Description of document:	National Aeronautics and Space Administration (NASA) records concerning the Lunar Gateway, 2019
Requested date:	02-April-2019
Release date:	24-May-2019
Posted date:	19-October-2020
Source of document:	NASA Headquarters 300 E Street, SW Room 5Q16 Washington, DC 20546 Fax: (202) 358-4332 Email: hq-foia@nasa.gov

National Aeronautics and Space Administration

NASA Headquarters
300 E. Street SW, Suite 5R30
Washington, DC 20546

May 24, 2019

Reply to attn. of: Office of Communications

FOIA: 19-HQ-F-00428

This is in response to your Freedom of Information Act (FOIA) request dated April 2, 2019, and received at the National Aeronautics and Space Administration (NASA) Headquarters FOIA Office April 3, 2019. Your request was assigned FOIA Case Number 19-HQ-F-00428 and was for:

> I am requesting copies of any and all reports, blueprints, drawings, presentations, briefing documents on the lunar "Gateway", specifically NASA Administrator Jim Bridenstine gave a town hall meeting on April 1, 2018 at NASA Headquarters, mentioning the lunar gateway and a brief mentioning of how its work. See Below Article.
>
> https://www.washingtonpost.com/technology/2019/04/01/nasa-is-scrambling-meet-white-house-mandate-return-astronauts-moon-by/?utm_term=.00567a0800b5

In response to your request, a search was conducted by the Office of the Administrator (OA) using the information you provided above. Specifically, the search terms lunar "Gateway" and town hall meeting held on April 1, 2018, as stated in your request. The Administrator Office has located 7 documents consisting of 31 pages, and your request is being granted in full.

In accordance with NASA's FOIA Regulation fees are under $50.00, and are not being charged in accordance with 14 CFR § 1206.503(c). If you have further questions, please feel free to contact me at hq-foia@nasa.gov or (202) 358-2462.

Sincerely,

Josephine Sibley
Headquarters
FOIA Public Liaison Officer

National Aeronautics and Space Administration

Action Document Summary

1. CONCURRENCES

DIRECTORATE/OFFICE	SIGNATURE	DATE IN	DATE OUT	DIRECTORATE/OFFICE	SIGNATURE	DATE IN	DATE OUT
OCFO		3/27		Jim Morhard			
HEO	in draft			Jim Bridenstine		3/27	
SMD	in draft						
Executive Secretariat	see attached						
Tom Cremins	in draft						
Gabe Sherman	in draft						
Janet Karika	in draft						
Melanie Saunders	in draft						
Steve Jurczyk		3/27/19					

2. ACTION OFFICER	2a. DIRECTORATE/OFFICE	2b. PHONE	2c. DATE
Mary D. Kerwin	Deputy Chief Financial Officer for Appropriations	(202) 358-1812	03/27/2019

3. TYPIST	TYPIST'S PHONE	4. QUALITY CONTROL LIAISON	4a. PHONE	4b. DATE
Allicsyn Beverly ab 3/27/19	(202) 358-1812	Allicsyn Beverly ab 3/27/19	(202) 358-1812	03/27/2019

5. ADMINISTRATOR'S HATS CONTROL NO.	6. DUE DATE	7. SUBJECT
A/2019-00087	03/27/2019	Cover Letter for FY 2019 Multi-Year Plan for Lunar Elements

8. EXECUTIVE SUMMARY

ENCLOSED

9. SPECIAL INSTRUCTIONS *(Use this section to provide information or special guidelines that are not indicative for processing routine "A" packages.)*

Cleared by OMB/Shawcross on 3/25/2019
Cleared by National Space Council/Pace 3/25/2019

10. QUALITY REVIEW

INITIALS	DATE

National Aeronautics and Space Administration

Executive Summary

HATS CONTROL NO.
A/2019-00087

DUE DATE
03/27/2019

SUBJECT TITLE: Cover Letter for FY 2019 Multi-Year Plan for Lunar Elements

Requesting to have Administrator sign letters going to both House and Senate Appropriations Subcommittee members on Commerce, Justice, Science, and Related Agencies regarding NASA's Multi-year Plan for Lunar Elements in response to direction in P.L. 116-6.

Identical letters going to:
The Honorable Jose E. Serrano
The Honorable Robert B. Aderholt
The Honorable Jerry Moran
The Honorable Jeanne Shaheen

Exec Sec

Beverly, Allicsyn (HQ-IM051)

From: Hall, Gina S. (HQ-AH000)
Sent: Tuesday, March 26, 2019 3:45 PM
To: Beverly, Allicsyn (HQ-IM051)
Cc: Kerwin, Mary D. (HQ-IA000)
Subject: RE: URGENT: CIC REVIEW: Cover Letter for FY 2019 Multi-Year Plan for Lunar Elements
Attachments: FY19 Multi-Year Plan for Lunar Elements_edits.docx

Hi Allicsyn,

The HATS number is A/2019-00087, and I have attached our edits

Gina

From: Beverly, Allicsyn (HQ-IM051)
Sent: Tuesday, March 26, 2019 2:51 PM
To: Hall, Gina S. (HQ-AH000) <gina.s.hall@nasa.gov>
Cc: Kerwin, Mary D. (HQ-IA000) <mary.d.kerwin@nasa.gov>
Subject: URGENT: CIC REVIEW: Cover Letter for FY 2019 Multi-Year Plan for Lunar Elements
Importance: High

Good Afternoon Gina, attached is the FY19 Multi Year Plan for Lunar Elements cover letter. We plan to present the package to the Administrator tomorrow morning.
Please review and provide an "A" number.
As always, We Thank You

From: Kerwin, Mary D. (HQ-IA000) <mary.d.kerwin@nasa.gov>
Sent: Tuesday, March 26, 2019 2:41 PM
To: Beverly, Allicsyn (HQ-IM051) <allicsyn.beverly@nasa.gov>
Subject: CIC REVIEW: Cover Letter for FY 2019 Multi-Year Plan for Lunar Elements
Importance: High

A:

Please ask for CIC review of this cover letter by COB today. We will be preparing letters to House and Senate Committees on Appropriations for signature by the Administrator tomorrow morning.

Thanks much.

MDK

National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001

March 27, 2019

The Honorable José E. Serrano
Chairman
Subcommittee on Commerce, Justice,
Science, and Related Agencies
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

The FY 2019 Omnibus Appropriations Act (P.L. 116-6), enacted on February 15, 2019, stipulates:

> *"Not more than 50 percent of the amounts made available in this Act for the Lunar Orbital Platform; Advanced Cislunar and Surface Capabilities; Commercial LEO Development; and Lunar Discovery and Exploration, excluding the Lunar Reconnaissance Orbiter, may be obligated until the Administrator submits a multi-year plan to the Committees on Appropriations of the House of Representatives and the Senate that identifies estimated dates, by fiscal year, for Space Launch System flights to build the Lunar Orbital Platform; the commencement of partnerships with commercial entities for additional LEO missions to land humans and rovers on the Moon; and conducting additional scientific activities on the Moon. The multi-year plan shall include key milestones to be met by fiscal year to achieve goals for each of the lunar programs described in the previous sentence and funding required by fiscal year to achieve such milestones."*

Based on Space Policy Directive-1, NASA has laid out five strategic goals for near-term exploration:

- Transition U.S. human spaceflight in LEO to commercial operations that support NASA and the needs of an emerging commercial economy;
- Lead the emplacement of capabilities that support lunar surface operations and facilitate missions beyond cislunar space;
- Foster scientific discovery and characterization of lunar resources through a series of robotic missions;
- Return U.S. astronauts to the surface of the Moon for a sustained campaign of exploration and utilization; and,

- Demonstrate on the Moon the capabilities required for human missions to Mars and other destinations.

