of the available $23.3 million award fee pool. While Bechtel was not paid award fees for Periods 4, 6, and 7, we question nearly $3 million awarded to Bechtel for Periods 8 and 9 despite multiple documented performance weaknesses. Although NASA and Bechtel revised the contract's award fee evaluation plan in March 2024 to add objective milestone-based incentives as criteria for earning additional award fees, it is too early to assess the merits of the revised plan.

The ML-2 contract also includes an option to request a cost estimate from Bechtel for converting the contract from cost-plus to fixed-price. A fixed-price contract could provide cost certainty, but the Agency has opted to prioritize the mission schedule and maintain a cost-plus contract structure. The anticipated high costs associated with converting the contract to fixed-price limits NASA's ability to significantly alter the project's trend of cost and schedule increases.

WHAT WE RECOMMENDED

To improve NASA's management of the ML-2 project, we recommended the Associate Administrator for Exploration Systems Development Mission Directorate: (1) ensure lessons learned from the ML-2's acquisition, contract, and project management are codified to inform future development efforts and (2) conduct a thorough analysis of the feasibility of utilizing the fixed-price option, and if NASA determines that it will not be exercised, remove the option from the ML-2 contract.

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

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TABLE OF CONTENTS

Acronyms

ABC	Agency Baseline Commitment
EGS	Exploration Ground Systems
ESDMD	Exploration Systems Development Mission Directorate
FDO	Fee Determination Official
FY	fiscal year
IFC	issue for construction
IFF	issue for fabrication
JCL	Joint Cost and Schedule Confidence Level
MEVV	multi-element verification and validation
ML-1	Mobile Launcher 1
ML-2	Mobile Launcher 2
OIG	Office of Inspector General
PMB	Performance Measurement Baseline
RFI	Request for Information
SLS	Space Launch System

INTRODUCTION

NASA announced the Artemis campaign in May 2019 with the goal of returning astronauts to the Moon and eventually sending crewed missions to Mars. Key to these efforts is the development of the mobile launcher, which serves as the ground structure NASA uses to assemble, process, transport, and launch various iterations of the integrated Space Launch System (SLS) heavy-lift rocket and Orion Multi-Purpose Crew Vehicle (Orion) system.[1] The Agency is currently developing a second mobile launcher at Kennedy Space Center (Kennedy) to support larger variants of the SLS for missions beginning with Artemis IV, scheduled to launch in September 2028.

In 2020, the NASA Office of Inspector General (OIG) issued a report examining the development efforts of both the first and second mobile launchers (ML-1 and ML-2), followed by another report in 2022 focusing on the ML-2 contract that NASA awarded to Bechtel National, Inc. (Bechtel).[2] As the prime contractor for the ML-2 project, Bechtel is responsible for the detailed design and construction of the launcher, including ML-2 project management, architectural and engineering designs, technical integration, fabrication, construction, testing, commissioning, and quality control. Starting in August 2023, the project entered the construction phase.

The ML-2 contract was awarded in June 2019 for $383 million, with a delivery date of the launcher from Bechtel to NASA in March 2023. By August 2022, the contract value had increased to over $1 billion, and the delivery date was delayed to May 2026. As of December 2023, cost and schedule estimates from both NASA and Bechtel showed $1.3 billion for contract costs and a delivery date of November 2026. In June 2024, NASA established a commitment to Congress for a total ML-2 project cost of $1.8 billion and a delivery date of September 2027. Despite progress since our 2022 report, NASA has struggled to develop a reliable cost and schedule estimate for the ML-2 project and incentivize significant improvement in contractor performance. Given the importance of ML-2 for future Artemis missions, it is critical that NASA effectively manage the project going forward to control further cost increases and schedule delays.

In this audit, we examined NASA's management of the ML-2 project. Specifically, we focused on (1) the extent to which NASA is meeting its cost, schedule, and performance goals and (2) the actions NASA has taken to control future cost growth and schedule delays.

[1] Orion consists of a crew module capable of transporting four astronauts, a service module that provides in-space propulsion and storage, and a launch abort system that can jettison the capsule to safety in the event of an anomaly during launch.

[2] NASA OIG, *Audit of NASA's Development of Its Mobile Launchers* (IG-20-013, March 17, 2020) and *NASA's Management of the Mobile Launcher 2 Contract* (IG-22-012, June 9, 2022).

Background

The first mobile launcher—ML-1—was originally constructed in 2010 as part of the Constellation Program.[3] After the program's cancellation, ML-1 underwent large-scale modifications to support Block 1, the first configuration of the SLS rocket. NASA plans to use ML-1 for the first three Artemis missions, the last of which is scheduled to return humans to the Moon's surface in 2026.

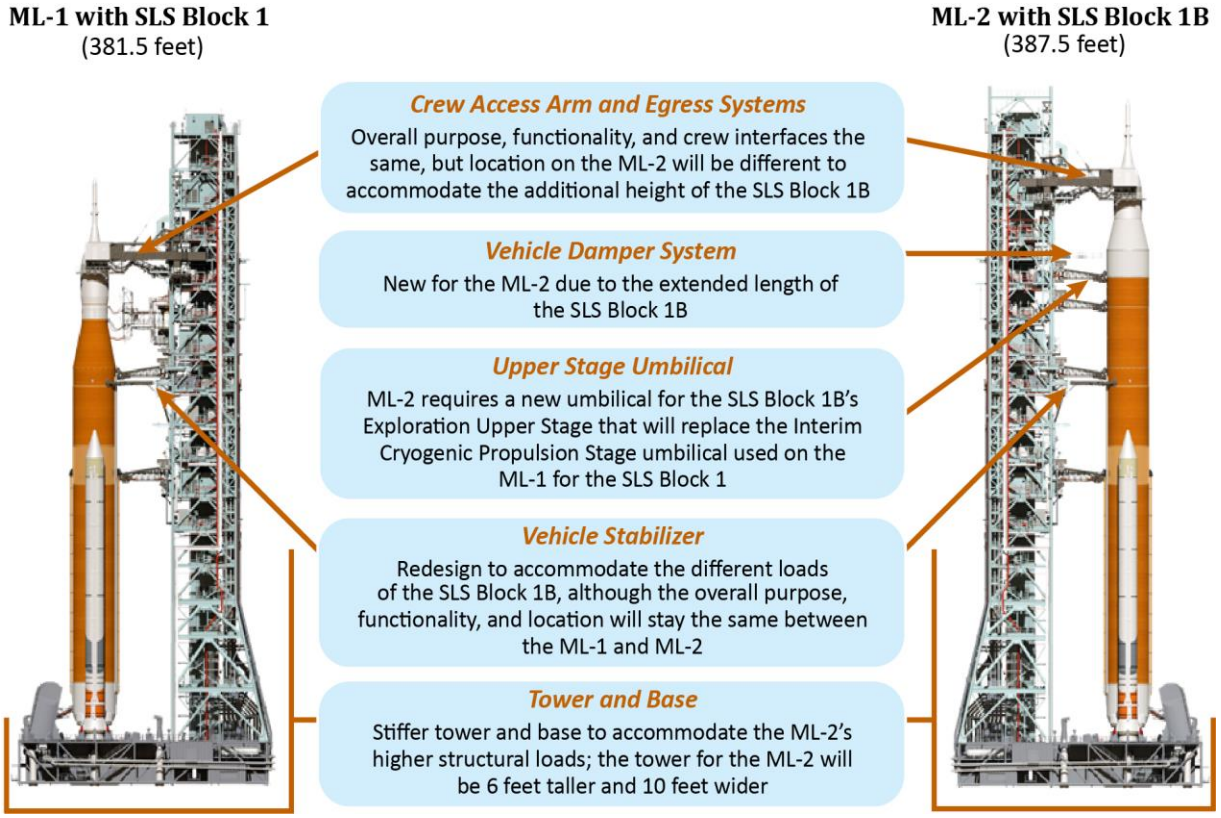
The mobile launchers consist of a two-story base structure—the platform to support the SLS—and a tower equipped with connection lines called umbilicals; launch accessories; a crew access arm (a walkway for personnel, equipment, and astronauts entering the Orion crew module during launch preparations); and over 40 interdependent electrical, fluid, and mechanical subsystems. Like ML-1, ML-2 will serve as the primary interface between the Ground Launch Control System and SLS and Orion flight hardware. Compared to ML-1, ML-2 will be slightly taller (by 6 feet), feature additional umbilicals in different locations, and have a stiffer structural design for the base and tower to account for the larger loads of the Block 1B—the more powerful and heavier configuration of the SLS rocket that will be used starting with Artemis IV.

NASA initially planned to accommodate the larger SLS Block 1B by modifying the ML-1 and conducted studies and preliminary design work as part of this effort. However, NASA decided not to use this approach due to technical challenges and the time that would be required between the Artemis III and Artemis IV launches to complete modifications to the structure. In 2017, the Aerospace Safety Advisory Panel recommended NASA build a second mobile launcher, and in 2018, the Agency received $350 million from Congress to begin ML-2 development and associated SLS activities.[4] See Figure 1 for a capability comparison between ML-1 and ML-2.

[3] Announced in 2005, the Constellation Program aimed to develop crew launch, heavy-lift launch, and crew exploration vehicles to return humans to the Moon and for future exploration of Mars and other destinations.

[4] The Aerospace Safety Advisory Panel provides advice and makes recommendations to the NASA Administrator on matters related to aerospace safety. The Panel raised concerns in October 2017 about a potential 33-month gap between SLS launches due to the time required to modify ML-1 for the larger SLS variants. They also concluded that modifying ML-1 would create potential safety risks given the expected rate of attrition of Kennedy's ground and launch workforce over the 33-month inactive period, resulting in a loss of experience and knowledge. Aerospace Safety Advisory Panel, *Annual Report for 2017* (January 2018).

Figure 1: Capability Comparison of ML-1 and ML-2 (as of July 2024)



Source: NASA OIG presentation of ML-2 project information.

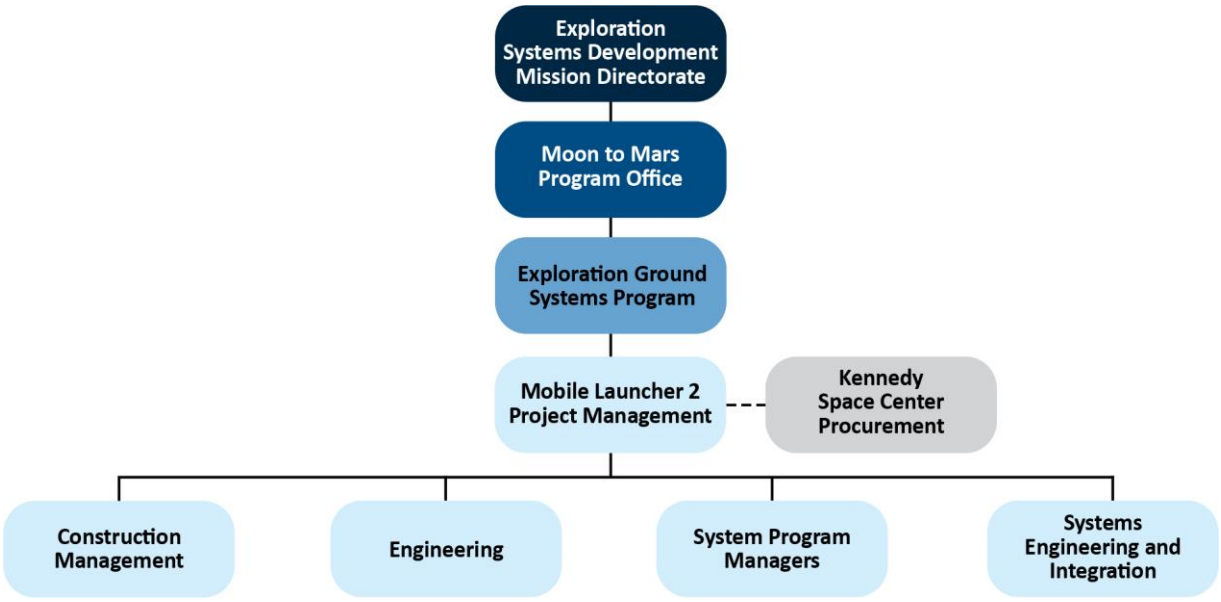
ML-2 Project Management and Organizational Structure

NASA's Exploration Systems Development Mission Directorate (ESDMD) manages systems development for programs critical to the Agency's Artemis campaign. In 2023, NASA announced the establishment of the Moon to Mars Program Office within ESDMD, as directed by the NASA Authorization Act of 2022.[5] The Moon to Mars Program Office focuses on the hardware development, mission integration, and risk management functions for missions to the Moon and Mars. The office reports directly to the Associate Administrator of ESDMD. The Moon to Mars Program Office encompasses the SLS, Orion, Exploration Ground Systems (EGS), Gateway, Human Landing System, and Extravehicular Activity and Human Surface Mobility programs.[6] The EGS Program develops and operates the facilities and ground support equipment, including ML-1 and ML-2, necessary to assemble, transport, launch, and recover rockets and spacecraft. Figure 2 provides the ML-2 project's organizational structure.

