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Technology Demonstration Missions

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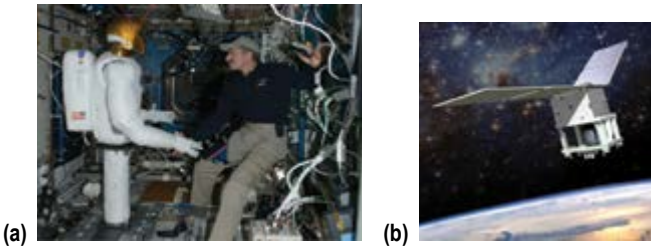
Sponsoring Program(s)

Space Technology Missions Directorate
Technology Demonstration Missions

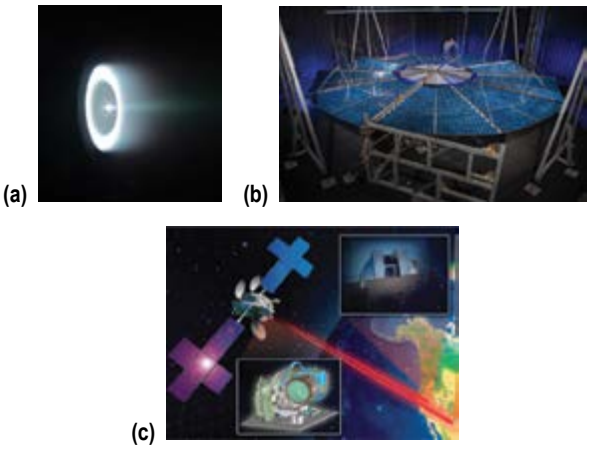
Project Description

Technology Demonstration Missions (TDM) is in its third year of execution, being initiated in 2010 and baselined in January of 2012. There are 11 projects that NASA Marshall Space Flight Center (MSFC) has contributed to or led:

(1) Evolvable Cryogenics (eCryo): Cyrogenic Propellant Storage and Transfer Engineering Development Unit (EDU), a proof of manufacturability effort, used to enhance knowledge and technology related to handling cryogenic propellants, specifically liquid hydrogen.
(2) Composites for Exploration Upper Stage (CEUS): Design, build, test, and address flight certification of a large composite shell suitable for the second stage of the Space Launch System (SLS).
(3) Deep Space Atomic Clock (DSAC): Spaceflight to demo small, low-mass atomic clock that can provide unprecedented stability for deep space navigation.
(4) Green Propellant Infusion Mission (GPIM): Demo of high-performance, green propellant propulsion system suitable for Evolved Expendable Launch Vehicle (EELV) Secondary Payload Adapter (ESPA)-class spacecraft.
(5) Human Exploration Telerobotics (HET): Demonstrating how telerobotics, remote control of a variety of robotic systems, can take routine, highly repetitive, dangerous or long-duration tasks out of human hands.
(6) Laser Communication Relay Demo (LCRD): Demo to advance optical communications technology toward infusion into deep space and near Earth operational systems, while growing the capabilities of industry sources.
(7) Low Density Supersonic Decelerator (LDSD): Demo new supersonic inflatable decelerator and parachute technologies to enable Mars landings of larger payloads with greater precision at a wider range of altitudes.
(8) Mars Science Laboratory (MSL) Entry Descent & Landing Instrumentation (MEDLI): Demo of embedded sensors embedded in the MSL heat shield, designed to record the heat and atmospheric pressure experienced during the spacecraft's high-speed, hot entry in the Martian atmosphere.
(9) Solar Electric Propulsion (SEP): 50-kW class spacecraft that uses flexible blanket solar arrays for power generation and an electric propulsion system that delivers payload from low-Earth orbit to higher orbits.
(10) Solar Sail Demonstration (SSD): Demo to validate sail deployment techniques for solar sails that are propelled by the pressure of sunlight.
(11) Terrestrial HIAD Orbit Reentry (THOR): Demo of a 3.7-m Hypersonic Inflatable Aerodynamic Decelerator (HIAD) entry vehicle to test second generation aerothermal performance and modeling.



Human Exploration Telerobotics (a) and Green Propellant Infusion Mission (b)



Solar Electric Propulsion (a) and (b) and Laser Communication Relay Decelerator Demo (c)

LDSD technologies and test capabilities.

Anticipated Benefits

TDM bridges the gap between advanced technologies and flight-qualified systems. Demonstrated technologies can be used in scheduled and future missions. Demonstrations give a wide range of data to be used to improve future technologies and define the ability of the hardware for future uses, making human spaceflight safer and flights more successful.

Potential Applications

TDM technologies can enable new missions or enhance existing ones.

Notable Accomplishments

2014 was an extremely successful year for TDM projects. There were 11 projects that had accomplishments involving MSFC:
(1) CEUS: A successful key design point-A (KDP-A) was completed for this project.
(2) DSAC: A successful KDP-C was completed. Repeatable manufacturing of the ion trap tube was demonstrated and multiple ion trap tubes in a closed loop configuration was operated successfully. Also, a completed Surrey Flight Services agreement was accomplished for this project.
(3) eCryo: A successful CPST KDP-B was completed as well as a successful eCryo KDP-A. The LOX Zero Boil-off test was successfully completed and a Zero Boil-off Industry Workshop was conducted. The project also completed testing of the EDU tank at MSFC.
(4) GPIM: This project had a very successful Critical Design Review. Testing of a 1 N engineering model thruster was completed which exceeded the 10,000 cycles for the L-1 requirement. Fabrication and integration of a 22 N engineering model thruster was completed and the integration of the BCP-100 spacecraft bus has started.
(5) HET: R2 climbing legs and torso upgrade parts for the International Space Station (ISS) were delivered, which launched April 2014. A new Smartphone was delivered to the ISS for integration into the Smart SPHERES, launched July 2014.
(6) LCRD: A successful Preliminary Design Review was conducted in 2014, with 95% of Flight Modem EEE parts ordered.
(7) LDSD: A Systems Integration Review was conducted. A successful supersonic test flight was conducted, and a parachute and supersonic inflatable aerodynamic decelerators development tests were conducted at China Lake.
(8) MEDLI: Turbulent flow duct arcjet testing was completed at NASA Ames Research Center and the draft of a NASA Technical Memorandum was delivered.
(9) SEP: Ambient and hot/cold thermal vacuum deployment testing of MegaFlex and ROSA (Roll Our Solar Array) solar arrays was completed. The fabrication and integration of a 12.5-kW class Hall Thruster and integration and test of a 300 V power processing unit was completed.
(10) SSD: Manual deployment of a full-size sail quadrant was completed for this project.
(11) THOR: This project was initiated in 2014 and TIG has conducted a review of proposed L1 requirements.