In FY 2019, NASA is taking specific steps, pursuant to P.L. 116-6, to implement SPD-1, with goals of looking at more innovative procurement models and increasing sustainability of the Agency's programs. The FY 2020 NASA budget request provides for the foundation of a national exploration campaign that will use the experience of the NASA workforce, coupled with the agility and innovation of our commercial and international partners, to create an architecture that is open, sustainable, and agile.

The enclosed report regarding NASA's Multi-year Plan for Lunar Elements responds to direction in P.L. 116-6, describing each of the Lunar Program Elements in detail.

I would be pleased to discuss this report with you in greater detail, if you wish.

Sincerely,

James F. Bridenstine
Administrator

Enclosure

National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001

March 27, 2019

The Honorable Robert B. Aderholt
Ranking Member
Subcommittee on Commerce, Justice,
Science, and Related Agencies
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Congressman Aderholt:

The FY 2019 Omnibus Appropriations Act (P.L. 116-6), enacted on February 15, 2019, stipulates:

> *"Not more than 50 percent of the amounts made available in this Act for the Lunar Orbital Platform; Advanced Cislunar and Surface Capabilities; Commercial LEO Development; and Lunar Discovery and Exploration, excluding the Lunar Reconnaissance Orbiter, may be obligated until the Administrator submits a multi-year plan to the Committees on Appropriations of the House of Representatives and the Senate that identifies estimated dates, by fiscal year, for Space Launch System flights to build the Lunar Orbital Platform; the commencement of partnerships with commercial entities for additional LEO missions to land humans and rovers on the Moon; and conducting additional scientific activities on the Moon. The multi-year plan shall include key milestones to be met by fiscal year to achieve goals for each of the lunar programs described in the previous sentence and funding required by fiscal year to achieve such milestones."*

Based on Space Policy Directive-1, NASA has laid out five strategic goals for near-term exploration:

- Transition U.S. human spaceflight in LEO to commercial operations that support NASA and the needs of an emerging commercial economy;
- Lead the emplacement of capabilities that support lunar surface operations and facilitate missions beyond cislunar space;
- Foster scientific discovery and characterization of lunar resources through a series of robotic missions;
- Return U.S. astronauts to the surface of the Moon for a sustained campaign of exploration and utilization; and,

- Demonstrate on the Moon the capabilities required for human missions to Mars and other destinations.

In FY 2019, NASA is taking specific steps, pursuant to P.L. 116-6, to implement SPD-1, with goals of looking at more innovative procurement models and increasing sustainability of the Agency's programs. The FY 2020 NASA budget request provides for the foundation of a national exploration campaign that will use the experience of the NASA workforce, coupled with the agility and innovation of our commercial and international partners, to create an architecture that is open, sustainable, and agile.

The enclosed report regarding NASA's Multi-year Plan for Lunar Elements responds to direction in P.L. 116-6, describing each of the Lunar Program Elements in detail.

I would be pleased to discuss this report with you in greater detail, if you wish.

Sincerely,

Jim Bridenstine

James F. Bridenstine
Administrator

Enclosure

National Aeronautics and
Space Administration

Office of the Administrator
Washington, DC 20546-0001

March 27, 2019

The Honorable Jerry Moran
Chairman
Subcommittee on Commerce, Justice,
Science, and Related Agencies
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

The FY 2019 Omnibus Appropriations Act (P.L. 116-6), enacted on February 15, 2019, stipulates:

> *"Not more than 50 percent of the amounts made available in this Act for the Lunar Orbital Platform; Advanced Cislunar and Surface Capabilities; Commercial LEO Development; and Lunar Discovery and Exploration, excluding the Lunar Reconnaissance Orbiter, may be obligated until the Administrator submits a multi-year plan to the Committees on Appropriations of the House of Representatives and the Senate that identifies estimated dates, by fiscal year, for Space Launch System flights to build the Lunar Orbital Platform; the commencement of partnerships with commercial entities for additional LEO missions to land humans and rovers on the Moon; and conducting additional scientific activities on the Moon. The multi-year plan shall include key milestones to be met by fiscal year to achieve goals for each of the lunar programs described in the previous sentence and funding required by fiscal year to achieve such milestones."*

Based on Space Policy Directive-1, NASA has laid out five strategic goals for near-term exploration:

- Transition U.S. human spaceflight in LEO to commercial operations that support NASA and the needs of an emerging commercial economy;
- Lead the emplacement of capabilities that support lunar surface operations and facilitate missions beyond cislunar space;
- Foster scientific discovery and characterization of lunar resources through a series of robotic missions;
- Return U.S. astronauts to the surface of the Moon for a sustained campaign of exploration and utilization; and,

- Demonstrate on the Moon the capabilities required for human missions to Mars and other destinations.

In FY 2019, NASA is taking specific steps, pursuant to P.L. 116-6, to implement SPD-1, with goals of looking at more innovative procurement models and increasing sustainability of the Agency's programs. The FY 2020 NASA budget request provides for the foundation of a national exploration campaign that will use the experience of the NASA workforce, coupled with the agility and innovation of our commercial and international partners, to create an architecture that is open, sustainable, and agile.

The enclosed report regarding NASA's Multi-year Plan for Lunar Elements responds to direction in P.L. 116-6, describing each of the Lunar Program Elements in detail.

I would be pleased to discuss this report with you in greater detail, if you wish.

Sincerely,

James F. Bridenstine
Administrator

Enclosure

National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001

March 27, 2019

The Honorable Jeanne Shaheen
Ranking Member
Subcommittee on Commerce, Justice,
Science, and Related Agencies
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Senator Shaheen:

The FY 2019 Omnibus Appropriations Act (P.L. 116-6), enacted on February 15, 2019, stipulates:

> *"Not more than 50 percent of the amounts made available in this Act for the Lunar Orbital Platform; Advanced Cislunar and Surface Capabilities; Commercial LEO Development; and Lunar Discovery and Exploration, excluding the Lunar Reconnaissance Orbiter, may be obligated until the Administrator submits a multi-year plan to the Committees on Appropriations of the House of Representatives and the Senate that identifies estimated dates, by fiscal year, for Space Launch System flights to build the Lunar Orbital Platform; the commencement of partnerships with commercial entities for additional LEO missions to land humans and rovers on the Moon; and conducting additional scientific activities on the Moon. The multi-year plan shall include key milestones to be met by fiscal year to achieve goals for each of the lunar programs described in the previous sentence and funding required by fiscal year to achieve such milestones."*

Based on Space Policy Directive-1, NASA has laid out five strategic goals for near-term exploration:

- Transition U.S. human spaceflight in LEO to commercial operations that support NASA and the needs of an emerging commercial economy;
- Lead the emplacement of capabilities that support lunar surface operations and facilitate missions beyond cislunar space;
- Foster scientific discovery and characterization of lunar resources through a series of robotic missions;
- Return U.S. astronauts to the surface of the Moon for a sustained campaign of exploration and utilization; and,

- Demonstrate on the Moon the capabilities required for human missions to Mars and other destinations.

In FY 2019, NASA is taking specific steps, pursuant to P.L. 116-6, to implement SPD-1, with goals of looking at more innovative procurement models and increasing sustainability of the Agency's programs. The FY 2020 NASA budget request provides for the foundation of a national exploration campaign that will use the experience of the NASA workforce, coupled with the agility and innovation of our commercial and international partners, to create an architecture that is open, sustainable, and agile.

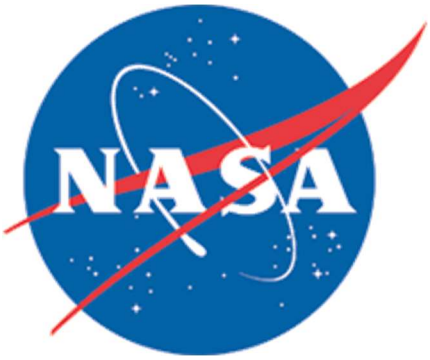
The enclosed report regarding NASA's Multi-year Plan for Lunar Elements responds to direction in P.L. 116-6, describing each of the Lunar Program Elements in detail.

