441 G St. N.W.
Washington, DC 20548

Comptroller General
of the United States

July 20, 2022

The Honorable Bill Nelson
Administrator
National Aeronautics and Space Administration
300 E Street Southwest
Washington, DC 20546

Priority Open Recommendations: National Aeronautics and Space Administration

Dear Administrator Nelson:

The purpose of this letter is to provide an update on the overall status of the National Aeronautics and Space Administration's (NASA) implementation of GAO's recommendations and to call your personal attention to areas where open recommendations should be given high priority.[1] In November 2021, we reported that, on a government-wide basis, 76 percent of our recommendations made 4 years ago were implemented.[2] NASA's recommendation implementation rate during this period was 100 percent. As of May 2022, NASA had 49 open recommendations. Fully implementing these open recommendations could significantly improve agency operations.

Since our June 2021 letter on open priority recommendations, NASA has implemented four of our 11 open priority recommendations.[3] Specifically, NASA

- established a time frame to develop an inventory and documentation of electronic information systems used to store agency records that includes all of the required elements in the *Managing Government Records Directive*.[4] NASA also identified an application that would be used for the entire agency's inventory of electronic information systems. These actions will better position NASA to reduce the heightened risk of records being lost and not identified and scheduled in accordance with agency records schedules.

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[1]Priority recommendations are those that GAO believes warrant priority attention from heads of key departments or agencies. They are highlighted because, upon implementation, they may significantly improve government operation, for example, by realizing large dollar savings; eliminating mismanagement, fraud, and abuse; or making progress toward addressing a high-risk or duplication issue.

[2]GAO, *Performance and Accountability Report: Fiscal Year 2021*, GAO-22-4SP (Washington, D.C.: Nov. 15, 2021).

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

[4]The *Managing Government Records Directive* (M-12-18) jointly issued by the Office of Management and Budget and the National Archives and Records Administration (NARA), started a government-wide effort to reform federal records management. GAO, *Information Management: Selected Agencies Need to Fully Address Federal Electronic Recordkeeping Requirements*, GAO-20-59 (Washington, D.C.: Feb. 27, 2020).

- included an Earned Value Management System Surveillance requirement in its NASA Procedural Requirements 7120.5F, NASA Space Flight Program and Project Management Requirements.[5] By establishing a surveillance requirement, NASA will improve the reliability and utility of its earned value management data, which will help reduce acquisition risks.

- established a process for aggregating and assessing cyber risk information across its enterprise.[6] Specifically, NASA uses an agency-wide scorecard to aggregate and assess key cyber risk indicators and provides an enterprise-wide view of its cybersecurity risk. By establishing such a process, NASA is better positioned to identify trends or prioritize investments in cybersecurity risk mitigation activities.

- approved an updated cost and schedule baseline for the second test flight of the Orion system, in accordance with best practices and based on an updated Joint Cost and Schedule Confidence Level analysis.[7] This analysis provides decision makers important information about the program's cost and schedule risks needed to make programmatic decisions.

We ask that you direct your attention to the remaining seven priority recommendations. We are also adding two new recommendations related to NASA (1) using outcome-oriented performance metrics to manage the agency's procurement organizations and (2) documenting the process used to determine the management practices and tools that it will apply to the lunar landing and later missions. This brings the total number of open priority recommendations to nine. (See the enclosure for the list of recommendations.)

The nine priority recommendations fall into the following three major areas.

Monitoring program costs and execution. NASA's acquisition management is one of the highest risks facing the agency due to the history of cost growth and schedule delays of its major projects.

Implementing seven priority recommendations in this area is critical for NASA to provide assurance that it will sustain the progress it has made toward addressing key acquisition management issues on its largest and most complex missions. These recommendations primarily focused on improving transparency into long-term costs and affordability of human spaceflight programs and improving the reliability of data used to inform acquisition decisions. For example, NASA should establish cost and schedule baselines for Space Launch System (SLS) Block 1B, SLS Block 2, Mobile Launcher 2, and Orion Docking System at their preliminary design reviews or as soon as practicable in advance of critical design reviews to ensure that each project is sufficiently mature to begin development and that the cost and schedule are adequate to enable mission success with acceptable risk. In addition, NASA has yet to create a life-cycle cost estimate for the Artemis III mission, which is important as NASA plans for this mission to return U.S. astronauts to the surface of the Moon by 2025.

