



VASIMR[®] MARS MISSION CONCEPT

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Nuclear Electric Propulsion (NEP) Could Enable Sustainable In-space Transportation Throughout Entire Solar System



To Interstellar Space

Fusion or Breakthrough Propulsion (1GW and up)

Edge of Solar System

High Power Nuclear Electric Propulsion (1 - 100 MW)

High Power Solar Electric Propulsion (100 kW - 1 MW) (Robotic Cargo)

Chemical Propulsion

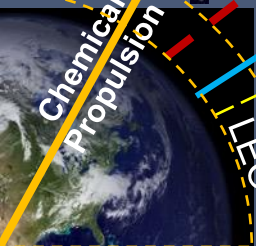
LEO
Lunar

Mars

...and beyond!

.15B Km

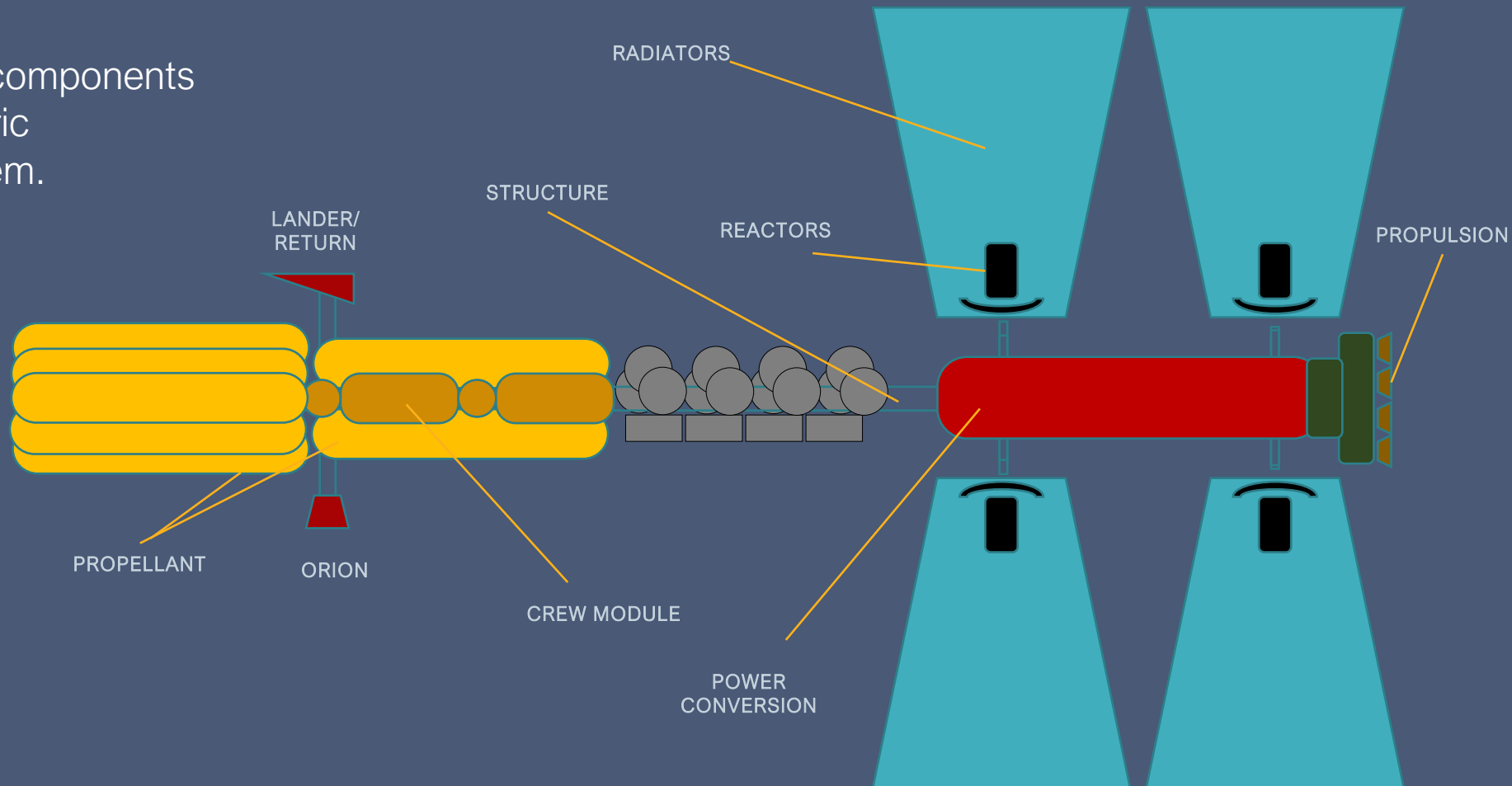
15B Km



COMPONENTS OF NEP

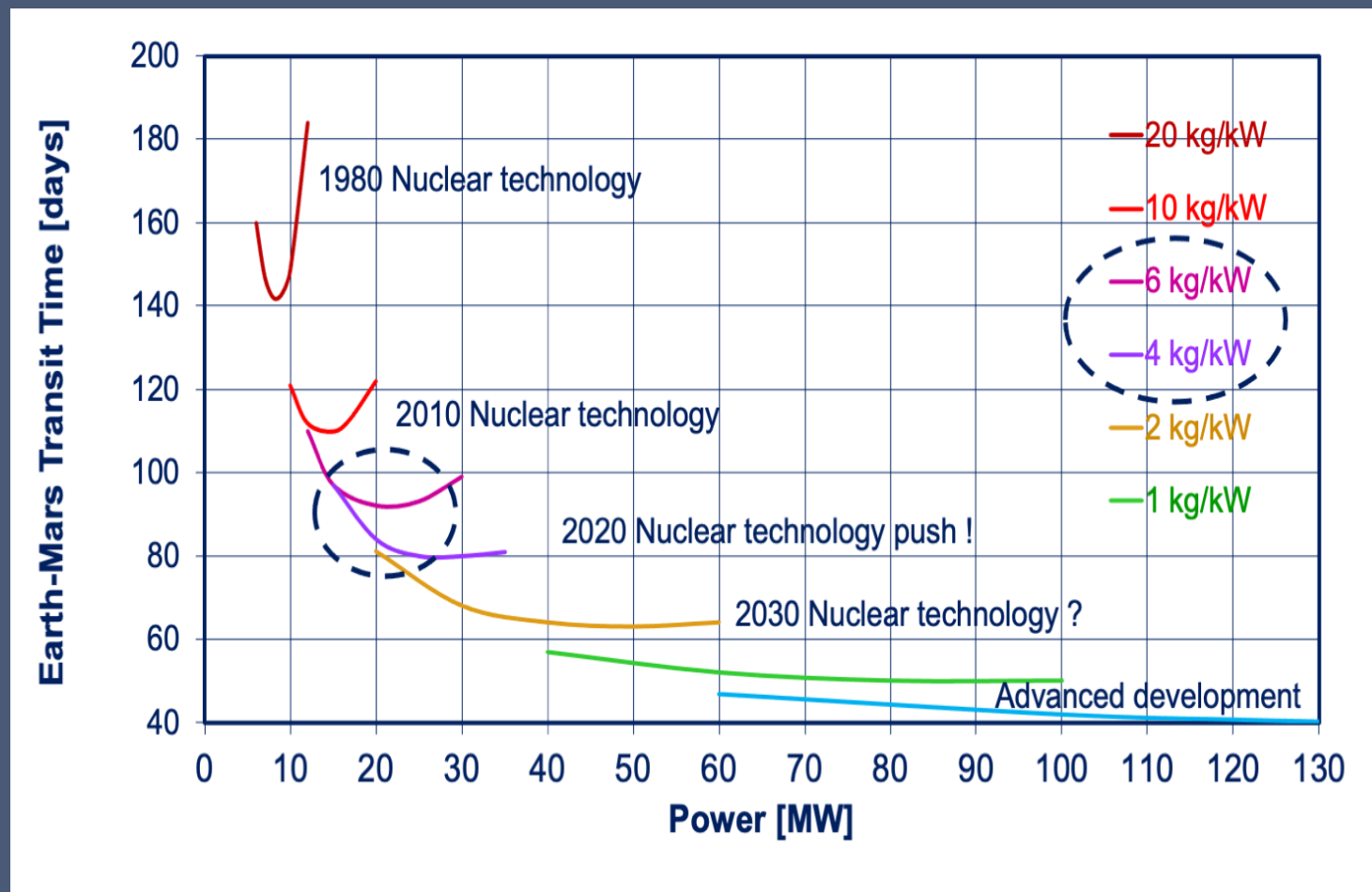
The following are the basic components required for a Nuclear Electric Propulsion (NEP) flight system.