I would be pleased to discuss this report with you in greater detail, if you wish.

Sincerely,

James F. Bridenstine
Administrator

Enclosure



Report

regarding

NASA's Multi-Year Plan for Lunar Elements

pursuant to

FY 2019 Consolidated Appropriations Act (P.L. 116-6)

March 2019

Report
regarding
NASA's Multi-Year Plan for Lunar Elements

Background

The FY 2019 Consolidated Appropriations Act (PL 116-6) limits FY 2019 obligations to not more than 50 percent of amounts appropriated for key Lunar Program elements until the Administrator has submitted a multi-year plan for these activities. Bill language states:

Multi-Year Plan regarding Lunar Initiatives: *"Not more than 50 percent of the amounts made available in this Act for the Lunar Orbital Platform; Advanced Cislunar and Surface Capabilities; Commercial LEO Development; and Lunar Discovery and Exploration, excluding the Lunar Reconnaissance Orbiter, may be obligated until the Administrator submits a multi-year plan to the Committees on Appropriations of the House of Representatives and the Senate that identifies estimated dates, by fiscal year, for Space Launch System flights to build the Lunar Orbital Platform; the commencement of partnerships with commercial entities for additional LEO missions to land humans and rovers on the Moon; and conducting additional scientific activities on the Moon. The multi-year plan shall include key milestones to be met by fiscal year to achieve goals for each of the lunar programs described in the previous sentence and funding required by fiscal year to achieve such milestones."*

Introduction

Based on Space Policy Directive-1, the *National Space Exploration Campaign Report*, submitted to Congress in September 2018, laid out five strategic goals for NASA's near-term exploration:

1. Transition U.S. human spaceflight in LEO to commercial operations that support NASA and the needs of an emerging commercial economy;
2. Lead the emplacement of capabilities that support lunar surface operations and facilitate missions beyond cislunar space;
3. Foster scientific discovery and characterization of lunar resources through a series of robotic missions;
4. Return U.S. astronauts to the surface of the Moon for a sustained campaign of exploration and utilization; and,
5. Demonstrate on the Moon the capabilities required for human missions to Mars and other destinations.

The approach to long-term human exploration of the lunar surface will start by focusing on further developing the detailed architecture for human sortie missions, while moving out on a more detailed integrated architecture and partner strategy built off of the an initial human sortie capability. A number of paths and goal-states – extending from a "touch and go" with robots, to stay posture, to a "lunar civilization" – are possible. All of these paths, however, go through robotic precursor missions and human surface sorties, making them the necessary first elements for lunar exploration.

The FY 2020 President's Budget

In keeping with Space Policy Directive-1, the FY 2020 NASA Budget provides for the foundation of a national exploration campaign that will use the experience of the NASA workforce, coupled with

the agility and innovation of our commercial and international partners, to create an architecture that is open, sustainable and agile.

As shown in Figure 1 (below), building on the FY 2019 appropriation with the funding requested in the FY 2020 budget, NASA will:

- Provide opportunities for at least 13 deep space CubeSat missions, including 7 to the Moon (on EM-1);
- Complete 6-7 Exploration Missions with SLS and Orion, strengthening American capabilities to launch astronauts and spacecraft;
- Fund the deployment of at least one commercial space station in Low Earth Orbit and begin conducting science, technology development, and human research on this new platform;
- Fly up to 10 Commercial Lunar Payload Services (CLPS) missions, enabling new science and demonstrating new technologies supporting human return to the lunar surface;
- Complete assembly, and begun supplying, the Lunar Gateway using competitively procured commercial launch vehicles - establishing the initial exploration infrastructure orbiting the Moon;
- Demonstrate, for the first time, industry-led lunar descent vehicles and a reusable lunar ascent vehicle;
- Use, for the first time on the Moon, key exploration technologies including precision landing, cryogenic fluid management, in-situ resource utilization, and surface nuclear power, and invested in technologies for long-term utilization;
- Launch a Mars Sample Return mission as early as 2026, later returning the first sample of another planet back to Earth;
- Return humans to the lunar surface; and
- Establish interoperability standards for human exploration systems that will allow for an open architecture approach to human exploration activities.

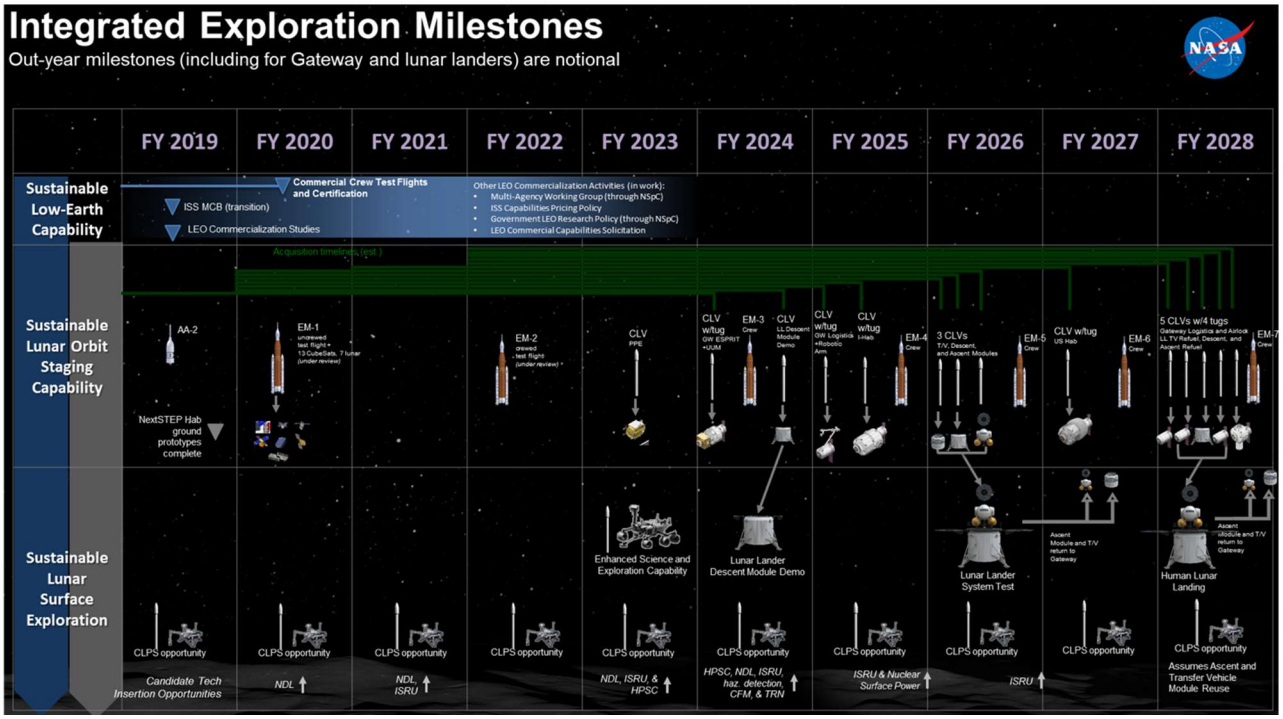


Figure 1: Planned Exploration Milestones consistent with the FY 2020 President's Budget. The schedule for the EM-1 launch is currently under review. Figure 1 is reproduced in larger format at the end of this report.

