National Aeronautics and Space Administration

Fission Surface Power (FSP) Project

AIAA ASCEND Conference

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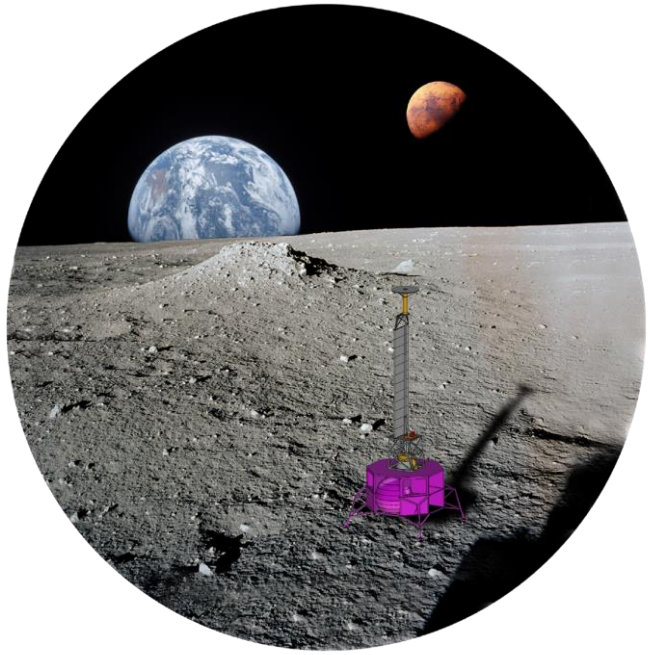
Nuclear Power for the Moon and Mars

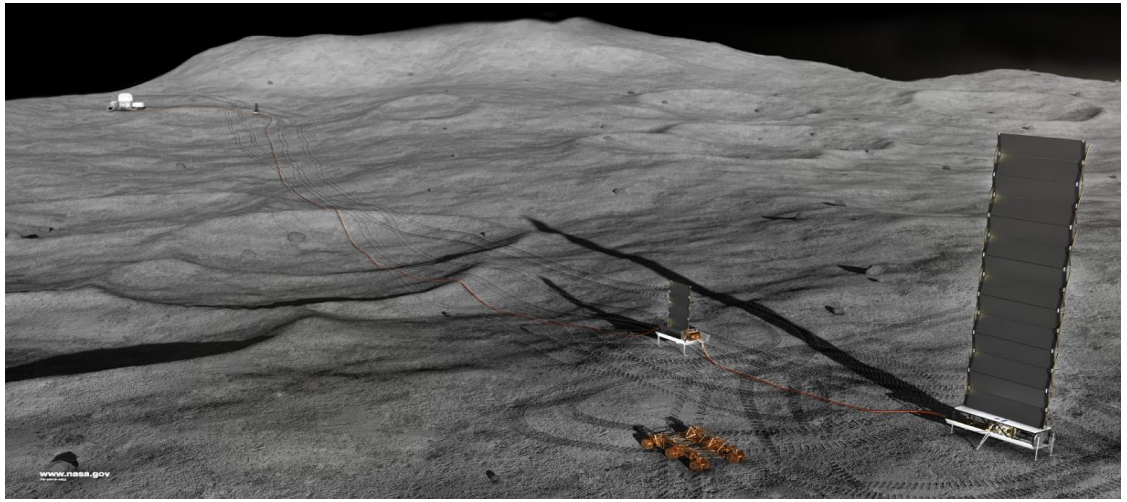
Nuclear power systems will enable robust exploration of Moon and Mars

- Reliable energy production is essential to human and scientific exploration missions
- Nuclear technology enables higher energy systems that operate continuously in extreme environments
- Fission power systems can provide abundant and continuous surface power in all environmental conditions on the Moon and Mars:
  - Lunar night is 14.5 Earth days long. Surface nuclear power is required for a sustainable and continuous lunar presence
  - Mars has recurring planet-wide dust storms that can last for weeks or months
- A fission system designed for a capability demonstration on the Moon will be directly applicable to human Mars exploration



Fission Surface Power (FSP) Project Overview

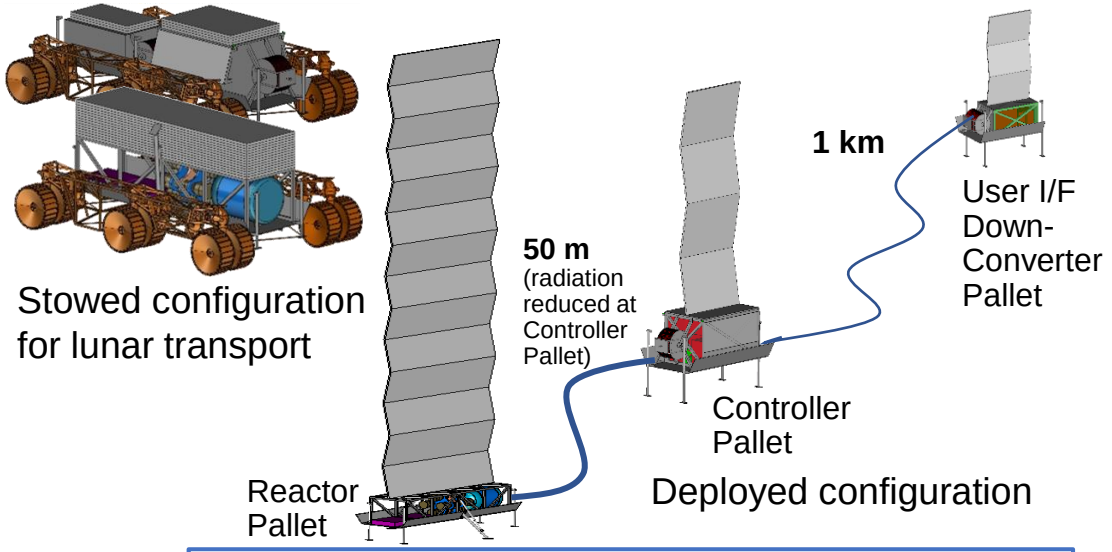
- Develop and deliver a space qualified fission surface power flight unit to the launch site before 2030
- Collaborate with the Department of Energy, Idaho National Lab (INL), Los Alamos National Lab (LANL)
  - INL will manage the design and development contracts with industry. LANL provides reactor expertise
  - Develop an independent government concept
  - Conduct power conversion system maturation
  - Conduct nuclear technology maturation for moderator materials, instrumentation and controls, and shielding



Key Design Characteristics

- 40 kWe output at 120 Vdc
- 6000 kg mass limit, fits on a lander
- 5 rem/year above background radiation limit at 1km
- Operate on the lander, or be transported then operated
- User loads from 0 to 100% power at the user interface

Government Reference Concept



Note: Industry will determine the design and the deployment sequence

Fission Surface Power Development Approach

Industry will design and develop the system in two phases:

- Phase 1:
  - Contractor teams working 1-year contracts for initial designs
    1. IX, a joint venture of Intuitive Machines and X-Energy – partnering with Maxar and Boeing.
    2. Lockheed Martin – partnering with BWXT and Creare
    3. Westinghouse – partnering with Aerojet Rocketdyne
  - Products include design documents, requirements, schedule and cost estimates for Phase 2
- Phase 2:
  - Will be a separate, open and competitive procurement
  - Deliverables include a qualification unit and flight unit; deliver it to the launch site

NASA and the DOE are collaborating on a fission surface power system to enhance sustainable lunar exploration with extensibility to Mars