NASA's 2026 Human Lander Challenge Q&A Session Summary Document

NASA's 2026 Human Lander Challenge Q&A Session was held on November 4, 2025, from 3:00 – 4:00 PM Eastern. Questions and answers from that session are included below.

If you have additional questions, please reach out to the Program Team at HuLC@nianet.org for a response. Questions received after the Q&A, and their responses, will also be posted to the FAQs Webpage for public awareness.

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QUESTIONS RECEIVED IN ADVANCE: NOISE SUPRESSION AND CONTROL

1. **What are the targeted frequency and intensities of the noise? Are there current metrics for noise suppression that the competition is looking to meet/beat?**
   - You can research this on the NASA Technical Reports Server (NTRS).
   - The International Conference on Environmental Systems (ICES) proceedings is another great resource.
   - The acoustic requirements can be found in NASA Standard 3001.

2. **What is the internal layout and material composition of the Human Lander and its Environmental Control and Life Support System (ECLSS)? What materials are commonly used in the Human Lander?**
   - You can research historical and proposed NASA spacecraft materials. Human Landing System Program specific layouts and materials will not be provided.

3. **What are the primary noise sources (e.g., fans, pumps, airflow ducts) in current ECLSS systems? What is the current noise suppression and control method?**
   - Do further research.

4. **For the noise sources, how much mass do they have and how much energy do they currently take up?**
   - Do further research.

5. **Are there any design restrictions or prohibitions? (Ex: Are there certain materials that cannot be used? Are there any noise suppression methods we cannot use?)**
   - All materials and noise suppression methods should be considered. Future vehicles will utilize various cabin pressures and oxygen concentrations which should be taken into consideration with your design.
   - Materials requirements can be found in NASA Standard 6016. We also recommend taking a look at any relevant safety standards.

6. **What frequency ranges (Hz) are most detrimental to crew health and communication?**
   - Do further research.

7. **Is there a distinction between evidence like bench measurements (duct rigs, cabin mockups), computational models (SEA/FEM/CAA), or in-situ analog testing in judge scoring?**
   - Credibility is a large portion of the scoring. Data that can help with credibility will be helpful.

8. **Will testing data be provided (such as data for ECLSS operations)?**
   - No. Published data and reports can be found on NASA Technical Reports Server (NTRS) and International Conference on Environmental Systems (ICES) proceedings.

9. **What does the competition want with regards to actual solutions to the noise suppression issue (are things like a redesigned crew schedule allowed, or is it only physical solutions)?**
    - Physical solutions. It should be noted that crew time is a limited and premium resource and solutions should minimize impact to crew.

10. **Are we allowed to make changes to current systems (can we update a pump or piping system or change a fan design)?**
    - Yes.

11. **Is there a limit on the size of our solution? (For example, are there lander dimensions currently that can be used to determine solution size?)**
    - We are unable to provide lander specific dimensions. We recommend using the International Space Station as a baseline.

12. **Is there a power limit for a potential electrical system solution?**
    - No limit provided. Do further research on existing spacecraft for design space.
    - It should be noted that power is currently a limited resource on spacecraft.

QUESTIONS RECEIVED IN ADVANCE: SENSOR REDUCTION IN HARDWARE HEALTH MONITORING SYSTEMS

1. **Is there a categorization of mission-critical and/or safety-critical sensors, and is there any related policy that requires one or more levels of redundancy for those sensors?**
    - We cannot provide a list of all the various sensors, but in general if a sensor is performing a mission-critical or safety-critical function, it will have some level of redundancy. The fault tolerance of any particular item is usually dependent on if it will cause a hazard, as well as the risk tolerance of the project/program. We recommend looking into NASA safety documents and publications on the subject.

2. **What sensors and hardware are currently used in each ECLSS subsystem, including their types, monitored parameters, quantities, physical properties, and operational details? What are the key parameters currently monitored in ECLSS hardware (temperature, pressure, flow rate, carbon dioxide (CO_2), etc.)?**
    - Do further research.