Table 1: FY 2020 President's Budget for Lunar Elements identified in P.L. 116-6

Programs *($ in millions)*	**FY 2019****	**FY 2020**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**
Gateway	$450.0	$821.4	$827.7	$717.0	$787.8	$757.5
Adv Cislunar and Surface Capabilities	$116.5	$363.0	$647.0	$967.7	$1,775.9	$2,360.0
Commercial LEO Development	$40.0	$150.0	$175.0	$200.0	$225.0	$225.0
Lunar Discovery and Exploration*	$197.0	$188.0	$305.0	$395.0	$419.0	$436.0
Total	$803.5	$1,522.4	$1,954.7	$2,279.7	$3,207.7	$3,778.5

**The Lunar Discovery and Exploration program budget excludes funding for the Lunar Reconnaissance Orbiter*
***FY 2019 as enacted in P.L. 116-006*

In FY 2019, NASA is taking specific steps to implement SPD-1, with goals of looking at more innovative procurement models and increasing sustainability of the Agency's programs:

1. In November 2018, NASA selected 9 companies as part of the Commercial Lunar Payload Services (CLPS) procurement, making them eligible to provide transportation services to the lunar surface for science, technology, and exploration payloads;
2. In February 2019, NASA selected 12 NASA-provided payloads that could be flown on the early CLPS missions;
3. In Q2 of calendar year 2019, additional payloads will be selected from the Lunar Surface Instrument and Technology Payloads NASA Research Announcement (NRA) which includes the broader U.S. scientific community, as well as technology and exploration payloads;
4. The Commercial Crew Program (CCP) is expecting crewed test flights during Summer of 2019 for both commercial providers, with flights to ISS by the end of calendar year 2019;
5. For the Lunar Gateway system, the contract for the Power & Propulsion Element (PPE) is planned for award in Q2/Q3 of calendar year 2019;
6. Also for Gateway, NASA issued RFP's for the habitation & logistics modules;
7. NASA issued a Broad Agency Announcement (BAA) seeking partners to study and develop a human-rated lunar lander system;
8. NASA commissioned 12 studies from industry to describe how a future commercial economy in LEO would be structured and financed to inform the first Commercial LEO Development solicitation; and,
9. NASA is maturing technologies and systems in preparation for deep space missions to the Lunar Gateway, and is developing advanced power and propulsion capability.

Lunar Elements

The subsequent pages describe each of the Lunar Program Elements cited in P.L. 116-6 in detail, including:

- an overview of the programs;
- achievements made or planned in FY 2018-2020;
- descriptions of any program elements;
- acquisition plans;
- research announcements; and,
- future milestones.

The Lunar Program Elements that follow include:

- Gateway
- Advanced Cislunar and Surface Capabilities
- Lunar Discovery and Exploration
- Commercial Low Earth Orbit (LEO) Development

Gateway

Overview: NASA will establish the Lunar Gateway, a way station that will orbit the Moon and enable human and robotic missions to the lunar surface. The Lunar Gateway will support exploration on and around the Moon, and sustainable human lunar surface exploration missions by supporting reusable human lunar landers. It will be a temporary home for astronauts and will foster growing domestic and international economic opportunities for commercial logistics and refueling services, as well as provide robust communications with spacecraft in cislunar space and on the lunar surface. The Lunar Gateway will allow for a continuously expanding knowledge base in the area of deep space maneuvering and solar electric propulsion (SEP). Through the development of Lunar Gateway, the United States will maintain its leadership in space exploration and discovery as it pioneers a new era of space travel, research, logistics, and economic development.

The Lunar Gateway will be assembled in orbit around the Moon, where it will be used immediately as a staging point for missions to the lunar surface. It can evolve depending on mission needs, and although there are various concepts for its configuration that continue to be evaluated, current analysis suggests that the functionality will support lunar landers and include four main functions: A Power and Propulsion Element (PPE); habitation; an airlock to enable Extra-Vehicular Activities (EVA); and, a logistics capability for cargo delivery. These functions will provide critical abilities for the Lunar Gateway to support human-class reusable landers, landing a crew of up to four astronauts on the lunar surface by 2028 and ultimately developing sustaining lunar operations on the Moon. Additional capabilities could enable science utilization, exploration technology demonstrations, and potential commercial utilization. The ISS international partners are heavily involved in helping to define and participate in the Gateway concept. International involvement, whether on the Gateway or on the lunar surface can spread costs and help maintain US leadership in human spaceflight

The PPE is the first element of the Lunar Gateway which will be launched on a commercial rocket in 2022 and placed in orbit around the Moon. Working in partnership with Exploration Technology, PPE will demonstrate advanced high-power SEP bus systems that will support both future NASA and commercial applications. It is being acquired as a public-private partnership and following a spaceflight demonstration period of up to one year, when NASA will then likely take over operations of PPE from the industry partner. The PPE will supply power and propulsion for elements and systems on the Lunar Gateway as well as accommodations for research payloads, and communication to and from Earth, space-to-space, and space-to-lunar. The Lunar Gateway is intended to be capable of supporting human-class lander deployments and operations using multiple docking ports. Once the PPE and habitation capabilities and logistics have been delivered to cislunar space, a crew of four - launched on Orion - will visit the Lunar Gateway on missions lasting up to 30 days.

The focus of the Lunar Gateway is on enabling sustainable lunar surface capability as soon as possible. It will support a reusable human lunar landing system, in addition to supporting other science and human exploration objectives on and around the Moon. Delivery of Lunar Gateway and lunar lander elements, including refueling of these elements, will create a reusable hub for sustainable lunar activity and feed forward to Mars.

Current and Planned Achievements through FY 2020: The Agency conducted an Acquisition Strategy Meeting (ASM) in August 2018, leading to the Lunar Gateway Formulation Sync Review (FSR) kickoff, which is the equivalent of a program-level System Requirements Review (SRR). The SRR is a preliminary look at functional and performance requirements defined for the system to ensure that the requirements and the selected concept will satisfy the Agency priorities and goals and was recently successfully completed. The Agency completed the FSR in February 2019 and is progressing towards a program-level Systems Design Review (SDR), currently planned for early next calendar year.

Lunar Gateway released several requests for information (RFIs) regarding utilization of Lunar Gateway science, technology, and commercial entities, as well as emerging commercial surface capabilities to enable regular access to the lunar surface. In February 2018, NASA hosted a Lunar Gateway science workshop to gather information that is being used to inform utilization opportunities. A few of the science possibilities resulting from these efforts include opportunities for Earth, Heliophysics, Astrophysics and fundamental physics investigations; additional transportation infrastructure (low lunar orbit) tug/pallet, surface access, sample return capability that can enable additional lunar science; and. external sample collections that will provide science about cometary material, solar composition, interstellar particles, and near-Earth objects. Additional opportunities include important tests of the effects of radiation on biological organisms.

Using the Next Space Technologies for Exploration Partnerships (NextSTEP) Broad Agency Announcement (BAA), NASA solicited inputs from U.S. industry on their current capabilities and plans that could be leveraged to provide an advanced SEP-based spacecraft bus for the Lunar Gateway. The request identified 23 topic areas including potential commercial synergies to support development of a PPE. These studies will provide data on U.S. commercial capabilities for PPE while NASA continues to define objectives and requirements as well as how to reduce risk for a new powerful and efficient SEP technology in deep space that will be used on future exploration missions.

PPE selected five proposals for further industry study from the inputs received in FY 2017. These industry studies provided data on U.S. commercial capabilities for PPE and were successfully completed in March 2018. Other progress included developing PPE requirements and planning for acquisition and partnership approaches including interactions with industry through release of a draft solicitation and holding an industry day. A final BAA for a public-private partnership for spaceflight demonstration of PPE was released on September 6, 2018.

As a decision from the Lunar Gateway Acquisition Strategy Meeting (ASM) in August 2018, the Lunar Gateway program leadership has transitioned in 2019 at the conclusion of the FSR, from NASA Headquarters-led formulation to Center-led execution as the program matures through the life cycle.

Lunar Gateway PPE will award one or more contracts for the spacecraft development in FY 2019 and mature plans with industry to baseline the preliminary design. Critical to the approach is realization of a deep space operational power and propulsion capability that is directly applicable to a wide range of commercial, robotic, and human spaceflight missions. This will also allow NASA to leverage existing commercial space communication capabilities.