[5] The National Aeronautics and Space Administration Authorization Act of 2022, as enacted by the CHIPS and Science Act, Pub. L. No. 117-167 (2022).

[6] In addition to the SLS heavy-lift rocket, Orion crew capsule, and the facilities and ground systems needed to process and launch rockets and spacecraft, other elements are required to support the Artemis campaign. These include the Gateway, a lunar orbiting station; the Human Landing System, the mode of transportation that will take astronauts to the lunar surface; and Extravehicular Activity and Human Surface Mobility activities, which are the next-generation spacesuits, human-rated rovers, and spacewalking support systems needed to go to the Moon.

Figure 2: ML-2 Project Organizational Structure (as of July 2024)



Source: NASA OIG presentation of Agency information.

Bechtel's Design-Build, Cost-Plus-Award-Fee Contract

In June 2019, NASA awarded a cost-plus-award-fee contract to Bechtel to design, build, and test the ML-2.[7] The initial contract was valued at $383 million with a performance period from July 2019 to March 2023. Due to an aggressive launch schedule for Artemis IV and using lessons learned from ML-1—which experienced contractor performance issues, cost increases, and schedule delays—the Agency decided to use a design-build approach and award a single contract for both project design and construction.[8] NASA has traditionally utilized a design-bid-build approach in which it employs separate design and construction contractors, as it did for ML-1.

NASA evaluates Bechtel's contract performance on an ongoing basis and develops a formal award fee performance evaluation report every 6 months to determine the award fee score and the amount of award fee the contractor will receive. The award fee is intended to incentivize and reward Bechtel for a timely, safe, high-quality, and cost-effective performance. The initial contract included eight award fee (or evaluation) periods with a total of $23.3 million in the award fee pool. To accommodate the contract's extended period of performance, NASA subsequently added 6 more award fee periods, for a total of 14 periods, but did not alter the total award fee pool at that time. After 9 award fee

[7] Cost-reimbursement contracts provide for payment of allowable incurred costs to the extent prescribed in the contract. A cost-plus-award-fee contract is a cost-reimbursement contract that provides for a fee consisting of (a) a base amount fixed at inception of the contract and (b) an award amount, based upon a judgmental evaluation by the government, sufficient to provide motivation for excellence in contract performance.

[8] In March 2020, NASA OIG reported on the development of the Agency's mobile launchers, specifically identifying the cost and schedule challenges NASA faced in developing the ML-1 (IG-20-013). The OIG also found that while the Agency had taken positive steps to address lessons learned from its efforts to modify the ML-1, NASA missed opportunities to improve project management and oversight of the ML-2. A design-build approach is when the government hires one contractor to perform both design and construction under a single contract.

periods, Bechtel has been awarded nearly $11.2 million for approximately $715.5 million of work completed by the contractor.[9]

NASA uses multiple criteria to evaluate the contractor's performance and determine the award fee. According to the ML-2 contract's award fee evaluation plan, NASA uses four weighted factors—technical and management, schedule, cost control, and small business utilization—to determine its proposed total award fee score for each evaluation period. Each weighted factor is evaluated separately and given a numerical value that the evaluation team recommends to the Award Fee Board and Fee Determination Official (FDO). Per the NASA Federal Acquisition Regulation Supplement, the FDO makes the final determination of the award fee score and rating.[10]

In May 2019, NASA updated its internal policy to require the FDO for contracts valued at over $1 billion to provide a presentation of the award fee score to an independent panel from NASA Headquarters. Additionally, in response to our 2022 ML-2 report, NASA designated the Kennedy Center Director as the FDO, a position previously held by the EGS program manager. NASA and Bechtel also revised their award fee evaluation plan in March 2024, which resulted in changes to the weighted values of the evaluation factors, placing an increasing emphasis on cost control. Table 1 shows the evaluation factors and their respective weighted values for the original award fee evaluation plan covering July 2019 to September 2023 and the new plan covering October 2023 to March 2026.

Table 1: Award Fee Evaluation Factors for the ML-2 Contract (as of July 2024)

Evaluation Factor	Weight (July 2019 to September 2023)	Weight (October 2023 to March 2026)
Technical and Management	40%	40%
Schedule	25%	15%
Cost Control	25%	35%
Small Business Utilization	10%	10%

Source: ML-2 Bechtel contract and the original and new award fee evaluation plans.

Federal guidance requires the contractor to meet specific criteria for cost, schedule, and technical performance to receive their numerical scores and adjective rating. Using these criteria, the Award Fee Board and FDO assess the contractor's performance and complete an award fee determination letter. This letter, signed by the FDO, is used by the contracting officer to prepare a contract modification that includes the award fee adjective rating, weighted evaluation score, and award fee amount. At the conclusion of each award fee period, NASA enters the contractor performance evaluation into a separate government-wide system known as the Contractor Performance Assessment Reporting System, which allows other federal agencies to review contractors' performance before entering into new contractual agreements. Figure 3 shows the criteria and numerical score required for each adjective rating.

[9] The $715.5 million represents total contract costs as of April 2024 and includes labor costs, other direct costs, and indirect costs.

[10] NASA's Award Fee Board evaluates the contractor's performance every award fee period based on input from the technical monitors, contracting officer's representative, contracting officer, and ML-2 project executive. The FDO meets with the board before making a final decision on the award fee amount. NASA Federal Acquisition Regulation Supplement 1816.405-273, *Award fee evaluations* (2021).

Figure 3: Award Fee Performance Ratings (as of July 2024)

Source: NASA OIG presentation of award fee evaluation plan in accordance with Federal Acquisition Regulation 16.401(3)(iv), *Award Fee Plan* (2024) and NASA Federal Acquisition Regulation Supplement 1816.405-275, *Award Fee Evaluation Rating* (2021).

Note: The guidance does not include a range of ratings for "Satisfactory." Any score received under 50 equates to zero award fee dollars.

ML-2 Activities Outside of the Bechtel Contract

While the Bechtel contract makes up approximately 90 percent of ML-2 project costs, NASA funds additional activities to support the ML-2 project, such as civil servant labor, engineering support contractors, testing, and government-furnished designs and equipment. In total, these costs were estimated at approximately $96 million in 2019 but over time have risen to $168 million.

According to ML-2 project management, this cost growth is due to the additional contracts required to cover work removed from the Bechtel contract, costs associated with the civil service and engineering support contract labor needed due to extending the Bechtel contract's performance period, and impacts of inflation. NASA is also performing work in-house and contracting with other companies to fabricate hardware that will be provided to Bechtel and integrated with the ML-2 structure during construction.[11]

[11] Awarded to Jacobs Technology Inc. in 2023, Kennedy's Center-wide services contract—Consolidated Operations, Management, Engineering and Test, known as the COMET contract—provides engineering; ground systems development; flight vehicle/spacecraft processing; and launch, landing, and recovery operations in support of the EGS, SLS, and Orion programs.

For example, in 2022 NASA removed—or descoped—6 of 11 umbilicals from the Bechtel contract, allowing the company to focus its efforts on other critical activities. NASA's decision to remove the umbilicals from the Bechtel contract accounted for approximately 30 percent of the cost growth in these other project costs. While Bechtel is still required to integrate and install all 11 umbilicals on the ML-2, NASA will provide the descoped umbilicals to Bechtel as government-furnished equipment.

Exploration Upper Stage Umbilical Arms

Source: NASA.

Prior NASA Office of Inspector General Audits

In March 2020, NASA OIG reported on the mobile launchers and noted the Agency was missing opportunities to improve project management and oversight of the ML-2. These opportunities included completing ML-2 specific milestone reviews, establishing an Agency Baseline Commitment (ABC) for Congress and the Office of Management and Budget, and coordinating with appropriate offices to mitigate cost and schedule risks.[12] In addition to highlighting the expected impacts of immature requirements—a consistent challenge across the Agency—on the ML-2's cost and schedule, we also questioned the use of an award fee contract and its ability to incentivize the contractor to control its cost and schedule, particularly given similar issues on other comparable contracts with select contractors for the SLS Program and ML-1.[13]

In June 2022, the OIG reported on issues with Bechtel's overall performance on the ML-2 contract, which included significant cost increases and schedule delays. We found the ML-2 was projected to cost NASA approximately $960 million and be available for Artemis IV by November 2026. Further, an Independent Review Team had low confidence levels that Bechtel would meet its cost and schedule targets and estimated the final cost of ML-2 to be $1.5 billion with a final delivery date to NASA of November 2027. While the Agency continued to work towards establishing a formal ABC at that time, we questioned nearly $3 million in award fees NASA provided to Bechtel despite the contractor's continued poor performance.

Congressional Reporting

After our 2022 report, Congress required NASA to provide a status update of the ML-2 project. Specifically, the NASA Authorization Act of 2022 required the Agency to provide Congress a report within 45 days of the Act on the steps the Administrator and industry partners were taking to address

[12] The ABC is the cost and schedule baseline committed to Congress and the Office of Management and Budget against which a project is thereafter measured.

[13] NASA OIG has found multiple instances of award fee earnings inconsistent with contractor performance and that NASA's use of such awards may limit the Agency's ability to motivate contractors to improve performance and control costs. In October 2018, we reported that NASA rated The Boeing Company's performance for the SLS Program as "Excellent" or "Very Good" despite the contract being billions of dollars over cost and several years behind schedule. As a result, we questioned nearly $64 million of award fees provided to the company. Further, in March 2020, we found the ML-1 contractor Vencore Services and Solutions was rated as either "Excellent," "Very Good," or "Good" despite design errors and contractor employee turnover that led to increased costs in the millions and significant schedule delays. See NASA OIG, *NASA's Management of the Space Launch System Stages Contract* (IG-19-001, October 10, 2018) and IG-20-013.

cost, schedule, and performance challenges to ensure the ML-2 was ready for the Artemis IV launch. In response, NASA provided an interim report in September 2022 and a final report in December 2022. In the final report, NASA reported Bechtel's estimate to complete the contract was $1.2 billion with construction to be completed by December 2026. Considering non-Bechtel costs, NASA reported the total ML-2 project was estimated to cost approximately $1.4 billion. The Agency noted that it used a Bechtel estimate provided in May 2022 rather than a later estimate—provided in October 2022—because NASA did not consider the latter a "good faith, concerted effort to mitigate cost increases and furthermore fails to meet established schedule need dates or budget requirements."

