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# Concept for a Shuttle-Tended Reusable Interplanetary Transport Vehicle Using Nuclear Electric Propulsion

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**Abstract.** NASA has placed new emphasis on the development of advanced propulsion technologies including Nuclear Electric Propulsion (NEP). This technology would provide multiple benefits including high delta-V capability and high power for long duration spacecraft operations. One potential mission application of this technology would provide a reusable deep space transfer vehicle for multiple transfers to and from the inner planets. Such a space "truck" would make full use of the high delta-V capability available from the NEP system, while providing additional benefits to the payload. It could be used for multiple transfers from the Earth to the inner planets and back, supporting both Mars Sample Return and Venus Sample Return cargoes. Point designs are developed for such a "multi-cycle" system and then compared against a similar single cycle system based on solar electric propulsion. In order to extend the operational life and versatility of the NEP system, we propose to enable the servicing of the vehicle and payload transfer using the Space Shuttle. A baseline operational scenario is developed for such a mission that would also include the change out of the xenon propellant tanks and the ion thrusters. The Shuttle provides a number of benefits to this type of mission, such as high launch reliability, a high degree of operational flexibility, availability of contingency operations, and prior experience with launch of radioactive payload components and on-orbit servicing. The launch and rendezvous orbit will be maximized for altitude and inclination to minimize radiological exposure during spiral transits through the Van Allen radiation belts. Preliminary examination of requirements indicates that Shuttle safety concerns for launch and servicing operations can be addressed through the standard Shuttle safety review process. A break-even point exists beyond which a multi-cycle NEP system could potentially become more cost-effective than a single cycle chemical or SEP system for both Mars and Venus sample return missions. However, greater utility of the NEP system could be realized if it were used to enable cycler missions involving the transportation of payload to and return of samples from the outer planets.