2020 Breakthrough, Innovative, Game-Changing (BIG) Idea Challenge

Q&A Session

October 15, 2019

http://bigidea.nianet.org/

The BIG Idea Challenge is sponsored by NASA's Space Technology Mission Directorate (Game Changing Development Program) and Office of STEM Engagement (Space Grant), and managed by the National Institute of Aerospace.

Agenda

(Please mute your mics)

- Welcome and Introductions
- Context for the 2020 Challenge:
    - Lunar Surface Innovation Initiative (LSII): NASA's near term plans for the moon
- Programmatic Remarks
- General Technical Remarks
- Questions Received in Advance
    - Technical
    - Programmatic
- Additional Questions (time permitting)
- Wrap Up

NIA BIG Idea Challenge Program Team

Shelley Spears

Program Director

Stacy Dees

Program Manager

Victoria O'Leary

Program Coordinator

Genevieve Ebarle

Program Coordinator

Game-Changing Development Program Stakeholders

Drew Hope

Program Manager, LaRC

Anthony Calamino

Deputy Program Manager, LaRC

Hillary Smith

Communications, LaRC

Carol Galica

Lunar Surface Innovation Initiative (GRC/HQ)

Judges

Kevin Kempton

NASA LaRC - Chair

Dr. Ben Bussey

NASA HQ

Dr. Jennifer Edmunson

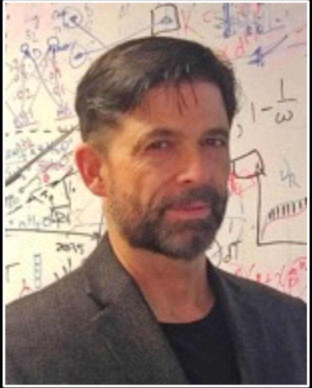
Jacobs (NASA MSFC)

Dr. Chris Jones

NASA LaRC

Bernard Kutter

United Launch Alliance



Dr. Philip Metzger

U. Of Central Florida

Jerry Sanders

NASA JSC

Dr. Kris Zacny

Honeybee Robotics

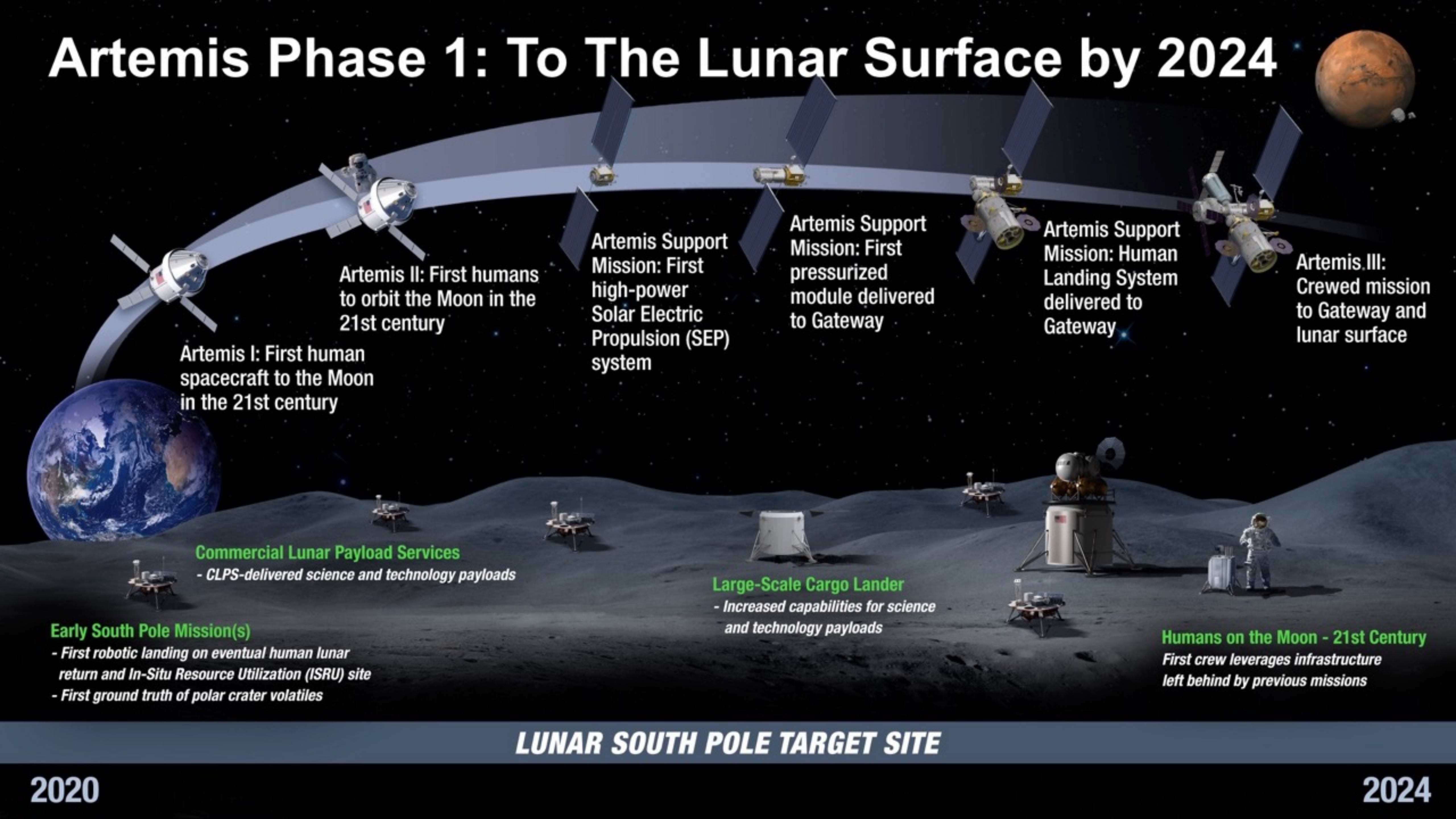
EXPLORESPACE TECH
TECHNOLOGY DRIVES EXPLORATION

Lunar Surface Innovation Initiative (LSII)

