

National Aeronautics and
Space Administration



USRA & SPI Symposium: Space Nuclear Technology

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Space Nuclear Propulsion (SNP) Investment

Advance HALEU reactor and non-nuclear technologies that support the demonstration of integrated nuclear propulsion systems

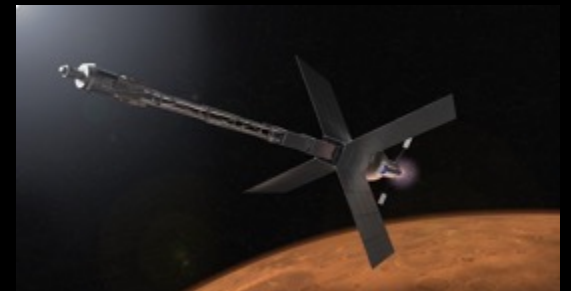
Nuclear thermal propulsion technology maturation plan considerations

- Extreme temperature reactor fuels and materials
- Engineering relevant, subscale low enriched uranium reactor design
- Integrated propulsion system design, build with limited ground testing
- Cis-lunar flight demonstration demonstration
- Liquid hydrogen propellant cryogenic fluid management



Nuclear electric propulsion technology maturation plan considerations

- Subscale (10's kWe) vehicle and mission concept design
- High-power (≥ 100 kWe) electric thruster assessments and testing
- Closed-loop Brayton power conversion system
- High voltage power management and distribution system
- Lox/CH₄ propellant cryogenic fluid management
- Initial investments in power management and thrusters



Subscale nuclear propulsion development accelerates technology advancements and potentially align with Artemis Moon-to-Mars as a cis-lunar transportation system

NASA-DARPA In-space Flight Demonstration

- DRACO in-orbit flight demonstration of a nuclear thermal rocket
- Conducting a flight demonstration of a Nuclear Thermal Rocket (NTR) has mutual benefit to NASA and DARPA as both agencies share interest in the propulsion capability
- Prime contractor awarded in Spring 2023 (Lockheed Martin with BWXT)
- NASA has responsibility to fund and manage the development, design, and test of the nuclear thermal rocket engine
- Performing a NTR engine test advances a transportation capability for cislunar space domain and provide an avenue to evolve performance to meet needs for Mars

DRACO



Current Status

- U.S. Space Force providing launch vehicle and launch support
- DOE-NNSA providing enriched uranium fuel
- Completed major NTR Engine milestone reviews for reactor PDR (Nov 2023) and integrated engine PDR (Jan 2024)
- Some open work identified, but DRACO project is on a reasonable path to flight system PDR
- NASA providing support for electric boost pump, turbopump, EDU cold flow, and nozzle hot-fire testing

Space Nuclear Propulsion Ground Development

Key 2024 activities:

- Extended 2 industry preliminary reactor design efforts to include hardware manufacturing and operational proof of design feasibility



- Industry is making progress on development of space nuclear system designs, fuel and engine component manufacturing capabilities, and mission analysis capabilities
- Completed NASA participation in upgrades to DOE test capability for nuclear propulsion fuel elements
- Initiated NEP investments for Megawatt capable power management and electric thrusters
- Increased collaboration with DARPA regarding NASA's role and engagement, focusing on NASA's expertise and areas for DRACO Nuclear Thermal Rocket Engine development and test activities that include insight, analysis, technical exchange and test support



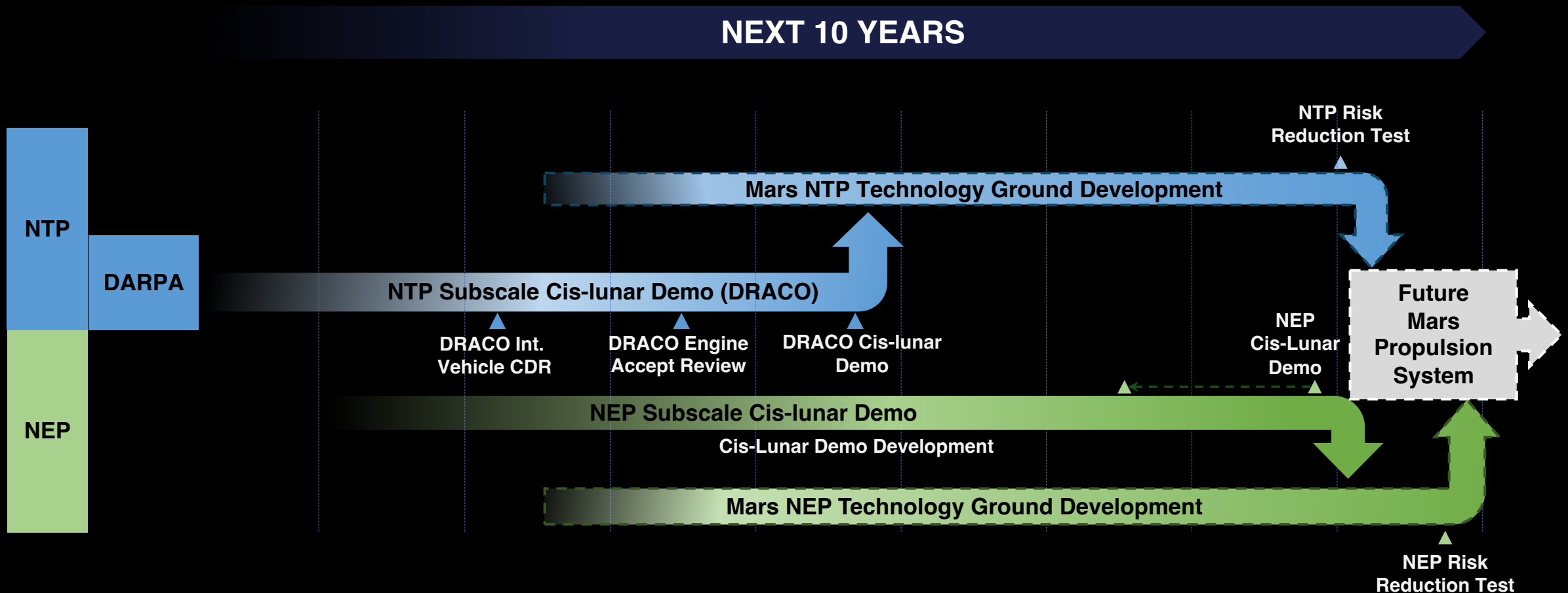
High density fuel samples for high temperature testing



High power electric thruster

Space Nuclear Propulsion Roadmap

NASA's Moon to Mars Architecture Concept Review carries both NTP and NEP as open trade, with a development horizon spanning at least 10 years



Fission Surface Power Progress

- Completed three industry-led integrated fission power designs with Westinghouse, IX, and Lockheed Martin for a 40 kWe system and mass goal of 6 MT
 - Funding contract extensions for design refinements and risk reduction testing
- Refined 40 kWe government reference concept design with lunar surface transportability option
- Executing three industry-led design contracts with Rolls Royce, Brayton Energy, and General Electric to develop high-temperature Brayton power conversion subsystem
- Forming a joint NASA/DOE/DOD agency initiative, Versatile Autonomous Lightweight Kilowatt-class Reactor Experiment (VALKRE), HALEU reactor protoboard experiment to inform a kilowatt class, fast spin-up, mobile, fission power system
 - Provides off-grid power to remote locations, small operations, disaster relief with reduced reliance on supply chain support

