

Exploration

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Theme: General Science, Space and Technology

Overview

Goal Statement

- Achieve critical milestones in the development of new systems for the human exploration of deep space. By September 30, 2019, NASA will conduct the Ascent Abort-2 test of the Orion Launch Abort System, perform the green run hot-fire test of the Space Launch System's Core Stage at the Stennis Space Center, and roll the Mobile Launcher to the Vehicle Assembly Building to support the start of Exploration Mission-1 stacking operations.

Challenge

- Develop the launch vehicle, spacecraft, and ground support systems necessary to send crew on long-duration space exploration missions.

Opportunity

- These systems will carry humans to the Moon and farther into space than ever before.
- NASA will provide the U.S. workforce opportunities to improve its technical expertise by developing the complex, specialized systems needed for human space exploration.
- NASA's human exploration portfolio will advance American leadership in space, creating a path for peace, diplomacy, and global cooperation.

Goal Structure & Strategies

To successfully achieve the first flight of the Space Launch System (SLS) and Orion, NASA will systematically progress through a number of major qualification, testing, and production milestones:

- The SLS, Orion, and Exploration Ground Systems (EGS) programs will continue to conduct monthly program reviews to assess development progress, risks, and technical and programmatic issues.
- NASA has a series of Systems Acceptance Reviews (SARs), Operational Readiness Reviews (ORRs), and Design Certification Reviews (DCRs) scheduled for FY 2018 and 2019 in preparation for its pre-Flight Readiness Reviews (FRRs) in FY 2020.
- The programs continue to make major hardware deliveries for integration and testing.

The Exploration Systems Integration office focuses on requirements development, management approaches, and procurement strategies across the SLS, Orion, and EGS programs, and helps to ensure that activities are well-integrated across the programs.

Summary of Progress – FY18 Q1

Orion:

- Completed the Structural Test Article (STA) stacking of the Launch Abort System, the Crew Module (CM), and the Service Module for environmental testing in Denver, Colorado.
- Completed the Exploration Mission (EM)-1 Crew Module thermal cycle testing and the EM-1 heat shield thermal cycle testing at the Kennedy Space Center in Florida.
- Completed the EM-1 Service Module propellant tank installation.
- Released the Flight Software load 28B, which included optical navigation; burn plan management; CM propellant fault detection, isolation, and recovery; and solar array control.
- Completed the first EM-2 weld at the Michoud Assembly Facility in New Orleans, Louisiana.

Space Launch System (SLS):

- SLS Engine Section (ES) STA testing successfully completed all qualification tests. The liquid hydrogen (LH₂) flight tank successfully completed proof testing. The full-size Core Stage Pathfinder was delivered. Intertank and LH₂ structural test facilities are ready to receive test articles. The Interim Cryogenic Propulsion Stage (ICPS) completed its acceptance review and was delivered to Exploration Ground Systems (EGS). The Orion Stage Adaptor (OSA) completed mechanical assembly.
- All EM-1 booster segments completed casting. All booster avionics completed qualification testing. Flight aft exit cones were completed. Certification of engine controller software was completed, as was the first hot-fire test of an additive-manufactured pogo device as part of SLS's affordability initiatives.
- SLS continues to monitor structural analysis resource availability with concurrent certification (Block 1) and development (Block 1B). Core Stage continues to actively manage first-time assembly challenges, particularly with engine section assembly.

Summary of Progress – FY18 Q1

Exploration Ground Systems (EGS):

- For EGS, six umbilicals have been tested and installed on the Mobile Launcher.
- At Launch Pad B, in-line liquid separator construction and ground cooling system modifications have been completed and liquid hydrogen (LH₂) and liquid oxygen (LO₂) tank cryofill activities have been started. Also completed a wet flow test of the ignition overpressure and sounds suppression system.
- At the Vehicle Assembly Building High Bay 3 platforms, handling and access and facility systems construction activities have been completed with the exception of the environmental control system, for which work continues into Q2.
- Spaceport Command and Control System (SCCS) 4.0 validation activities have been completed. SCCS 4.0.1 and 4.1 activities continue.
- For landing and recovery, the Underway Recovery Test #6 has been completed.
- The program started System Integration Review (SIR) activities in preparation for the start of multi-element verification and validation activities.

Key Milestones

NASA follows an “alternative form,” or milestone-based, approach to reporting on its goals. Following are key quarterly milestones that NASA tracks in support of this goal:

Milestone Summary			
Key Milestone	Milestone Due Date	Milestone Status	Comments
Begin SLS flight Core Stage liquid hydrogen tank proof testing	FY 2018 Q1	Green	• Successfully completed
Mate the heatshield to the Orion EM-1 Crew Module structure	FY 2018 Q2	Green	• On track
Complete assembly of SLS flight Core Stage liquid oxygen tank	FY 2018 Q3	Green	• On track
Conduct Mobile Launcher and Vehicle Assembly Building integrated verification and validation testing	FY 2018 Q4	Green	• On track
Deliver Orion EM-2 Crew Module pressure vessel to the Kennedy Space Center	FY 2019 Q1	Green	• On track
Complete EGS multi-element verification and validation testing in preparation for Exploration Mission-1 stacking	FY 2019 Q2	Green	• On track
Perform SLS Core Stage green run hot-fire test at the Stennis Space Center	FY 2019 Q3	Green	• On track
Conduct Ascent Abort-2 (AA-2) test of the Orion Launch Abort System	FY 2019 Q4	Green	• On track

Data Accuracy and Reliability

- Verification and Validation:
 - NASA monitors and tracks its progress towards this goal using various Agency documents and reports, including Directorate Program Management Council materials, Quarterly Program Status Report packages, project schedules, and other program-internal documents.
- Data Source(s):
 - Press releases and program-internal documents indicating whether or not NASA has met its major quarterly development milestones.
- Level of Accuracy Required for Intended Use:
 - Using the documents and reports referenced above, the Agency is able to accurately report at the end of each quarter on whether or not it has met its planned milestones.
- Data Limitations:
 - NASA has not identified any data limitations that would preclude it from reporting accurate, reliable, and timely performance information.
- How the Agency Compensates for Data Limitations:
 - Not applicable.

Additional Information

Contributing Programs

NASA Program Activities:

- The principal contributors to this goal are the Advanced Exploration Systems, Exploration Ground Systems, Orion, and Space Launch System (SLS) programs.
- Other NASA programs contribute to the goal, including Space Communications and Navigation, Rocket Propulsion Test, Exploration Research & Technology organization, and Office of the Chief Technologist.

Other Federal Activities:

- Other federal contributors include the United States Air Force, United States Navy, and United States Army. NASA conducts tests at Department of Defense facilities, and the United States Navy will assist with the readiness for Exploration Mission-1 launch.

International Partners:

- The European Space Agency is a partner on the Orion Service Module, which will serve as the primary power and propulsion component of the Orion spacecraft.

Stakeholder/Congressional Consultations

- NASA provides regular updates to Congress on the status of Exploration Systems Development (ESD), including quarterly reports on SLS funding. NASA also provides regular briefings to Congressional staff and testimony on ESD progress, most recently to the House Subcommittee on Space in November 2017.
- NASA supports regular audits by the Government Accountability Office (GAO) as part of both the annual “Assessment of Major Projects” report and other focused reviews.
- NASA regularly updates the Aerospace Safety Advisory Panel and the NASA Advisory Council on ESD progress.