NASA is formulating the Lunar Gateway by defining system requirements, developing design and interoperability standards, establishing program and system-level control boards, developing strategy and execution mechanisms to acquire Lunar Gateway modules, and developing an integrated ground test plan for prototype habitats. The NextSTEP Phase 2 Habitation contracts, funded in Advanced

Exploration Systems (AES), are developing prototype deep space Lunar Gateway habitats that are allowing NASA and the NextSTEP habitation partners to: 1) evaluate configurations and habitability attributes of the habitat; 2) assess how the various systems interact together and with other capabilities such as propulsion modules and airlocks; 3) provide platforms to test and validate standards and common interfaces; and, 4) reduce the risk of Lunar Gateway development and assembly.

At the end of NextSTEP Phase 2 study contracts, industry partners will provided the functional habitat ground prototype units to NASA for testing. Ground testing beginning in 2019 will further enable Lunar Gateway habitation design through a demonstrated consistent test and verification approach, allowing NASA to incorporate and test subsystems, facilities, crew training approaches, and human factors. The intended outcome of these activities is a complete set of long-duration deep space architecture designs (including standards, common interfaces, and testing approaches) from the awarded contractors as well as development and test of full-size ground prototypes.

While the NextSTEP Habitation activities are identifying potential U.S. industry implementation approaches and partnerships for the Lunar Gateway, concurrent assessments are underway by the International Space Station (ISS) partners to evaluate alternative/complementary approaches for implementation that focuses on international capabilities and contributions for the Lunar Gateway buildup in cislunar space.

The International Space Station (ISS) Multilateral Coordination Board (MCB), which oversees the management of the ISS and consists of representatives from NASA and our four ISS partners, met on March 5, 2019, and released a joint statement on the ISS and extending human exploration to the Moon and subsequently to Mars. The MCB emphasized the importance of affordable and sustainable exploration and acknowledged Gateway as a critical next step, as it will support human and robotic access to the lunar surface, and build invaluable experience needed for the challenges of later human missions to Mars. The MCB endorsed plans to continue the Gateway development and welcomed each agency's intention to proceed toward their respective stakeholders' approval and funding processes for providing specific elements, modules, and capabilities to the Gateway and associated benefits based on a common concept.

During FY 2019, NASA will further relationships with both its commercial and international partners to solidify acquisition and partnership plans.

The ISS approach to international partnerships will serve as a model that has proven to be flexible and adaptable with international entities. It has presented opportunities for NASA to provide a global leadership role, while advancing exploration goals and objectives.

With the growing number of commercial activities in space, partnerships with the private sector offer increasingly beneficial opportunities to help NASA achieve its mission objectives. Public-private partnerships with domestic entities may also present opportunities for NASA to advance exploration goals and objectives in a cost- and/or time-efficient manner. For these reasons, Lunar Gateway shall seek both international and domestic collaborations with industry and academia to strengthen the overall endeavor. A RFI for Lunar Gateway Logistics was released in October 2018 to help NASA understand service options to transport cargo, equipment and other goods, like food, to and from the orbiting outpost. Responses were due in November 2018 and results are being incorporated into a future solicitation planned for later in 2019.

Moreover, the systems and elements that are required for deep-space missions will need to work together and be certified for spaceflight. NASA is working with experts across the globe to establish

interoperability standards that will make it possible for any developer to design deep space-compatible human exploration systems. The initial set of high priority standards – avionics, communications, ECLSS, power, rendezvous, robotics, and thermal – are planned to be baselined this year. Additional standards will be developed or updated as necessary. An iterative approach to developing these standards is being used, leveraging the ISS partnership for standards development while and also gathering NextSTEP industry and broad NASA feedback. Additionally, the draft high priority standards were published on a public website for anyone in the world to provide comments.

Internal to NASA, a cross-functional working group leveraged lessons learned from existing efforts such as Commercial Crew, focused on existing standards and their applicability to deep-space habitation and transportation architecture.

NASA will continue working with the newly-selected PPE industry partner(s) to enable successful delivery of their development schedule. The expected milestones will include requirements and design reviews, and component procurements. PPE will work with NASA internal partners to codify deliverables and ensure NASA's confirmation baseline is established.

As Lunar Gateway formulation continues, NASA anticipates making selections for the U.S. habitation module development in 2020. Agreements for internationally provided contributions will be finalized including international partner provided European System Providing Refueling, Infrastructure, and Telecommunications (ESPRIT).

Building upon the current NextSTEP commercial engagement contracts, the Lunar Gateway will continue to advance commercial habitation, avionics, flight software, life support, in-space refueling capabilities, and other commercial space industries that may be incorporated into the Lunar Gateway modules.

Advanced Cislunar and Surface Capabilities

Overview: NASA is continuing to advance its lunar campaign through the Advanced Cislunar and Surface Capabilities (ACSC) program to establish U.S. preeminence to, around, and on the Moon. NASA is developing a series of lunar missions that build in capability to return humans to the surface in the late 2020s. Utilizing commercial and international partners as appropriate to enhance U.S. leadership and ensure affordability, ACSC will use new approaches to accelerate human-class lander capability development.

ACSC has accelerated development of a human lunar landing architecture that will include uncrewed demonstration missions in 2024 and a crewed demonstration mission to return humans to the lunar surface.

The ACSC program is an integral part of NASA's Exploration Campaign, working in parallel with exploration technology, scientific lunar exploration, Orion, Gateway, and SLS and commercial launch capabilities. Agency partnerships through the Exploration Campaign will continue with the Science Mission Directorate (SMD) Lunar Discovery and Exploration Program (LDEP) and Exploration Technology account. The partnership with SMD includes coordinating and identifying NASA payloads to fly on commercial lunar transportation services missions, and identifying long-term exploration needs. Exploration Technology's Tipping Point program includes 6 awards that are related to lunar landers. ACSC will work with the Exploration Technology Mission Directorate to ensure that the technologies developed are relevant and have high potential to on-ramp to the lunar missions.

ACSC will solicit, engage, and nurture growing capabilities and progress to the ultimate goal of landing a crew of astronauts on the lunar surface by 2028. Through development of sustaining operations and in-situ resource utilization (ISRU) with refueling options, reusable vehicles will be able to transport astronauts back and forth between Gateway and the surface of the Moon.

Current and Planned Achievements through FY 2020: In FY 2018, HEO/Lander Technologies released a Request for Information (RFI) soliciting emerging commercial capabilities, short- and long-term mission plans, information on what commercial sector opportunities there are that would be enabled through regular access to the lunar surface, and innovative public-private partnership acquisition approaches.

The responses from the RFI released in 2018 were used to develop a solicitation released in February 2019 to support joint risk reduction activities. Using a new Human Landing System (HLS) appendix under the Next Space Technologies for Exploration Partnerships (NextSTEP) Phase 2 Broad Agency Announcement (BAA), NASA is soliciting lander risk reduction activities and concepts from industry leading to sending humans to the surface of the Moon and bringing them home safely as part of a sustainable campaign of exploration.

These activities will be closely coordinated with SMD and the LDEP so that NASA ensures continued options to on-ramp new commercial robotic/cargo landing capabilities as those services become available and economically sustainable.

FY 2018 accomplishments from the AES Lunar Cargo Transportation and Landing by Soft Touchdown (Lunar CATALYST) partnerships continue to be assessed to evaluate efforts that are directly applicable to ACSC. The CATALYST partnerships encourage development of robotic lunar landers that can be integrated with U.S. commercial launch capabilities to deliver payloads to the lunar surface.

Through a partnership with the Korea Aerospace Research Institute, ACSC will deliver the ShadowCam flight instrument for the Korea Pathfinder Lunar Orbiter. NASA will provide Deep Space Network lunar navigation and trajectory assistance in return for instrument space on their orbiter. The ShadowCam will image the shadowed regions on the Moon's poles.