Additionally, the fiscal year (FY) 2023 Consolidated Appropriations Act directed NASA to submit a plan to the Committees on Appropriations of the House of Representatives and the Senate, the Government Accountability Office, and NASA OIG detailing a cost and schedule baseline for the ML-2.[14] While this report maintained the overall estimated project cost baseline of $1.4 billion, it notably added that "the Agency made a conscious decision to retain the May 2026 ML-2 construction complete current contractual requirement . . . as the interim baseline for schedule." The report also noted that NASA planned to continue using the award fee process "to incentivize Bechtel to improve performance and achieve the best possible completion date" and establish an ABC in July 2023, which NASA completed in June 2024.

[14] Consolidated Appropriations Act, 2023, Pub. L. No. 117-328 (2022).

MOBILE LAUNCHER 2 COST AND SCHEDULE ARE UNSUSTAINABLE DESPITE NASA'S EFFORTS TO IMPROVE PROJECT PERFORMANCE

In June 2024, NASA established a formal cost and schedule baseline for the ML-2 project that is over three times its original cost estimate and 4.5 years behind its original schedule. While Agency officials are optimistic about Bechtel's future performance, in our judgment, the total project cost may be significantly higher than the current baseline. This is due to the continued rate of increases to the contractor's cost estimate to complete remaining work. Further, considering the post-delivery activities NASA needs to complete, we project the ML-2 will be ready in spring 2029, surpassing the planned September 2028 Artemis IV launch date. For the ML-2 project's first 5 years, NASA lacked a reliable cost and schedule estimate, making it difficult for the Agency to accurately identify ML-2 budget requirements, be accountable to Congress and other stakeholders, and accurately measure project and contractor performance. Bechtel's performance also drove the ML-2 project's significant cost increases and schedule delays, along with the company's inability to provide NASA with reliable estimates. Despite NASA's efforts to stabilize the project, the Agency has had limited leverage to incentivize Bechtel to further improve and sustain its performance.

ML-2 to Cost over Three Times More than Planned and Will Not Be Completed in Time to Meet the Current Artemis IV Schedule

NASA Projects ML-2 Costs to Reach $1.8 Billion with Delivery Scheduled over 4 Years Later than Planned

In 2019, NASA estimated the entire ML-2 project from design through construction would cost under $500 million with construction completed and the ML-2 delivered to NASA by March 2023.[15] However, by August 2022 the contract value had increased to over $1 billion, and in December 2023, NASA estimated the ML-2 project's total cost would reach nearly $1.5 billion, including $1.3 billion for the Bechtel contract and $168 million for other project costs.[16]

[15] This included a $383 million contract with Bechtel for the primary design and construction of the ML-2 and approximately $96 million for other project costs, such as NASA's government-furnished designs and equipment.

[16] The $1.5 billion includes NASA's current Performance Measurement Baseline (PMB) of $1.3 billion for the Bechtel contract and the estimate of $168 million for other project-related costs through FY 2027. According to NASA/SP-2023TBD, *Integrated Baseline Review (IBR) Handbook* (January 2023), the PMB is the time-phased cost plan for accomplishing all authorized work scope in a project's life cycle, which includes both NASA internal costs and supplier costs.

In June 2024, 5 years after the ML-2 contract was awarded, NASA established the ABC—the cost and schedule baseline committed to Congress and the Office of Management and Budget against which a project is measured. The ABC identified a project cost of $1.8 billion—which includes Bechtel's costs as well as other project costs for ML-2 activities outside of the contract—and a delivery date from Bechtel to NASA of September 2027. Despite the establishment of the ABC, NASA intends to keep Bechtel accountable to the cost and schedule agreed to in December 2023 ($1.3 billion and a November 2026 launcher delivery). Now that NASA has established an ABC for the project, ML-2 project management is required to notify the NASA Administrator if there is reasonable cause to believe that the ABC threshold is likely to be exceeded.[17]

According to ML-2 project management, NASA decided that after the launcher is delivered to the Agency, the ML-2 project would come to an end. At that point, the ML-2 will be integrated with EGS Program infrastructure, and its operational costs will be funded as part of the EGS Program rather than as part of the ML-2 project. Therefore, the ML-2 project's ABC does not include the cost and schedule for activities required after delivery—approximately 2 additional years for multi-element verification and validation (MEVV) software and testing activities and launch operations.[18]

As part of the Agency's preparation for establishing the ABC, a NASA Independent Review Team updated the EGS Program's Joint Cost and Schedule Confidence Level (JCL)—a risk-based estimate of cost and schedule to help predict the likelihood that a program or project will achieve its objectives within budget and on time—which informed the ABC.[19] The Independent Review Team made several adjustments to the EGS Program JCL to reflect less optimistic assumptions, estimating ML-2 project costs at $2.1 billion with a delivery of the launcher to NASA in January 2028. While the Independent Review Team noted the project has made significant recent progress, they also stated the current ML-2 budget and schedule are insufficient to meet NASA's project goals. In fact, the JCLs performed by the EGS Program and Independent Review Team both found a zero percent likelihood of Bechtel delivering the launcher by November 2026. Notably, NASA has conducted two prior JCL analyses for programmatic reviews since the ML-2 contract award and the cost and schedule estimates have grown significantly for each.[20]

[17] According to 51 U.S.C. § 30104(d)(1), NASA is required to notify Congress if a program's or project's development costs will exceed 15 percent of the established ABC or be delayed 6 months beyond the commitment date. The Administrator must then submit an updated cost and schedule status for the program or project within 6 months of the Agency's determination. If the development costs are likely to exceed 30 percent, and absent congressional reauthorization, NASA is prohibited from spending any additional money on the program or project beginning 18 months after the date the Agency notifies Congress. In that event, the Agency must also submit to Congress a rebaseline of the program's or project's scope, expected costs, and schedule commitments before Congress will reauthorize spending. 51 U.S.C. § 30104(e).

[18] MEVV refers to the verification and validation process. Verification tests are performed on a system or element to show that it meets allocated requirements or specifications including physical and functional interfaces. Validation tests are conducted under realistic or simulated conditions on an end product to determine the effectiveness and suitability of the product for use in mission operations. It ensures the system operates as expected when placed in a realistic environment.

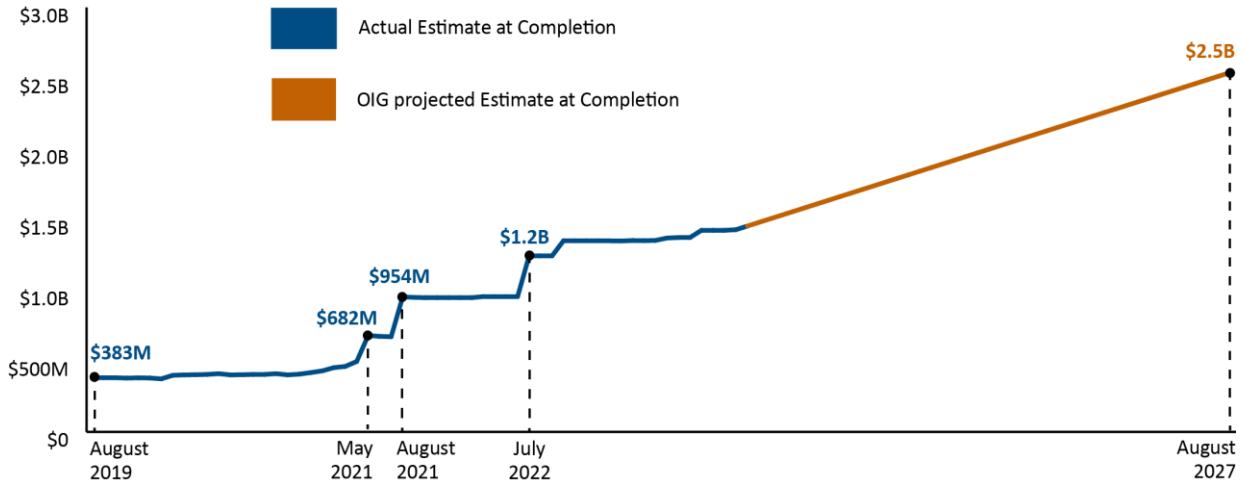
[19] NASA projects generally develop budgets and schedules with a 70 percent confidence level—meaning a 70 percent likelihood the project will finish within the cost and schedule developed from the JCL analysis.

[20] In December 2021, the ML-2 project conducted a JCL analysis that resulted in a 3.9 percent confidence in the project's $1 billion cost and October 2025 delivery estimates. In February 2022, an Independent Review Team conducted a JCL assessment and concluded that to reach a 70 percent confidence level, the ML-2 project would cost approximately $1.5 billion with a launcher delivery date of November 2027.

NASA OIG Projects ML-2 Costs Could Reach $2.7 Billion and Will Not Be Ready for Artemis IV

Despite the Agency's increased cost projections, our analysis indicates that ML-2's costs could be even higher. In particular, if current cost growth trends continue, we project the ML-2 project's cost through delivery of the launcher to NASA could climb to $2.7 billion, nearly $1 billion more than the Agency's ABC. This includes $2.5 billion for the Bechtel contract (as shown in Figure 4) and the additional $168 million in other project costs that NASA estimates it will need through FY 2027. Our projections are based on the substantial cost growth that the Bechtel contract has incurred over the last 3 years, past performance issues observed during design with the production of detailed drawings for steel fabrication and management of the launcher's weight, and the significant amount of construction work that remains.

Figure 4: NASA OIG Projection of Estimate at Completion Cost for Bechtel ML-2 Contract (as of January 2024)



Source: NASA OIG presentation of Bechtel monthly cost reporting data and OIG projections.

Note: Estimate at Completion is a value (expressed in dollars or hours) developed to represent a realistic projection of the final cost of a task (or group of tasks) when completed. It is the sum of direct and indirect costs to date, plus the estimate of costs for all authorized remaining work.

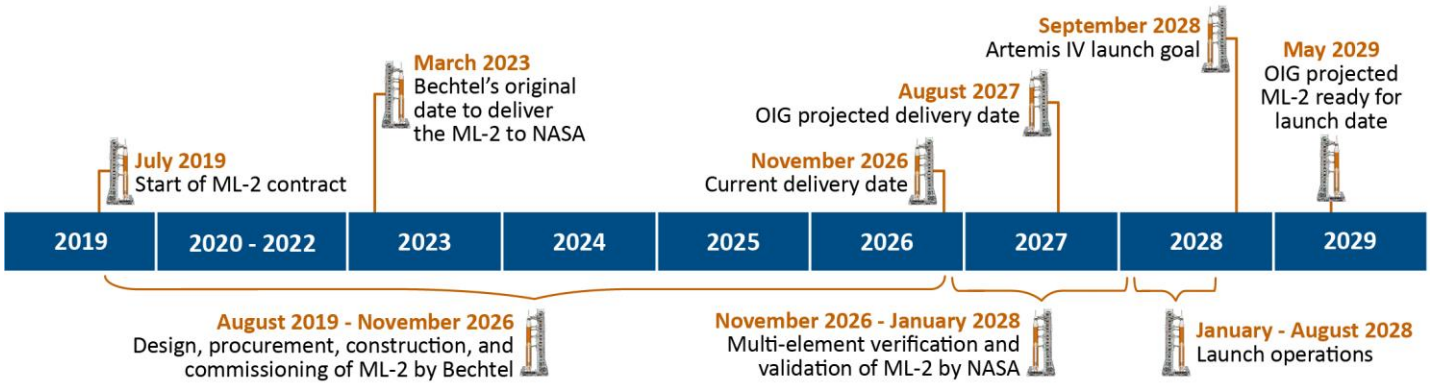
NASA officials disagree with our analysis and expect cost growth to lessen over time now that Bechtel has started construction of the launcher. The Agency believes this is an area of expertise for the contractor. Further, ML-2 project management noted that all material and equipment subcontracts have been awarded and engineering labor should decrease as the design is nearly complete.[21] While progress has been made with the beginning of construction of the ML-2, in our judgment it is still too early to determine the impact on the contract's continued cost growth and whether Bechtel can achieve and sustain an improved level of performance throughout the construction phase. Although a reduction in some estimated costs may eventually occur, we believe that Bechtel has yet to demonstrate the sustained level of performance needed to reduce overall costs and improve the project's timeline for

[21] We did not independently verify the accuracy of this information.

completion. Cost projections for the ML-2 project—whether from the EGS Program, the Independent Review Team, or NASA OIG—reflect each entity's expectations of Bechtel's performance going forward.

