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GATEWAY PROGRAM ACQUISITION STRATEGY OVERVIEW

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Abstract

This paper will provide an overview of the acquisition strategy for the Gateway Program. The Gateway will be an outpost orbiting the Moon that provides vital support for a sustainable, long-term human return to the lunar surface, as well as a staging point for further deep space exploration. The Gateway will foster U.S. industry and international partnerships and enable multi-discipline utilization. The National Aeronautics and Space Administration (NASA) will lead this next step and will serve as the integrator of the spaceflight capabilities and contributions of U.S. commercial partners and international partners to develop the Gateway. The Gateway will be developed in a manner that will also allow future capabilities and collaborations with U.S. Government, private sector companies, and international partners.

Gateway is embracing innovation and flexibility; both in system architecture and in procurement approach. The Gateway's agile acquisition strategy will shape the entire system life cycle, from design and analysis through production, verification, launch, logistics and operations. This strategy will encourage new ways of doing business to accommodate new techniques, technologies and approaches; improving affordability and maximizing Gateway utility. The full range of acquisition authorities and contracting mechanisms available to NASA will be considered and appropriately tailored in response to the unique demands of each procurement activity.

This paper will include publicly appropriate procurement status and timelines for each Gateway element, primarily focusing on: 1) strategic planning for the execution of public-private partnerships that nurture and advance a cislunar space economy while advancing the NASA's exploration mission, 2) how results from integrated analysis cycles inform requirements definition, 3) applicable program management approaches for Gateway regarding U.S. Government oversight versus insight gathered via lessons learned from other NASA programs, government agencies, and industry best practices.

I. INTRODUCTION

In December of 2017, President Trump signed Space Policy Directive-1, or SPD-1, which directs the NASA Administrator to "lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities. Beginning with missions beyond low-Earth orbit, the United States will lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations."[1]

This next wave of lunar exploration will be fundamentally different than the past. The goal today is sustainability – sustainability of presence in Earth orbit, exploration around the Moon, exploration anywhere on the Moon, and challenging exploration missions beyond the Moon. Sustainability is the key to enabling human expansion across the solar system and bringing back to Earth new knowledge and opportunities, and requires the early engagement of scientific, international, and U.S. commercial interests, innovations, and new approaches.

Gateway is more than a destination for deep space crew expeditions and science investigations. It is a port for deep space transportation – for landers en route to the lunar surface or spacecraft embarking to destinations beyond the Earth-Moon system. NASA envisions the Gateway as a site where spacecraft may be assembled, refurbished, and refueled in orbit, outside of the Earth and Moon gravity wells, and with the benefit of Gateway logistics and infrastructure.

As we transition low-Earth orbit (LEO) operations to the private sector, it is important to have an outpost in deep space to further understand how to live and work far away from Earth as well as how to maximize use of robotics and autonomous systems to keep our missions, including the Gateway, most productive even when uncrewed. Gateway enables early crew missions to the lunar surface in a sustainable way. Gateway will allow for aggregation of human lander systems and for partners to participate in lunar activities. This partnership is enabled by Gateway's location and open architecture. The location allows U.S. commercial launch vehicles available today to play a role in human exploration. The open

architecture allows anyone international or commercial to participate in human lunar exploration.

II. GATEWAY OVERVIEW

NASA's Gateway plans are aligned with the national objectives for deep space exploration as stipulated in SPD-1. Following the Vice President's announcement on March 26, 2019, NASA re-evaluated the deep space Gateway plans to ensure that development of the system would support the 2024 mission to land humans on the South Pole of the Moon in 2024. Following initial analyses of the mission requirements, the basic Gateway capabilities remained unchanged. The outpost orbiting the Moon fosters U.S. industry and international partnerships, but focuses initial development and deployment for providing the vital support in cislunar space required for a human return to the lunar surface.