In 2020, ACSC will primarily be focused on partnering with industry to develop the FY 2024 human-class lunar lander (descent element), which will be sized for the largest commercial launch vehicle available at that time. Operational analysis will begin in order to study how to integrate future landers with a lunar surface payloads at the Gateway, allowing for the largest possible payload and increased extensibility for the human lander.

ACSC will release studies, develop architecture designs, and perform risk reduction activities for the FY 2026 reusable transfer vehicle, which will serve as a means of transport between Gateway and Low Lunar Orbit (LLO), as well as begin development of a reusable human ascent element to return astronauts to the Gateway after landing on the lunar surface. ACSC will continue risk reduction activities on Extravehicular Activity (EVA) suits for astronauts on the lunar surface. Studies and risk reduction activities will begin on a refueling element that will refuel the reusable elements near the Gateway to allow a sustainable cadence of missions to the lunar surface and prepare for missions beyond the Moon

ACSC will also continue to partner with the Science Mission Directorate and the Exploration Technology Mission Directorate for related lander and surface systems.

Program Elements: Lunar Lander Missions

Human Landing System (HLS)

The HLS consists of multiple elements that together will provide transportation for astronauts between Gateway and the lunar surface and will be flown in a series of demonstrations to the Moon that culminates in a human lunar return in 2028. NASA's reference architecture is based on a three-stage lander design that includes an Ascent Element, Descent Element, and Transfer Vehicle Element. The Ascent Element, potentially consisting of separate crew and service modules, will carry up to four astronauts and will be reusable and refuelable. The Descent Element performs propulsion and braking functions to the lunar surface and will support the Ascent Element, as well as possibly also serving as a lander for robotic cargo missions. Initially it will be expendable, but NASA is studying options to phase in reusable capability by leveraging future ISRU propellant production on the Moon. The Transfer Vehicle Element will dock to the Descent and Ascent Elements and transport them from Gateway to Low Lunar Orbit before separating and returning to Gateway for reuse. The HLS also includes Refueling Elements that will enable reuse of the Ascent and Transfer Vehicle Elements by supplying Earth-based propellant.

This three-stage architecture enables overall mass savings by staging the delivery of crew between Gateway and the lunar surface and lowering the amount of required propellant. By separating the lander function into relatively small pieces, this architecture also enables options to launch each HLS element on commercial launch vehicles.

This first HLS demonstration mission will be focused on the descent element of the human landing system. The 2024 mission is intended to demonstrate extended cryogenic fluid management operations that are needed to establish a high performance, reusable propulsion system for sustainable human-class landing systems on later missions. Development of the descent element is intended to be achieved through industry-led design and development using a fixed-price/milestone based contract approach for this demonstration and follow-on missions. NASA is currently targeting a lunar pole for the first landing site because of the potential to collect and utilize lunar polar resources including water and the unique lighting conditions that are highly favorable for long-term exploration. HEO/ACSC and SMD/LDEP will continue to assess existing lunar data sets and information from planned lunar missions, including Commercial Lunar Payload Services (CLPS) missions, to further identify and characterize specific candidate sites for the 2024 mission and beyond.

Future Lander Missions

ACSC is also planning a demonstration mission in 2026 and a human crewed mission to the surface in 2028. The 2026 lander mission will be an end-to-end test flight of an uncrewed human-class lunar landing system. The 2026 mission will demonstrate the full lunar surface access architecture including the Transfer Vehicle from Gateway to LLO, the full human-class Descent Element from LLO to the lunar surface and the full human-class Ascent Element return to Gateway from the lunar surface. Both the Transfer Vehicle and the Ascent Element will be tested for reusability for future missions to demonstrate landing sustainability.

In 2028, the third ACSC lander mission will land a crew of astronauts on the Moon and return them safely to Gateway. For this mission, ACSC will demonstrate EVA space suits on the lunar surface, as well as utilize the reusable Transfer Vehicle and Ascent Element to carry

astronauts from Gateway to LLO and to the lunar surface and back, respectively. ACSC will continue the assessment of fueling / refueling capability near Gateway for the lowest amortized cost and sustainability for the human landing system and deep space missions.

Lunar Surface Capabilities

To support lunar exploration missions after the 2028 human landing, ACSC will also develop lunar surface capabilities, including ISRU systems that harvest lunar resources such as oxygen and hydrogen as well as produce propellant for the Descent Element so that it can be reused between the lunar surface and Gateway. Development of these ISRU system capabilities will build on technologies matured by the ET account.

ACSC will also continue conducting studies to determine the scope of future lunar surface missions and evolvability to Mars landings.

ACSC Lander Technology

Activities like Lunar CATALYST will continue to develop necessary technologies, such as propellant liquefaction, and next generation propellant tank health monitoring to enable lunar surface missions. ACSC will continue to focus on lander capabilities, completed designs, and overall risk reduction and access to the lunar surface.

ACSC Core

In the Core area, ACSC will focus on non-landing capabilities tied to lunar exploration. Activities include lunar mapping and participation in international partnerships for lunar orbiters.

Acquisition Strategy: Acquisition plans for all functions/elements of ACSC will be determined over the course of FY 2019 and FY 2020, as required, and will utilize full and open competition, public-private partnerships, and international partnerships. NASA issued a NextSTEP HLS BAA in February 2019 to initiate multiple six-month Phase A studies and risk reduction activities for the Descent Element, Transfer Vehicle Element, and Refueling Element. The awards will be for firm fixed-price, milestone-based contracts, and the Descent Element awards may be followed by Phase B work that includes design, development, test, evaluation, and lunar flight demonstration in 2024. Additional acquisitions for the HLS elements will also be occurring in FY 2020 and FY 2021.

Major Contracts/Awards

Future awards for the ascent and transfer vehicle elements will also be occurring in the late FY 2020 and early FY 2021 timeframe.

Spring 2019
- HLS BAA Proposals Due
- HLS BAA Selections

Summer 2019
- HLS BAA Contract Awards

Independent Reviews

An independent review board will be established in 2019 to participate in the major reviews for the Human Landing System.

Lunar Discovery and Exploration

Overview: The Lunar Discovery and Exploration Program (LDEP) in Science is a key component of the Exploration Campaign. It includes activities such as: the establishment of commercial contracts for lunar landing transportation services; the development of instruments that serve lunar science; long-term exploration and utilization needs; the development of smallsats that will provide innovative investigations; continued operations of the Lunar Reconnaissance Orbiter; and, the development of long-duration lunar rovers that will utilize commercially developed landers to get to the lunar surface. NASA will prioritize capabilities that support lunar resource analysis and prospecting to inform future human space flight objectives.

Instruments, experiments, or other payloads on the lunar surface will address the variety of exploration, science, technology demonstration, and utilization objectives identified by NASA. In partnership with U.S. industry and the scientific community, the program will develop lunar surface payloads (and supporting orbital payloads), along with cost-effective ways to deliver and provide services for these payloads. These payloads and services will address the nation's lunar exploration, science, and technology demonstration goals, many of which are outlined in the National Academies of Sciences 2011 Decadal Survey: Vision and Voyages for Planetary Sciences in the Decade 2013-2022, the National Research Council 2007 Report: The Scientific Context for the Exploration of the Moon, and the NASA Strategic Knowledge Gaps (see https://www.nasa.gov/exploration/library/skg.html).

NASA expects to fly NASA payloads or instruments on existing and forthcoming commercial missions and purchase transportation services to the Moon for the NASA payloads or instruments (to include landing and surface access to agreed-upon locations on the lunar surface). NASA payloads will obtain "utilities" from commercial landers such as power, communications, thermal control, etc., during launch integration, launch, and cruise phase, and potentially after landing. In addition, NASA will pursue the purchase of science or engineering data provided by contractor payloads, and the return of payload and/or samples to the Earth. This approach offers NASA the potential to address critical strategic objectives related to exploration, science, and technology demonstration using commercially provided domestic space services and hardware.

