Design title: Lunar Electricity Challenge

Challenge overview

“Lunar Power Challenge”（Watts on the Moon Challenge) is designed to attract innovative engineering approaches to integrate power transmission and energy storage technologies to support mission operations in the lunar extreme cold vacuum environment. A successful demonstration will complementNASAContinued investment in electricity generation on the lunar surface.

Background and background information

existArtemisUnder the plan,NASAPlans to return to the moon through innovative technologies and explore more of the lunar surface than ever before. This mission requires a lunar surface power system that can provide continuous and reliable power to support various industrial activities and human habitation. However, new technologies and systems are necessary, especiallyNASAThe following two key technology gaps were identified in lunar surface power systems:

1. **power transmission**: The ability to transmit power from a remote generating source to mission-critical operating loads, where:
   * a) Electrical loads are often or permanently exposed to extremely cold environments.
   * b) The variation between average power load and peak power load is large.
   * NASAInterested in both wired and wireless transmission, this challenge encourages and demonstrates both solutions.
2. **energy storage**: Have the following abilities:
   * a) Powers mission loads when power generation is unavailable.
   * b) Able to survive and function normally in extremely cold environments.

To meet these two technology gaps, maximizing system efficiency and minimizing system weight will be important considerations becauseNASAThese power systems will need to be transported to the lunar surface.

challenge goals

“Lunar Power Challenge”is a total amount500The $10,000 competition focuses on solving critical technology gaps related to power transmission and energy storage in lunar surface power systems.NASASolutions are being sought that can be designed, built and tested in a simulated lunar environment, and that can continue beyond the challenge to flight readiness and ultimately lunar surface operations.

In addition, these technologies may also create synergies with energy needs on Earth, and this challenge also hopes to promote the terrestrial application and commercialization of these technologies.

Challenges do not include power generation

This challenge does not include electricity generation. While electricity generation on the lunar surface will be crucial,NASAThere are already various initiatives focused on developing and deploying power generation solutions. Therefore, the team should not propose any power generation options in the solution and such proposals will not be evaluated by the jury.

Technical requirements

NASALooking for a solution that meets the following criteria:

1. from intermittentNASApower is taken from the power supply and continuously transferred toNASAload equipment.
2. Able to operate in simulated lunar temperatures and vacuum environments.
3. Continuous operation without any additional power generation.
4. Demonstrate the ability to3The ability to transmit electricity over distances of kilometers.
5. Optimize overall system quality and efficiency.

key performance requirements

Teams must be in two designated“Power activation transfer cycle”ZhongcongNASAAll energy used for power delivery and thermal management is captured from the power supply and is used throughout the test (from timeT=0arrive48hours) continues toNASAThe load device provides the required power. Electricity must be24-32 VDCvoltage range delivered to the load device. The total energy (electrical energy stored) is in“Only powered from storage device”stage transfer toNASAThe energy of the load device is approximately5500Watt hour. allowed fromNASAThe maximum power drawn from the power supply is6000watt. The system is usually surrounded by a liquid nitrogen cold wall (approx.77 K), insulated floors and10^-3 Torr(or lower) vacuum environment.

Explanation of relevant environmental conditions

This challenge does not cover all possible environmental conditions on the lunar surface, but focuses on the main environmental conditions involved in critical technology gaps.

* **temperature**: This challenge focuses on the ability to operate as low as77 K(about-196°C) temperature.
* **atmospheric pressure**: This challenge focuses on being able to0.1 Pa（~10^-3 torr or ~10^-5atmospheric pressure) or lower atmospheric pressure.

Other environmental conditions on the lunar surface, such as dust and radiation, are outside the scope of this challenge and the team does not need to consider these factors.

key assumptions

When developing solutions, teams should make the following assumptions:

* **Transport to the lunar surface**: This challenge does not involve transportation of solutions to the lunar surface. The team should not discuss transportation issues in the proposal.
* **Deployment on the lunar surface**: Teams are asked to describe how to deploy or set up their power delivery design on the lunar surface after landing and address the challenges of deployment in the lunar environment.
* **NASApower supply**: This challenge does not include electricity generation. The team needs toNASAA power supply obtains power. The power supply has the following characteristics:
  + Fixed position operation.
  + Provide up to6 kWof electricity, the voltage is120VDC。
  + Only in the picture1Provide power within the specified time period.
  + conform toSAEinternational space power standardsAS5698Power quality specifications.
* **NASAload equipment**:The team needs to transmit power toNASALoad equipment, the load equipment has the following characteristics:
  + Fixed position operation.
  + Follow the picture1The load profile and timeline shown in are continuously running.
  + Run in constant power mode.
  + Electricity must be24-32 VDCvoltage range delivered to the load device.
  + The power adjustment rate between load changes should be less than100watt/Second.

**Long distance power transmission demonstration**: The team needs to assumeNASAPower supply andNASAload equipment distance3kilometer. All solutions need to be proven through testing and analysis to be able to transmit power over this distance