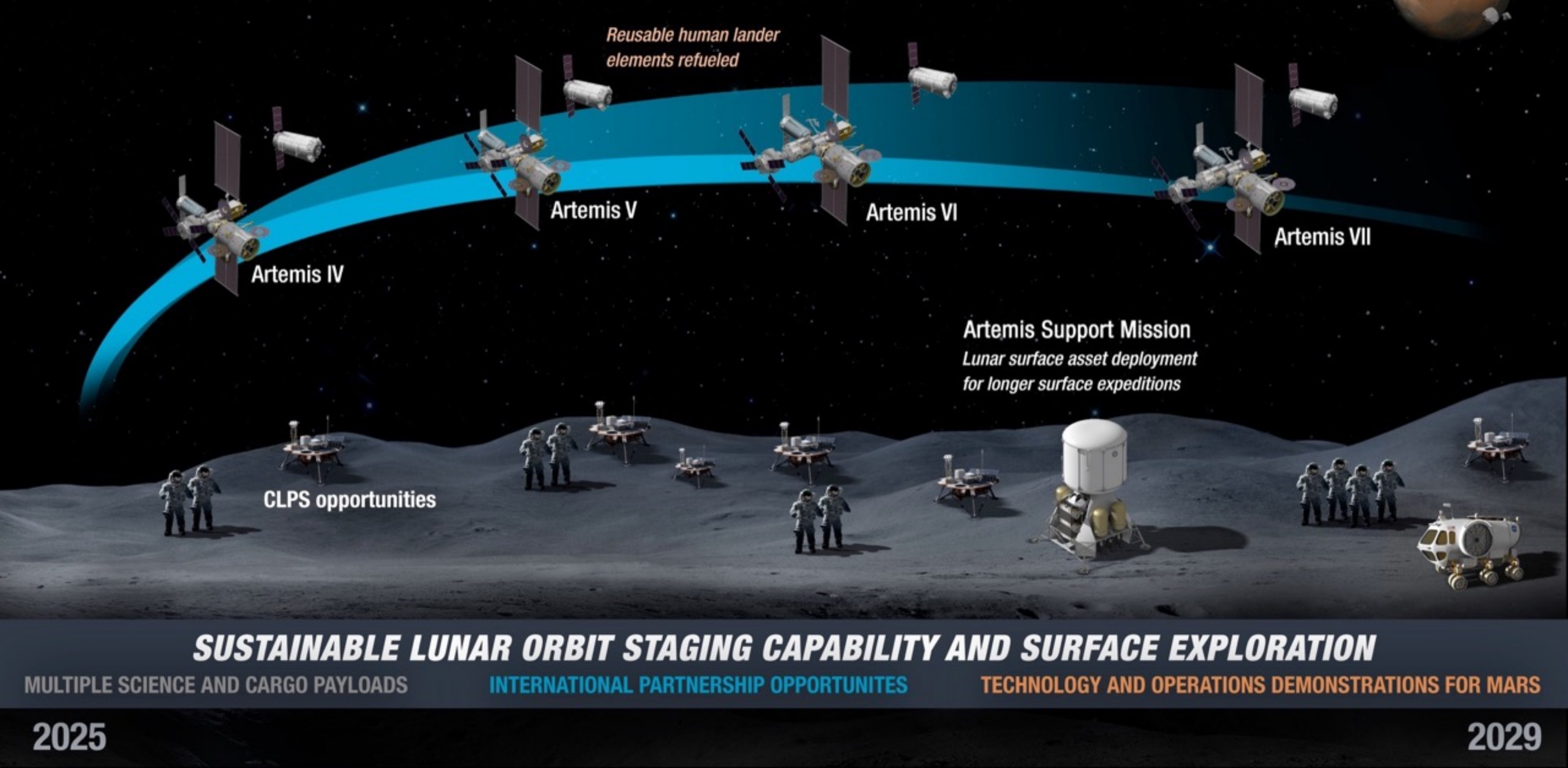
Carol Galica

Space Policy Directive 1: To The Moon, Then Mars

"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…"

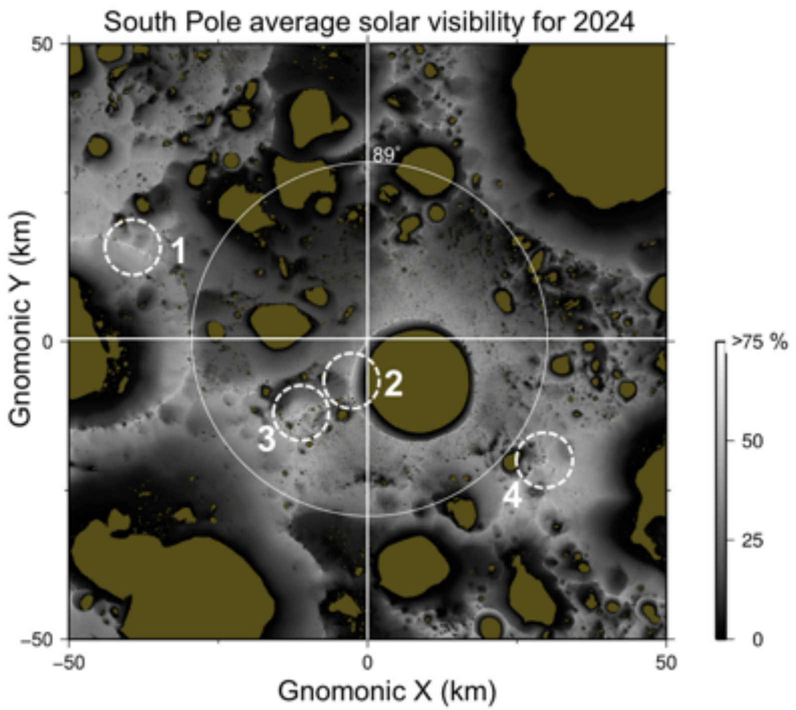

Artemis Phase 1: To The Lunar Surface by 2024
Artemis I: First human spacecraft to the Moon in the 21st century
Artemis II: First humans to orbit the Moon in the 21st century
Artemis Support Mission: First high-power Solar Electric Propulsion (SEP) system
Artemis Support Mission: First pressurized module delivered to Gateway
Artemis Support Mission: Human Landing System delivered to Gateway
Artemis III: Crewed mission to Gateway and lunar surface
Commercial Lunar Payload Services
- CLPS-delivered science and technology payloads
Early South Pole Mission(s)
- First robotic landing on eventual human lunar return and In-Situ Resource Utilization (ISRU) site
- First ground truth of polar crater volatiles
Large-Scale Cargo Lander
- Increased capabilities for science and technology payloads
Humans on the Moon - 21st Century
First crew leverages infrastructure left behind by previous missions
LUNAR SOUTH POLE TARGET SITE
2020
2024

Artemis Phase 2: Building Capabilities For Mars Missions



American Strategic Presence on the Moon –

High solar illumination areas within 2 degrees (<50 km) of the lunar south pole.



Four highly illuminated areas shown above:

1. De Gerlache Rim,
2. Shackleton Rim
3. Shackleton – De Gerlache Ridge
4. Plateau near Shackleton

High Priorities for Sustained Surface Activities

- **Long duration access to sunlight:** A confirmed resource providing power and minimal temperature variations
- **Direct to Earth communication:** Repeatable Earth line-of-sight communication for mission support
- **Surface roughness and slope:** Finding the safest locations for multiple landing systems, robotic and astronaut mobility
- **Permanently Shadowed Regions and Volatiles:** Learning to find and access water ice and other resources for sustainability

Lunar Science by 2024

POLAR LANDERS AND ROVERS

- First direct measurement of polar volatiles, improving understanding of lateral and vertical distribution, physical state, and chemical composition
- Provide geology of the South-Pole Aitken basin, largest impact in the solar system

NON-POLAR LANDERS AND ROVERS

- Explore scientifically valuable terrains not investigated by Apollo, including landing at a lunar swirl and making first surface magnetic measurement
- Using PI-led instruments to generate Discovery-class science, like establishing a geophysical network and visiting a lunar volcanic region to understand volcanic evolution

ORBITAL DATA

- Deploy multiple CubeSats with Artemis I
- Potential to acquire new scientifically valuable datasets through CubeSats delivered by CLPS providers or comm/relay spacecraft
- Global mineral mapping, including resource identification, global elemental maps, and improved volatile mapping

IN-SITU RESOURCE INITIAL RESEARCH

- Answering questions on composition and ability to use lunar ice for sustainment and fuel

Science After 2024

Human and Robotic Missions Provide Unique Science Opportunities

ON GATEWAY

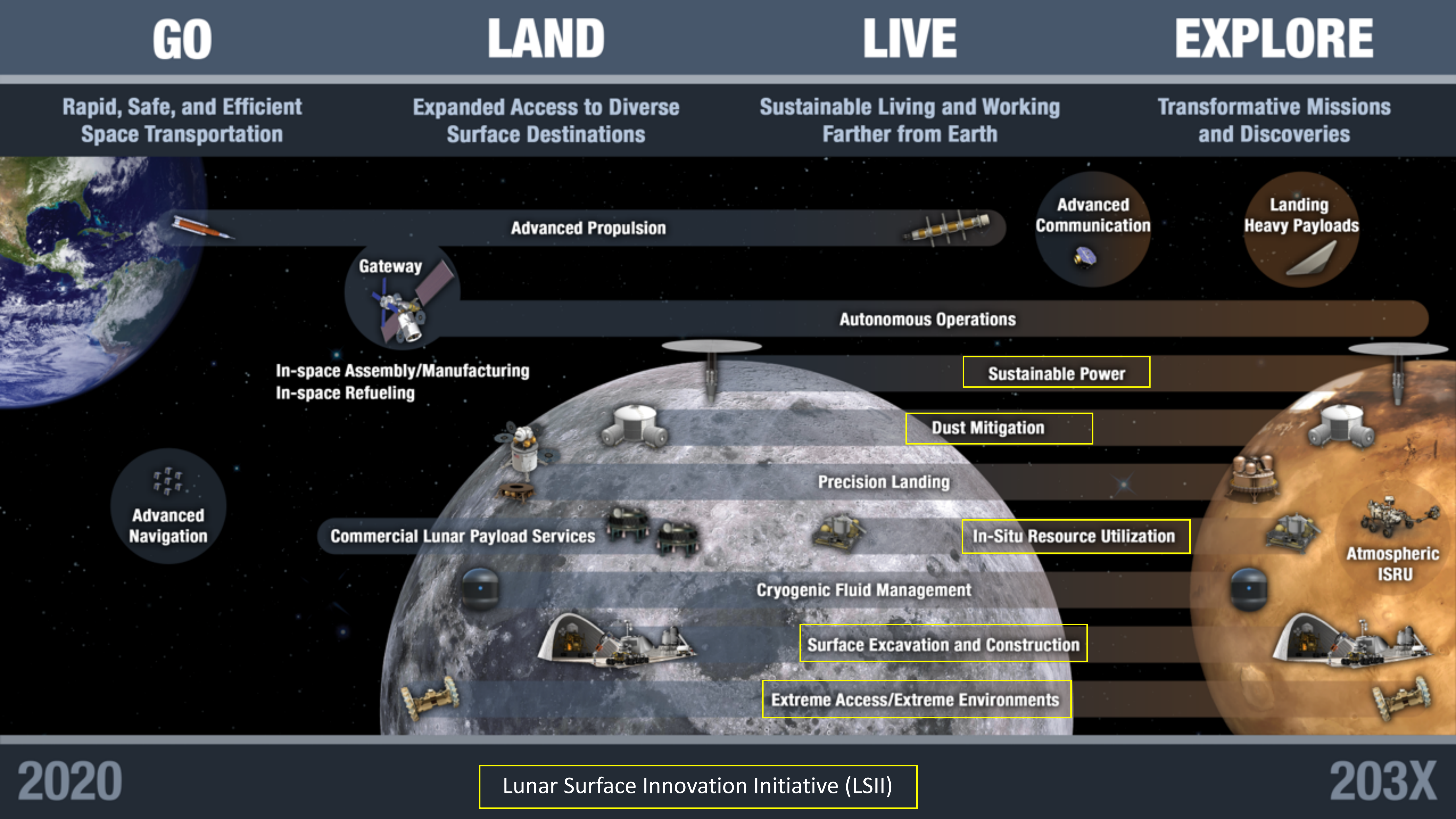
- Deep space testing of Mars-forward systems
- Hosts groundbreaking science study and observation
- Mars transit testbed for reducing risk to humans