Gateway will initially operate in a halo orbit around the Moon – one that is accessible not only by NASA's Space Launch System (SLS) and Orion spacecraft for crews and outsized cargo, but also by many existing rockets on the U.S. domestic and international market today. From this orbit, the Gateway will have a continuous view of Earth, and will be able to support lunar surface telerobotics, including those on the far side. Over its operational lifetime, the Gateway can be transferred to other lunar orbits to increase the potential for demonstrations and scientific investigations, and to expand lander access across the lunar surface.

Since the Gateway will not be continuously occupied like the ISS – NASA envisions crew visits approximately once per year – a strong focus is placed on robotic integration and data systems to foster ongoing investigations and operations that can operate autonomously between crew visits. NASA envisions other U.S. industry and international partners being able to send their crews to the Gateway as part of a growing human lunar presence.

Gateway is designed to support a variety of utilization activities during both crewed and uncrewed periods and is planned for continuous operations throughout its lifetime. These operations include demonstrating key exploration capabilities in a relevant deep space environment, conducting science beyond the influence of Earth, and providing opportunities for Gateway partners and customers for deep space exploration. Located in cislunar orbit, the Gateway capabilities can be further leveraged to enhance lunar and Mars exploration.[2]

Element Status

To accelerate plans to land humans on the surface of the Moon, the Gateway Program has focused development on the initial critical elements required to support the 2024 landing – the Power and Propulsion Element (PPE), the Habitation and Logistics Outpost (HALO), and logistics delivery services.

The PPE, the first element of the Gateway, is a high-power, 50-kilowatt solar electric propulsion spacecraft that will provide power, high-rate communications, attitude control, and orbital transfer capabilities for the Gateway, while demonstrating long-life and advanced solar electric propulsion for NASA and U.S. industry. On May 23, 2019, NASA selected Maxar Technologies of Westminster, Colorado as the industry partner to develop, build, and conduct the in-space demonstration of the PPE with a targeted launch on a commercial rocket in late 2022.[3]

NASA intends for the PPE to be fully owned and operated by Maxar through completion of the spaceflight demonstration, the duration of which would be up to one year from launch. During this first year of flight, NASA's objectives are to demonstrate the performance of the PPE's solar electric propulsion system and orbital transfer and maintenance capabilities; to validate models; and to assess the spacecraft's suitability for use as the first element of the Gateway. Maxar also provided their flight demonstration objectives, and the success of the demonstration will be based on this joint set of objectives. At the completion of the demonstration, NASA has the option to acquire the spacecraft, specifically as the first element of the Gateway.

The HALO will be the initial habitable volume of the Gateway. Its primary purpose is to provide the life support needs for the visiting astronauts after they arrive in the Orion and prepare for departure to the lunar surface. The HALO will be a functional pressurized volume providing sufficient command, control, and data handling cpaabilities, energy storage and power distribution, thermal control, communications and tracking capabilities, environmental control and life support systems to augment the Orion spacecraft and support crew members; two axial and up to two radial docking ports; stowage volume; and utilization capabilities.The HALO will be designed as the minimum capability necessary to support a lunar landing mission, with significant reliance on Orion life support and crew systems. HALO is scheduled to launch in 2023 on a commercial launch vehicle.

Gateway logistics services are the final critical component required to ensure a successful 2024 human lunar landing. NASA is seeking capabilities from American companies to deliver a logistics spacecraft with pressurized and unpressurized cargo to the Gateway for six months of docked operations followed by automatic disposal. The logistics

spacecraft must launch on a commercial rocket. Logistics services include delivery of science, cargo, and supplies. The first logistics module is intended to launch in 2024, just ahead of the Orion crewed flight for the Artemis III landing.

Gateway Organization/Governance Structure

The Gateway Program Office was established in early calendar year 2019 at the NASA Johnson Space Center in Houston, Texas. The Gateway Program utilizes a series of integrated analysis cycles to inform requirements definition and lifecycle reviews. Decision-making within the Program is conducted via a series of control boards. The Program is comprised of multiple integration and system offices and receives matrixed support from across the Agency. This includes an Agency-wide Office of Procurement team with representation from NASA Headquarters, the Marshall Space Flight Center, the Glenn Research Center, the Kennedy Space Center, and the Johnson Space Center. This distributed team is a result of NASA's Mission Support Future Architecture Program (MAP).