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[5]GAO, *NASA: Earned Value Management Implementation across Major Spaceflight Projects is Uneven,* GAO-13-22 (Washington, D.C.: Nov. 19, 2012).

[6]GAO, *Cybersecurity: Agencies Need to Fully Establish Risk Management Programs and Address Challenges,* GAO-19-384 (Washington, D.C.: July 25, 2019).

[7]GAO, *Orion Multi-Purpose Crew Vehicle: Action Needed to Improve Visibility into Cost, Schedule, and Capacity to Resolve Technical Challenges*, GAO-16-620 (Washington, D.C.: July 27, 2016).

Ensuring cybersecurity. We have designated information security as a government-wide, high-risk area since 1997 and subsequently expanded this high-risk area to include protecting cyber critical infrastructure and securing personally identifiable information. Accordingly, federal agencies need to take urgent actions to ensure that they have programs in place to protect their information technology systems and sensitive information against increasing cyber risks. We have one priority recommendation aimed at NASA having a qualified, well-trained cybersecurity workforce. While some steps have been taken, NASA still needs to provide evidence that it assessed the accuracy of its information technology, cybersecurity, or cyber-related position descriptions for us to consider the recommendation fully implemented.

Federal contracting metrics. We found that the use outcome-oriented performance metrics to manage procurement organizations helps organizations to determine whether they are achieving desired outcomes, such as reducing costs and improving performance. Our one priority recommendation in this area is for NASA to use a balanced set of performance metrics to manage the agency's procurement organizations, including outcome-oriented metrics to measure (a) cost savings/avoidance, (b) timeliness of deliveries, and (c) quality of deliverables.

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In March 2021, we issued our biennial update to our High-Risk List, which identifies government operations with greater vulnerabilities to fraud, waste, abuse, and mismanagement or the need for transformation to address economy, efficiency, or effectiveness challenges.[8]
One of our high-risk areas—NASA Acquisition Management—centers directly on NASA.

Several other government-wide, high-risk areas also have direct implications for NASA and its operations, including (1) improving the management of IT acquisitions and operations, (2) improving strategic human capital management, (3) managing federal real property, (4) ensuring the cybersecurity of the nation,[9] and (5) government-wide personnel security clearance process. We urge your attention to the NASA and other government-wide, high-risk issues as they relate to NASA. Progress on high-risk issues has been possible through the concerted actions and efforts of Congress, Office of Management and Budget, and the leadership and staff in agencies, including within NASA.

Copies of this report are being sent to the Director of the Office of Management and Budget and appropriate congressional committees including the Committees on Appropriations, Budget, and Homeland Security and Governmental Affairs, and Commerce, Science, and Transportation, United States Senate; and the Committees on Appropriations, Budget, and Oversight and Reform, and Science, Space, and Technology, House of Representatives. In addition, the report will be available on the GAO website at http://www.gao.gov.

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

[9]With regard to cybersecurity, we also urge you to use foundational information and communications technology supply chain risk management practices set forth in our December 2020 report: GAO*, Information Technology: Federal Agencies Need to Take Urgent Action to Manage Supply Chain Risks*, GAO-21-171 (Washington, D.C.: Dec. 15, 2020).

I appreciate NASA's continued commitment to these important issues. If you have any questions or would like to discuss any of the issues outlined in this letter, please do not hesitate to contact me or Timothy J. DiNapoli, Managing Director, Contracting and National Security Acquisitions, at 202-512-4841 or DinapoliT@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Our teams will continue to coordinate with your staff on all of the 49 open recommendations, as well as those additional recommendations in the high-risk areas for which NASA has a leading role. Thank you for your attention to these matters.