3. **Is there an actual or notional list of sensors, their quantities and types (ex: inertial, force/pressure, optical, acoustic, thermal, chemical), their reporting frequencies, their masses and volumes, power requirements, and spatial arrangements?**
    - We cannot provide a list of all the various sensors and their functions. Do further research on what sensors are available.
4. **How are vibrations related to their working conditions?**

- Most flight hardware must pass environmental vibration testing. ECLSS sensors are designed for applications (the majority of sensors are Commercial Orbital Transportation Services (COTS) or modified COTS) that are not necessarily vibration dependent; but in most cases the sensors are qualified or protoflight tested to ensure they will work for the use case. If testing is required, it is done per NASA Standard 7001.

5. **Are there any currently redundant or inefficient sensors and what are their roles?**
    - We cannot provide a list of all the various sensors and their functions. In general, there are redundant sensors on many systems. There may also be a lack of sensors in some locations (i.e. lack insight into some functions) that can lead to system inefficiencies. Information can be found in the International Conference on Environmental Systems (ICES) proceedings.

6. **Is a connectivity structure diagram available to illustrate how and where sensors are connected (wired, wireless). Is there a common bus the sensors communicate on?**
    - Look for info on NASA spacecraft and International Space Station command and data handling (C&DH) systems.

7. **Are there any sensors we can't use?**
    - All sensors should be considered from legacy to cutting edge.
    - Short answer: probably not. Slightly longer answer: As long as the sensor can meet all of the levied requirements.

8. **For wired sensors, are there extensive wiring harnesses that tie them together? What is the typical gauge and length of wires that connect them for both power and communication?**
    - Yes, there are extensive wiring harnesses. Length and gauge vary. NASA has utilized MIL-SPEC in addition to other standards.

9. **What are the priorities and trade-offs regarding sensor performance, functionality, and resource efficiency (mass, volume, power use)? Alternatively, is the functionality more important than efficiency?**
    - This sounds like a good trade study as part of your research.

10. **What hardware health monitoring requirements exist that may specify what pieces of hardware require sensor-based monitoring?**
    - Think of what data you would want to be able to monitor and use for troubleshooting hardware that you may not be able to see or touch.
    - Sensors are usually added for system health and safety. That said, there is limited space, power, and data bandwidth so the suite of sensors should be optimized.

11. **What proportion of the sensors in-scope for reduction are internal components (built-in as part of a sub-system's original design) verses "bolt-on" sensors to those sub-systems? Is it only 'bolt-on' monitoring sensors that are in-scope for reduction?**
    - Majority of sensors are integral to the systems/hardware. But all sensors should be considered. Future ECLSS systems have yet to be built.

12. **What data generated by these sensors is processed and stored locally and not transmitted out from the space vehicle? (In other words, what sensor data and originating sensors produce data that is also monitored on Earth?)**
    - Agree that not all data is transmitted to Earth. Engineering judgement and best practice are used to prioritize data sent to Earth.
    - Using the International Space Station as an example, many of the system controllers poll the sensors at 10hz and higher, but data is nominally downlinked at 1hz. In other cases, redundant sensors may have a voting scheme and only one value is transmitted.
    - When sensors are used to detect fault, we try to get enough data downlinked to catch a fault or failure before it happens and initiate a graceful shutdown of the system for maintenance or be able to understand the failure so we can guide the crew in fixing the problem.

13. **For challenge scope, are we considering sensors for space vehicles in transit between Earth and the Moon or Mars, or are we also considering sensors on landed vehicles and surface structures that may be deployed to Moon/Mars surfaces?**
    - Both scenarios are valid.
    - Interoperability between vehicles/missions is also something to consider.

14. **Which sub-systems (water recovery, air revitalization, oxygen generation, etc.) present the greatest and worst opportunities for sensor reduction and why? What sensors do they already contain?**
    - Water systems and oxygen generation have the most sensors. There may be sensors for temperature, pressure, flow rate, water quality, etc.

15. **Is it more important/useful to consider mass and volume separately, or is improvement in mass-volume ratio equally valuable?**
    - This is part of the trade space. Both play important roles.

16. **How much mass and energy do the sensors take up on the Human Lander? Is the goal to use as little sensors/resources as possible?**
    - We are unable to provide lander specific data. The goal would be to obtain the data needed for effective feedback while minimizing sensors/resources.

