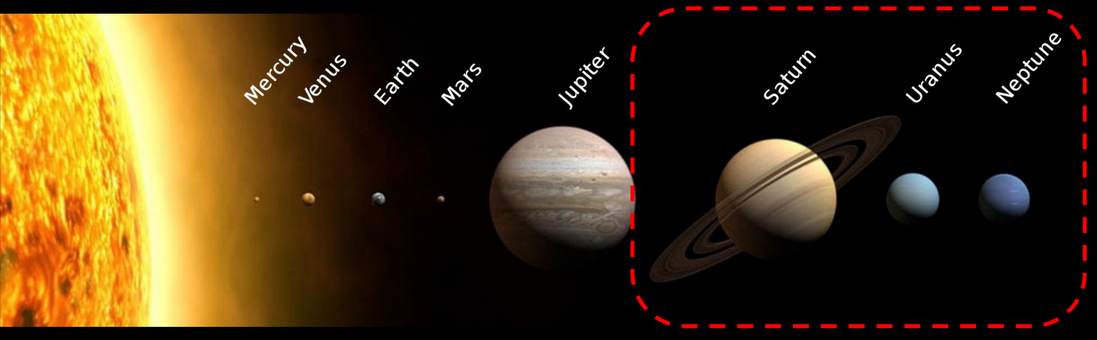
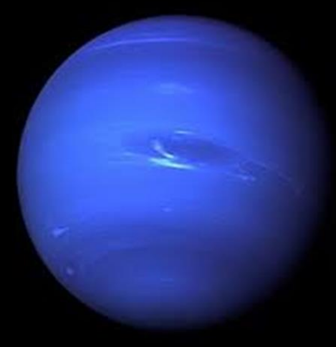
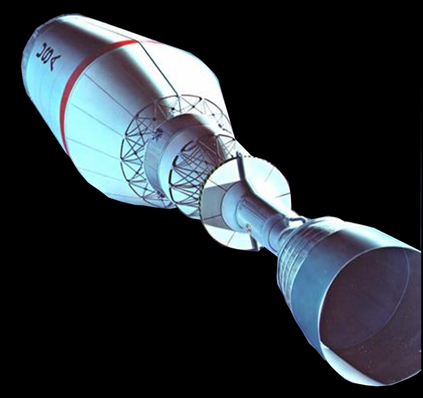
Nuclear Thermal Propulsion (NTP) and Power
A New Capability for Outer Planet Science and Exploration

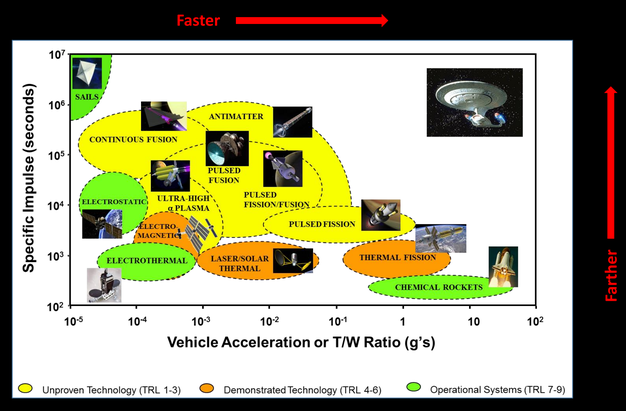


- Imagine Cassini class mission at Uranus or Neptune
- Curiosity class rover possible on Triton
- Cut trip times

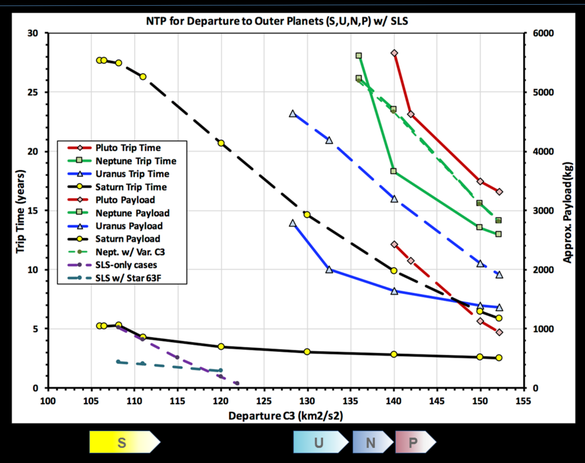




Why NTP?



The robustness supported by NTP's higher performance enables programmatic flexibility and increases probability of mission success



NTP SLS Combination Provides New Capability for Science at the Ice Giants and Beyond

Current NTP systems can be designed to use Low Enriched Uranium (LEU) with minimal (or no) impact on performance. Past NTP systems used Highly Enriched Uranium (HEU) requiring maximum security

Fission products produced in one week at a LEU university research reactor = 1 entire Roundtrip Mars mission using NTP

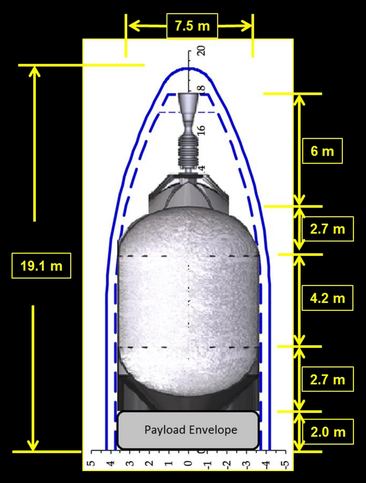
The use of LEU reduces cost, lowers the risk and should dramatically decrease the regulatory burden.