1. Reactor
2. Power Conversion
3. Propulsion
4. Radiator
5. Structure



MARS TRANSIT TIME VS POWER

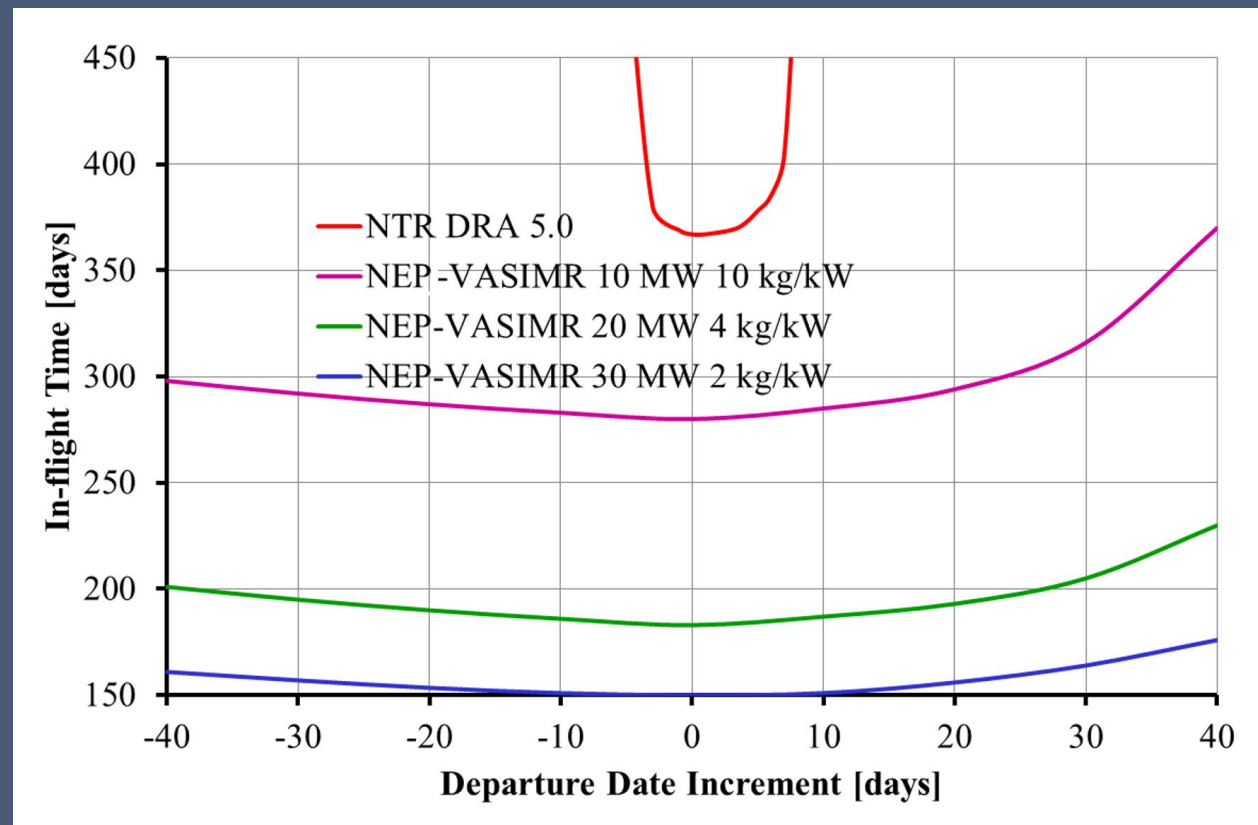
- Transit times decrease with increasing power
- The lighter the power system, the better
- For reasonable assumptions of power specific mass (kg/kW) the transit times can be less than 100 days



HIGH-POWER NEP VS NTP DEPARTURE WINDOW

This graph shows the round-trip times in days and the launch windows per each propulsion configuration.