QUESTIONS RECEIVED IN ADVANCE: POTABLE WATER DISPENSER

1. **Is there a specific interface zone or internal volume limit that the Potable Water Dispenser (PWD) must remain on the International Space Station, or can it integrate partially with existing thermal loops or water lines?**
   - The current PWD is in a Galley Rack (modified EXPRESS Rack). Do further research on International Space Station EXPRESS Rack interfaces.

2. **Are teams allowed to route any part of the potable water dispensing system (such as pipes, condensers, or radiators) through or externally along the International Space Station structure if proper insulation and safety are ensured?**
   - Any routing must stay within the pressurized volume.

3. **How are we expected to handle heat rejection are we limited to internal thermal control system or can we design a subsystem that interfaces with the International Space Station external radiators?**
   - Use internal thermal control systems (fans, fluid loops, etc.).

4. **Are there restrictions on penetrating or modifying International Space Station panels (for routing, wiring, or piping) in our conceptual design phase, or should all external interfaces be assumed as sealed?**
   - Any routing must stay within the pressurized volume.

5. **How strict are the contamination and microbial control requirements for potable water subsystem at this phase of the competition?**
   - Look for info on NTRS, ICES proceedings, and in NASA-STD-3001 Vol. 2.

6. **Should we design our system assuming recycled water input from the International Space Station, or a dedicated fresh supply line?**
   - There are no significant differences between the two.

7. **How many people would be on the human lander? (How many liters of water should be aim for per day?)**
   - Current missions' baseline two crew members for Artemis landers. Future mission may have two or more. Research liters/day. The NASA Baseline Values and Assumptions Document is a good source for usage rates.

8. **What is the flowrate of the water coming from the existing water recycling system?**
   - This is not relevant to the PWD. For missions that require water recovery there will be a potable water bus. Look for info on NTRS and ICES proceedings.

9. **Are there any weight/mass restrictions or size restrictions?**
    - Ideally the solution would be able to fit into double locker size space in a NASA EXPRESS Rack (or something similar). Weight and mass are major drivers in spacecraft design and should be considered as part of the trade space.
    - Exploration will likely not use this form factor. Our advice would be to optimize the size of the system and not exceed the size of the current PWD.

10. **What is the desired temperature range for both hot water and the cold water?**
    - See NASA Standard 3001.

11. **Is it possible to dump down extracted heat from the cooler into the inside air in the spacecraft?**
    - Yes, subject to thermal interface requirements. You can research International Space Station payload requirements. Given the thermal requirements for exploration have not been codified yet, but depending on the amount of excess heat and the hazard analysis it can be assumed that "air breathers" will be allowed.

12. **Are there environmental limits (temperature range, pressure, dust levels, radiation exposure) we should assume for the water dispenser's operation and storage?**
    - We suggest researching NASA's Exploration Atmosphere and the Design Specification for Natural Environments (DSNE) specification.

13. **What is the baseline mission duration assumed for the dispenser to survive?**
    - Research Artemis IV and V mission baselines. Landers could also be utilized multiple times. Could also be used for Mars transit missions. Look at the NASA Moon to Mars Architecture Definition Document (ADD).

14. **What are the quality and biocide requirements for the potable water entering the dispenser?**
    - Water should be clean when entering the PWD, but overall water quality can be researched by looking on NTRS and ICES proceedings. Historically biocide has been used in the potable water (iodine, silver, or some other novel method). The International Space Station currently filters the iodine out of the water in the PWD. Remember: the crew rehydrates their food/ beverages with this PWD, and do not want it to taste weird.

15. **How will you handle both hot and cold/ambient water dispensing?**
    - This should be part of your trade space and final design.

16. **What are the mass, volume, and power budgets for the dispenser subsystem?**
    - This should be part of your trade space. Mass, Power, and Volume are driving factors in spacecraft design and can have cascading impacts across systems.

17. **Is there a specific source of the water that we should focus on?**
    - Water could come from the recycled water system or from consumable water brought along from Earth.

QUESTIONS RECEIVED IN ADVANCE:
FLUID TRANSFER BETWEEN SURFACE ASSETS ON THE MOON AND MARS

1. **Does creating a fluid connector port that works in cislunar environment only count towards this? If not, what about one designed for both cislunar and lunar surface environments?**
    - Both environments are valid.

2. **What is a good assumption for how far the fluid must travel between surface assets?**
    - Could be a few feet (like a car at a gas pump) or greater distances (between neighboring structures). This should be part of your trade space and final design of what your system can handle.