III. GATEWAY ACQUISITION STRATEGY

Overview

NASA's Gateway acquisition strategy is a comprehensive, integrated plan that describes the business, technical, and support strategies to meet program objectives. The strategy guides acquisition execution across the entire Gateway Program life cycle. It defines the relationship between the acquisition phases and work efforts, and key program events such as decision points, reviews, contract awards, test activities, production lot/delivery quantities, and operational deployment objectives. This dynamic strategy evolves over time and will continuously reflect the current status and desired end point of the program.

The acquisition of the Gateway elements will incorporate a hybrid mix of contracted development, international and domestic partnerships, in-house builds as well as initiatives that have not yet been identified. All approaches that preserve NASA's acquisition agility and responsiveness to an evolutionary mission will be considered. NASA's mandate to return American astronauts to the lunar surface by 2024 necessitates that all acquisition options must be considered and that the enterprise transform itself into a leaner, more accountable, and more agile agency. The comprehensive attribute that binds the Gateway acquisition strategy is adherence to NASA's strategic principles for sustainable exploration. Figure 1, below, illustrates these principles.

Strategic Principles for Sustainable Exploration	
Fiscal Realism	Implementable in the near-term with the buying power of current budgets and in the longer term with budgets commensurate with economic growth.
Scientific Exploration	Exploration enables science and science enables exploration; leveraging scientific expertise for human exploration of the solar system.
Technology Pull & Push	Application of high TRL technologies for near term missions, while focusing sustained investments on technologies and capabilities to address the challenges of future missions.
Gradual Buildup of Capability	Near-term mission opportunities with a defined cadence of compelling and integrated human and robotic missions, providing for an incremental buildup of capabilities for more complex missions over time.
Economic Opportunity	Opportunities for US commercial business to further enhance their experience and business base.
Architecture Openness and Resilience	Resilient architecture featuring multi-use, evolvable space infrastructure, minimizing unique developments, with each mission leaving something behind to support subsequent missions.
Global Leadership and Collaboration	Substantial new international and commercial partnerships, leveraging current International Space Station partnerships and building new cooperative ventures for exploration.
Continuity of Human Spaceflight	Uninterrupted expansion of human presence into the solar system by establishing a regular cadence of crewed missions to cislunar space during the ISS lifetime.

Figure 1**:** *NASA's Strategic Principles for Sustainable Exploration.*

NASA's procurement authority is quite broad and is intended to afford flexibility and responsiveness to the often unique acquisition environment of human spaceflight. NASA, more than most Federal agencies, utilizes its other transactional authority to access sources of innovation. NASA procurements are guided by the Federal Acquisition Regulation (FAR), and are tailored by the NASA FAR Supplement (NFS). In addition, the National Aeronautics and Space Act of 1958, as amended, in Section 203 (C) (5) authorizes NASA to "enter into and perform such contracts, leases, cooperative agreements, or other transactions as may be necessary in the conduct of its work and on such terms as it may deem appropriate." NASA's other transactions, referred to as Space Act Agreements (SAAs), are legally enforceable agreements other than procurement contracts, grants, cooperative agreements, and Cooperative Research and Development Agreements (CRADAs).

Enabled by a culture embracing innovation and flexibility, the Gateway agile acquisition strategy will impact the entire product life cycle, from design and analysis through production, verification, launch, logistics, and operations. This strategy will encourage new ways of doing business to accommodate new

techniques and approaches, improving affordability and maximizing Gateway utility. The full range of contracting mechanisms available to NASA, including Broad Agency Announcements (BAAs), FAR Part 12 Commercial Acquisitions, FAR Part 15 Best Value Trade-Offs, partnerships, cooperative agreements, grants and SAAs will be considered and appropriately tailored in response to the demands of each procurement activity.