SURFACE EXPLORATION

- Understanding how to use in-situ resources for fuel and life
- Revolutionizing the understanding of the origin and evolution of the Moon
- Studying lunar impact craters to understand impact cratering
- Setting up complex surface science instrumentation
- Informing and supporting sustained human presence

SURFACE TELEROBOTICS TO PROVIDE CONSTANT SCIENCE

- Sending rovers into areas too difficult for humans to explore


GO
LAND
LIVE
EXPLORE
Rapid, Safe, and Efficient Space Transportation
Expanded Access to Diverse Surface Destinations
Sustainable Living and Working Farther from Earth
Transformative Missions and Discoveries
Advanced Propulsion
Advanced Communication
Landing Heavy Payloads
Gateway
Autonomous Operations
In-space Assembly/Manufacturing
In-space Refueling
Sustainable Power
Dust Mitigation
Precision Landing
Advanced Navigation
Commercial Lunar Payload Services
In-Situ Resource Utilization
Atmospheric ISRU
Cryogenic Fluid Management
Surface Excavation and Construction
Extreme Access/Extreme Environments
2020
203X
Lunar Surface Innovation Initiative (LSII)

STMD Lunar Surface Innovation Initiative (LSII)

The STMD Lunar Surface Innovation Initiative (LSII) aims to spur the creation of novel technologies needed for lunar surface exploration and accelerate the technology readiness of key systems and components. The LSII activities will be implemented through a combination of unique in-house activities, competitive programs, and public-private partnerships.

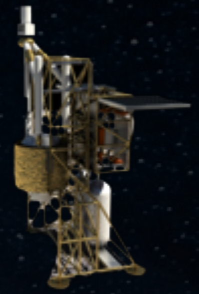
LSII Roles and Responsibilities Include:

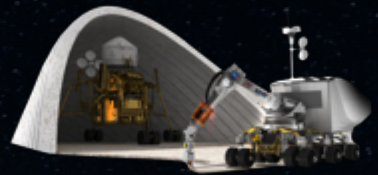
- Ensuring that there is an ambitious, cohesive, executable Agency strategy for development and deployment of the technologies required for successful lunar surface exploration.
- Integrating a broad spectrum of stakeholders to develop an acquisition strategy which efficiently facilitates robust collaborations and partnerships with industry and academia.
- Addressing planning, implementation, and budget needs to enable lunar surface activities across STMD Programs.
- Collaborating with Agency stakeholders, as well as Other Government Agencies (OGAs), universities, industry, and international partners in order to better align the Agency's investments relative to lunar surface demonstrations.

Lunar Surface Innovation Initiative (LSII)

In Situ Resource Utilization

Collection, processing, storing and use of material found or manufactured on other astronomical objects



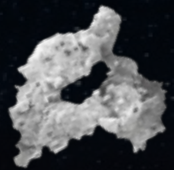


Surface Excavation/Construction

Enable affordable, autonomous manufacturing or construction

Sustainable Power

Enable continuous power throughout lunar day and night

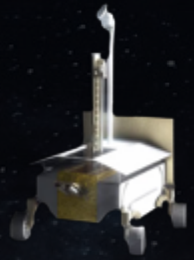


Lunar Dust Mitigation

Mitigate lunar dust hazards

Extreme Access

Access, navigate, and explore surface/subsurface areas



Extreme Environments

Enable systems to operate through out the full range of lunar surface conditions

- STMD LSII will develop the technologies required for establishing lunar infrastructure across these six primary capability areas.
- LSII will accelerate technology readiness for key components and systems and provide early technology demonstrations which will help to inform relative early uncrewed commercial missions, as well as development of crewed flight systems.
- The Humane Exploration and Operations Mission Directorate (HEOMD) will focus on development of crewed flight systems for lunar exploration and operations, such as surface habitats, pressurized rovers for crew mobility, and advanced life support systems.

Lunar Surface Power

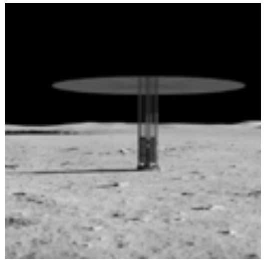
STMD is developing technologies which can provide the capability for continuous power throughout day and night for lunar and Mars Surface missions.

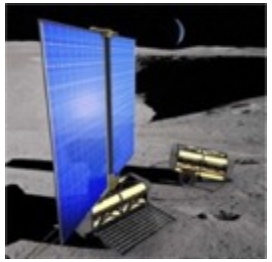
Technology Developments Underway:

- Power Generation
  - Fission Surface Power: Flight reactor demonstration (2027)
  - Adaptable Lunar Lander Solar Array Systems: Requirements definition and concept evaluation leading to a 10kW-class solar array
  - Chemical Heat Integrated Power Source: Develop 100 W-class, 350 hour lunar night power source
- Energy Storage: Develop a sub-kW class, integrated Regenerative Fuel Cell (RFC) and conduct lunar relevant ground testing to demonstrate long-duration energy storage & night power generation (~350 hr)

Additional Investments:

- Conducting a phased, system level assessment of power architecture for lunar surface missions
- Primary Fuel Cell Technology Tipping Point (September 2019): Demonstrate fuel cell element on early lander using propellant-grade hydrogen and oxygen reactants to extend the lander surface mission duration
- Technology development efforts initiated for surface-to-surface power beaming, advanced rover energy storage technology and power distribution architectures.





Programmatic Remarks

- We have updated Resources on the Competition Basics Page – check them out!
- Eligibility Requirement Change
    - Pathways students (and other federal co-op students) may now participate – but cannot receive direct support from the development award
    - *"BIG Idea Challenge awards may not be used to directly support travel or stipends for federal employees acting within the scope of employment (this includes co-op students with civil servant status)."*
- Carefully review all requirements
    - Printable 2020 BIG Idea Challenge Guidelines

Programmatic Remarks cont'd…

- Unusual University Competition
  - Limited constraints; open innovation
  - YOU are selling the value of your proposed concept/system/payload to the judges
  - Proof-of-concept testing
    - Add'l funding and duration has been made available so teams can demonstrate/test concepts on their own
  - No competition field
    - Forum = Oral & Poster Presentation with testing results
- Date of Forum is TBD (~ October/November 2020)

General Technical Remarks

- We are looking for ALL technologies & capabilities needed to help us explore, conduct science and operate in the PSRs in and near the Moon’s polar regions.
  - Concepts can be hardware; software
- Teams do not have to define the full mission architecture; just their payload and its capabilities
- Teams should not feel pressed to mesh designs with current NASA planning.
  - Tell us why/how your concepts can help us achieve general science/exploration in the Moon’s polar regions.
  - You pick the location within the PSR to operate in.

