



Agency Priority Goal Action Plan

Exploration

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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 Q3

Orion:

- Completed three of the Structural Test Article (STA) test programs. The fourth (modal) is in progress, and the Crew Module (CM)/Launch Abort System (LAS) pyrotechnic shock test will follow.
- Continuing to process the Exploration Mission (EM)-1 CM towards a late September readiness for mate. Completed the recovery from avionics hybrid driver issue and planned system retests.
- Completed all EM-1 Service Module (SM) system installations, progressing through system functional test sequences, and preparing for pre-shipment review. European Space Agency (ESA) largely maintaining Kennedy Space Center (KSC) delivery date, currently early September.
- Released the Flight Software load 28D, which included Optical Navigation, Guidance, Navigation, and Control (GNC) commands, Cross-Channel restart, Display Control Module (DCM) restart, Compact Unique Identifier (CUI) updates [EGS], European Service Module (ESM) Fault Detection Isolation Recovery (FDIR) (partial GNC), CM FDIR, Safe Mode/Dead Bus Recovery, and Ascent Aborts.
- Completed the first six of seven EM-2 welds at the Michoud Assembly Facility (MAF) in New Orleans, Louisiana. Maintaining September delivery to KSC.

Space Launch System (SLS):

- SLS Intertank STA has begun qualification testing at Marshall Space Flight Center (MSFC). The liquid hydrogen (LH₂) flight tank successfully completed sensor installation. The liquid oxygen (LO_x) flight tank successfully completed Thermal Protections System (TPS) application. SLS Core Stage LO_x Structural Qualification Article (SQA) completed hydrostatic proof test and non-destructive evaluation. The LH₂ qualification tank successfully completed TPS application (the longest TPS application ever). SLS Engine Section has completed installation of all helium tanks, Thrust Vector Control (TVC) platforms, and the avionic bay. SLS flight Forward Skirt completed functional test. The Intertank is commencing functional test.
- The Orion Stage Adaptor (OSA) delivered to KSC. SLS Launch Vehicle Stage Adaptor (LVSA) completed TPS application. Interim Cryogenic Propulsion Stage had already been delivered to KSC in earlier reporting period.)

Summary of Progress – FY18 Q3

Space Launch System (SLS) (continued):

- All 10 EM-1 booster segments completed casting; seven of these segments are finalized and in storage. Half the EM-2 segments are cast.
- RS-25 engine controller deliveries continue (into the third mission set). RS-25 testing paused for test stand maintenance. Significant engine affordability milestone achieved with new hot isostatic press (HIP)-bonded Main Combustion Chamber completing build and installation into test engine.
- Completed first Formal Release of Green Run Application Software (GRAS).
- Core Stage continues to actively manage first-time assembly challenges, particularly with engine section assembly. Significant challenges were experienced with tube contamination; however, this has been mitigated with revised processes and is no longer affecting schedule.

Exploration Ground Systems (EGS):

- EGS Program continues to make significant progress in preparation for Multi-Element Verification and Validation (MEVV).
- Crawler-Transporter 2 (CT-2) performed three lifts of the Mobile launcher (ML) to practice lifting procedures, validate interface locations, confirm weight and develop a baseline for modal analysis.
- Vehicle Assembly Building (VAB) Verification and Validation (V&V) Testing complete, ready for ML.
- ML loads analysis is nearing completion. Structural reinforcement modifications are 'in-work'.
- Spaceport Command and Control System (SCCS) team has commenced development of the 500K cycles per second (cps) software coding. Firing Room 3 (FR3) Launch Control System (LCS) Development Sets 500K cps hardware (HW) conversion complete; Firing Room 2 (FR2) HW mods are 'in-work'.
- Ground and Flight Application Software (GFAS) Drop 15 completed with closure of 28,929 Ground and Flight Application Software Team Complexity Units (GCUs) (106% of plan).

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	Risk/Trend	Comments
Begin SLS flight Core Stage liquid hydrogen tank proof testing	FY 2018 Q1	Green	n/a	<ul style="list-style-type: none"> Successfully completed.
Mate the heatshield to the Orion EM-1 Crew Module (CM) structure	FY 2018 Q2	Green	→	<ul style="list-style-type: none"> Heatshield was ready to mate to the CM in FY 2018 Q2. In order to preserve access to CM environmental control and life support (ECLS) systems to resolve a suspect sensor, heatshield/CM mate was deferred until August. Overall CM schedule and readiness for CM/Service Module mate operations in CY 2018 are unaffected.
Complete assembly of SLS flight Core Stage liquid oxygen tank	FY 2018 Q3	Yellow	↓	<ul style="list-style-type: none"> Liquid oxygen tank completion currently forecast for August 2018 in support of forward join to intertank and forward skirt in September 2018.
Conduct Mobile Launcher (ML) and Vehicle Assembly Building integrated verification and validation testing	FY 2018 Q4	Green	→	<ul style="list-style-type: none"> On track. Vehicle Assembly Building (VAB) verification and validation (V&V) testing complete. ML loads analysis is nearing completion.
Deliver Orion EM-2 Crew Module pressure vessel to the Kennedy Space Center	FY 2019 Q1	Green	→	<ul style="list-style-type: none"> On track. The sixth of seven welds completed May 31 and all necessary hardware is in place at Michoud Assembly Facility (MAF).
Complete EGS multi-element verification and validation (MEVV) testing in preparation for Exploration Mission-1 stacking	FY 2019 Q2	Green	→	<ul style="list-style-type: none"> On track. System Integration Review Board held on June 6 and Center Management Council on June 8. ML structural reinforcement mods progressing on-schedule. ‘VAB Ready for ML’ complete. The Crawler Transporter/ML/Pad Fit Check preparations are continuing as planned. Flame Trench/Deflector 92% complete as of last Quarterly Program Status Report.
Perform SLS Core Stage green run hot-fire test at the Stennis Space Center (SSC)	FY 2019 Q3	Yellow	↓	<ul style="list-style-type: none"> First-time assembly challenges in engine section have delayed Core Stage shipment to SSC to a current forecast of June 2019.
Conduct Ascent Abort-2 (AA-2) test of the Orion Launch Abort System	FY 2019 Q4	Green	→	<ul style="list-style-type: none"> On track. CM test article has been shipped from Langley Research Center to Johnson Space Center and Initial Power on testing started on July 10. The test article ships to Plum Brook Station in late July for acoustics testing.

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.