Sincerely yours,

Gene L. Dodaro
Comptroller General
of the United States

Enclosure(s) – 1

cc: The Honorable Shalanda Young, Director, Office of Management and Budget
       Mr. Robert D. Cabana, Associate Administrator, NASA
       Mr. James Free, Associate Administrator for Exploration Systems Development, NASA
       Mr. Jeffrey Seaton, Chief Information Officer, NASA

Enclosure

Priority Open Recommendations to National Aeronautics and Space Administration (NASA)

Monitoring Program Costs and Execution

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

Recommendation: To provide the Congress with the necessary insight into program affordability, ensure its ability to effectively monitor total program costs and execution, and facilitate investment decisions, the NASA Administrator should direct the Human Exploration and Operations Mission Directorate to establish a separate cost and schedule baseline for work required to support the Space Launch System (SLS) Block I Exploration Mission (EM)-2 and report this information to the Congress through NASA's annual budget submission.[10] If NASA decides to fly the SLS Block I beyond EM-2, NASA should establish separate life-cycle cost and schedule baseline estimates for those efforts, to include funding for operations and sustainment, and report this information annually to Congress via the agency's budget submission.

Actions Needed: NASA partially agreed with this recommendation, stating that it defined and documented life-cycle costs for SLS to a first demonstrated capability, consistent with cost estimating best practices and NASA project and program management policy. In April 2021, NASA stated that it planned to establish a cost and schedule baseline for the SLS Block 1B Exploration Upper Stage and associated capabilities in 2021. Further, NASA stated that it would identify for Exploration Systems Development programs a transition point for sustainment and operations and provide a 5-year cost estimate of production and operation costs on an annual basis. To fully implement this recommendation, NASA needs to provide documentation of these efforts to determine the extent to which it has developed cost and schedule estimates for future SLS work. This will provide insight into the program's costs and allow decision makers to monitor program execution, including efforts to improve long-term affordability.

Recommendation: To provide the Congress with the necessary insight into program affordability, ensure its ability to effectively monitor total program costs and execution, and facilitate investment decisions, the NASA Administrator should direct the Human Exploration and Operations Mission Directorate to establish separate cost and schedule baselines for each additional capability that encompass all life-cycle costs, to include operations and sustainment. NASA intends to use the increased capabilities of the SLS, Orion, and Ground Systems Development and Operations efforts well into the future and has chosen to estimate costs associated with achieving those capabilities. When NASA cannot fully specify costs due to lack of well-defined missions or flight manifests, it should forecast a cost estimate range—including life-cycle costs—having minimum and maximum boundaries. These baselines or ranges should be reported to Congress annually via the agency's budget submission.

Actions Needed: NASA partially agreed with this recommendation, stating that it had established separate programs for SLS, Orion, and the ground systems and adopted a block upgrade approach for SLS. In April 2021, NASA stated that it planned to establish in 2021: (1) an updated baseline commitment of the Orion system for Artemis II to include a docking

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[10]EM-2 was renamed Artemis II when NASA renamed its efforts to return to the Moon and eventually on to Mars.

capability; and (2) a separate cost and schedule baseline commitment for work required to support the SLS Block 1B Exploration Upper Stage and Mobile Launcher 2.

Further, NASA stated that it will identify for Exploration Systems Development programs a transition point for sustainment and operations and provide a 5-year cost estimate of production and operation costs on an annual basis. NASA established an updated baseline commitment of the Orion system for Artemis II to include a docking capability in August 2021. As of June 2022, NASA had not established separate cost and schedule baselines for each additional SLS and Exploration Ground Systems capability block.

To fully implement this recommendation, NASA needs to provide evidence that it established separate cost and schedule baselines for each additional SLS and Exploration Ground Systems capability block that encompass all life-cycle costs, including operations and sustainment. Delineating costs for operations and sustainment of the initial capabilities or separate cost and schedule baselines for future capabilities will improve the ability to assess program affordability by decision makers.

Director: W. William Russell, Contracting and National Security Acquisitions
Contact information: russellw@gao.gov, (202) 512-4841

Space Launch System: Resources Need to Be Matched to Requirements to Decrease Risk and Support Long Term Affordability. GAO-14-631. Washington, D.C.: July 23, 2014.

Recommendation: To provide the Congress with the necessary insight into program planning and affordability, and to decrease the risk of cost and schedule overruns, the NASA Administrator should direct the Human Exploration and Operations Mission Directorate to structure each future increment of SLS capability—with a total cost exceeding the $250 million threshold for designation as a major project—as a separate development effort within the SLS program. In doing so, NASA should require each increment to complete both the technical and programmatic reviews required of other major development projects, per the agency's acquisition and system engineering policies.