In parallel with the development of commercial partnerships to provide lunar surface payload delivery and support services, LDEP will develop the exploration, science, and technology payloads to support this on-going investment. One area of focus will be instrumentation to advance the knowledge and technologies for the use of local resources, such as lunar water ice. Working with the science and human exploration communities, our international partners, and U.S. industry, NASA will refine the goals and objectives for a robust and sustainable lunar exploration and science program.

Current and Planned Achievements through FY 2020: NASA released the Lunar Surface Cargo Transportation Services Request for Information (RFI) soliciting information to determine the extent of interest and availability of domestic vendor sources capable of providing commercial launch and landing services on commercial missions to the lunar surface for NASA payloads. NASA subsequently released the Commercial Lunar Payload Services Request for Proposal (RFP) to procure commercial lunar landing services.

NASA continued operations of the Lunar Reconnaissance Orbiter (LRO). LRO continues to provide a treasure trove of lunar data that directly support the advancement of lunar science and the planning of future lunar missions by helping to characterize and to conduct detailed surveys of potential landing sites for commercial missions. Early in FY 2018, the scientific journal, Icarus published Part III of the three-part Special Issue on the scientific results from LRO.

NASA released a call for smallsats in support of planetary science investigations. The expectation is that some proposals will include investigations of the Moon, and if selected, this program would fund them.

In FY 2019, NASA awarded Commercial Lunar Payload Services (CLPS) contracts for the purchase of commercial transportation and services to deliver NASA scientific, exploration, and technology payloads to the surface of the Moon.

NASA selected 12 NASA-provided science and technology demonstration payloads to fly on the first CLPS missions. Additional payloads will be selected in the spring from the Lunar Surface Instrument and Technology Payload call through the Research Opportunities in Space and Earth Science (ROSES) process. Robotic payload proposals will be selected that advance NASA's exploration, scientific, and technology goals.

NASA will work with the science community, NASA's international exploration partners, and U.S. industry to refine the exploration, scientific, and technology objectives in support of the Lunar Discovery and Exploration Program.

NASA will continue operations of LRO in support of scientific research and future science and exploration mission planning. NASA will provide LRO landing site characterization capabilities to international partners for future lunar lander missions.

NASA will conduct studies to develop rover capabilities for future resource investigations and utilization. NASA will assess options for commercial landers that could transport a rover to the lunar surface.

In FY 2020, NASA will continue to work with the selected CLPS contractors to launch and land NASA scientific, exploration, and technology payloads on the surface of the Moon.

NASA will competitively select additional robotic lunar surface payloads that advance NASA and U.S. industry's exploration, scientific, and technology goals to include resource utilization. These payloads will fly on the CLPS-provided launch and landing services to the lunar surface.

NASA will continue operations of LRO in support of scientific research and future science and exploration mission planning. NASA will continue to offer LRO landing site characterization capabilities to international and commercial partners upon request.

NASA will determine an acquisition approach for a rover capability that would utilize a commercially developed lander and implement the approach.

Program Elements:[1]

Commercial Lunar Payload Services (CLPS)

With the strategic goal of supporting affordable commercial operations to and on the Moon that support NASA and the needs of an emerging private sector market, Commercial Lunar Payload Services (CLPS) will open competition to U.S. commercial providers of space transportation services, consistent with the National Space Transportation Policy and Commercial Space Act. CLPS will produce a multi-vendor catalog, 10-year indefinite-delivery-indefinite-quantity (IDIQ) contract, managed through task order competition for specific lunar surface transportation services of payloads with NASA being one of several customers.

NASA announced the awards for the Commercial Lunar Payload Services (CLPS) contract. This is a 10-year IDIQ contract for landed lunar payload delivery services. NASA awarded tasks to commercial services companies that will provide opportunities for NASA to fly science instruments and technology development units to the surface of the Moon, along with other customers as well. See the list of commercial service company awardees in the Major Contract/Awards table of the Lunar Discovery and Exploration Program section.

Lunar International Mission Collaboration

Under the Lunar International Mission Collaboration project (LIMC), NASA funds instruments and scientific investigators and will provide navigation and data relay services in exchange for participation.

NASA signed an agreement with the Israel Space Agency (ISA) on October 3, 2018, to cooperatively utilize the Israeli nonprofit SpaceIL's commercial lunar mission, expected to land on the Moon in 2019. The agreement exemplifies the innovative approach that NASA and its international partners are taking to team up with commercial partners to advance important science and exploration objectives on and around the Moon.

NASA will contribute a laser retroreflector array to aid with ground tracking, and Deep Space Network support to aid in mission communication. ISA and SpaceIL will share data with NASA from the SpaceIL lunar magnetometer installed aboard the spacecraft. NASA will publicize the data through NASA's Planetary Data System. In addition, NASA's Lunar Reconnaissance Orbiter will attempt to take scientific measurements of the SpaceIL lander as it lands on the Moon.

NASA will continue to look for opportunities to fly LRAs and other instrumentation in collaboration with existing and future international partners.

Lunar Future

Lunar Future Missions will support public-private partnerships and innovative approaches to achieving human and science exploration goals, including the return of humans to the moon. It will also support activities such as the establishment of commercial contracts for transportation services, the development of small rovers delivered via commercial landers,

[1] Does not include a description of the Lunar Reconnaissance Orbiter, which is also part of the Lunar Discovery and Exploration program.

and the building and launching of instruments that serve lunar science and exploration needs. Example missions include deploying nodes for the Lunar Geophysical Network, a priority identified by the National Academy of Sciences; in situ investigation of potential lunar resources, a priority identified in the Exploration Strategic Knowledge Gaps; and the demonstration of technologies to enable long-term robotic missions on the lunar surface despite the power and thermal challenges imposed by the lunar night.

NASA is also planning future missions to better understand the nature of lunar volatiles, a priority for the science and exploration communities, as well as industry. These missions will follow in the footsteps of a number of lunar missions such as LCROSS, LRO, and Chandrayaan, addressing the Global Exploration Roadmap (GER) ISRU recommendation of prospecting for the lunar resources, demonstrating an In-Situ Resource Utilization (ISRU) capability. NASA is working with commercial industry to develop mobile science instrument packages to look for and sample water-ice (volatile) deposits for potential follow-on resource utilization investigations.

Program Schedule:

- FY 2019
  - Award first CLPS mission task order
  - Award Development and Advancement of Lunar Instrumentation (DALI) program procurements
  - Award robotic surface payloads procurements
  - Conduct rover capability studies/Assess commercial lander options for rover
- FY 2020
  - Award second CLPS mission task order
  - Request for proposal for robotic surface payloads
  - Request for proposal for the DALI program
  - Determine and implement acquisition approach for rover and commercial lander

Acquisition Strategy: The Lunar Discovery and Exploration Program acquisition strategy established flexible contract mechanisms, such as indefinite delivery, infinite quantity (IDIQ) contracts, that enable the flexible and rapid procurement of commercial transportation and services to deliver NASA scientific, exploration, and technology development payloads to the surface of the Moon, including potential supporting services (orbital assets) and sample return.

In parallel, NASA will use its established solicitation mechanism, such as the Research Opportunities in Space and Earth Science (ROSES) NASA Research Announcement (NRA) and the Stand Alone Missions of Opportunity (SALMON) Announcement of Opportunity (AO) processes, to select and develop exploration, scientific, and technology development payloads for delivery to the Moon. In some cases, NASA may direct a NASA Center to develop a lunar capability or surface payload when it is in the government's best interest, such as when that capability supports multiple NASA applications or when a commercial entity or international partner identifies a near-term opportunity for a lunar surface mission on a timeframe that does not support competitive selection. However, to the extent possible, NASA will leverage commercial efforts.