3. **What is the pressure range of fluid tanks utilized during NASA Artemis missions?**
    - Artemis extravehicular activity (EVA) suit pressure is the driving function for pressurized gas tanks.
    - There will be other fluids as well such as liquids that will be at much lower pressures.

4. **What infrastructure/surface assets are planned for the Moon within the next 5-8 years?**
    - NASA and its partners are developing the foundational systems for long-term exploration at the Moon. These included landers, habitats, and rovers. For more, visit nasa.gov/Artemis.

5. **What is the composition and condition of the fuel being transferred? Is it cryogenic?**
    - Fuel will likely be cryogenic (super cold) but non-fuels could be liquids (water, urine) and gasses (dioxygen [O_2], dinitrogen [N_2], air).

6. **What fluids are being transferred between which surface assets? Should the system be designed specifically to transfer the mentioned fluids (water, waste, fuel, and oxygen), or just support a variety of fluids? What types of fuels will be transferred?**
    - The listed fluids are expected along with other gasses such as air and dinitrogen (N_2).
    - Cryogenic (super cold) and possibly hypergolic fuels.

7. **What is the max vertical distance a fluid system needs to be pumped to?**
    - This is something to consider in your trade space.

8. **To what magnitude do you want to transfer the fluids?**
    - For most ECLSS applications there would not be huge tanks to transfer, but more on the order of several weeks of crew usage. If transferring fuels this would be a much bigger scale.

9. **Is it pure oxygen and water being transferred, or are there other substances such as breathable air or compounds in the water?**
    - Potable water, grey water, urine, gasses (dioxygen [O_2], dinitrogen [N_2], air), and possibly fuels.

10. **What is the operational time for system usage, how long per day are the systems running? Is the pipe constantly transferring fluids, or just for a period of time and then put away?**
    - Most likely would not be a continuous process, but primarily transfer as needed, or transfer at the start/end of a mission (i.e. offload a cargo lander or moving fluids to storage for a future mission)

11. **Is it ok if we assume there is already an expulsion system that pressurizes the fluids for transfer?**
    - Some fluids will inherently be pressurized (gasses), but liquids may be at a much lower pressure. This is something to consider in your trade space.

12. **What assets are in the scope of this design? Do we need to consider fluid storage?**
    - It can be assumed that fluid storage is available at the source (offload) and destination (receiver), but it should be in your trade space if other fluid storage is needed. Consider all aspects of fluid transfer between vehicles and what would be needed to facilitate that process.

13. **How fast should the fluid be transferred?**
    - This should be part of your trade space and design. This could differ by the type of fluid being transferred and its intended need/purpose for the mission.

14. **Should teams consider fecal waste transfer, or limit scope to liquid waste, such as urine and condensate?**
    - No need to consider fecal waste for this project.

15. **Is there any planned infrastructure you want to integrate with during fluid transfer (such as pipes, valves, etc.)?**
    - This should be part of your trade space and final design.

16. **Should our design be a solution for both Lunar and Martian environments or can we focus primarily on one?**
    - Either scenario is valid.

17. **Are we assuming buried pipelines, surface routing, or mobile transfer for initial deployments?**
    - This should be part of your trade space and final design.

18. **Is there an expected range of operating pressures and flow rates we should aim for or account for?**
    - This should be part of your trade space and design. This could differ by the type of fluid being transferred and its intended need/purpose for the mission.

19. **Are teams expected to develop a new or innovative connection and disconnection mechanism for fluid transfer, or may we base our design on existing coupling technologies such as the CryoMag or Low Force Disconnect while focusing on integration and compatibility?**
    - This is part of your trade space and design. All options should be considered.

QUESTIONS RECEIVED IN ADVANCE: MISCELLANEOUS

1. **Are teams expected to submit CAD models and detailed schematics in the next phase, or are conceptual diagrams sufficient until Phase 2? What level of supporting data or analysis such as drawings, CAD and simulations should be included for the technical content to be competitive?**
    - The more data and understanding of the design that can be presented will better help the judges in their evaluations.

2. **Will other technical reference documents or data files be made available?**
    - No, use what info is publicly available.

3. **Does our design have to be feasible for launch, space travel, and landing?**
    - The full mission cycle should be considered.