Public-Private Partnerships

Public-Private Partnerships (P3s) are one of NASA's most powerful tools for encouraging innovative participation from Government contractors in research and development (R&D) efforts. The P3 model allows NASA to contribute personnel, funding, services, equipment, expertise, information, and facilities to a wide range of R&D efforts in addition to leveraging the corporate capabilities of their partner. For some elements of the Gateway, NASA is implementing P3s through FAR 35-based BAAs and SAAs. These arrangements typically involve NASA contracting with an industry partner (or partners) to design, fabricate, integrate and test a subsystem, system or spacecraft module. Each partner justifies their economic stake by demonstrating a business case that generates income resulting from the partnership. Such a venture, although a contractual arrangement, differs from typical service contracting in that the private-sector partner usually makes an at-risk capital equity investment in the project in return for favorable property usage rights. The goal of the P3 is to share risk and lower cost, with NASA becoming a marginal buyer of a delivered service rather than the sole proprietor of a unique, single-user capability.

The contract vehicles that NASA is using to procure the various elements of the Gateway include a Fixed-Priced, Indefinite Delivery/Indefinite Quantity (ID/IQ) Task Order contract for Gateway Logistics Services (GLS), and separate Fixed-Price, Milestone-Based BAAs for the PPE and the HALO. While the PPE development utilizes a new purpose-written BAA, the HALO effort is being accomplished through NASA's existing Next Space Technologies for Exploration Partnerships (NextSTEP) BAA.[4] Ongoing technology maturation, risk reduction and architecture definition for deep space habitation is also being accomplished with several industry partners via the NextSTEP BAA.

NextSTEP Broad Agency Announcement

NASA's NextSTEP BAAs is a solicitation method for R&D efforts that provide for full and open competition in accordance with Federal Acquisition Regulations (FAR) 6.102(d)(2) and merit-based, competitive procedures in accordance with NFS 1835. BAAs are established in FAR 35.016 and are authorized for the acquisition of basic and applied research and that part of development not related to the development of a specific system or hardware procurement. NextSTEP is a P3 model that seeks commercial development of deep space exploration capabilities to support more extensive human spaceflight missions in and beyond cislunar space. NextSTEP is managed by NASA's Advanced Exploration Systems Division within the Human Exploration and Operations Mission Directorate at NASA Headquarters. An important part of NASA's strategy is to stimulate the commercial space industry to help the agency achieve its strategic goals and objectives for expanding the frontiers of knowledge, capability, and opportunities in space. A key component of the NextSTEP partnership model is that it provides an opportunity for NASA and industry to partner to develop capabilities that meet NASA's human space exploration objectives while also supporting industry commercialization plans. NASA issued the original NextSTEP BAA to U.S. industry in late 2014, and issued the second NextSTEP BAA in April 2016. The second NextSTEP BAA is an omnibus announcement with appendices that solicit proposals in specific research areas. As of October 2019, NASA has issued 57 separate contracts via the NextSTEP program. Appendices A through H have been solicited, and plans exist for an additional 4 appendices.

The standard structure of NextSTEP enables industry to propose to familiar contract terms & conditions. This standard structure also streamlines NASA procurement activities. The BAA process is efficient and inherently flexible and responsive to program needs. NextSTEP awards result in fixed price, milestone-based contracts which minimize NASA's cost risk exposure, post-award requirements growth. NextSTEP embodies innovative acquisition techniques such as the use of phasing and Contract Line Items in program structures whereby work scope is focused and progress is easier to assess. This also isolates risk through contractual on-/off-ramps and allows tailoring/prioritization of proposed work to best fit NASA portfolio of R&D needs. The NextSTEP model maintains competition longer and provides NASA with varied solution sets. NextSTEP also acts as a P3 enabler by equitable sharing of Intellectual Property (IP) rights shared with industry to stimulate the space economy. The contract structure also serves to incentivize efficient program management by industry to protect margins. The contract itself is agnostic to oversight/insight requirements; management approaches are defined in contract deliverables.