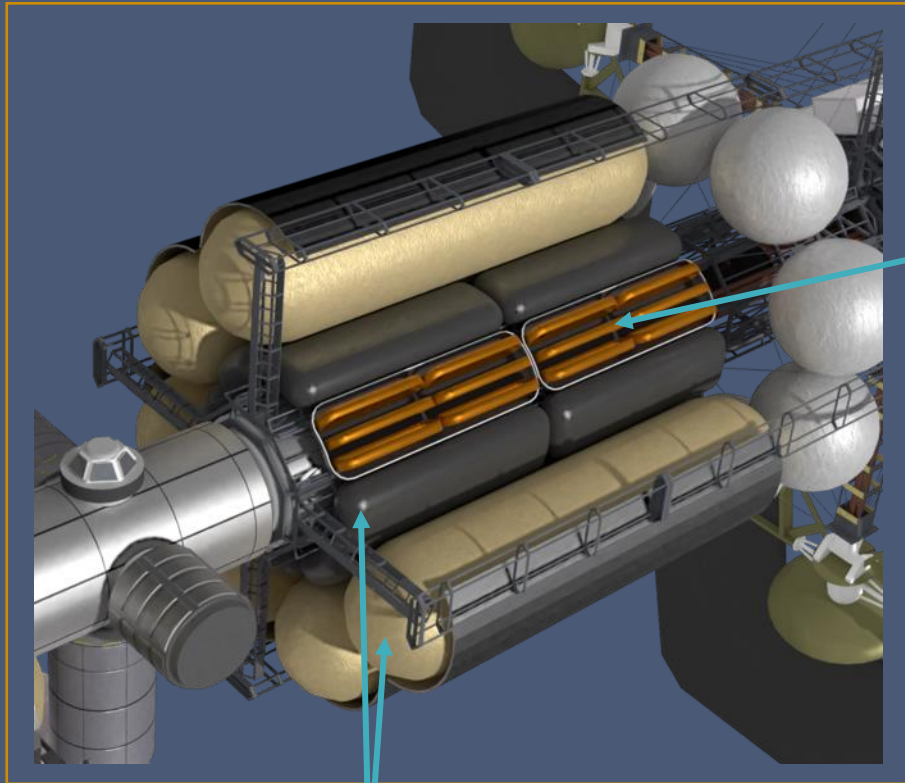
- Departure window for NTP (Nuclear Thermal Propulsion) system is on the order of days, significantly less than with NEP.
- Departure windows for NEP extend for several weeks
- NEP provides much shorter round-trip timelines



CONCEPT NEP MARS SPACE CRAFT



This concept ship is equipped with two layers of radiation shielding keeping crew safety as a priority.