Along with significantly increased costs, we project the ML-2 will not be ready by the September 2028 Artemis IV launch date. Currently, Bechtel's estimated date to deliver the ML-2 to NASA is November 2026, more than 3.5 years after the original March 2023 delivery date. Following the handover, NASA will need 12 to 14 months to complete the MEVV process to ensure the ML-2 works as intended. After the MEVV is completed, NASA estimates needing an additional 7 months to perform launch operations, which includes placing the SLS/Orion system on the ML-2 and transporting it to the launch pad. Considering these time frames, the ML-2 would not be ready until late summer 2028, placing the ML-2 on the critical path to Artemis IV with only one month of schedule margin.[22] However, we project the ML-2 will not be delivered to NASA until August 2027, and with the additional time NASA requires after delivery to prepare the launcher, it will not be ready for Artemis IV until spring 2029—surpassing the planned September 2028 launch date.[23] Figure 5 provides an overview of the ML-2 project's current timeline.

Figure 5: ML-2 Project Timeline of Major Milestones (as of July 2024)



Source: NASA OIG analysis of NASA and Bechtel schedule information and OIG projections.

Importantly, if these cost and schedule growth trends continue at the current rate, NASA's budget may not be able to sustain the ML-2's continued development without negatively impacting other Agency programs and projects. Specifically, the ML-2's rising costs and schedule delays are not accounted for in NASA's two most recent budget submissions to Congress. In its FY 2025 budget request, NASA asked for $415.5 million to cover all EGS development costs between FYs 2025 and 2027—an increase of 72 percent over the prior year's request. NASA's justification for these additional funds identifies material cost inflation and government contract changes but does not mention contractor-related performance issues. Including current FY 2024 funding and future budget requests, EGS development

[22] The Critical Path Method calculates the longest sequence (or path) of tasks throughout the entire schedule to completion. A delay of a task on that critical path will impact the completion date of the project or consume any available schedule margin.

[23] The OIG's August 2027 schedule projection is based on cost and schedule data input into the NASA Schedule Analysis Tool, which is used to generate a range of estimated project completion dates. The August 2027 date takes into consideration both worst- and best-case scenarios and assumes that Bechtel's planned tasks will be completed at a similar rate as Bechtel has done in the past.

would be funded (if appropriated by Congress) at a total of $771.7 million through FY 2027. However, considering our projections, NASA would need at least $1.1 billion to complete ML-2 development, leaving a shortfall of nearly $400 million for the EGS Program. This also does not account for other funding requirements outside of the ML-2 project such as refurbishment of the ML-1 after it sustained damage from the launch of the Artemis I mission.

NASA Has a History of Unreliable Cost and Schedule Estimates for the ML-2 Project

Until NASA established the ABC in June 2024, the Agency lacked a cost and schedule estimate, or official baseline, for the ML-2 project. Cost and schedule estimates from both NASA and Bechtel for the ML-2 contract have changed several times and increased significantly over time, making it difficult for NASA to identify its funding needs, be accountable to Congress and other stakeholders, and accurately measure project and contractor performance. The Agency's history of increasing the ML-2's cost estimate over time also contributes to our assessment that costs will be higher than what NASA currently projects in its ABC.

Described below are some of the most significant contract value and cost and schedule estimate changes that occurred prior to the establishment of the ABC, illustrating NASA's previous difficulty in reliably forecasting an accurate cost and schedule:

- **Contract Award**. In June 2019, Bechtel was awarded the $383 million ML-2 contract with a period of performance from July 2019 to March 2023, ending with Bechtel's delivery of the launcher to NASA.
- **Interim Estimate at Completion**. In January 2021, Bechtel began an in-depth assessment of its costs and identified significant potential cost growth. In response to two separate Letters of Concern from NASA, in May 2022, Bechtel provided the Agency an interim cost and schedule estimate—an updated but incomplete projection of the final cost of tasks when complete.[24] This estimate included the initial assessment of the effects from Bechtel's ongoing performance issues, underestimation of work requirements, and impacts from the COVID-19 pandemic. Bechtel's new estimate for the ML-2 contract was approximately $1.2 billion with completion by May 2026, and a risk-informed delivery to NASA in November 2026.[25] According to ML-2 project management, Bechtel's risk-informed estimates did not meet NASA's contract need date and were not within the Agency's budget.
- **Contract Value Changes**. In June 2022, NASA adjusted the ML-2 contract to account for impacts from the COVID-19 pandemic, bringing the contract value to $625 million. By August 2022, NASA increased the contract value based on Bechtel's estimates to over $1 billion (approximately $1.05 billion) and extended the period of performance to May 2026.

[24] By December 2021, NASA had issued Bechtel two Letters of Concern noting the contractor's poor performance and inability to control rising costs and schedule delays, along with other areas of concern such as the contractor's Earned Value Management System (a contractually required tool for measuring and assessing project performance).

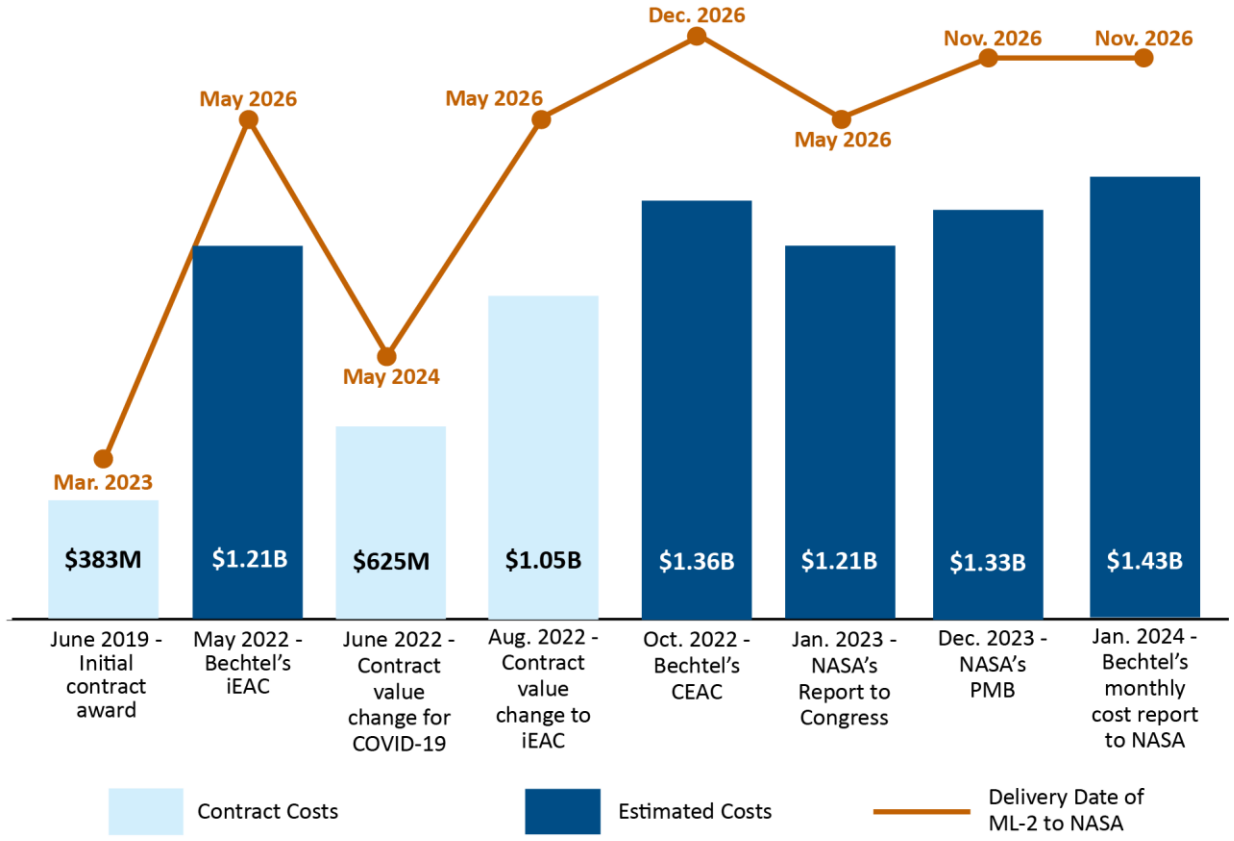
[25] Bechtel's November 2026 date to deliver the ML-2 to NASA includes time built into the schedule in case many of Bechtel's risks are realized, known as the "risk-informed" date. If none of the risks are realized, the earliest delivery date is May 2026, known as the "deterministic" date.

- **Comprehensive Estimate at Completion**. In October 2022, Bechtel completed its cost and schedule assessment and provided NASA with updated estimates. This analysis included an estimated cost to complete the contract at nearly $1.4 billion and a delivery date to NASA in February 2026, with a risk-informed delivery of December 2026—exceeding the contract value of $1.05 billion.
- **Report to Congress**. The FY 2023 Consolidated Appropriations Act directed NASA to submit to Congress a cost and schedule baseline for the ML-2. In response, NASA submitted a report to Congress in January 2023 indicating the ML-2 contract would cost $1.2 billion with a delivery date of May 2026, using Bechtel's Interim Estimate at Completion as the basis for this estimate.
- **Performance Measurement Baseline (PMB)**. In December 2023, NASA established the PMB—the budget and schedule plan for accomplishing the ML-2 contract—at $1.3 billion and November 2026 for Bechtel's delivery date to align more closely with Bechtel's Comprehensive Estimate at Completion. The PMB was confirmed during the Integrated Baseline Review, a NASA-required risk-based review to establish a project performance baseline during which NASA and the contractor ensure the PMB is realistic for accomplishing the work.[26]
- **Monthly Cost Report to NASA**. In accordance with contract requirements, Bechtel includes an Estimate at Completion in their monthly cost reports to NASA. For January 2024—the final month included in our analysis—Bechtel's cost estimate had risen to more than $1.4 billion. These cost reports do not include an estimated delivery date; however, input provided by Bechtel a month prior for the Integrated Baseline Review included a delivery date of November 2026.

Figure 6 depicts the various cost and schedule estimates from NASA and Bechtel.

[26] According to the Bechtel contract and NASA policy, an Integrated Baseline Review should be conducted within 60 calendar days after a significant funding realignment or a significant change in contractual requirements occur (e.g., incorporation of major modifications). Despite major contract value increases in both June 2022 and August 2022, an Integrated Baseline Review was not conducted until December 2023.