Insight Versus Oversight

In formulating the Gateway acquisition strategy, NASA reviewed lessons learned from the Commercial Crew Program, the Commercial Orbital Transportation System (COTS), NASA Launch Services Program (LSP), as well as numerous GSA and Government Accountability Office findings, professional reports and academic white papers addressing government Insight versus Oversight in federal procurement. Government oversight exists to provide the government with the information it needs to evaluate the cost, schedule, and performance of contractors building systems on the government's behalf. The activities required for oversight, while necessary, add additional costs to a program. Estimated additional costs from complying with oversight range from 2-5% of a program's total costs to factors of 3-5 times the cost of commercially available alternative products.[5] Therefore, it is crucial for NASA to pursue a Gateway acquisition strategy that will maximize mission success, ensure that all crew safety and mission assurance requirements are met while not unduly impacting industry's ability to get the job done efficiently and in a cost effective manner. In support of this goal, the Gateway program management model envisions a lean organization that seeks to minimize overhead and leverage the efficiencies of commercial business practices. The NASA team will need to transform from their traditional role to become collaborators and influencers with thoughtful and discrete control opportunities. Legacy NASA human spaceflight programs with significant oversight responsibilities were characterized by Government/Industry headcount ratios between 1:10 and 1:4, while contemporary NASA programs with less oversight responsibilities, such as COTS and LSP, have headcount ratios between 1:80 and 1:17. [6]

It is NASA's intent to procure Gateway modules using fixed-price, milestone-based contracts to the greatest extent possible, subject to approval from NASA leadership. This contract type places upon the contractor maximum risk and full responsibility for all costs and resulting profit or loss. It provides maximum incentive for the contractor to control costs and perform effectively and imposes a minimum administrative burden upon NASA. All other appropriate contract types will be considered for the procurement of subsystems and future elements. The Gateway acquisition strategy will execute an approach that leverages the technology maturation already performed under the NextSTEP program.

While contract mechanisms are agnostic to the level of Government insight into a development program, it is more typical of fixed-price contracting for providers to adopt lean management structures in return for assumption of risk. Fixed-price contracts provide greater incentive than cost-reimbursement contracts for the contractor to control costs and perform efficiently. Fixed price contracting shifts risk from the Government to the developer. Contracts should be structured to minimize risk and maximize value for the buyer; in this case, NASA. In most cases, fixed-price contracts will be best suited for achieving this goal because they provide the contractor with the greatest incentive for efficient and economical performance. A balanced program management construct must be defined in the contract terms whereby NASA is afforded sufficient insight into the contractor's ongoing engineering processes while the contractor has the freedom to pursue their solution as long as it meets NASA performance, price, and schedule requirements. [7] NASA experts will collaborate with contractors to provide advice on key development issues and insight to NASA review boards regarding approvals for requirements changes and milestone accomplishments. In addition, the insight/oversight model is structured to provide the Gateway Program Manager with ultimate approval authority for all contractor activities, which provides an established mechanism to hold contractors accountable.

IV. PROCUREMENT STATUS

Power and Propulsion Element

The first Gateway element to be procured is the PPE. The contract for the PPE was awarded in May 2019 to Maxar Technologies. Maxar was awarded a Fixed Price, Milestone-Based contract with a maximum total value of $375 million. Contract performance is broken into phases and begins with a 12-month base period where the spacecraft design will be completed. Maxar Technologies is leveraging its 1300-class satellite platform for the PPE design. NASA requires that the PPE provide a high-power, 50-kilowatt solar electric propulsion system, as well as communications, attitude control, orbit maintenance, and power to future Gateway elements.

