

Design of a Shuttle-Tended Interplanetary Transfer Vehicle Using Nuclear Electric Propulsion

John O. Elliott, Roy Nakagawa, Tom Spilker, JPL
Ron Lipinski, Sandia National Laboratory
Dave Poston, Los Alamos National Laboratory

The application of Nuclear Electric Propulsion (NEP) to space missions has been a topic of increasing interest. NEP systems appear ideally suited for a range of deep space missions where high delta-V and high power at the target bodies are enabled by the use of nuclear power and electric propulsion systems. Somewhat less obvious, however, are the benefits of NEP for inner planet missions to Mars or Venus, or other near-Earth objects (NEOs) where chemical propulsion and solar power have proven adequate in the past. The utility of NEP vehicles in the inner solar system is greatly enhanced, however, when the versatility, longevity, and reusability of such a system is considered.

Recently, a study was performed by a team from JPL and the DoE to develop a mission architecture for a reusable NEP Interplanetary Transfer Vehicle, a "Space Truck". This vehicle is designed to be used for delivery of payloads from Earth to a variety of destinations, including Mars and Venus, dependent on mission needs. In addition to delivering payloads to the target bodies, the vehicle is designed to perform autonomous rendezvous and capture of sample return capsules at the destination for return to Earth. In order to maximize the utility of the vehicle, its design is optimized for servicing between missions with the Space Shuttle. Fuel tanks, ion thrusters, and Power Management and Distribution electronics are all on-orbit replaceable units, located at the payload interface end of the spacecraft to ensure a minimal radiation dose to the Shuttle and crew during maintenance and resupply operations. Operational flexibility is maximized through the use of replaceable fuel tanks and thrusters, allowing tailoring of fuel load to any given destination and payload mass.

This paper discusses the preliminary design developed for the NEP Interplanetary Transfer Vehicle, including its configuration and design features, and outlines the concept for mission design, including discussion of unique requirements for launch, deployment and operations with the Space Shuttle, and rendezvous and servicing by the Shuttle in Earth orbit following a return from each target destination.