Figure 6: NASA and Bechtel ML-2 Contract versus Estimated Costs and Delivery Dates (as of January 2024)



Source: NASA OIG presentation of NASA and Bechtel information.

Note: Interim Estimate at Completion (iEAC), Comprehensive Estimate at Completion (CEAC), and Performance Measurement Baseline (PMB). Delivery dates for the contracted costs represent the end of the contract period of performance, whereas the delivery dates for the estimates are risk informed. Bechtel's CEAC estimate and their January 2024 monthly cost report include the award fee pool of approximately $23 million, whereas NASA's PMB plan of $1.33 billion does not include the fee.

As of June 2024, NASA had increased the contract value to $1.1 billion, which includes $58 million for changes to the award fee evaluation plan. The Agency has consistently maintained a lower contract value than Bechtel's estimates, which according to ML-2 project management, was intended to hold the company accountable to contractual commitments and encourage them to reduce costs and meet the Artemis IV schedule. Despite NASA's attempt to hold Bechtel more accountable for its performance, cost and schedule estimates for ML-2 have continued to increase.

Bechtel's Performance Drove ML-2 Cost Increases and Schedule Delays

While ML-2 project management has reported improvements from Bechtel since our 2022 report, we have again found that Bechtel's performance was the primary reason for the significant cost increases and schedule delays to the design and development of the ML-2. NASA's current contract value of $1.1 billion includes $594 million of Bechtel overruns due to contractor performance, including

underestimation of project scope and complexity along with ongoing technical challenges. These cost overruns account for 82 percent of the contract value increase from the original value of $383 million at contract award in 2019. In addition, approximately $130 million of the contract value increase is related to impacts from the COVID-19 pandemic. Bechtel's performance has also stymied the company's ability to provide a reliable cost and schedule estimate for the project.

Bechtel Continued to Underestimate Scope and Complexity of the ML-2 Project

In 2022, we reported on Bechtel's underestimation of the ML-2's scope and complexity at the onset of the contract, which resulted in significant cost increases in various cost categories. Based on a review of Bechtel's monthly cost reports to NASA over the last 2 years, we found that Bechtel has continued to underestimate costs to complete the ML-2 project. For example, Bechtel's January 2024 monthly cost report lists the Estimate at Completion at $1.4 billion. This is over $1 billion more than the original contract award value of $383 million and nearly 50 percent higher than the $956 million estimate in Bechtel's May 2022 monthly cost report, which the contractor submitted to NASA in the same time frame as its Interim Estimate at Completion. The categories discussed below—labor costs, other direct costs, and indirect costs—represent different components of Bechtel's monthly cost reports to NASA, each of which experienced substantial increases from May 2022 to January 2024.

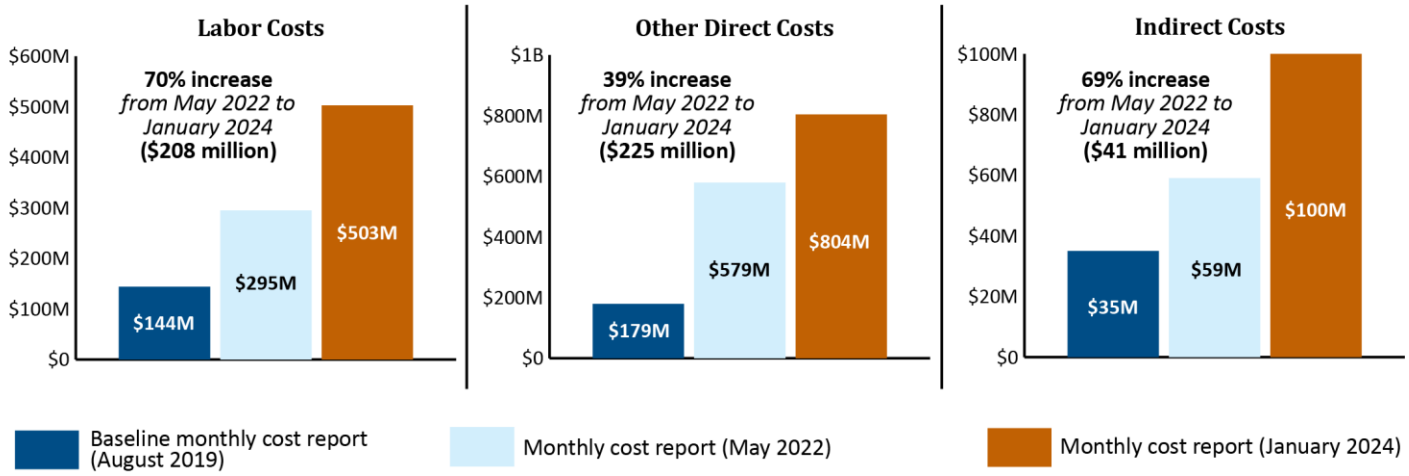
Labor Costs*.* Bechtel vastly underestimated the number of labor hours required to complete the ML-2 project and, as a result, has incurred more labor hours than anticipated. From May 2022 to January 2024, estimated overtime hours doubled to nearly 850,000 hours, reflecting the company's attempts to meet NASA's schedule goals. Overall, Bechtel reported in January 2024 needing 1.7 million more hours than its May 2022 estimate of approximately 4 million. Consequently, standard time costs increased from $181 million to $298 million and overtime costs increased from $26 million to $60 million. Finally, fringe costs, which cover payroll-related expenses such as taxes, insurance, and retirement benefits and are driven by labor hours, rose during this same period from $87 million to $144 million. Labor cost overruns have been attributed to extended design efforts, complexities in different parts of the launcher designs, and construction delays.

Other Direct Costs. This category includes costs associated with equipment, minor subcontractors, and estimated management reserves, among others. Estimated costs for equipment—which include costs related to the procurement and fabrication of steel, aluminum, wiring, and other construction-related material—increased from $264 million in May 2022 to $395 million in January 2024. Estimated costs for minor subcontractors also increased significantly, more than doubling over this same time frame from $86 million to $176 million as Bechtel continued to rely on more vendors to complete work.

Indirect Costs. These costs include overhead and general and administrative expenses. Overhead costs are typically incurred based on labor hours, so as labor hours increase, overhead costs also increase. Given the significant increase in labor hours mentioned above, estimated overhead costs increased accordingly: in January 2024 Bechtel estimated $64 million in overhead costs, 85 percent higher than its May 2022 estimate. General and administrative cost estimates—which account for costs such as those associated with corporate offices, office supplies, and insurance—also rose by nearly 50 percent to $35 million in that same time frame.

Figure 7 shows the increase in costs in these categories—as reported in monthly cost reports to NASA—from the baseline costs in August 2019, to Bechtel's estimates in May 2022, and to the latest monthly cost report included in our analysis from January 2024.

Figure 7: Increase in Bechtel Labor, Other Direct, and Indirect Costs (as of January 2024)



Source: NASA OIG presentation of Bechtel cost information.

Bechtel has misestimated its monthly estimates by at least 10 percent five times over the last 2 years, resulting in a mandatory reporting requirement by NASA's Office of the Chief Financial Officer's Continuous Monitoring Program.[27] Further, the most recent award fee performance evaluation report included in our analysis—which covered April 2023 through September 2023—noted that "it is imperative that the Contractor focus on improving their operating plan forecasts," with current cost overruns described as "unrecoverable through the life of the project and indicative of additional cost risk as design efforts continue to extend longer than planned." Given this continuing trend of substantial cost underestimation, and with nearly 2 years remaining on the contract's period of performance, we expect Bechtel's Estimate at Completion to experience additional growth.

Bechtel's Performance and Technical Challenges Pose Cost and Schedule Risks

Despite Bechtel's past performance issues, according to NASA officials, the company has made significant progress on the ML-2 project since it began construction in August 2023. This includes progress on the ML-2 base structure and completion of the first of seven tower modules in December 2023.[28] In May 2024, Bechtel completed the critical path milestone of "jack and set," which refers to completing the steel frame of the base structure and ensuring its stability for placing the base on top of the crawler-transporter (see Figure 8).[29] Although the jack and set was delayed by 3 months, NASA is optimistic that Bechtel achieving this milestone demonstrates significant performance

[27] NASA instituted the Continuous Monitoring Program to ensure the most accurate financial data is available through ongoing management reviews and validations of financial data so that errors and discrepancies are identified, tracked, and corrected in a timely manner. In accordance with the Continuous Monitoring Program, information shall be requested and reviewed when monthly report actuals are greater than $1 million and NASA Form 533, *Monthly Contractor Financial Management Report*, estimates are off from the actual amounts by at least 10 percent.

[28] Progress on these structures only refers to the steel skeleton, as additional work will be required to install critical piping and electrical equipment.

[29] The crawler-transporter moves the ML-2 between Kennedy's Vehicle Assembly Building and the launch pad.

improvement. However, Bechtel continues to face a variety of technical challenges that risk further cost increases and schedule delays related to steel fabrication and weight management.

Figure 8: Construction of Mobile Launcher 2 at Kennedy Space Center

Base of the ML-2 under construction in April 2024 with the Vehicle Assembly Building in the background

ML-2 base structure mounted on top of the crawler-transporter in May 2024

Source: NASA OIG (left photo) and NASA (right photo).

Steel Fabrication. Steel fabrication is the process by which the prime contractor, Bechtel, delivers designs to its prime steel fabrication subcontractor who is then responsible for creating more detailed steel shop designs that will be used to build the ML-2 structure. Steel fabrication is the primary driver on the ML-2 contract's critical path. Delays in steel deliveries impact the project's schedule because steel is required for the construction of the ML-2 structure. While Bechtel and NASA both reported that supply chain issues have affected the procurement of steel—including increased fabrication costs and longer lead times—ML-2 project management continues to have major concerns about Bechtel's steel fabrication design.

Bechtel is responsible for developing *issue for construction* (IFC) drawings, which are design drawings of the ML-2 structure delivered to Bechtel's primary steel fabrication subcontractor. The prime steel subcontractor is responsible for developing *issue for fabrication* (IFF) drawings, which are detailed steel shop drawings of the components necessary to construct the ML-2. IFF drawings include steel connection details like welding and bolt sizing that are not included in the IFCs. Completed IFFs are sent to steel fabrication shops so they can build the various steel subassemblies for the ML-2 structure. Once the steel pieces are fabricated, the prime steel fabricator delivers the steel to Bechtel for ML-2 construction activities.

Since April 2022, there have been setbacks in the steel fabrication process that have impacted the ML-2 project's schedule. As Bechtel continued to work on the ML-2 design, it sent incremental IFCs to the prime subcontractor to keep steel fabrication moving forward.[30] Once the prime subcontractor created the IFFs—based on the incremental IFCs—and sent them to the steel fabrication shops, the shops sent

[30] NASA agreed with Bechtel's decision to incrementally release the IFCs, but the drawback was that the steel fabricators were not sure if they had a complete or partial steel design.

back over 3,000 Requests for Information (RFI) about the steel design.[31] ML-2 project management reported that this was an excessive number of RFIs, which suggested to them that Bechtel's design was unclear to the steel fabrication shops.

While Bechtel revised its IFCs in response to the RFIs, according to ML-2 project management, the company did not allot sufficient time in its schedule to do so, and this iterative process resulted in cost increases and schedule delays. In mid-2023, ML-2 project management found the delays in steel fabrication and delivery resulted in a 3-month schedule slip, leaving Bechtel with no additional schedule reserve to meet the May 2026 contract end date. Further, project management is tracking additional risks related to steel fabrication delays, which could potentially add $50 million to $85 million to Bechtel's steel fabrication contract.

