

Small Spacecraft Electric Propulsion (SSEP) ACO

Gabriel Benavides and Eric Pencil, NASA Glenn Research Center

Project Overview

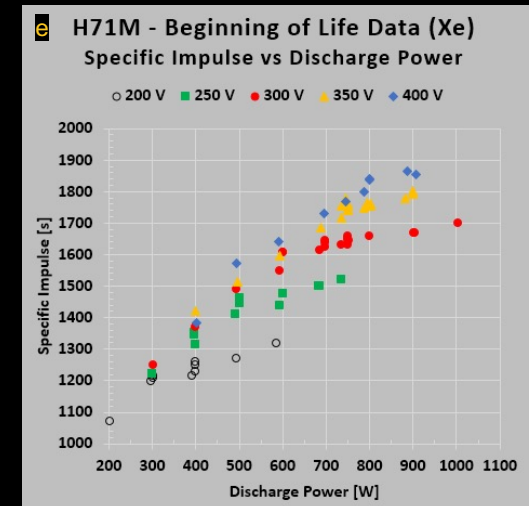
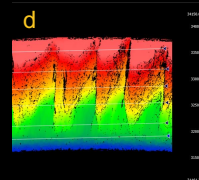
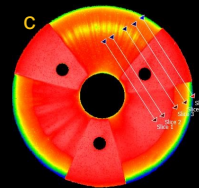
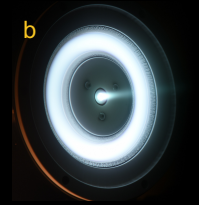
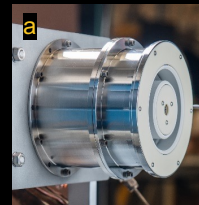
- Northrop Grumman (NG) and NASA Glenn (GRC) are collaboratively developing a Small Spacecraft Electric Propulsion (SSEP) system,
- Goal: an affordable, high efficiency, high propellant throughput Electric Propulsion (EP) system for small spacecraft requiring large delta-v.
- Performance goals:
 - Input power range from 200 to 1000 W
 - Specific impulse up to 1850 sec with total impulse >2.0 MN-s
- Each element of the system is designed for cost without compromising the reliability and radiation requirements for deep space missions.

Technical Approach

- Environmental, component life cycle, and wear testing of two Engineering Model (EM) Hall thrusters
- Integrated hot fire testing of an EM thruster with an EM Power Processing Unit (PPU) and EM Xenon Flow Controller (XFC).
- NG furnishes the EM hardware, while GRC provides the facilities, expertise, and personnel for the testing.

Results/Summary

- GRC has made considerable progress preparing and validating the required test facilities and diagnostics. GRC has developed specialized test hardware as needed. NG completed PDR and initiated EM hardware fabrication. Delivery of NG EM hardware expected in Q1 of 2022.



a. NASA H71M-PM Hall-effect thruster

b. Thruster operating with xenon propellant in GRC Vacuum Facility 8

c. Profilometry of inner pole cover used to estimate rate of pole erosion

d. Profilometry of discharge channel

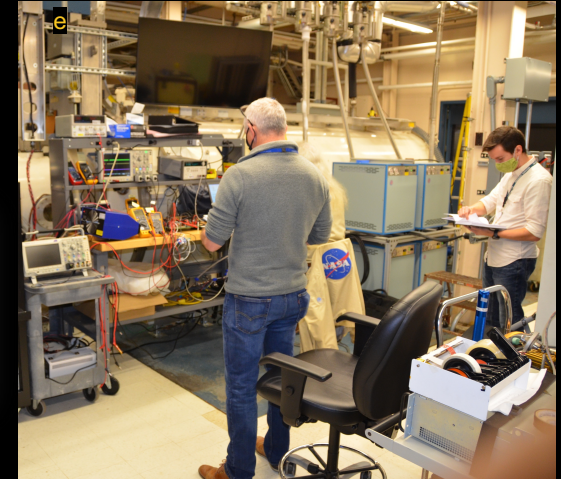
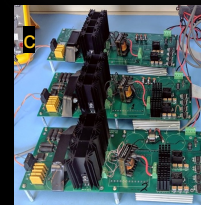
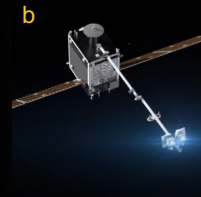
e. H71M beginning of life specific impulse

Contributing Partners

- The Smaller ACOT is a collaboration between Northrop Grumman and NASA GRC to commercialize a low power SSEP technology.
- The NASA SSEP project is also collaborating with a range of domestic entities to similarly advance low power EP components, thrusters, and power processing technologies.
 - Presently, there are 6 evaluation licenses for the SSEP technology with 2 in the process of converting to commercial licenses.

Infusion and Transition Plan

- GRC's effort to develop and commercialize a robust SSEP technology includes a novel licensing model to promote U.S.-based consortium building, information sharing, and market adoption.
 - GRC is making these patent-pending technologies available to U.S. companies through a no-cost, non-exclusive license agreement and companion SAA.
- An initial SSEP application is NG's MEP mission, which has similar requirements to many NASA small spacecraft planetary mission concepts. First MEP launch anticipated in 2024.
 - NG further plans to extend SSEP to other spacecraft lines.
 - This collaboration, amongst others, promises to soon make low power, high delta-v SSEP available to NASA and other Government agencies as a marginal buyer.



- a. NASA engineers inspecting H71M thruster
- b. Artistic rendering of NG's Mission Extension Pod (MEP) spacecraft. First anticipated flight of NG's SSEP system
- c. NASA low power PPU circuitry. NG licensed as basis for their PPU design
- d. Magnetic mapping of H71M thruster
- e. NG personnel performing breadboard PPU testing with NASA thruster at GRC in FY21Q1