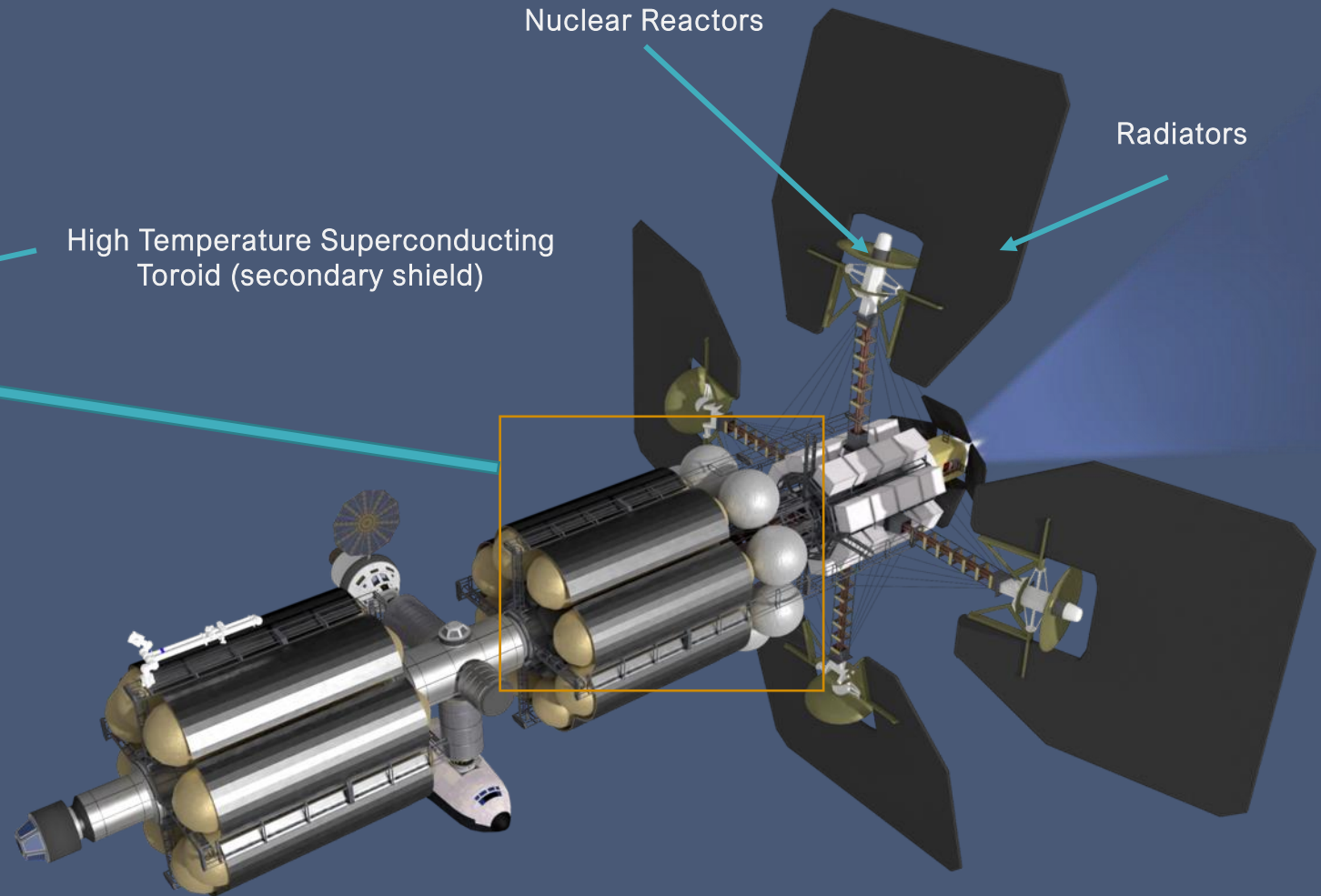


Liquid Hydrogen Propellant
(primary shield)

High Temperature Superconducting
Toroid (secondary shield)