General Technical Remarks cont'd…

- Assume no human astronaut assistance will be available to operate or deploy systems
- For the purpose of this challenge, teams can make reasonable assumptions on use of an existing rover (although this may or may not correlate to actual NASA plans).
- There is no minimum/maximum duration requirement
  - Some payloads may have a very short lifetime (i.e., an impactor or a payload that performs remote sensing during landing)
  - On the other hand, a laser reflector will last almost indefinitely and will not be dependent on the lander.
  - Lander will likely only operate for a max of 12 days, so please demonstrate you can get all your data back within that timeframe since the telemetry system on the lander will not be available after it runs out of power.

General Technical Remarks cont'd…

- Teams cannot take credit for work that has already been completed
- BIG Idea Challenge Funds should not be used to cover already funded work.
    - If using the BIG Idea Challenge to augment an existing effort, teams need to document what slice they plan to accomplish and have a clear delineation on what falls under the project and what is not

General Technical Questions Received in Advance

1: Are there preliminary landing sites already being considered? Can we know the projected landing site of the lander? Should we design with a specific landing site in mind, or a specific description of a landing site?

- Answer: Landing sites have not been chosen. We suggest you describe why you need a specific site, along with any constraints you have for where you would need the lander to go.

2: What is the expected surface topography at the landing site?

- Answer: The landing site selected will be a difficult trade between mission risk and scientific interest. These two desires typically do not align. There are many resources that provide information on the topography at the lunar poles. The LRO mission provides a lot of imagery: https://svs.gsfc.nasa.gov/Gallery/moonpole.html
  As described in the guidelines it is expected that the landing site will be ~100 m from a PSR. Most craters have an elevated rim. The selected landing site selected will have stringent limits on slope, hazard densities, etc.
  See https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20100025705.pdf for a paper on the ALHAT precision landing system. It is unlikely that the landing site will have slopes greater than 10%. This may rule out landing near very large craters where the impact rim apron extends a long distance. However there are multiple smaller PSRs which likely have flat regions just outside them.

General Technical Questions cont…

3: Is the location or PSR hypothetically chosen by our needs? Can we pick the PSR?

- Answer: Yes, an assumption for location or PSR can be made. The selected landing site will be determined by a trade that is made to provide maximum benefit to all of the payloads as well as to reduce mission risk. Please describe any specific constraints you require from a landing site. If you need a specific site, please explain why.

4: Are we assuming a certain size/selection of crater or could it be an arbitrary permanently shaded region? How large is the crater estimated to be?

- Answer: Your location could be an arbitrary PSR. There are no requirements for a specific crater size. It may be that larger craters collect more volatiles per unit area since they have a more extensive cold trap but the transport mechanisms are not well understood. Equally, smaller PSRs may be easier to land next to. At the lunar poles there may be areas that stay in shadow simply by being surrounded by elevated areas and/or large rocks.

5: Will the payload be expected to conduct research in multiple craters or just one specific crater?

- Answer: It is expected that a single representative crater will be investigated. A concept that can cover more than one would provide a better dataset which would be valuable to scientists and industry.

General Technical Questions cont…

6: What initial mission parameters are available to be built off of?

- Answer: Can you clarify what you are looking for?

7: Is there any idea how the lunar soil changes when inside a crater or PSR?

- Answer: This is a key question for operations at the lunar poles. We want to get in situ data about this. Some studies indicate the soil porosity increases in the PSRs. This would impact mobility systems. There are several papers that can be found in this area. See example: https://lunarscience.nasa.gov/wp-content/uploads/2012/08/12_RetherfordNLSF2012.pdf
- There is an ongoing discussion within the science community on this topic. Some scientists think that the soil porosity increases in the PSRs, which could affect mobility systems, while some do not. This is one of the reasons we want to explore these interesting regions. For alternate views please see for example: https://nesf2019.arc.nasa.gov/abstract/nesf2019-010 and https://lunarscience.nasa.gov/wp-content/uploads/2012/08/12_RetherfordNLSF2012.pdf
- LCROSS data suggest soil density is lower (around 1.5 g/cc) in PSRs. However, some PSRs have volatiles and in turn even though density is lower, soil itself would be stronger because of the presence of volatiles. Regolith density also changes as a function of depth and distance from crater rims. Please see Apollo soil penetrometer data.

General Technical Questions cont…

8: What is the process of exiting the lander?

- Answer: The deployment mechanisms should be considered part of the payload. For higher reliability, space mechanisms typically have a two step command (arm/fire) that pyrotechnically activates a spring based deployment mechanism. Any separation mechanisms will be part of your payload allocation. You should have a drawing on how your payload will bolt on to the lander. A spring could separate your payload at a preselected time during descent or after landing. Simple systems are more reliable in the space environment (especially mechanisms). Consider risk in your concept.

9: Will our exploratory device be required to remove itself from the provided lander, or will the provided lander have an off-loading system?

- Answer: See 8Q. The deployment mechanisms should be considered part of the payload. The payload will be attached to the designated mounting locations on the lander. The mounting locations will likely be distributed to help maintain the vehicle's center of mass which has a high tolerance. A single large payload may be difficult to place on a small CLPS lander.

General Technical Questions cont…

10: Are payloads delivered within 100 meters, or are deliveries going to occur further out, with payloads requiring flight to ~100 meters?

- Answer: A good design has margin. The ~100m from the edge of the PSR is centered on an error ellipse around the intended landing point (the CLPS requirement did not have a confidence level but 1 sigma can be assumed). The size of the error ellipse is determined by the risk that the CLPS/NASA team will accept based on the estimated performance of the landing system. For a CLPS lander the risk posture is lower than a human mission. A 30% margin would be an acceptable assumption.

11: Can we assume that the lander which brings our exploratory device to the surface of the moon can also put into orbit a small satellite of sorts, provided we design a deployment mechanism?

- Answer: Yes, a CLPS delivery can include dropping off a small satellite in lunar orbit before landing on the Moon. Please include a range of acceptable orbits for your satellite, as well as its mass, and why you need it.

12; What power connectors will be provided?

- Answer: In the references provided there is an example Payload User's Guide. Page 44 has information on the power connector this company plans to use (which can be used as a baseline). Spacecraft power buses commonly operate at 28 Vdc.

General Technical Questions cont…

13: Can we assume that we have a power supply from a separate system from our design?

- Answer: Again see page 44 in the example payload users guide for lander power supplied to the payloads. The lander can supply power while the payload is attached to it. The competition basics page provides some basic power numbers for attached payloads: http://bigidea.nianet.org/competition-basics/

14: Are the Power Requirements stated in the CLPS contract meant for the systems we create, or should we assume throttled values assuming some of the power will be going to the lander?

- Answer: The available power listed in the rules for a 15 kg payload is: At least 8 W continuous and 40 W peak for 5 minutes. This is based on the minimum values in the CLPS solicitation. If you need more power you should document your assumptions or include an additional power source on your payload. You may have to make some difficult systems engineering trades. Mass, volume and power on CLPS landers will be very limiting for payload developers. If assumptions are made for more resources they must be credible.

15: Are the payload (specifically power) constraint specifications on the delivery system or constraints on the robot/payload being delivered?

- Answer: The payload (see 14A). The power listed is the minimum target in the solicitation for the CLPS landers. There is a link to an example payload user's guide in the reference section. The numbers are not hard constraints but your payload power numbers must be credible.

General Technical Questions cont…

16: What kind of power limitations are set for each of the categories? Is there a power maximum for our payload?

- Answer: Same as 15A: The power listed is the minimum target in the solicitation for the CLPS landers. There is a link to an example payload user's guide in the reference section. The numbers are not hard constraints but your payload power numbers must be credible.

17: Why are the mass, power, and bandwidth payload constraints such low values? This greatly limits the payload capabilities and mobility inside a PSR.

- Answer: Mass, volume and power on CLPS landers will be very limiting for payload developers. This is driving non-traditional solutions. Low cost CLPS payloads can be used to demonstrate new technologies and new science instruments and reduce the risks for future missions. You may have to make some difficult systems engineering trades. Teams should consider demonstrating a subsystem that will enable a future capability or a full scale system.
- Some CLPS teams will offer greater bandwidth, mass allocation etc. However, payload provider would need to pay for everything (extra mass, extra bandwidth, power etc.). It's just like with airlines - you can check in luggage but it will cost you.

