

Boeing Study of Mars 2033 Human Flyby Mission

- A 2033 Mars Flyby mission allows for a free return trajectory with no propulsive maneuver required at Mars to affect a return to Earth.
- This greatly reduces the energy requirements for the transfer stages and allows for lighter stages and fewer launches than which would be required for a stopover mission.
- Four elements are required:
 - Crew habitat
 - Earth entry capsule
 - in-space stage
 - Earth departure stage.

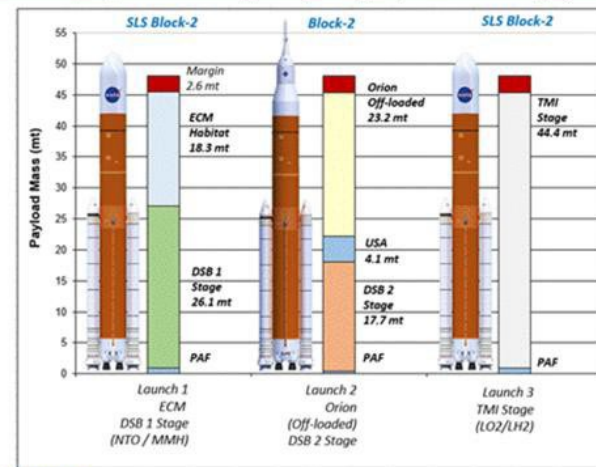
Manifest: 4-Launch, 26.4 mt Hab (Recovered At Earth) + Orion to Orbit Only, (3 Deep Space Burn Stages, 1 TMI Stage)

Manifest: 4-Launch, 28.1 mt Hab + Orion Capsule to Mars, (3 Deep Space Burn Stages, 1 TMI Stage)

Manifest: 3-Launch, 23.2 mt Hab + Commercial Capsule to Orbit Only, + Small Earth Reentry Capsule to Mars (1 DSB Stage, 1 TMI Stage)

Manifest: 3-Launch, 15.7 mt Crew Hab + Commercial Capsule to Mars (1 DSB Stage, 1 TMI Stage)

SLS Launch Manifest: 3-Launch, 18.3 mt Crew Hab + Orion to Mars (2 Deep Space Burn (DSB) Stages, 1 TMI Stage)



Crewed Mars Flyby Mission

Case 1

Three Launch Scenario
3 Launches of SLS Block 2
Aggregation: EML2
ECM: 18.3 mt, expended
Earth Arrival Velocity: 12.5 km/s
DSB Stage Fuel: MMH: 339 isp
TMI Stage Fuel: H2: 465 isp
EEC Launch: Orion
EEC Mission: Orion
EEC Return: Orion

Block 2 =48 mt to TLI.
Orion goes to Mars.
Orion is off-loaded

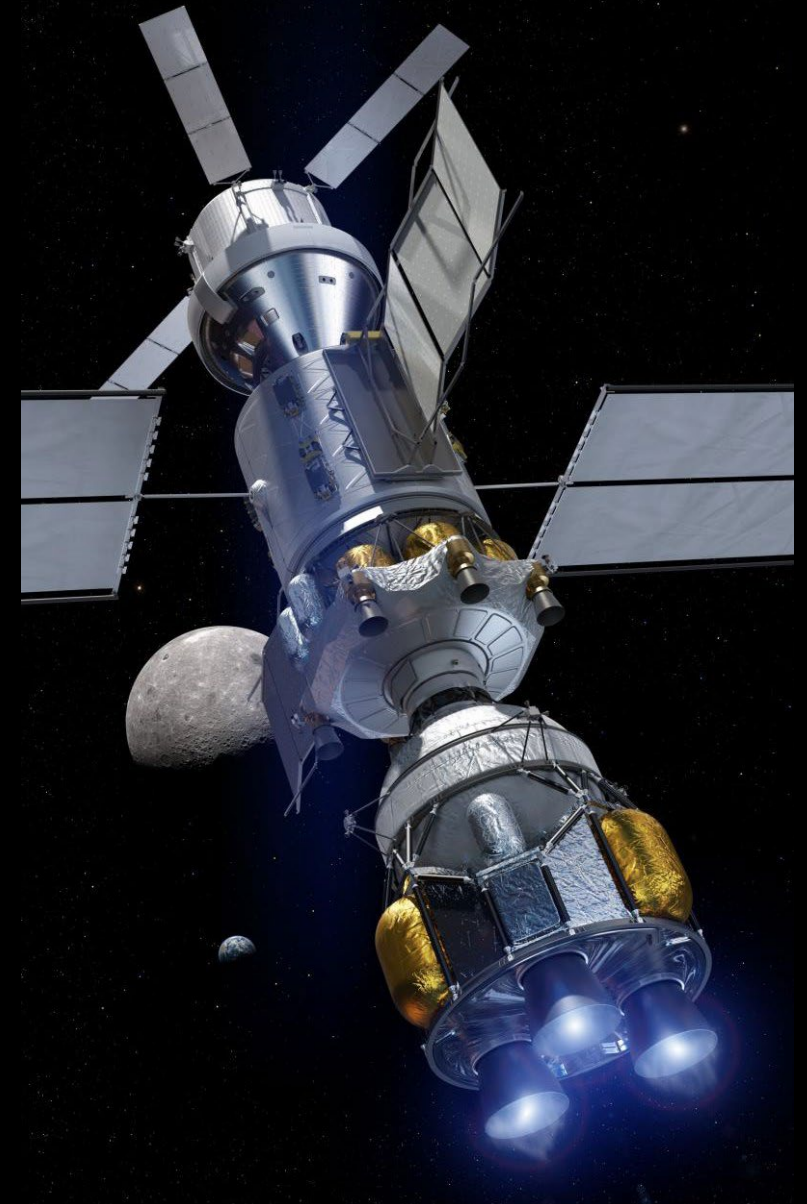


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Tradeable Mission Variables

- Number and type of launch vehicles
- Aggregation orbit for Earth departure
- Habitat and Return Vehicle mass
- Earth return via an Earth Entry Capsule or recapture of the crew habitat
- Magnitude of Deep Space Burn DSB burn
 - Earth entry speed and Thermal Protection System
- Propulsion/fuel type for transfer stages
- Number of crew



Advantages of a Flyby Mission

- 2033 is a favorable, low dV cost opportunity due to planetary alignment and mechanics.
- Flybys are dramatically cheaper in prop than stopover missions.
- A Flyby mission is consistent with Apollo approach – a steady buildup and test of capabilities.
- A Flyby mission is the first step to a surface landing.