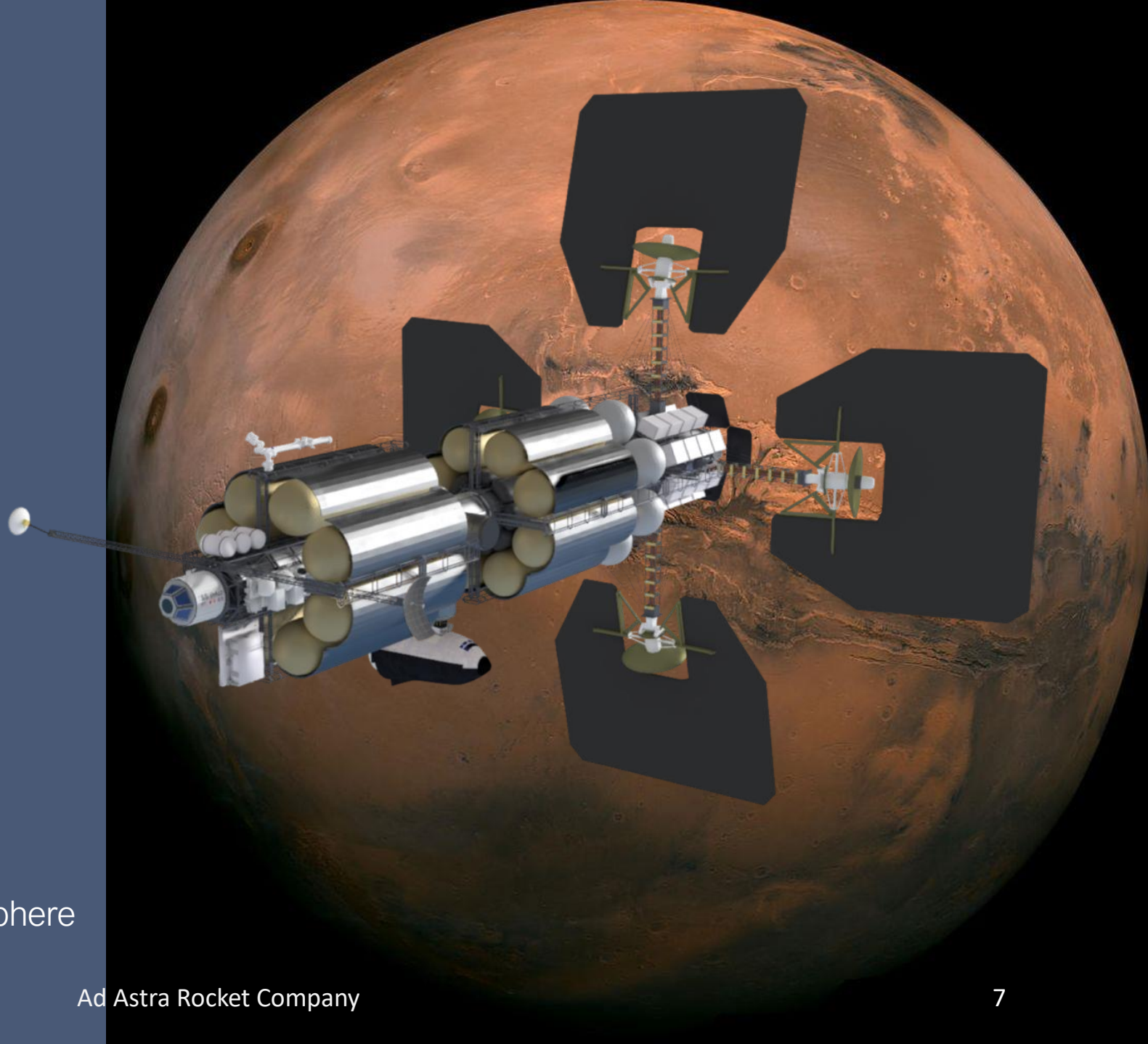
Nuclear Reactors

Radiators



CONCEPT NEP MISSION PARAMETERS

- Departure date: May 20, 2035
- Payload: 62 t
- Stay on Mars: 30 days
- Tank/Propellant ratio: 10%
- Power: 40 MW
- System efficiency: 70%
- Total specific mass: 2 - 4 kg/kW
- Departure: $IM_{L_1} = 300 - 600$ t
- Variable I_{sp} range: [2000; 30,000] sec
- Arrival: Medium Mars Orbit (20,000 km)
- Relative velocity: 10 km/s at Mars atmosphere