General Technical Questions cont…

18: How will telemetry be handled? Will wired comms be provided?

- Answer: Data and commands will be passed through the lander telemetry systems. Payloads that separate are responsible for communications back to the lander via a subsystem that remains on the lander. A transmitter/receiver that communicates with a detached payload must be included in your payload allocation if using the landers telemetry system. Teams should consider the difficulties of communicating directly to Earth (or via a relay satellite) where SNRs and LOS make it very challenging. This will be handled by each CLPS team. Please consult payload user guides for the 9 CLPS teams.

19: Are there any physical size constraints/dimensions we should assume for the lunar payload? i.e. Volume? Max Dimensions? What are the max. dimensions we are given to work with? Is there any other relevant payload restrictions on the Lander, such as stowage payload volume? How should we design the payload packaging method?

- Answer: Page 41 of the example payload user's guide (see the resource section on the Big Idea Challenge site) provides some insight into realistic volume constraints. Note how payload space is distributed around the lander. There are no hard limits but as in a real proposal you have to stay credible. Judges will be looking for innovative ideas that offer the most value with the lowest risk. This first round of CLPS landers have very limited payload volume. Although they will likely exceed the guidelines in the solicitation you should stay credible.

General Technical Questions cont…

20: Is the mass limit of 15kg for lander and PSR-payload, or just the PSR-payload? If the limit does not include the lander, is there a mass restriction on the lander?

- Answer: Payload Only. The competition basics state: Surface Mass – Teams should start with a 15 kg total packaged mass limit (including all mechanical and electrical components), unless there is a compelling reason that justifies additional mass.” The 15 kg is not a hard limit but is a good target for your payload. Near term CLPS landers are not expected to be delivery systems for a large traditional lander. They provide a delivery service for small payloads to the lunar surface. Any customization over the baseline lander will greatly increase cost and affect the value of your proposal.

21: In terms of extra weight, how much will we be allotted if we want extra weight and show that it is necessary?

- Answer: That is up to you to decide, but be prepared to make a convincing argument to the judges about its necessity.

22: What qualifies as a “compelling reason” to justify additional mass?

- Answer: That is up to you to decide...and make a convincing argument to the judges.

General Technical Questions cont…

23: If our design has two or three independent systems, would the combined mass have to be under 15 kg, or will each system be allocated 15 kg?

- Answer: Each payload slot should follow the recommended 15kg mass ceiling for all components. The recommended mass ceiling was selected to be consistent with the minimum capabilities in the CLPS solicitation. This is a guideline and not a hard limit. The CLPS service providers are still finalizing the lander designs. Having a higher likelihood of being compatible with a standard CLPS lander will help your proposal. Requiring a highly customized lander will hurt your proposal since it will greatly increase costs. In the example payload user's guide the lander is being designed with a higher payload capacity but the payloads are distributed around the vehicle. If your systems take multiple payload slots, they must have a higher value than the multiple payloads it will replace. Again the 15 kg is not a hard limit but higher numbers must be justified and have higher value. Payloads that allow the mass to be distributed may help simplify integration on the lander.

24: Under the design assumptions: "Any surface delivery [...] will likely contain multiple payloads." Is this meant to say that a proposed robot will be delivered in parts summing to 15kg, or a robot totaling more than 15kg can be delivered in 15kg packages?

- Answer: See 23. This is meant to signify that a delivery will likely have multiple payloads, and you will be one of those payloads. Your total mass should be less than 15Kg, or you need to provide additional justification.

25: If multiple payloads are used, does the power constraint apply to all three simultaneously or individually? Is the power constraint divided between all the payloads or does it apply to each individual one?

- Answer: Use the power guidelines as exactly that, guidelines. Tell us how much power you need, with justification.

General Technical Questions cont…

26: How deep is the proposed ice inside the PSRs?

- Answer: We really want to find out! See: https://science.nasa.gov/science-news/science-at-nasa/2010/21oct_lcross2/
- One factor is if the ice is too deep below the surface, it may not represent a resource. Data indicates that if present, it should be within a meter of the surface. Also, other datasets point to the possibility of a surface frost being present.
- From neutron spectrometer data the depth is at least 1 m. But we don't really know the distribution of ice as a function of depth. LCROSS data points to a max of 5wt% in the top 1 m.

27: If a project's design goes beyond the pre-defined constraints of the CLPS lander, does that serve as a deduction in scoring when evaluating its proposal?

- Answer: Although, the CLPS landers are expected to continually improve performance, we are looking for potential payloads that could be fielded for near term missions (for science and/or technology demonstrations). Teams will not be penalized for making credible assumptions beyond the payload constraints that are minimum numbers in the solicitation (see example payload users manual). Proposals that are clearly incompatible with expected near term CLPS missions may be considered outside the challenge's scope and will get a lower score.

General Technical Questions cont…

28: What frequencies would we need to use to communicate with lunar satellites to inevitably communicate to Earth?

- Answer: This is not specified. A dedicated relay satellite is not expected to be available for near term CLPS missions. There are very few orbiters currently operating and they are not expected to be available as relays. S-band is more appropriate for omni-directional antennas and higher frequencies such a Ka-band would likely require active pointing. Depending on a satellite relay would require good justification since implementation on a near term mission would be difficult.

29: Other than no nuclear power, are there any other restrictions to technology that can be used?

- Answer: The other restriction mentioned was that the technology should be available for a near term mission (TRL 5 to 6). In fact, teams are expected to include plans for testing that will demonstrate their systems work in a relevant environment (i.e. thermal vacuum, vibration, shock, SW functional testing, etc.).

30: How much consideration (if any) do we need to give to the "packaging" of our payload to make sure it stays safe on its trip to the Moon?

- Answer: The example user's guide provides information on the expected environments (shock and vibration envelopes, max/min temps, etc.). It is expected that all payloads will be integrated in a clean room type environment. This is probably typical of all the landers. Your proposed payloads should accommodate this.

General Technical Questions cont…

31: What is the desired lifetime of this mission? How long must the mission take?

- Answer: There is no minimum/maximum duration requirement. A payload that performs remote sensing during the landing or an impactor may have a very short lifetime. The lander will likely only operate for a maximum of 12 days, so please demonstrate you can get all your data back within that time frame since the telemetry system on the lander will not be available after it runs out of power. On the other hand a Laser reflector will last almost indefinitely and will not be dependent on the lander.

32: Are sample return and resupply within the scope of the proposed mission?

- Answer: No.

33: How much do you recommend that we focus on "mission context" and forward applications of the technology we're developing for this challenge?

- Answer: Depending on your choice of topic, the forward applications may be a critical piece of your resulting work (e.g. how much your proposed concept is a technology demonstration that will have later application).

34: It is recommended that we give special attention to potential stakeholders/funders - should this just be a list of possible entities who could use the technology, or should we contact stakeholders to get statements of interest?

- Answer: A list is fine.

General Technical Questions cont…

35: Can you provide guidance on balancing the Challenge objective to explore and develop technologies for use inside a PSR with the fact that the CLPS lander will not land inside a PSR?

- Answer: You will need to define how you get your demonstration from the CLPS lander to wherever it needs to be with respect to the PSR.

36: For teams that are more experienced in software than hardware, would it be acceptable to simulate hardware rather than build prototypes?

- Answer: Yes. The key criteria is to propose payloads that could be fielded for relatively near term CLPS missions. If the simulations have the fidelity needed to provide confidence that a proposed payload would operate as intended it is within the scope of the challenge.

37: Can we attach an auxiliary, fixed payload to the lander? (e.g solar array)

- Answer: Yes, but you are meant to keep total mass to less than 15 Kg. Also you could add your own communications and batteries if you wanted to operate longer than the lander is functioning.

38: Is 801.11n compliant WIFI meant to be 802.11n? I see that the IEEE Standard is stated to be 801.11n; however, I can't find any IEEE Standard that is 801.11n, only 802.11n. If the 801.11n is the actual intended IEEE Standard, would it be possible to get some resources on it?

- Answer: Yes that is likely a typo. Use 802.11n which is listed in the Example payload user’s guide.

General Technical Questions cont…

39: According to the design assumptions section, a lander delivered through CLPS will be delivered within 100m of the crater. Are we responsible for designing the orbital maneuvers for this delivery?

- Answer: No, the payload providers are not involved unless they have specific requests such as imaging requirements or separating a payload at a specific time.

40: According to the design assumptions section, a surface delivery should be assumed to contain multiple payloads. Are we designing the lander that will handle these multiple payloads?