Actions Needed: NASA agreed with this recommendation. In April 2021, NASA stated that it planned to establish separate cost and schedule baselines for work required to support the SLS Block 1B Exploration Upper Stage and Mobile Launcher 2 and to update the Orion baseline to include docking capability. NASA established an updated baseline commitment of the Orion system for Artemis II to include a docking capability in August 2021. As of June 2022, NASA had not established separate cost and schedule baselines for each additional SLS and Exploration Ground Systems block.

To fully implement this recommendation, NASA needs to provide evidence that it established separate cost and schedule baselines for each additional SLS and Exploration Ground Systems block exceeding the $250 million threshold for designation as a major project. Further, NASA needs to provide evidence that each capability upgrade is designated a major project and is required to complete the technical and programmatic reviews required of other major development projects. Structuring future SLS increments as separate development efforts can provide decision makers transparency into costs and enable them to assess long-term affordability and progress.

Recommendation: To provide the Congress with the necessary insight into program planning and affordability, and to decrease the risk of cost and schedule overruns, NASA's Administrator should direct the Human Exploration and Operations Mission Directorate to identify a range of possible missions for each future SLS variant that includes cost and schedule estimates and plans for how those possible missions would fit within NASA's funding profile.

Actions Needed: NASA agreed with this recommendation. In April 2021, NASA stated that it planned to establish a separate cost and schedule baseline commitment for work required to support the SLS Block 1B Exploration Upper Stage and Mobile Launcher 2 in 2021. As of May 2022, however, NASA had not released cost and schedule baselines for either effort.

To fully address this recommendation, NASA needs to provide documentation that it established cost and schedule estimates for each future SLS variant and its plan for how possible missions would fit within NASA's funding profile. Further, NASA needs to identify cost and schedule estimates for SLS missions beyond Artemis I and how its planned missions would fit within NASA's funding profile. Identifying a range of mission possibilities and their required funding will ensure the decision makers have information to make decisions about the affordability of the program within the agency's funding profile.

Director: W. William Russell, Contracting and National Security Acquisitions
Contact information: russellw@gao.gov, (202) 512-4841

NASA Lunar Programs: Opportunities Exist to Strengthen Analyses and Plans for Moon Landing. GAO-20-68. Washington, D.C.: December 19, 2019.

Recommendation: The NASA Administrator should ensure that the NASA Associate Administrator for Human Exploration and Operations creates a life-cycle cost estimate for the Artemis III mission.

Actions Needed: NASA agreed with the recommendation and stated that the agency would provide a preliminary cost estimate for the Artemis III mission by the end of calendar year 2020. However, NASA has not yet created this cost estimate. NASA officials told us that a 5-year funding plan provided to Congress in September 2020 serves as the agency's cost estimate through the Artemis III mission, which was at the time planned for 2024. The officials stated that the agency would establish cost and schedule commitments for projects but not the overall mission.

To fully implement this recommendation, NASA needs to develop a life-cycle cost estimate for the lunar landing mission as a whole. This is because the 5-year funding plan includes costs outside of this mission, such as costs for the Artemis I and II missions. Similarly, project baseline commitments do not necessarily include the scope of work required for the Artemis III mission. For example, the SLS baseline commitment includes a cost estimate only for the Artemis I mission. As a result, there is still no comprehensive Artemis III life-cycle cost estimate. NASA officials said that they are on track to complete this recommendation by August 2022. Without an overall cost estimate for the Artemis III mission, decision makers have limited cost information to inform decisions on the overall lunar investment.

Director: W. William Russell, Contracting and National Security Acquisitions
Contact information: russellw@gao.gov, (202) 512-4841

NASA Human Space Exploration: Significant Investments in Future Capabilities Require Strengthened Management Oversight. GAO-21-105. Washington, D.C.: December 15, 2020.

Recommendation: The NASA Administrator should ensure that the NASA Associate Administrator for Human Exploration and Operations Mission Directorate establish cost and schedule baselines for SLS Block 1B, SLS Block 2, Mobile Launcher 2, and Orion Docking System at their preliminary design reviews or as soon as practicable in advance of critical design reviews.

Actions Needed: NASA agreed with this recommendation. In April 2021, NASA stated that it was on track to establish a baseline for SLS Block 1B and a separate baseline for Mobile Launcher 2 by September 30, 2021. As of May 2022, however, NASA had not released cost and schedule baselines for either effort. To fully implement this recommendation, NASA will need to provide documentation that it established cost and schedule baselines for all four systems—including SLS Block 2—before their respective critical design reviews. Establishing cost and schedule baselines for these programs will provide decision makers an important oversight tool to monitor program performance.