Additionally, Bechtel has had difficulties managing its numerous subcontractors. In mid-2021, ML-2 project management noted that Bechtel's "interactions and business relationship with the steel fabricator deteriorated to the point of dysfunction," resulting in unresolved fabrication issues that impacted the ML-2 project's critical path. Bechtel's lack of awareness and oversight of critical second-tier subcontractors responsible for steel fabrication contributed to a delayed construction start date. One subcontractor, which Bechtel allocated approximately 46 percent of the fabrication work to, sold all of its shop space to a non-NASA customer because Bechtel's steel fabrication plan lacked a signed contract with the subcontractor. As a result, Bechtel attempted to find another subcontractor with available shop space but was unable to do so in a timely manner. The delay in the steel fabrication process continued to impact the ML-2 project's schedule.

Moreover, Bechtel did not take into consideration the lack of resources at the subcontractor level, which included an insufficient number of certified welders and amount of shop space. By spring 2023, Bechtel had made efforts to improve its subcontractor management by working with the prime steel fabrication subcontractor to bring on additional second-tier subcontractors to complete fabrication work. Bechtel also contracted with a second steel fabrication subcontractor with the intent that another steel fabricator could help move fabrication forward. While Bechtel continued to experience cost and schedule issues associated with its subcontractors, according to ML-2 project management, the company's steel deliveries have shown improvement, with no additional delays from October 2023 through April 2024.

Weight Management. The ML-2 must remain under a certain weight limit requirement due to the maximum capacity of the crawler-transporter. In our 2022 audit on the ML-2 contract, we reported that weight management was a significant issue for Bechtel and one of the primary drivers for cost increases and schedule delays. During the design phase of the launcher, Bechtel reported to NASA in January 2022 that the ML-2 design significantly exceeded its maximum weight limit requirement of approximately 12.4 million pounds.[32] Specifically, the ML-2 design experienced two substantial weight increases in February 2021 and January 2022, bringing its total projected weight to nearly 12.9 million pounds. Once the weight increases were identified, Bechtel stopped working on structural design efforts to focus on

[31] In construction, an RFI is a business process used to request clarification about documents, drawings, specifications, or other project conditions. RFIs are used to resolve information gaps, eliminate ambiguities, and capture and share specific decisions during the course of the project.

[32] Maintaining the ML-2's weight is critical because the crawler-transporter, which will move the ML-2 from the Vehicle Assembly Building to the launch pad, can only carry a maximum of 18 million pounds. Thus, the ML-2 must stay within a certain weight limit because the crawler-transporter will be moving both the ML-2 and the integrated SLS/Orion system to the launch pad.

weight mitigation. NASA worked with Bechtel to stabilize the weight through a combination of redesigns and an increase in the weight limit to establish reasonable margins, but these processes resulted in an approximate 12-to-18-month project delay.

As of March 2024, the ML-2's weight was stable, but weight management continues to be a risk that ML-2 project management is monitoring. This is a particularly important activity considering the damage ML-1 experienced during the November 2022 Artemis I launch. During launch, the SLS generates exhaust blast plume pressure, random vibration, vibration from acoustics, and heat. These loads can cause damage to the launch vehicle, payload, launch pad, and surrounding structures. After the Artemis I launch, NASA found higher-than-expected thermal, acoustic, and blast loads to the ML-1. ML-2 project management is assessing these lessons learned from Artemis I and anticipates the ML-2 structure will require some additional strengthening to withstand the predicted loads. Bechtel is currently analyzing the ML-2 design to determine the extent of changes necessary to fortify the launcher, which may add to the weight of the launcher. If changes are made to the ML-2's design, NASA anticipates further cost increases, though the overall potential increase remains uncertain since post-launch data from Artemis I is still under review and could lead to additional design changes. NASA considers these potential design changes to be the most significant risk to the ML-2 project.

SLS Rocket and Orion Capsule on Top of Mobile Launcher 1 in August 2022 during an Artemis I Launch Attempt

Source: NASA OIG.

NASA Has Taken Steps to Stabilize the ML-2 Project but the Agency Has Few Options to Incentivize Better Contractor Performance

NASA Has Made Advances to Stabilize the ML-2 Project

NASA has made progress in better managing the Bechtel contract since our 2022 report, such as descoping work from the ML-2 contract, minimizing requirements changes, and improving contract management.

Descoping Work from the ML-2 Contract. Efforts to reduce Bechtel's responsibilities have largely focused on removing—or descoping—various ML-2 umbilicals from the contract. Of the 11 umbilicals needed for the launcher, 6 were descoped from the contract after Bechtel encountered difficulties with its subcontractors. NASA then took over the responsibility for procuring these 6 umbilicals and providing them to Bechtel to install on the ML-2 as government-furnished equipment. Specifically, NASA descoped $21.3 million from the Bechtel contract for 4 of the 6 descoped umbilicals and awarded fixed-price task

orders through NASA's existing fabrication contract for a total value of $25 million.[33] While this effort did not save costs, it allowed Bechtel to focus on other tasks and enabled NASA to work directly with fabricators, avoiding potential future Bechtel cost and schedule increases. For the two other descoped umbilicals, one will be purchased under an existing contract, and the acquisition strategy for the other is undetermined as of April 2024. NASA also descoped an additional $1.4 million worth of work from Bechtel's contract for matters unrelated to umbilicals.

Minimizing Requirements Changes. As we noted in our 2022 report, by March 2022 NASA had added approximately $77.2 million and 10 months of additional schedule to the ML-2 contract due to government-driven requirements changes. These changes were the result of the ML-2 contract being awarded to Bechtel while the SLS Exploration Upper Stage—the main driver requiring a second mobile launcher—was early in its design phase and lacked final requirements. However, as of January 2024, there have been no additional SLS Exploration Upper Stage requirements changes affecting the ML-2 project, and total government-driven design changes now total $71.9 million, or approximately 10 percent of the project cost growth as of April 2024.

Improving Contract Management. Following a December 2021 Management Alert from the OIG regarding significant concerns with the ML-2 project's cost and schedule, NASA's Office of Procurement completed an assessment of the project. This resulted in several recommendations related to project management and contract administration. One of those recommendations was to separate the contract's cost tracking into two categories—known as contract line item numbers—representing the design and construction phases.[34] ML-2 contracting officers successfully separated the contract line item numbers between design and construction, providing NASA better visibility into the costs associated with those activities. ML-2 procurement officials also held discussions with Bechtel and other federal agencies that have contracted with Bechtel to better understand how to best incentivize the company. They found Bechtel is most incentivized by objective areas of emphasis—performance elements the government has deemed require the highest priority attention in each award fee evaluation period.

NASA's Leverage to Incentivize Bechtel to Perform Better Is Limited

NASA's primary tool for incentivizing better contractor performance remains the use of award fees. Although NASA previously demonstrated a willingness to hold Bechtel accountable for substandard work, we found the Agency more recently awarded questionable award fees to the company. Separately, while converting the ML-2 contract to fixed-price could provide cost certainty, the Agency has opted to prioritize the mission schedule and maintain a cost-plus contract structure. The anticipated high costs associated with converting the ML-2 contract to fixed-price limits NASA's ability to significantly alter the project's trend of cost and schedule increases.

[33] A fixed-price contract or task order provides a set price that does not change if the contractor's costs increase during the period of performance, resulting in less risk to the government from subcontractors and suppliers.

[34] A contract line item number is a specified portion of work within a contract used to organize and group related work and expenditures.

Use of Award Fees for Contractor Performance

In the nine award fee periods from contract inception in July 2019 through September 2023, NASA has awarded Bechtel approximately $11.2 million (48 percent) out of the total available award fee pool of $23.3 million. To NASA's credit, this included three periods (Award Fee Periods 4, 6, and 7) where Bechtel was not paid any award fees due to receiving "Unsatisfactory" adjective ratings—a rare outcome in the Agency's dealings with its contractors. See Table 2 for a summary of Bechtel's interim award fee ratings through September 2023.

Table 2: Bechtel Interim Award Fee Evaluation Ratings (July 2019 through September 2023)

Award Fee Period	Maximum Available Award Fee	Earned Award Fee	Score	Adjective Rating
Period 1 (July 2019 to September 2019)	$987,907	$790,325	90	Very Good
Period 2 (October 2019 to March 2020)	$1,275,347	$1,020,277	88	Very Good
Period 3 (April 2020 to September 2020)	$4,320,765	$3,456,612	90	Very Good
Period 4 (October 2020 to March 2021)	$4,691,450	$0	45	Unsatisfactory
Period 5 (April 2021 to September 2021)	$5,546,542	$2,939,667	53	Good
Period 6 (October 2021 to March 2022)	$3,622,925	$0	28	Unsatisfactory
Period 7 (April 2022 to September 2022)	$1,581,588	$0	44	Unsatisfactory
Interim Periods 1 through 7	$8,206,881[a]	$8,206,881		
Period 8 (October 2022 to March 2023)	$1,671,470	$1,236,888	74	Good
Period 9 (April 2023 to September 2023)	$2,485,956	$1,740,169	70	Good
Total	**Award fee pool to date:** $12,364,307 **Overall award fee pool:** $23,262,385	$11,183,938	65 (average)	Good (average)

Source: NASA OIG presentation of ML-2 Bechtel contract documentation.

[a] In February 2023, NASA modified the award fee evaluation plan to account for the delayed completion and delivery of the ML-2. This modification increased the number of award fee periods from 8 to 14, aligning the award fee evaluation plan to the revised contract end date which changed from March 2023 to May 2026. While the total award fee pool available remained unchanged, the unearned portion was redistributed over Award Fee Periods 8 to 14.

For the next two periods (Award Fee Periods 8 and 9), NASA awarded Bechtel nearly $3 million largely because the company had met several objective areas of emphasis, such as completing a major design review, beginning construction, and obtaining Earned Value Management System certification from the Defense Contract Management Agency.[35] However, we question these award fees based on remarks in award fee performance evaluation reports from March and September 2023 (for Award Fee Periods 8 and 9, respectively), indicating that Bechtel was still not meeting its baseline cost and schedule goals. Specifically, the award fee justification documentation noted several critical weaknesses during those periods:

- the provision of substandard or unclear engineering designs to its steel fabricators
- a failure to accelerate the construction critical path required for Bechtel to meet NASA's contract need date of May 2026, and instead adding 3 months of potentially unrecoverable schedule slip
- a failure to meet 90 percent of design comment incorporation goals, with some slipping 7 months past the baseline target, risking further delays to fabrication activities[36]
- an inefficient and expensive "corporate process" for implementing engineering changes to over $400 million worth of ground support equipment fabrication
- the completion of only 11 of 30 steel deliveries required to maintain the project's critical path, several of which were out of sequence or otherwise not ready for installation

Despite these documented performance weaknesses, NASA awarded Bechtel a rating of "Good" in both Award Fee Periods 8 and 9, indicating they believed Bechtel "exceeded some of the significant award fee criteria and has met overall cost, schedule, and technical performance requirements of the contract in the aggregate." According to ML-2 project management, Bechtel earned ratings of "Good" after NASA considered Bechtel's combined strengths and weaknesses in those periods. Moreover, Agency officials explained that although the rating is "Good," this rating is not considered a positive accomplishment by either NASA or Bechtel and does not send the message that the Agency is pleased with the contractor's performance. Overall, while Agency officials appear to have followed proper procedures, we disagree with their judgment on the award fee scores. See Appendix B for award fee criteria from NASA and other agencies.