- Answer: No. CLPS providers provide a service to land payloads on the lunar surface. The service provides a standard interface at a specific cost per kg. Any changes to the standard interface will cost extra which impacts a payload's value. These cost increases must be negotiated with the service provider and are not quantified.

41: Could you provide more information on coordinating with existing satellites/missions for communication and mission support?

- Answer: The LRO could potentially be used to relay data (https://lunar.gsfc.nasa.gov) however a payload in the mass range available for a CLPS mission would be challenged to implement this.

General Technical Questions cont…

42: Could you provide more information on how lander-satellite communications would work?

- Answer: As there is not a communication relay at the Moon at this time, the landers will be using direct to Earth communication. They therefore need to land at a location that can see the Earth

43: What vibration conditions can we expect the lander (and payload) to experience during launch/transit/landing?

- Answer: You could look at those values for the two launch vehicles that are being used by the first two CLPS providers; Space X Falcon 9, and ULA Vulcan Centaur.

44: If we are proposing a concept that has a TRL of less than 6, how in depth do we need to go with respect to bringing it up to a TRL of 6 in our proposal?

- Answer: This depends on the current TRL and what relevant conditions are needed to test. If all that is required is to environmentally test a component at a lower temp it may be easily described. This year the challenge duration, schedules, and awards have been increased primarily to allow teams to build and test prototype HW and SW. This means that a good plan for doing this is essential for technical, cost and schedule credibility. This will provide a great opportunity to learn about key development areas that are often not covered in the classroom.

General Technical Questions cont…

45: How much should temperature affect our considerations for electronic components?

- Answer: You will need to plan to keep your components within acceptable temperatures. You could plan to be thermally isolated from the lander, or you could state any heating/cooling requirements that you need from the lander. Heaters and thermal management are significant challenges for space systems (and the thermal environments at the lunar poles present a significant challenge for thermal management)

46: Are we expected to sustain ourselves in lunar night conditions?

- Answer: Only if you want to operate then. Do not expect the lander to operate during the night.

47: Are we allowed to use a small RTG as a heating source or to keep electronics alive?

- Answer: No.

48: Is there some advantage to adding sensors to the rover? If so, are certain sensors preferred?

- Answer: You should determine what if any sensors would be valuable.

49: Can CLPS do computation for us?

- Answer: If you mean “Does the lander have a computer we can use?” Then the answer is no.

General Technical Questions cont…

50: Would the CLPS lander be able to relay data from our payload back to a ground station, or will the payload have to manage earth-moon communications itself?

- Answer: The lander will send your data back to Earth.

51: If there is no line of sight between the payload and the lander inside the PSR, how can the data be sent back to Earth without a communications satellite?

- Answer: This is one of the key challenges! Think about deploying a relay, an optical fiber or some other innovation. Your team can even focus on this one enabling technology for operation in PSRs. We may have orbital assets at one stage.

52: Would the lander itself have the capabilities to analyze a sample?

- Answer: Yes, but please indicate what analyses you would like done. Remember that the cost of doing this would need to be negotiated with the lander service provider.

53: Will the built payload be a real scale or scaled-down version of the real payload that will be sent by 2023?

- Answer: You should determine what is feasible for your team to accomplish within the resources and constraints for the BIG Idea Challenge. Either option is acceptable if you can demonstrate proof-of-concept.

General Technical Questions cont…

54: If multiple payloads are used in the mission, must each payload have the same design or can each payload have a different purpose?

- Answer: They can have different purposes, but describe what they are.

55: If we choose to pack the payload in a rover, shall we design our own rover or just assume there will be a rover available to deploy the payload? If the rover is designed, can the payload be a part of the rover or must the payload be a separate system?

- Answer: You could do either.

56: What rovers can be used by 2023? What would be the operational capabilities of a rover inside a PSR?

- Answer: Right now, the CLPS providers do not all offer rover capability. More may offer this in the future.

57: How do we recharge the rover that will be packing the payloads?

- Answer: If you want to go on a rover, then you will need to describe your requirements on what you need from that rover.

General Technical Questions cont…

58: What are the requirements for a rover or communication satellite for this mission?

- Answer: Transmitting data from the lunar surface (especially near the poles) is very challenging and it is recommended that your payload communicate via the lander's telemetry system. Direct communication to Earth takes a significant amount of power and resources. This may not be practical with the resource constraints available to a CLPS payload.

59: What does the 1 krad radiation constraint mean for the payload?

- Answer: 1 krad is not extremely high but this means the payload avionics should be designed to use rad-hard parts or be built with parts that have a rad-hard equivalent available for testing. The software designs should be developed for fault tolerant (i.e Two step commands for critical systems (Arm/Fire), fault tolerant operating systems, etc.).

60: If a communication satellite is used, is it an assumption or must we design it?

- Answer: It would be an assumption. Please be aware that there is not currently a comm relay capability at the moon, but several agencies are thinking of providing this in the future.

Questions for “Exploration of PSRs in lunar polar regions”

61: Can we use the entire bandwidth of the 2-meter VHF frequency band (144~148 MHz) without being limited by any federal/world radio regulations? Does NASA have a facility to test VHF transceivers using the entire 4 MHz bandwidth?

- Answer: Spectrum authorization is dependent on operating power. This question appears too specific for an open Q&A session. Please submit to the NIA with additional details so we can respond.

62: Can a small access point (receiver) for the 2-meter VHF link be installed on the lunar lander ~100m away from the rim; or can a small payload containing a VHF receiver be deployed (by ejection from the lander) within ~30m from the rim?

- Answer: Yes, but these elements must be included in your mass budget. A wireless subsystem can remain on the lander that communicates to the lander avionics through the payload’s command and data connection.

63: How wide and deep will NASA’s target PSR be for the lunar lander to land near its rim?

- Answer: A target PSR has not been selected yet. You should simply describe your requirements in order to get the data you want

64: Will our exploratory device be required to remove itself from the provided lander, or will the provided lander have an off-loading system?

- Answer: Yes. (See question 8)

Questions for "Exploration of PSRs in lunar polar regions"

65: Should non-ADCS-related sensor packages be given significant weight in the design of exploratory devices?

- Answer: The judges do not understand the question. ADC systems are critical for autonomous navigation and non-ADC systems are critical for other things. There is no weighting for either type.

66: What locations/regions/PSRs is NASA most interested in exploring?

- Answer: For the purpose of this challenge, all locations/regions are of equal importance.

67: What Vehicle will our payload be integrated into?

- Answer: It would be integrated into whichever CLPS provider wins the delivery contract - so teams should operate under baseline capability assumptions.

68: Does the in-situ resource utilization have to occur inside the PSR, or can samples be returned to an analyzer outside the PSR?

- Answer: You can do either.

69: Is there a NASA datasheet for mechanical properties of regolith that we could reference?

- Answer: Take a look at the Lunar Source Book.

Questions for “Exploration of PSRs in lunar polar regions”

70: Are the PSRs going to be explored by humans, or only by teleoperated robots/drones?

- Answer: Initially robotically to reduce risks for crewmembers.

71: Would there be opportunities to have a separate payload collect/analyze samples from inside a crater if brought out?

- Answer: Yes. Your system could simply be something that extracts a sample, and brings it back to the lander. Please indicate what analyses you would like done.

72: Is leaving waste on the surface of the moon of concern for this theme?

- Answer: No.

73: Must the payload be recovered from the PSR?

- Answer: No.

74: What happens with the lander, rover, and payloads after the mission is finished?

- Answer: They take a long nap. ;)

75: Is there any possibility of using landers from providers outside of the CLPS contract?

- Answer: No.

Questions for “Technologies to support lunar ISRU in PSR”

76: What are the limitations to Technologies to support lunar in-situ resource utilization (ISRU) in a PSR?

- Answer: No nuclear power sources.

77: Are we allowed to use a biological process, such as something that will eat the regolith and create hydrogen?

- Answer: Yes, cool.

78: Are we restricted to having a process on the surface of the moon? For instance, could we propose a process that would occur under the surface or while orbiting?

- Answer: There are no restrictions.

79: Can we expect the resources of a previously set up lunar base to get help from, or are we expected to prep for one later? If so, where will the base be located relative to our landing position?

- Answer: Do not assume the presence of any pre-emplaced infrastructure. We are looking for payloads that will be available for near term CLPS missions.

Questions for "Technologies to support lunar ISRU in PSR"

80: Are we allowed to plan to use the propellant, hydroxyl ammonium nitrate, the "green" fuel alternative to hydrazine?