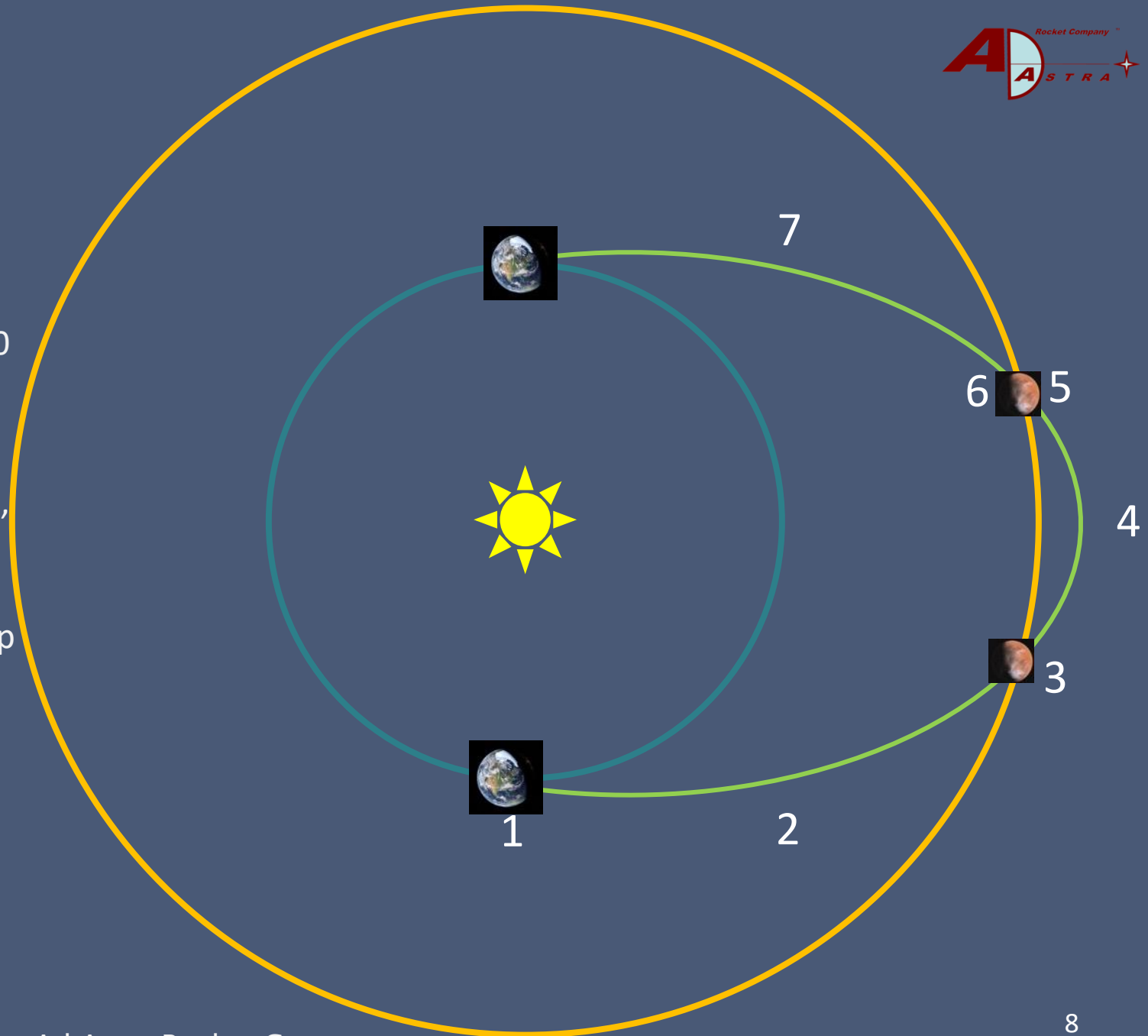


95 DAYS TO MARS

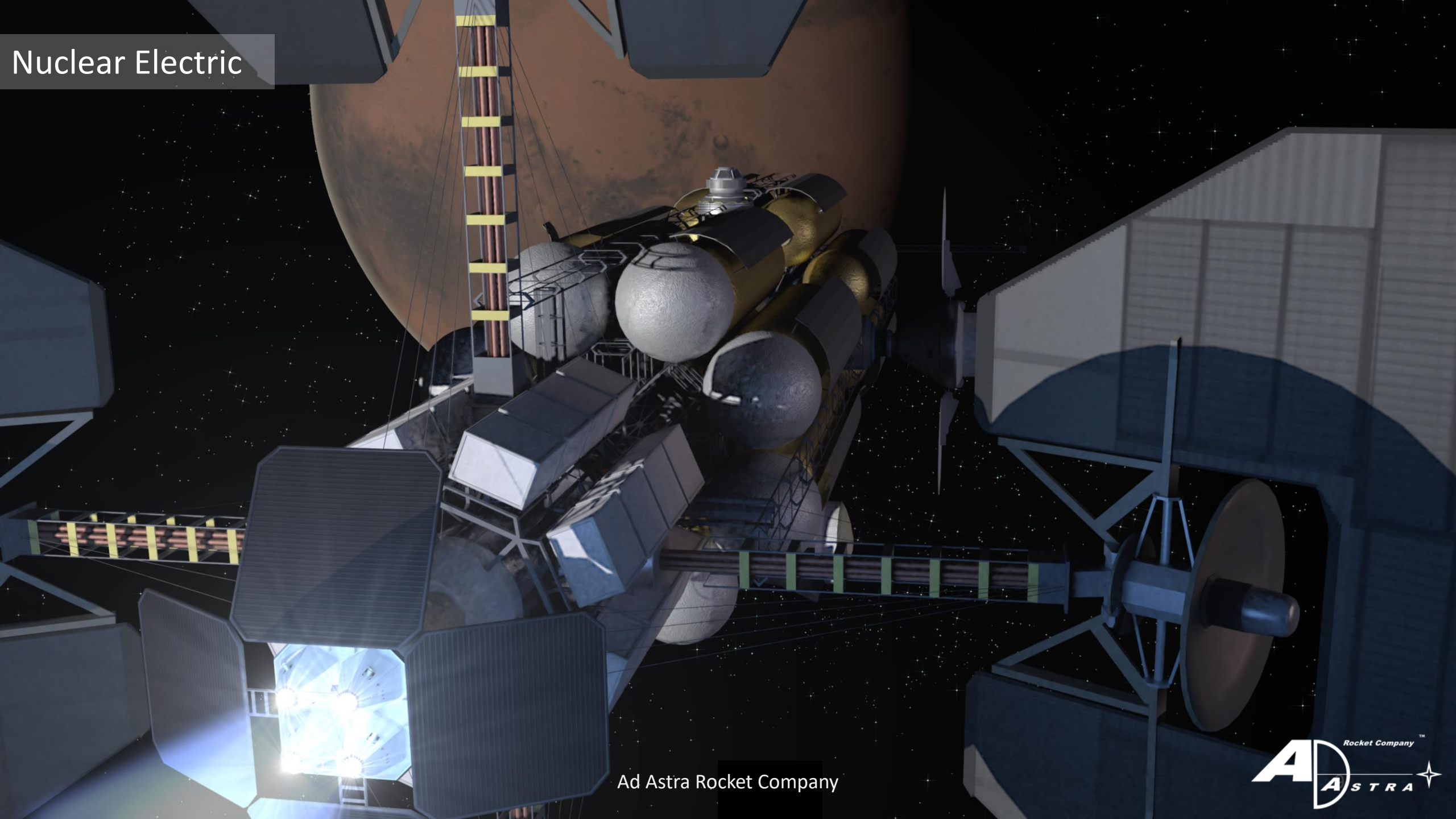
1. L1-ESOI, 6d, $I_{sp} = 3000$ sec, Prop = 36 t
2. ESOI-MSOI, 89d, $I_{sp} = \text{var}$, Prop = 112 t
3. Mars arrival, Lander aerobrakes $V_{arr} = 10$ km/sec
4. OTV returns to MSOI, 30d, Prop 26 t
5. OTV spiral to MMO, 6d, $I_{sp} = 7000$ sec, Prop = 6 t
6. After 36 days on Mars, CRV docks with OTV and departs MMO – MSOI, 5d, Prop = 15 t $I_{sp} = 4000$ sec
7. MSOI – ESOI, 95d, Prop = 41 t $I_{sp} = \text{var}$

DEFINITIONS

ESOI:	Earth Sphere of Influence
MSOI:	Mars Sphere of Influence
OTV:	Orbit Transfer Vehicle
CRV:	Crew Return Vehicle
MMO:	Medium Mars Orbit



Nuclear Electric



Ad Astra Rocket Company