Major Contracts/Awards

Commercial Lunar Payload Services

- Astrobotic Technology
  - Pittsburg, PA
- Deep Space Systems
  - Littleton, CO
- Firefly Aerospace
  - Cedar Park, TX
- Intuitive Machines
  - Houston, TX
- Lockheed Martin
  - Bethesda, MD
- Masten Space Systems
  - Mojave, CA
- Moon Express
  - Cape Canaveral, FL
- Orbit Beyond
  - Edison, NJ
- The Charles Stark Draper Laboratory
  - Cambridge, MA

Commercial Low Earth Orbit (LEO) Development

Overview: NASA seeks to achieve a continuous U.S. human presence in low Earth orbit (LEO) – both with government astronauts and with private citizens – in order to support the utilization of space by U.S. citizens, companies, academia, and international partners and to maintain a permanent American foothold on the nearest part of the space frontier. NASA is undertaking the Commercial LEO Development program as a focused effort to develop a commercial space economy in LEO that will support these goals for the Nation. NASA's Commercial LEO Development effort is intended to stimulate both the development of commercially owned and operated LEO destinations from which NASA can purchase services, and the continued growth of commercial activities in LEO such that NASA is but one of many users purchasing those services. As those commercial LEO destinations become available, and without a gap between ISS and future platforms, NASA intends to implement an orderly transition from current International Space Station (ISS) operations to the new commercial enterprise as laid out in NASA's ISS Transition Report of March 30, 2018.

To achieve the Commercial LEO Development program's overall goals, NASA will utilize a multi-faceted approach. The activities to be undertaken will address three main areas key to the development of a commercial market in LEO as identified by the ISS Transition Report - policy, enabling commercial supply, and enabling demand. The policy work led by the Commercial LEO Development team will support acquisition activities funded by this program, as well as ongoing research, technology demonstration, research, and commercialization activities conducted by the ISS program. Until now, NASA has evaluated many proposed commercial initiatives related to ISS on a case-by-case basis. New, forward-looking policies developed by the Commercial LEO Development team will provide more transparency to prospective space station users by setting expectations about activities that may be conducted on ISS based on current statute. In addition, new policies will provide more certainty that NASA will avoid competing with commercial entities offering the same

or similar services. Finally, NASA will focus on increasing its understanding in a variety of areas including the appropriate role of the United States Government in enabling and expanding commercial LEO development, real and perceived barriers to entry from both supply and demand sides, and understanding marketplace needs and issues.

Current and Planned Achievements through FY 2020: To gain better insight and help inform recommendations for how the program will move forward with both policy and acquisition efforts, NASA entered into agreements with 12 industry partners in FY 2018 to study the commercialization of LEO. These studies, which were funded by the ISS program, were designed to solicit industry's commercialization concepts, business plans and viability for habitable platforms in LEO, whether using ISS or free flying, that would enable a commercial marketplace in LEO where NASA is one of many customers. The studies also sought to understand the role of government and the evolution of ISS in the roadmap to the commercialization of LEO and how private demand for commercial LEO services could be stimulated in order to sustain a long-term LEO marketplace with primarily non-NASA commercial revenue. An independent executive panel, established to evaluate results from each industry partner, observed that crew/cargo transportation cost is a major barrier to LEO commercialization, impacting both space station operations costs and market demand. Additionally, the panel observed that a long-term LEO marketplace with primarily non-NASA commercial revenue is not viable without a significant transition period during which the U.S. Government continues to make investments in the market and purchases services from it. During this transition period, which will be years in duration, the study participants reported expecting NASA to be an anchor tenant. Based on these observations and several others, the panel will develop a solicitation strategy for Commercial LEO Development and make recommendations to Agency leadership for final acquisition strategy approval.

To enable the supply of commercial space station services, NASA will work with commercial partners on development of capabilities that could serve the needs of the private sector, NASA and others around the globe. These efforts will focus on enabling, developing, and deploying commercial orbital destinations that would allow NASA to transition from ISS for its low Earth orbit research and technology demonstration requirements, as well as meeting non-NASA demand for such commercial LEO activities. NASA has demonstrated great success through partnerships with industry in developing multiple commercial capabilities for delivery of cargo and crew to the ISS, then competitively purchasing delivery services using those capabilities. NASA intends to apply a similar model for the development of commercial LEO destinations through the Commercial LEO Development program. One of the primary purposes of the Commercial LEO Development program is to ensure that the United States has access to an orbital platform on which to conduct research and develop new technologies.

The Commercial LEO Development program will conduct an open competition for development of commercial LEO destinations in FY 2019. This competition will pursue public-private partnerships to develop LEO destinations that could be module(s) and/or platform(s) attached to the ISS or free flying in LEO. Ultimately, these destinations are intended to meet NASA's long-term needs and ensure that there is not a gap in NASA access to LEO capabilities during the ISS transition. The industry studies commissioned by NASA revealed several credible concepts for commercial LEO modules or platforms, including modules initially attached to ISS then transitioned to free flying destinations; however, several study participants opined that a commercially owned/operated ISS was not considered desirable nor feasible, including its prospective operation as a public-private partnership. Proposals submitted for this competition will also include market analysis and business plans for non-NASA activities. NASA intends to select winning proposals and make initial awards prior to the end of FY 2019.

NASA will also implement a mechanism for funding new emerging ideas beyond the initial module-focused solicitation. The partners engaged through this mechanism will be encouraged to utilize LEO destinations for commercial for-profit activities that are beyond NASA's and the ISS National Laboratory's missions. In the longer term, activities currently supported by NASA and the ISS National Laboratory will be transitioned onto these new destinations once available. This will allow private industry to seek out new emerging commercial activities and demonstrate the viability of commercial human spaceflight markets.

To further enable demand, NASA will engage and collaborate with the Department of Commerce and the Federal Aviation Administration to understand and address real and perceived barriers to entry associated with emerging and potential markets. NASA will also solicit proposals and award demand development activities that may include manufacturing and advanced research capabilities and activities. NASA is continuing to increase the cooperative use of the ISS to enable increased commercial investment and transition to more public-private partnership models. The end goal is where NASA is one of many customers of a commercial market in LEO. Today on ISS, NASA has already enabled increased commercial investment and partnerships through the National Laboratory, agreements such as Nanoracks/Boeing Commercial Airlock, and contracts for commercial services once performed by NASA. The ISS, Commercial Crew, and Crew and Cargo programs will continue working together to solidify the important commercial successes that were enabled by these programs and NASA's commercial and international partners.

Additional studies in focused areas, market surveys, workshops or other activities will be conducted in FY 2019 and FY 2020 to help ensure NASA is making the most effective policy and investment decisions to achieve its long-term goals. As an example, NASA will develop a policy that ensures that NASA or ISS National Laboratory activities avoid competing with the capabilities provided by commercial LEO destinations. Legal, technical and programmatic issues will require further study and coordination among the International Partners and commercial industry to ensure a smooth transition.

Commercial LEO Development will advance the Nation's goals in LEO and exploration by furthering the development and maturity of the commercial space market. This will enable private industry to assume roles that have been traditionally Government-only, by creating new opportunities for economic growth through new markets and industries in LEO, and potentially yielding long-term cost savings to the Government by leveraging private industry innovation and commercial market incentives.

Summary

For the first time in a decade, NASA has a budget for pursuing sustainable activities on the lunar surface. We have called on American companies to help design and develop human lunar landers and reusable systems for surface activities. The Space Launch System and Orion, critical components of our exploration architecture, will reach important milestones in construction and testing this year, and our new lunar command module, the Gateway, will see international and commercial partnerships solidified and construction begin.

NASA will continue to focus on meeting current program milestones while refining and optimizing program plans to most effectively implement SPD-1. This includes pursuing opportunities and updating plans to accelerate program milestones with the goal of enabling crewed lunar surface missions as soon as possible.

Through these activities, NASA will realize exploration opportunities in the near-term and set the stage for America space leadership decades to come, empowering American global leadership, spurring innovation and economic growth, and returning the United States to the forefront of space exploration.

Figure 1 (reproduced from Page 3)