- Answer: If your payload is designed to use a propellant not routinely used in space then it would add risk for a near term mission. In addition the lander and launch provider would want to minimize any risks associated with loading and launching a new propellant type. Teams should not plan to scavenge propellant from the lander.

81: Must the collected water be transported and stored outside the PSR?

- Answer: No. A complete water collection system is probably beyond the scope of a CLPS payload. Think about testing an enabling technology needed for water collection, transportation and storage.

82: Will some of the collected water be used for experimentation and testing or is it purely for the purpose of the purification of drinking water?

- Answer: Use as drinking water is a very small fraction of what the water resource would be used for. The primary use is propellant which does require high purity. The hydrogen in water is also very important since it is not plentiful (like oxygen) in the lunar regolith. If you are going to extract water, then NASA could consider an analysis package to fly on the lander.

Questions for “Technologies to support lunar ISRU in PSR”

83: Can we assume that our system is located outside of a PSR?

- Answer: Yes, the lander will land in sunlight and will survive for one lunar day. It is not expected to survive a lunar night. If you want to get into the PSR then you either need to get yourself there, or explain that you need to be mounted on a CLPS compatible rover. You must provide some assumptions about the rover and how your system will integrate with it. Many payloads will not need to enter the PSR. If your payload is intended to demonstrate subsystems needed to increase the TRL of a key technology or gather data outside the PSR you can remain on the lander or deploy nearby. Just getting LOS inside the PSR would be a significant achievement for remote sensing, relays, etc. providing an enabling capability.

84: If we choose to locate our system outside of a PSR, can we assume that another system would be in place to retrieve regolith from the PSR?

- Answer: It is best to assume no existing infrastructure is in place for an early CLPS mission. You can assume another payload will be able to gather a sample for your payload but would need to provide a good set of assumptions.

Questions for "Technologies to explore and operate in PSRs"

85: Is the integration of multiple technologies either with or without direct flight heritage of interest?

- Answer: Yes, but describe what they are and what their respective TRLs are.

86: Does the adaptation of a flight proven technology for use in PSRs warrant placement of a project or part of a project within this theme?

- Answer: Yes, integrating mature technologies to create a new capability or operate in a new environment is valid.

87: Can design methodologies be considered part of this theme? For example, specific approaches to sizing power systems.

- Answer: Yes as long as it directly benefits exploration and/or science near the lunar poles. With that said, a general purpose methodology is not really what we are looking for. A methodology specific to developing systems exploring the lunar poles could be appropriate. Validation of the methodology would be challenging since the environments are not fully known.

Questions for "Technologies to explore and operate in PSRs"

88: A system made to collect ice, may be optimal inside of a PSR; can the assumption be made that a CLPS payload will be delivered Inside a PSR?

- Answer: Please see the Competition Basics page on the website -- "Basic Challenge, Constraints, & Design Assumptions". Under 'Design Assumptions' we state that it is NOT expected that CLPS lander will land INSIDE a PSR. However, the team can assume that the lander trajectory will allow it to fly over a PSR and it could eject a payload during the flyover (although this would be negotiated with the service provider since it adds complexity to the baseline landing sequence.). In this case the challenge will be getting the data back after separation from the lander. Teams can also make assumptions on a small, CLPS compatible rover that could deliver their payload to the PSR. If using an assumed host rover the payload resource constraints would be even more limited.

89: For just a mobility system, would experiments or other technologies used to analyze Ice, regolith, etc. be included in the maximum 15 kg mass limit.

- Answer: No. You could use your 15Kg to design a mobility system, but then describe what instrumentation you would like it to carry.

Programmatic Questions

90: The scope of the project spans the end of the 2019-2020 academic year. Are students who graduate in May 2020 permitted to continue participation through to October 2020?

- Answer: Technically, yes from the NIA/NASA standpoint. However, this is something that you may need to work out with the university as it relates to funding (i.e., there may be considerations/regulations about travel reimbursement or stipend support for students no longer enrolled full time at the university that you may need to take into account).

91: How will funds be disbursed?

- Answer: (See “Award Funding for Finalist Teams”) - Funding will be received in two separate installments:
    1. The 1st installment will be received immediately upon selection so that teams may begin development of their proposed concept, and will equal one-half of the budget requested.
        - These funds will be provided directly to the lead university, from the National Institute of Aerospace (on behalf of NASA’s Space Technology Mission Directorate’s GCD Program)
    2. The 2nd installment (i.e., 2nd half of the requested funds) will be provided after teams successfully complete their mid-project review in May.
        - These funds will be provided directly to the state Space Grant Consortium affiliated with the lead institution from NASA’s Office of STEM Engagement (Space Grant Program). The state Space Grant Consortium will then direct the funds to the lead university for the BIG Idea Challenge

Programmatic Questions cont…

92: How long should the initial proposal be? (General Information on the proposal length, sections, information important to judges). What format should the proposal be?

- Answer: (See “Requirements & Forms” page and click on the “Learn More” button under “Proposal and Video”) We have provided a full list of what the proposals and video need to include, as well as the formatting requirements for each. Proposals should be 15 - 20 pages in length.

93: How long should our video submission be, and in what format?

- Answer: (See “Requirements & Forms” page and click on the “Learn More” button under “Proposal and Video”) We have provided a full list of what the proposals and video need to include, as well as the formatting requirements for each. Videos are limited to 3 minutes. The videos need to be uploaded to YouTube as “unlisted” or “public” and you will provide a link to your video’s YouTube URL on the online proposal submission form.

94: Does the BIG Idea Challenge allow for alterations, updates, changes in the scope proposed in the originally submitted NOI?

- Answer: Absolutely! We anticipate that your concept will change/morph organically as you continue working on it, and that many proposals will look significantly different from the initial concept mentioned in the NOI.

Programmatic Questions cont…

95: What kind of aid are we allowed to accept from NASA research centers?

- Answer: Collaboration and cost sharing is encouraged (as long as the personnel are not directly affiliated with the competition as a judge or sponsor). Again you must not take credit for existing work.

96: How detailed should the initial proposal be? Is more always better?

- Answer: The proposal needs to be detailed enough to successfully "sell" your concept to the judges.

97: What kind of aid are we allowed to accept from outside resources, companies, groups, and grants?

- Answer: You may obtain any outside assistance you can. We encourage all collaborations that will help you to be successful, and it is certainly within the bounds for teams to raise outside funds to augment your BIG Idea Challenge awards.

Programmatic Questions cont…

98: How would "student research stipends" be disbursed and what can they be used on?

- Answer: Finalist teams will receive the awards in 2 installments as mentioned earlier. Once you have the funding, you may use it as needed (and as proposed), based on your university and state employment policies. Our definition of “student research stipend” is money used to compensate students for their time/effort/work product as related to working on this project. This could be set up as a specific research fellowship, an hourly wage, and or a scholarship or stipend. The delivery mechanism is up to you (based on your university and state employment policies). Note: You do not need to propose student research stipends if that isn’t applicable for your project, but we wanted you to know that it would be an acceptable use of the funds if it was needed.

99: Provided a team is invited to demonstrate their work in October, are there limitations as to how many members will be flown out and how can our project be transported, particularly in the case of large projects?

- Answer: At this time, we do not anticipate that there will be limits to the number of team members who attend the on-site Forum next Fall. It will be up to you to determine the best method to transport your project. However, as mentioned earlier, the Forum is designed to be an Oral and Poster presentation of your project - so you may not even need to transport your project (although we encourage it if possible).

Programmatic Questions cont…

100: Is the targeting of multiple themes allowed? Can our design attempt to accomplish multiple goals, such as demonstrating capabilities for exploration of PSRs and ISRU? (cross-category) Similarly: Are teams limited to propose concepts responding to the chosen category in the NOI or can proposed concepts address more categories?

- Answer: Yes. Given the limitations on payload size, mass and power this will be a real challenge.

101: Are mathematical and mechanical derivations of interest for the initial report?

- Answer: If there are high risk areas in the concept that would benefit from an in depth analysis to provide needed credibility then it may make sense to include. With that said the initial proposal is not intended to be a research paper and there are some pretty limiting page counts to include all of the information listed (15-20 pages with the project description not to exceed 10 pages). Could use more context to answer the question properly.

102: If we have technical questions based on previous or ongoing research conducted by one of the Challenge judges, is it okay to contact them or would that present a conflict of interest?