How best to use NTP?

SLS

+

NTP

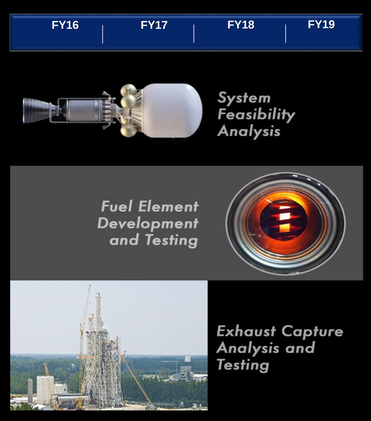


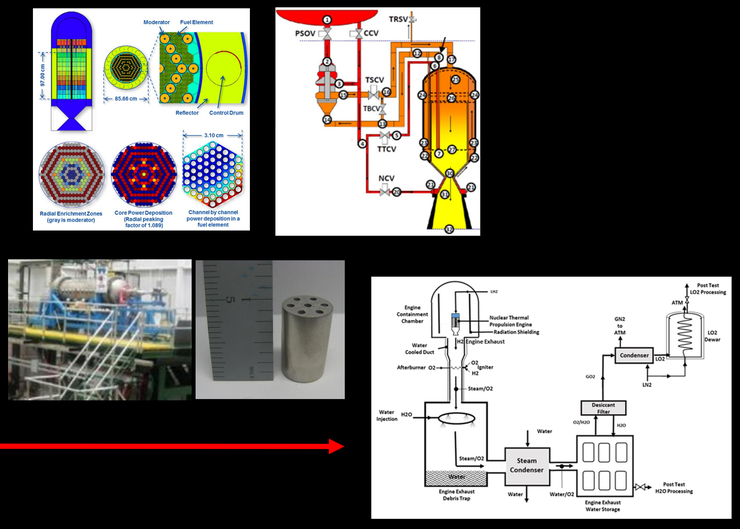
Configuration – SLS 1B (8.4-m fairing)

- Ground Rules & Assumptions:
  - Direct flight to target planets
  - NTP engine (3.5 mT engine mass, 850 s Isp, 25,000 lbf thrust, LH2 propellant)
  - All Earth Departures take place from a C3 = -10 km2/s2
  - SLS to C3 = -10 km2/s2: 42.8 mt
  - Length in 62.7ft SLS fairing for S/C: 17.8 m
  - Falcon Heavy to C3 = -10 km2/s2: 15 mt
  - Length in 13.1m FH fairing for S/C: <13 m
  - NTP is dropped off after departure burn
  - Captures at outer planets are into elliptical orbits w/ apoapses at moons' distances
  - Capture is done w/ storable prop (Isp = 320 sec)
  - SLS + SRM comparison case done with a STAR 63F-derived motor (Isp = 295 sec)

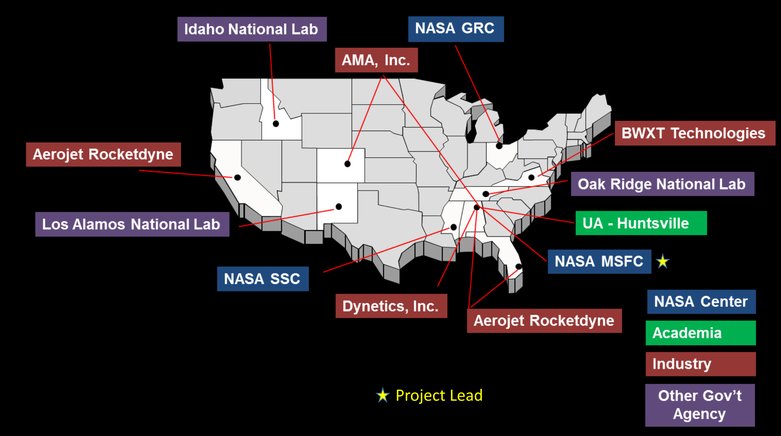
On-going Work

The goal of current NTP project is to determine the feasibility and affordability of a Low Enriched Uranium (LEU)-based NTP engine with solid cost and schedule confidence.





Current Partners with the NTP Project



Other Future Possibilities?

- Using NTP for braking at mission destination using advancements in Cryogenic Fluid Management
- NTP reactor providing multiple kWe electric power for entire mission
- Other potential users showing interest

"Specific investments include development of …. and rapid transit nuclear thermal propulsion technology utilizing low-enriched uranium that could potentially provide 20 percent shorter travel time to Mars while substantially improving mission flexibility."