After holding discussions with Bechtel and other federal agencies that have contracted with the company, NASA procurement officials negotiated with Bechtel in March 2024 to revise the contract's award fee evaluation plan to add objective milestone-based incentives as criteria for earning award fees to better incentivize performance.[37] The new plan ties a portion of the fees to specific critical milestones to provide Bechtel additional objective criteria to receive award fees. For example, Bechtel could earn an additional fee by delivering the launcher to NASA earlier than the May 2026 contract end date so the Agency can begin the MEVV process. This would allow NASA to potentially mitigate one of the top risks to the overall Artemis IV September 2028 launch date, given the anticipated timeline needed for MEVV

[35] A part of the U.S. Department of Defense, the Defense Contract Management Agency—which has a Memorandum of Understanding with NASA—is responsible for determining Earned Value Management System compliance.

[36] Incorporating design review comments is critical to achieving 100 percent design completion.

[37] Objective milestone-based incentives involve meeting certain schedule milestones, such as the construction of portions of the ML-2 structure, installation of all umbilicals, and final delivery of the ML-2 to NASA.

activities and launch operations.[38] The updated plan adds $36.5 million in potential fees if Bechtel completes nine objective milestones, while separately increasing the available award fee pool related to the evaluation factors from $23.3 million to $44.7 million. This action increased the total contract value by $58 million to $1.1 billion.

While it is too early to assess the merits of the Agency's revised award fee evaluation plan, the award fee process has not proven to be a strong performance motivator for Bechtel up to this point. NASA has a history of inflating the contractor's scores and providing overly generous award fees to Bechtel. In our 2022 report we questioned $3 million of award fees earned in Award Fee Period 5, and we now question an additional $3 million for Award Fee Periods 8 and 9 (see Appendix C). Increasing the available award fees also allows NASA the flexibility to provide Bechtel award fees for a performance that may not align with the Agency's criteria guidance. Further, the Bechtel contract uses an end-item award fee structure under which the fees earned by the contractor during the award fee periods are not final until completion of the contract. Therefore, at the end of the contract, NASA has discretion to award previously unearned award fees or rescind portions of the previously earned award fees.[39]

Converting to a Fixed-Price Contract

NASA's contract with Bechtel includes an option that allows the contracting officer to request from Bechtel a cost estimate for converting the cost-plus contract to a fixed-price contract following the Interim Critical Design Review, which was completed in March 2023.[40] ML-2 project management told us their original intention was to eventually request a fixed-price proposal to compare the cost difference between the two contract structures. In response to related recommendations from our 2022 report on the ML-2, NASA noted that it was evaluating various contractual options to mitigate Bechtel's cost and schedule issues but would not make a decision on converting to fixed-price until the launcher's design was complete.

While the option officially remains in the contract, NASA officials informed us they do not intend to request a fixed-price proposal from Bechtel. EGS Program and ML-2 project management told us they presume Bechtel would likely provide a cost proposal far beyond NASA's budgetary capacity to account for the additional risk that comes with a fixed-price contract. According to EGS Program management, at the time of contract award, they estimated that performing, evaluating, and negotiating the estimate would take 9 to 12 months at a cost of about $1 million. Bechtel officials advised they do not want the contract converted due in part to the difficulty and cost of making design changes—which they anticipate will recur following subsequent Artemis missions—in a fixed-price environment. Bechtel also said it would cost more than the original $1 million estimate to provide a fixed-price proposal given that construction had already begun and resources would need to be reallocated to develop the proposal while maintaining the pace of construction.

[38] For reference, MEVV activities for ML-1 took between 16 to 18 months, and NASA estimates these activities will take 12 to 14 months for ML-2. At the time of our 2022 report, NASA had only allotted 6 to 9 months for this process.

[39] As part of a contract modification in early 2023 to extend the ML-2 contract's period of performance from March 2023 to May 2026, NASA "locked in" the $8.2 million of award fees earned by Bechtel through September 2022 and reallocated the $15 million unearned portion across the remainder of the contract. Unless there are further modifications, at the contract's end NASA will have discretion to award additional award fees from October 2022 onward.

[40] The Critical Design Review demonstrates the design is sufficiently mature to proceed to full-scale fabrication, assembly, integration, and testing, and that the technical effort is on track to meet performance requirements within identified cost and schedule constraints.

Aside from the financial and administrative concerns, Bechtel indicated it may replace its entire ML-2 project management team if the contract was converted to fixed-price, which would imperil existing relationships and lines of communication between NASA and Bechtel. The ML-2 project team previously experienced issues with Bechtel leadership turnover, which is currently on its fourth leadership team. According to ML-2 project management, they have a positive relationship with Bechtel's current project management and maintaining this relationship is in the best interest of the project.

Moving forward, some NASA procurement officials believe a conversion is still possible as the construction phase continues. ML-2 project management noted that a conversion could be leveraged in future negotiations with Bechtel on separate issues such as further award fee evaluation plan adjustments. However, because any potential conversion to a fixed-price contract would require bilateral agreement between NASA and Bechtel, Federal Acquisition Regulations limit the Agency's ability to unilaterally convert the contract.[41] Further, NASA's minimal schedule margin in its Artemis IV schedule to accommodate ML-2 alternatives—such as terminating the current ML-2 contract with Bechtel and procuring a new contract or making adjustments to ML-1 instead of using the ML-2, both considered unreasonable by project management at this point—prevents NASA from substantially adjusting its current course of action.

[41] Federal Acquisition Regulation 16.103, *Negotiating contract type* (2024), and Federal Acquisition Regulation 43.103, *Types of contract modifications* (2024).

CONCLUSION

The ML-2 is a critical part of the infrastructure needed to launch larger variants of the integrated SLS/Orion system, beginning with the Artemis IV mission. Bechtel was initially contracted to design, build, and test the ML-2 for $383 million and deliver it to NASA by March 2023. However, the contract value has nearly tripled to $1.1 billion and the delivery date has been delayed by more than 3 years to May 2026.

Cost and schedule estimates from both NASA and Bechtel for the ML-2 contract have changed several times and increased significantly over time. NASA's lack of an official baseline for the first 5 years of the ML-2 project has limited visibility into its potential total cost and the information needed for Congress and others to better hold the Agency accountable. In June 2024, NASA established a commitment to Congress for a total ML-2 project cost of $1.8 billion and a delivery date of September 2027. We project, however, that the ML-2's total cost could reach $2.7 billion by the time Bechtel delivers the launcher to NASA in 2027.

NASA officials are encouraged by recent progress as ML-2 project management reports the design is nearly complete and the frame of the base structure and first tower module are complete. While officials expect cost growth to lessen over time now that Bechtel has started construction of the launcher, it is too soon to tell if these developments will have an impact on the overall cost growth and schedule delays. Although NASA has taken steps to better manage the Bechtel contract since our 2022 report, the Agency has limited leverage to incentivize the company to further improve its performance. Since the ML-2 is critical to Artemis IV and future missions, NASA must effectively manage the project to control cost increases and avoid further schedule delays.

RECOMMENDATIONS, MANAGEMENT'S RESPONSE, AND OUR EVALUATION

To improve NASA's management of the ML-2 project, we recommended the Associate Administrator for Exploration Systems Development Mission Directorate:

1. Ensure lessons learned from the ML-2's acquisition, contract, and project management are codified to inform future development efforts.
2. Conduct a thorough analysis of the feasibility of utilizing the fixed-price option, and if NASA determines that it will not be exercised, remove the option from the ML-2 contract.

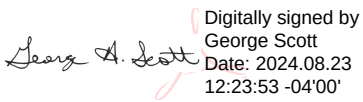
We provided a draft of this report to NASA management. In their response, management disagreed with the OIG's cost projection for the ML-2. Our projection was based on the substantial cost growth the contract incurred over the last 3 years. While we acknowledge the project is now in the construction phase, we are less optimistic than the Agency that the contractor can sustain the level of performance needed to significantly reduce costs. Given past performance and the significant amount of work that remains, we believe our cost projection is credible.

NASA concurred with Recommendation 1 and partially concurred with Recommendation 2 and described planned actions to address them. We consider the proposed actions responsive and will close the recommendations upon completion and verification of the proposed corrective actions.

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

Major contributors to this report include Ridge Bowman, Human Exploration Audits Director; Susan Bachle, Assistant Director; Dan Fenzau; Areeba Hasan; Tyler Martin; Michele Schaeffer; and Lauren Suls.

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



George A. Scott
Deputy Inspector General

APPENDIX A: SCOPE AND METHODOLOGY

We performed this audit from September 2023 through July 2024 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

We examined NASA's management of the ML-2 project to include both Bechtel's contract performance and NASA's overall project cost and schedule management. To assess the ML-2 project, we conducted interviews with officials from the ML-2 project office at Kennedy Space Center, EGS Program, Moon to Mars Program Office, Kennedy Space Center Office of Procurement, Defense Contract Management Agency, and Bechtel. In preparation for the audit, we conducted routine coordination with the Associate Counsel to the Inspector General and the OIG Office of Investigations.

To assess Bechtel's contract performance and NASA's cost and schedule management of the ML-2 project, we reviewed ML-2 contract modifications from July 2019 through March 2024, Bechtel's monthly financial reports (known as NASA Form 533M) from July 2019 through January 2024, project risk documentation, award fee performance evaluation reports, Contracting Performance Assessment Reporting System reports, key milestone documentation, and schedule reports. We also conducted interviews with Moon to Mars Program Office officials, the EGS program manager, the ML-2 program manager and deputy program manager, ML-2 contracting officers and contracting officer's representatives, and where appropriate, resource analysts, to discuss Bechtel's contract performance and NASA's cost and schedule management.

Assessment of Data Reliability

We used limited computer-processed data for this audit. We reviewed and analyzed NASA cost, obligation, and funding data from FYs 2019 to 2024 in NASA's financial accounting system. The obligation and funding data was derived from the ML-2 project. We concluded that the data was sufficiently reliable for the purposes of this audit.

We also collaborated with the OIG's Office of Data Analytics to use the NASA Schedule Analysis Tool, which resides in the Agency's One NASA Cost Engineering database. NASA personnel can request access to the database and use it to make project schedule projections. The tool used three methodologies with each projecting a separate ML-2 contract end date—the date Bechtel will hand the launcher over to NASA. The first was based on task completion, the second on work completed and efficiency of completed tasks, and the third on planned work being completed at the same level of past performance. We selected the third methodology as the basis for our projection of the ML-2 contract's end date, which fell in the middle of the other two dates. We concluded the data obtained from the NASA Schedule Analysis Tool was sufficiently reliable for the purposes of this audit.

Review of Internal Controls

We reviewed and evaluated the internal controls associated with the management of the ML-2 project. We also reviewed appropriate policies, procedures, and regulations, and conducted interviews with responsible personnel. We concluded that the internal controls were adequate, but because our review was limited to these internal control components and underlying principles, it may not have captured all internal control deficiencies at the time of this audit. Our recommendations, if implemented, will correct the identified control weaknesses.

Prior Coverage

NASA OIG and the Government Accountability Office have issued nine reports containing significant relevance to the subject of this report. Unrestricted 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 Supply Chain (IG-24-003, October 19, 2023)

NASA's Management of the Space Launch System Booster and Engine Contracts (IG-23-015, May 25, 2023)

NASA's Management of the Mobile Launcher 2 Contract (IG-22-012, June 9, 2022)

Artemis Status Update (IG-21-018, April 19, 2021)

Audit of NASA's Development of Its Mobile Launchers (IG-20-013, March 17, 2020)

Government Accountability Office

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

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

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

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

APPENDIX B: AWARD FEE CRITERIA FROM NASA AND OTHER AGENCIES

During this audit, we learned that NASA's interpretation of the award fee criteria—scoring and adjective ratings—does not align with federal guidance. NASA, the U.S. Department of Defense, and the Office of Management and Budget have all released relevant guidance on the management of award fees.

