

AAE 450 Spacecraft Design/EAPS 391

PROJECT DESTINY

Mission Specifications for AAE 450 Spring 2017

The objective of this class is to determine if SpaceX's plan for a million person colony on Mars in 40 to 100 years is feasible. The class will assume that the Interplanetary Transport System (ITS) is built following the timeline and at the cost specified in Elon Musk's presentation. The class will investigate the startup and growth of the colony until one million people are living on Mars.

SpaceX is already preparing missions to Mars. The Red Dragon mission planned for 2018 will test supersonic retropropulsion using a modified Dragon V2 capsule to land on the surface of Mars.

SpaceX plans to send at least one mission to Mars every synodic period starting in 2018. These missions will provide SpaceX with experience at landing on Mars and also provides the opportunity to send prototype payloads of in-situ resource utilization (ISRU) modules designed to extract water for the CH_4 and O_2 Sabatier reaction, which will be required to refuel the ITS.

The first launch of the ITS to Mars with cargo will take place in 2024. The first mission will send a large ISRU propellant plant. The ship will stay on Mars until a small crew of around twelve astronauts arrive on the second ship during the next synodic period in order to assemble and operate the propellant plant. Once the propellant is operational, ships can begin to be refueled and launched back to Earth.

SpaceX wants to double the number of flights with each Earth-Mars synodic period until the city can grow itself. This will require an expanding manufacturing capability, reliable reuse of the vehicles, and a high launch rate. Elon Musk predicts that a million person colony is possible within 40 to 100 years of the first launch.

The students will analyze all parts of this plan to determine the feasibility of each area including manufacturing rate, interplanetary travel, and colony establishment and growth. The students will also analyze the use of a cycler vehicle to ferry people to and from Mars with the ITS acting as a taxi to ferry passengers between the planets' surfaces to the cycler and back down.

The Mission Specs are subject to the following constraints:

Each first stage booster can be used 1,000 times

Each tanker can be used 100 times

Each ship can be used 12 times

Once 1,000,000 people are on Mars, they must be sustained for 20 years (1 generation)

A cyclor concept must also be developed

Artificial gravity (0.38 G) must be provided for both concepts: cyclor and SpaceX

Colonists must be protected from space radiation

Two-way continuous HD video communication must be provided at all times

Colonists must be able to leave the habs in a shirt sleeve environment at least three times

a week Science rovers must be provided (specs supplied by science group)

Game rooms (e.g. wallyball courts) must be provided to insure muskuloskeletal health

Food growth

- No food is grown the 1st synodic period
- 10% increase in percent of food grown on Mars vs. shipped from Earth every synodic period
- 100% of food is grown on Mars by the 11th synodic period

—End of Project Specifications for Spring 2017—

These specifications are subject to change at the discretion of the customers (Dr. Andy Aldrin and Dr. Buzz Aldrin).