PPE is scheduled to launch aboard a commercial launch vehicle in 2022, and have a service life of at least 15 years. The PPE must first operate for up to one year as a spaceflight demonstration before NASA acquires the vehicle. The PPE procurement represents a new way of doing business for NASA. The acquisition of a flight vehicle on-orbit, following a successful flight demonstration, is much closer to a commercial COMSAT acquisition that traditional NASA acquisitions. This P3 construct imparts less programmatic and cost risk to NASA, and Maxar Technologies is provided with the option to build more PPEs for different customers and different missions. The win-win strategy is at the heart of a P3 approach.

The PPE is managed out of the NASA Glenn Research Center.

Habitation and Logistics Outpost (HALO)

The 2024 objective has accelerated the initial timeline for building and launching the first habitation module for the Gateway, and as a result on 30 May 2019, NASA issued Synopsis Number: 80JSC019GTWYHAB with NASA's intent to use one or more existing contracts already in place via the NextSTEP-2 BAA Appendix A, Habitat Systems in order to meet the Gateway Program schedule.

Due to the time and expense required to design and fabricate a human-rated deep space module, it is necessary to begin development activity as quickly as possible and be able to leverage the work already accomplished under Appendix A of the NextSTEP-2 BAA. Over the past three years, NextSTEP-2 BAA contractors have extensively developed initial designs and operational concepts for establishing a Gateway in lunar orbit.

On 19 July 2019, NASA issued its Justification for Other than Full and Open Competition for the HALO, then known as the "Minimal Habitation Module."

NASA determined that Northrop Grumman Innovation Systems (NGIS) was the only NextSTEP-2 contractor with a module design and the production and tooling resources capable of meeting the 2024 deadline. NGIS intends to leverage its extensive production capabilities and design maturity from its Cygnus cargo spacecraft.[8]

NASA expects to definitize the contract by the end of calendar year 2019. The HALO is managed out of the Johnson Space Center.

Gateway Logistics Services

NASA has been working with U.S. industry to understand the capabilities available to provide deep space logistics services and has been making progress towards awarding a logistics services contract. To date, an initial Sources Sought/Request for Information (RFI) was released in October 2018 seeking input from U.S. industry to provide pressurized and unpressurized cargo to the Gateway. A follow-on draft request for proposals (RFP) was released in June 2019 and following feedback from industry, a final solicitation was released in August 2019. The solicitation reflects minimizing spacecraft requirements on industry to allow for commercial innovation, and asking Industry to propose their best solutions for delivering cargo and enabling a deep space supply chain.

The Gateway Logistics Services solicitation is for a multi-award, firm-fixed price, indefinite delivery/indefinite quantity contract for 15 years, with a maximum $7 billion value. The guaranteed minimum value for any award is two missions.

Awards are anticipated by the end of 2019. Logistics Services are managed out of the Kennedy Space Center.[9]

V. CONCLUSION

With the Gateway and other elements of the Artemis Program, NASA is encouraging new ways of doing business to accommodate new techniques, technologies and approaches, consider affordability, and encourage innovation from U.S. industry. The full range of acquisition authorities and contracting mechanisms available to NASA has been and will continue to be considered and appropriately tailored in response to the unique demands of each procurement activity. The acquisition strategy for the Gateway will continue to evolve. For future Gateway elements, NASA will seek both international and domestic collaborations. And for the initial elements of the Gateway, NASA is demonstrating acquisition agility, procurement speed, and a desire to speed up and simplify "business as usual" in U.S. Government contracting.

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[8] GATEWAY PROGRAM MODULE(S) Continued use of NextSTEP-2 Broad Agency Announcement (BAA) Appendix A. Solicitation Number: 80JSC019GTWYHAB. NASA Johnson Space Center. https://www.fbo.gov/index?s=opportunity&mode=form&tab=core&id=36ebf3fc4d57c88b6bd8c94d1806dfb9

[9] Gateway Logistics Services - Draft RFP. Solicitation Number: 80KSC019R0002-DRAFT. NASA Kennedy Space Center. https://www.fbo.gov/index?s=opportunity&mode=form&id=1db8b3856facecb73b2c4c77069ff7dd&tab=core&_cview=1