For example, NASA's *Award Fee Contracting Guide* outlines when it is best to use cost-plus-award-fee contracts, performance incentives, and award fees. As a general rule, the guide states that "a contractor which satisfactorily meets its contractual commitment will fall into the 'satisfactory' range," thereby earning a score of no more than 50. When scoring the cost control evaluation category, the guide also notes that "whenever there is a significant cost overrun that was within its control, a contractor should be given a score of zero."

Similar guidance from the Department of Defense, released in 2016, emphasizes that award fees must be earned by the contractor. It states that "the contractor begins each evaluation period with 0 percent of the available award fee and works up to the evaluated fee for each evaluation period. Contractors do not begin with 100 percent of the available award fee and have deductions taken to arrive at the evaluated fee for each evaluation period." The guidance also notes that the Department of Defense has generally shifted away from award fee contracts "because of concerns that award fee contracts are limited in their ability to motivate contractors to control costs."

The Office of Management and Budget released guidance for all federal agencies on their use of award fees in December 2007. The guidance states that award fees "must be tied to demonstrated results, as opposed to effort, in meeting or exceeding specified performance standards." It also lists several practices identified by the Government Accountability Office as reducing the effectiveness of award fees as a motivational tool for contractors. They include

- evaluating contractors on incentive criteria that are not directly related to cost, schedule, and performance goals;
- paying contractors a significant portion of the available fee for what is considered acceptable or satisfactory performance; and
- giving contractors additional opportunities to obtain initially unearned fees, also known as rollover fees.

APPENDIX C: ML-2 AWARD FEE QUESTIONED COSTS

Table 3 summarizes the questioned costs identified during out audit and discussed in this report. The questioned costs are the result of the improper award fees NASA gave Bechtel in 2023 for Award Fee Periods 8 and 9. Based on our audit work, Bechtel should not have received any award fees as they were experiencing significant cost, schedule, and management performance challenges.

Table 3: Questioned Costs and Associated Recommendations

Issue	Recommendation Number	Questioned Cost
Unsupported award fee given to Bechtel during Award Fee Period 8	1	$1,236,888
Unsupported award fee given to Bechtel during Award Fee Period 9	1	$1,740,169
	Total	**$2,977,057**

Source: NASA OIG analysis.

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

APPENDIX D: MANAGEMENT'S COMMENTS

National Aeronautics and Space Administration

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

Reply to Attn of: Exploration Systems Development Mission Directorate

TO: Assistant Inspector General for Audits

FROM: Associate Administrator for Exploration Systems Development Mission Directorate

SUBJECT: Agency Response to OIG Draft Report, "NASA's Management of the Mobile Launcher 2 Project" (A-23-14-00-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 Mobile Launcher 2 Project" (A-23-14-00-HED), dated July 16, 2024.

As NASA's first crewed Artemis mission approaches, the programs within the Exploration Systems Development Mission Directorate (ESDMD) are embarking on one of humanity's most daring quests--to venture deep into space with human explorers. This ambitious endeavor aims not just for discovery and scientific advancement, but also seeks to ignite inspiration on a scale unparalleled in history. NASA's commitment to this mission is profound, underscoring the gravity of the Agency's responsibilities in pushing the boundaries of human exploration. The Exploration Ground Systems (EGS) Program develops and operates the systems and facilities needed to process and launch rockets and spacecraft for NASA's Artemis missions. EGS plays a primary role in assembly, launch, and recovery of rockets and spacecraft.

NASA remains steadfast in acknowledging the OIG's pivotal role in advancing accountability and transparency within the Artemis Campaign. ESDMD continues to commit to cooperation with the OIG, ensuring access to all pertinent information and documents essential for its audits, evaluations, and inquiries. During this specific audit, ESDMD provided 372 products, attended 8 requested meetings, and participated in 21 hours of interviews. Altogether, this activity recorded an estimated 180 hours of work from our ESDMD team.

As stated in the report, NASA recently set the Mobile Launcher 2 (ML2) Agency Baseline Commitment (ABC) of $1.873 billion. ESDMD disagrees with the OIG-projected ML2 cost estimate of $2.7 billion. Simply using a straight-line extrapolation, as the OIG did, does not accurately reflect the current development situation. EGS has transitioned to a different phase of the project (i.e., construction) than what was in place at the beginning of the audit (i.e., the design phase). Application of a straight-line projection misses this key advancement, overlooks recent performance improvements, and does not provide a credible

estimate of what we can expect in the future. For example, the OIG states its concern for the increased cost associated with equipment, minor subcontractors, and estimated management reserves, which includes costs related to the procurement and fabrication of steel, aluminum, wiring, and other construction-related material. Prior to the release of this draft report, contracts were put in place for 90 percent of materials and sub-contracts and 60 percent of all steel was delivered, with 70-80 percent in process to be delivered by October 1, 2024.

ESDMD values the OIG's commitment to updating cost and schedule data during the audit to incorporate the latest ML2 information. However, the extended duration and pace of the audit created challenges and resulted in a misrepresented performance profile. The OIG projected a linear performance whereas the actual performance is nonlinear in nature. Cost reports through April 2024 further reinforce NASA's cost estimate. ESDMD calculates that the current OIG estimate would be reduced by 15 percent based on recent reports provided by the prime contractor, Bechtel National, Inc. (Bechtel), further illustrating the nonlinear relationship.

The OIG states that by its projections, the ML2 will not be ready in time for the September 2028 Artemis IV launch readiness date. The ML2 ABC was established to reflect the most current position of the project taking into consideration that the ML2 has transitioned from design phase into construction phase. In prior estimates, the complete scope of the ML2 was underestimated but is now fully understood and risks associated with uncertainties have been included in NASA's estimate. NASA also worked with Bechtel to establish and negotiate an incentive plan to motivate cost and schedule performance. To date, these changes have shown a positive effect. ESDMD continues to closely monitor Bechtel's progress and remains confident in NASA's ABC to complete ML2 by 2027.

NASA appreciates the OIG's acknowledgement of our improvement efforts to manage the Bechtel contract. The report states that a primary tool for incentivizing better contractor performance remains the use of award fees; however, the OIG disagrees with NASA's judgment on the Bechtel award fee scoring. The process of awarding fees involves rigorous evaluation and feedback from multiple stakeholders and a consideration of the entire context within which the work is completed. NASA adheres to Federal Acquisition Regulation (FAR) requirements for all award fee assessments, and an independent group conducts the evaluations. The award fee structure considered specific, documented areas of emphasis and efforts necessary to reestablish project momentum and ensure successful outcomes. The award fee decisions were made by the Center Director of the Kennedy Space Center, who, as the Fee-Determining Official, was closely involved in overseeing the work and evaluating performance. Additionally, an Award-Fee Board provided thorough analysis and feedback on all inputs related to technical, cost, and schedule aspects. The award fee process underwent review and approval by NASA's General Counsel and senior managers. Most importantly, there were no violations of FAR requirements during these activities.

NASA places a strong emphasis on contractor performance as a cornerstone of its mission success. By holding contractors to high standards and fostering a culture of accountability, NASA ensures that projects are executed with excellence and efficiency. The award fee mechanism plays a crucial role in this framework by incentivizing contractors to go above and beyond basic contract requirements. Recently, Bechtel completed a critical integration

milestone two weeks ahead of schedule, marking a critical advancement in its construction and assembly capabilities within the Artemis Campaign. The integration of the "Jack and Set" milestone, which allowed the entire base to be weighed and the project to be deemed within anticipated weight margins, demonstrated Bechtel's ability to meet stringent technical requirements and timelines set by NASA, as well as proved out the utility of the new incentive fee process.

NASA's dedication to the ML2 ABC underscores its commitment to accountability, transparency, and responsible stewardship of resources. NASA aims to maintain alignment with strategic objectives, effectively manage risks, and deliver on its promises to stakeholders, including the American public. This commitment drives continuous improvement and innovation across all facets of NASA's operations, ensuring that projects are executed efficiently and effectively to advance exploration, scientific discovery, and space exploration capabilities.

The OIG makes two recommendations addressed to the Associate Administrator (AA) for ESDMD to improve NASA's management of the ML2 project.

Specifically, the OIG recommends the AA for ESDMD:

Recommendation 1: Ensure lessons learned from the ML2's acquisition, contract, and project management are codified to inform future development efforts.

Management's Response: NASA concurs.

Lessons learned are an important aspect to NASA's program/project management approach. NASA Procedural Requirements (NPR) 7120.5F, NASA Space Flight Program and Project Management Requirements, Section 3.2.1.c., requires Mission Directorates to capture lessons learned for use in developing constructive solutions for future programs/projects. As was demonstrated with the first mobile launcher (ML1) development project, EGS will develop a similar product for ML2. Upon completion of the ML2 project, the EGS Program will conduct an ML2 knowledge capture lessons learned study and document the results, which will be submitted to the ML2 stakeholders for future use consistent with the OIG recommendation.

Regarding the questioned costs in Appendix C referencing recommendation one, NASA addresses the award fee process within this Agency response letter. NASA will determine whether it agrees or disagrees with the concerns expressed in Appendix C of the report and will subsequently communicate its management decision to the OIG. ESDMD estimates it will complete this analysis by December 2024.

Estimated Completion Date: February 29, 2028, which is six months after the planned completion of ML2.

Recommendation 2: Conduct a thorough analysis of the feasibility of utilizing the fixed-price option, and if NASA determines that it will not be exercised, remove the option from the ML2 contract.

Management's Response: NASA partially concurs.

The Fixed-Price Proposal Deliverable Requirement Document (DRD) does not provide an "option" to convert the contract type. The contract allows for NASA to solicit a proposal with updated terms and conditions. It is not an "option" to be exercised, it is a deliverable required of the contractor if NASA decides to issue a request for proposal with restructured terms and conditions.

NASA agrees and conducted an analysis of utilizing the fixed-price DRD 1.0-8 to convert the contract to fixed-price. The Agency determined that the inherent advantages to a firm-fixed-price type contract do not outweigh the potential costs/impacts at this time. For example, such a change in the current supply chain market would drive higher upfront costs to cover the contractor's fixed price risk, disrupt the project team to develop the cost proposal, and direct costs to the Government to develop the proposal.

ESDMD does not concur with removing this DRD from the contract. Changes and adjustments to a contract necessitates administrative efforts to update documentation and could impose additional administrative burdens and costs. The process often involves renegotiating terms with the contractor, potentially leading to disputes over contractual obligations, terms, or the interpretation of clauses. Leaving the DRD on the contract allows for future flexibility ensuring NASA's ability to adapt to new information or changing circumstances without requiring a complete renegotiation.

Estimated Completion Date: February 1, 2025.

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.

CATHERINE KOERNER
Digitally signed by CATHERINE KOERNER
Date: 2024.08.12 10:01:06 -05'00'

Catherine A. Koerner

APPENDIX E: REPORT DISTRIBUTION

National Aeronautics and Space Administration

Administrator
Deputy Administrator
Associate Administrator
Chief of Staff
Associate Administrator for Exploration Systems Development Mission Directorate
Exploration Ground Systems Program Manager
ML-2 Project Executive
Kennedy Space Center Director

Non-NASA Organizations and Individuals

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

Government Accountability Office
    Director, Contracting and National Security Acquisitions

Bechtel National, Inc.

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 Space and Science

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 Accountability
    Subcommittee on Government Operations and the Federal Workforce

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

(Assignment No. A-23-14-00-HED)