The National Academies of
SCIENCES • ENGINEERING • MEDICINE

DIVISION ON ENGINEERING AND PHYSICAL SCIENCES
AERONAUTICS AND SPACE ENGINEERING BOARD

SPACE NUCLEAR PROPULSION TECHNOLOGIES COMMITTEE

STATEMENT OF TASK
The National Academies of Sciences, Engineering, and Medicine will convene an ad hoc committee to identify primary technical and programmatic challenges, merits, and risks for developing and demonstrating space nuclear propulsion technologies of interest to future exploration missions. Nuclear propulsion has been shown to offer the potential for rapid human transit to Mars with one-way transit times less than 9 months and total roundtrip times including Mars surface stays less than 3 years. The committee will also determine the key milestones and a top-level development and demonstration roadmap for each technology. Additionally, the committee will identify missions that could be enabled by successful development of each technology.

The space nuclear propulsion technologies of specific interest are:

1. High-performance nuclear thermal propulsion (NTP) that heats hydrogen propellant to 2500K or more and produces specific thrust of at least 900 seconds.

2. Nuclear electric propulsion (NEP) that converts thermal energy to electricity to power plasma thrusters for highly efficient and rapid transport of large payloads (e.g., a propulsion system with a power level of at least 1 MWe and a mass-to-power ratio (kg/kWe) that is substantially lower than the current state of the art of NEP systems).

PLAN OF ACTION
This study should examine the merits and challenges of developing and demonstrating NTP and NEP systems as described in the statement of task. This examination should consider the following factors:

- The key technical and programmatic challenges and risks;
- The options for full-scale system-level ground demonstration testing;
- The benefits and drawbacks of foregoing ground demonstration testing in favor of flight demonstration testing;
- The prospects for developing a fuel element form or other reactor subsystems that could be common to at least two of NTP, NEP, and the mobile 1-10 MW power reactors being considered for development by the Department of Defense Strategic Capabilities Office;
- The technical, programmatic, and policy considerations associated with selecting highly enriched uranium (HEU) rather than high assay low enriched uranium (HALEU) as the fissile material;
- The capability of NASA, the Department of Energy, and industry to develop the key subsystem technologies to readiness for mission infusion (i.e., to technology readiness level 6); and
- Key milestones and a top-level development and demonstration roadmap.

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