- Answer: Teams are NOT allowed to contact any of the judges on this panel, as it presents a conflict of interest. However, after this Q&A session, teams may send any future questions to "bigidea@nianet.org", and can even identify a specific judge that the question is targeted for. The BIG Idea Program team will send the question to the appropriate judge(s) anonymously and send a response back to the team who asked the question, as well as post the question and its answer on the BIG Idea Challenge FAQs page for equal viewing access to all participating teams.

Programmatic Questions cont…

103: Is any documentation required to confirm industry collaboration with the university?

- Answer: Yes. Please provide a Letter of Support for any key partners on the proposal, including industry collaboration, documenting the general scope of the collaboration and signed by a representative of the collaborating institution.

104: What exactly can the stipend money be used for?

- Answer: BIG Idea Challenge Funding is to be used for full-participation in the competition, including the purchase of hardware/software, creation of analog testing environment, stipends for student research that directly supports the proposed activity, travel to the culminating design review (2020 BIG Idea Forum), etc. The only exception is that BIG Idea Challenge funds are not to be used to directly support research and/or travel for anyone with civil servant status (i.e., NASA Pathways Interns or other Federal Co-op students).

105: Can current NASA employees who are also students at the proposing institution work with or be on a Challenge team and, if so, can they be paid/compensated from the stipend?

- Answer: NASA employees who are also students at the proposing institution may participate as a part of the team, however, BIG Idea Challenge funds may not be used to directly support travel or stipends for federal employees acting within the scope of employment (this includes co-op students and NASA pathways interns with civil servant status).

Programmatic Questions cont…

106: Can you provide a list of NASA facilities that are interested in collaboration on these proposals and what kind of testing facilities/resources they can offer? Will access to NASA test facilities and equipment be provided?

- Answer: Please visit the Competitions Basics page, and click on “Resources.” We provide a list of NASA testing facilities by Center. Teams are encouraged to reach out to the facility/facilities needed to conduct their testing and determine the process for using the facility (including scheduling and cost/fees). Once finalist teams have been selected, NIA and NASA will work with each finalist team individually to see how we can support access to any required NASA testing facilities. Note that each testing facility is operated independently and may or may not choose to support requests.

107: Should our proposal include sections about how NASA might add to or expand on our concept after this competition?

- Answer: Infusion Plans are very important to GCD and this type of information would help your proposal.

Miscellaneous Questions

108: The format of this competition is similar to that of SBIR grants. Provided the project demonstrated in October, 2020 and its scientific/engineering goals are of merit, might there be opportunity for a "phase 3" of sorts?

- Answer: While NASA is not committing to any further funding beyond the current scope of the BIG Idea Challenge, they are certainly open to expanding the scope of the program for a “phase 2 or 3” type of opportunity if warranted by the quality of the final submissions, and if funding is available.

109: Is there any way for us to receive statistics on the teams who have expressed interest in the competition (interest areas, university, etc.)?

- Answer: While we do not provide the exact number of NOIs or proposals that we received, we can tell you that there will be a healthy competition.

110: Are we allowed to budget student pay over the summer for this project?

- Answer: Yes, stipends can be used to support students working on this project at any point in the year. The only exception is that BIG Idea Challenge funds are not to be used to support research and/or travel for anyone with civil servant status (i.e., NASA Pathways Interns or other Federal Co-op students).

Miscellaneous Questions cont…

111: What should be accomplished to maximize the probability that we'll pass the Mid Project Review?

- Answer: Your proposals will include technical goals and objectives, schedule and a budget. As with any project, if it is clear that the challenge team is not making technical progress and/or is well over budget and behind schedule the panel may decide to cancel the effort. This means your proposals should be realistic and include some margin when things go wrong.

  Purchasing: This challenge was extended and the budget was increased to allow some level of testing. Since you will likely need to order parts make sure you understand how your university does this and verifying vendors early is a good idea. Purchasing delays cause more problems than just about any other cause.

  Early test planning: Plan for testing early on. Facilities, test equipment, test definition. Many teams run into schedule problems because testing considerations are not planned early.

  The details will be different for each finalist team, because the scope of each project will be drastically different. The judges will connect with each of the finalist teams to provide specific details on what needs to be accomplished by the Mid-Project Review. Generally speaking, the entire purpose of the mid-project review is for teams to demonstrate they are on target to successfully complete their project as outlined in their proposal.

Miscellaneous Questions cont…

112: Can only a limited number of teams pass after the Mid Project Review?

- Answer: No - our desire is that all of the finalist teams will pass their Mid-project review.

113: Can we start Proof of Concept Testing prior to the Mid Project Review?

- Answer: Yes, absolutely. Each team can decide the most appropriate timeline for their project - no two timelines will look the same.

114: What can we expect for an environment for the competition? What kind of power will be supplied at the competition? Is the system expected to be autonomous or can it be remotely controlled for the competition?

- Answer: I think there may be some confusion. This challenge is very unique in that there is not one specific competition field/environment for proof-of-concept testing. It is up to each individual team to tell US how you will test your concept - and then you will need to create your own simulated testing environment and conduct your tests before coming to the final Forum next Fall. During the Forum, teams will give Oral and Poster Presentations to the judges, providing results of your testing. These presentations may be augmented by a video of your testing, a modeling/simulation preview, etc.

Miscellaneous Questions cont…

115: How much does budget play a role in selection?

- Answer: Please visit the “Requirements and Forms” page of the website, and carefully read the Proposal & Video section, including the Proposal Evaluation Criteria section. You will see that the budget (i.e. cost plan) is considered within the Technical Management criteria, which is worth 30% of the overall proposal score. Because NASA will be investing a significant amount of money in each team, you can be sure that budget will be a major consideration in the selection process.

116: Are there multiple of these payloads being sent up to the moon, or is NASA expecting to only send up one rover?

- Answer: There may be some confusion about what is being sent to the moon, and when. NASA is working with commercial companies through CLPS to deliver multiple payloads to the moon over the next few years. Each payload will have different capabilities and different instruments (and not all of them will be from NASA). Although very compact rovers such as the PUFFER are being considered as technology demonstrations on a CLPS lander there are no large rovers expected for near term CLPS missions. It is possible that multiple rovers will be deployed, but not certain at this time. https://www.nasa.gov/feature/jpl/origami-inspired-robot-can-hitch-a-ride-with-a-rover

  In addition, NASA is continuing to formulate a dedicated rover mission at the lunar poles and it is hoped CLPS payloads can collect data that will help inform the designers who are investigating this concept.

Miscellaneous Questions cont…

117: Do we have an expected lifespan our rover should fulfill?

- Answer: Teams are not required to propose a rover (that is one of a thousand potential payload concepts teams could propose) - and the expected lifespan will be different for each concept, based on the work proposed.

118: How is the rover going to be attached to the lander?

- Answer: The Challenge description provides the following guidance: “Teams will be asked to design their concepts based on the lunar surface delivery capabilities of the commercial providers selected under NASA’s Commercial Lunar Payload Services (CLPS) contract”. A rover is not a required part of this proposal, but you can propose a rover that will be compatible with the limited capabilities of a CLPS lander. You can also propose an instrument/subsystem for a CLPS compatible rover.

119: If we propose something with different milestones, can we write the proposal in such a way that we will explore these options? If we present these options, is that valuable or a detraction from our proposal?

- Answer: We expect plans to change as you learn things during formulation. Feel free to include flexible timeline options, but remember your page limitation.

Future Questions?

Please send all future questions to:
BigIdea@nianet.org

Each question will be responded to directly, as well as posted on the FAQs page for everyone to see.

We encourage you to visit the FAQ's page frequently for updates:

http://bigidea.nianet.org/faqs/

2020 BIG Idea Challenge – Open now!

- The **B**reakthrough, **I**nnovative and **G**ame-changing (BIG) Idea Challenge is an initiative supporting NASA's Game Changing Development Program (GCD) efforts to rapidly mature innovative/high impact capabilities and technologies for infusion in a broad array of future NASA missions.

- The 2020 challenge asks university teams for ideas on systems and technologies to explore and operate in Permanently Shadowed Regions (PSRs) in and near the Moon's polar regions.

- Between five and eight teams will be awarded between $50,000 and $180,000 to participate in the competition.

BIG Idea Challenge Announced
August 23, 2019

Proposals & Videos Due
Jan. 16, 2020

Finalists Notified
Feb. 14, 2020

BIG Idea Forum
October 6 - 8, 2020