4. **What is the maximum extravehicular activity crew size?**
    - Current Missions have two extravehicular activity crew members. Future missions may have more.

5. **Is there a target TRL that we should aim for in our proposed concept?**
    - Higher TRL is always beneficial, but all TRLs should be considered. Carefully review the NASA TRL definitions.

6. **Are we limited to flight-certified materials, or can we propose experimental or novel materials if they are justified in the design rationale?**

- Proposals can include any types of materials, but they would eventually need to be flight certified.

7. **What is the best way to validate our design for space flight and lunar conditions?**
    - Team should propose a validation approach.

8. **How many times a day/week will an extravehicular activity (EVA) be performed?**
    - Look for publicly available info. The NASA Moon to Mars ADD may also provide info.

9. **Do our systems have to be able to be monitored from Earth to the Moon?**
    - Solution would need to remain safe and functional. Minimal insight can help to understand overall mission impacts.

10. **What mass will an astronaut be allowed to lift during an extravehicular activity (EVA)?**
    - Check for publicly available info.

11. **How detailed should cost estimates be in the proposal? Should they be order-of-magnitude or fully calculated?**
    - Order of magnitude.

12. **We have identified problem areas with ECLSS that are not necessarily contained within the challenge subtopics (Potable Water Dispensing, Hardware Sensor Reduction, etc.). Are we still eligible for the competition if we do not focus within the challenge's subtopics, but another subtopic within the realm of ECLSS?**
    - The subtopic areas listed reflect real-world needs identified by NASA engineers and scientists and present meaningful opportunities for students to directly influence technologies that support the future of human spaceflight. However, **teams are permitted to propose ECLSS solutions outside of these topic areas**. We do not want anything ruled out if it pertains to the overall topic of ECLSS. The intention of the subtopic areas was to provide thought provocation not project exclusion. We've noted this update on the Challenge Guidelines, updated it on the website, and added an "Other" field to the NOI and proposal forms.

QUESTIONS RECEIVED IN ADVANCE: PROGRAMMATIC

1. **Can students from multiple universities compete on the same team?**
    - Yes. One university must serve as the "lead" institution. The primary advisor must be from the lead university, and all correspondence will go through that advisor and the team lead. Joint teams receive a single prize, issued to the lead university. The lead university is responsible for determining how the prize will be distributed.
2. **Will any additional specifications/information be provided as the competition advances?**

- Teams should rely on the published 2026 Proposal Package Guidelines, which include the complete competition context, constraints, and requirements. Any clarifications from this Q&A session or future questions will also be made publicly available on the FAQs. No additional specifications are planned as the competition advances. If any significant changes were to occur, teams that submitted an NOI will be notified directly

3. **Will concepts be evaluated primarily on feasibility, innovation, or relevance to future Artemis missions?**
    - Proposals will be evaluated based on the 2026 Proposal Package Scoring Matrix (40% Technical Innovation, 40% Credibility, 15% Technical Management, and 5% for the Video).

4. **Can non-US citizens participate on a team?**
    - Please review the Participation Agreement for full eligibility details. Eligible foreign citizens attending the proposing U.S.-based university/college are allowed to participate on a team if: 1) they are full-time students at that institution and, 2) they reside in the United States. Please note, however, foreign citizens may not be approved to attend any culminating Human Lander Challenge forum events that take place onsite at a NASA Center (including tours). Students attending foreign universities are not eligible to participate, regardless of citizenship status.

5. **Are there any restrictions on AI?**
    - Your proposed concept can use AI as a tool, as long as it's explained and justified (for example, in the use of hardware health monitoring sensors). Generative AI, however, may not be used to develop any Human Lander Challenge deliverables.

6. **Will NASA engineers provide feedback or mentorship after the NOI stage or only during the next design milestone?**
    - NASA does not provide mentorship at any stage of the competition, including during proposal development. All teams will receive written feedback on their proposal from the judging panel only once selections are announced. No additional feedback or advisory support is provided beyond that point.

7. **Is there going to be someone we can email if any questions come up throughout the challenge?**
    - Yes. Please send any questions to HuLC@nianet.org. Responses will be provided by email, and questions and answers will also be posted to the FAQs Webpage. Teams are encouraged to check the FAQs Webpage regularly for updates.