Director: W. William Russell, Contracting and National Security Acquisitions
Contact information: russellw@gao.gov, (202) 512-4841

NASA Lunar Programs: Significant Work Remains, Underscoring Challenges to Achieving Moon Landing in 2024. GAO-21-330. Washington, D.C.: May 26, 2021.

Recommendation: The NASA Administrator, in coordination with the Associate Administrator for Human Exploration and Operations Mission Directorate, should ensure the Advanced Exploration Systems Division documents the process used to determine the program and technical management practices and tools that it will apply to the Artemis III and later missions, in the absence of establishing a formal Artemis program.

Actions Needed: NASA agreed with this recommendation. NASA said that in September 2021 the Advanced Exploration Systems Division reviewed the set of products that will be used to govern the integration of the Artemis III and later missions. However, NASA recently created the Exploration Systems Development Mission Directorate and the Space Operations Mission Directorate, and is evaluating the structure within each organization including the execution and operation of the Artemis missions. As part of this reorganization, NASA is also assessing the possibility of establishing an Artemis program or campaign office.

To fully implement this recommendation, NASA needs to provide evidence that it documented the program and technical management practices and tools that it will apply to the Artemis III and future missions. Determining what program and technical management practices and tools are needed to guide mission level decisions and oversight could reduce the risk that NASA will discover gaps late in development.

Director: W. William Russell, Contracting and National Security Acquisitions
Contact information: russellw@gao.gov, (202) 512-4841

Ensuring Cybersecurity

Cybersecurity Workforce: Agencies Need to Accurately Categorize Positions to Effectively Identify Critical Staffing Needs. GAO-19-144. Washington, D.C.: March 12, 2019.

Recommendation: The NASA Administrator should take steps to review the assignment of the "000" code to any positions at NASA in the 2210 IT management occupational series, assign the appropriate National Initiative for Cybersecurity Education (NICE) framework work role codes, and assess the accuracy of position descriptions.

Action needed: NASA agreed with our recommendation and stated that it would complete a review of the assignment of the "000" code to its positions in the 2210 IT management occupational series, assign the appropriate NICE framework work role codes, and assess the accuracy of position descriptions. In April 2022, NASA provided evidence showing that it has assigned appropriate NICE framework work role codes to its positions in the 2210 IT management occupational series. However, NASA had not yet provided sufficient evidence that it had assessed the accuracy of position descriptions. To close this recommendation, NASA needs to provide evidence that it assessed the accuracy of position descriptions. Accurately categorizing its positions will provide decision makers with reliable information that they can use to examine its cybersecurity workforce, and improve workforce planning.

Director: David Hinchman, Information Technology and Cybersecurity
Contact Information: hinchmand@gao.gov, (214) 777-5719

Federal Contracting Metrics

Federal Contracting: Senior Leaders Should Use Leading Companies' Key Practices to Improve Performance. GAO-21-491. Washington, D.C.: July 27, 2021.

Recommendation: The NASA Administrator should ensure the NASA Senior Procurement Executive uses a balanced set of performance metrics to manage the agency's procurement organizations, including outcome-oriented metrics to measure (a) cost savings/avoidance, (b) timeliness of deliveries, (c) quality of deliverables, and (d) end-user satisfaction.

Action Needed: NASA agreed with the recommendation. In January 2022, NASA provided evidence that it was using an outcome-oriented metric to measure end-user satisfaction. In February 2022, the NASA Senior Procurement Executive shared plans to implement metrics in the future to measure (a) cost savings/avoidance, (b) timeliness of deliveries, and (c) quality of deliverables. In order to close this recommendation, NASA will need to provide evidence that it has implemented the performance metrics to manage the agency's procurement organizations. Using a balanced set of performance measures, including both process- and outcome-oriented measures—and obtaining complete and reliable performance information—can help federal agencies identify improvement opportunities, set priorities, and allocate resources.

Managing Director: Timothy J. DiNapoli, Contracting and National Security Acquisitions
Contact information: DiNapoliT@gao.gov, (202) 512-4841

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