



Agency Priority Goal Action Plan

Exploration

Goal Leader: William Hill, Deputy Associate Administrator, Exploration Systems Development (ESD)

Deputy Goal Leader: Thomas Whitmeyer, Assistant Deputy Associate Administrator, ESD



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.



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.



Space Launch System (SLS):

- The Core Stage forward skirt was completed and is ready for join. The liquid hydrogen (LH2) flight tank successfully completed acreage thermal protections system (TPS) application. The engine section 180 and 0 degree downcomers (main propulsion system hardware) completed installation. The core stage auxiliary power units 1 and 2 were installed into the engine section. The Core Stage pathfinder began maneuvers that will demonstrate ground support equipment capability and processes to move the stage.
- All ten Exploration Mission (EM)-1 booster segments completed casting; eight of these segments are finalized and in storage. Seven of ten of the EM-2 segments are cast. The thrust vector control systems (TVC) were installed on the booster left-hand and right-hand aft skirts. The booster separation motors installed on the left-hand frustum, which is the first ordnance installed in EM-1 forward assembly hardware.
- RS-25 engine controller deliveries continue (into the fourth mission set). The RS-25 engine completed two hot fire tests, which included engine controller green run and testing of the the Hot Isostatic Pressure (HIP)-bonded main combustion chamber and pogo accumulator (a component that dampens potential propellant pressure oscillations), which represent significant affordability milestones.
- The B-2 test stand East and West hold-down fixtures were installed at Stennis Space Center in preparation for Core Stage green run.
- Completed Flight Computer Application Software (FCAS) Test Readiness Review Two (TRR#2). Delivered Green Run Application Software (GRAS) to the Software Development Facility (SDF) for upcoming regression testing. Delivered latest scheduled update to the Advanced Real-Time Environment for Modeling, Integration, and Simulation (ARTEMIS) to the Software Development Facility (SDF) and System Integration Laboratory (SIL).



Orion:

- Completed four of the Structural Test Article (STA) test programs. The STA Configuration Five Stack Stiffness Test Preparations are underway with testing planned for completion in November.
- Continuing to process the EM-1 Crew Module (CM) towards April 2019 readiness for mate.
- Completed all EM-1 Service Module (SM) system installations, concluding system functional test sequences that were delayed due to issues seen in testing and subsequently resolved. European Space Agency (ESA) is preparing for the pre-ship review and subsequent delivery to the Kennedy Space Center (KSC), currently planned for early November.
- Released the Flight Software load 28E, which included Guidance, Navigation, and Control (GNC) commands, European Service Module (ESM) Fault Detection Isolation Recovery (FDIR) (partial GNC) and Safe Mode, Backup Flight Software and Redundancy Management.
- Completed EM-2 Pressure Vessel Delivery from Michoud Assembly Facility (MAF) in New Orleans, Louisiana to KSC in August 2018. Primary structure installation underway.

Exploration Ground Systems (EGS)

- Ground and Flight Application Software (GFAS) Drop 16 completed in August 2018.
- At KSC in September 2018, Crawler-Transporter 2 (CT-2) rolled the Mobile Launcher (ML) to Launch Complex 39B (LC-39B) for water suppression and environment control system fit checks, then from LC-39B to the Vehicle Assembly Building (VAB) for the start of integrated verification and validation (IV&V) testing.
- Multi-Payload Processing Facility (MPPF) hot flow verification and validation testing was begun in September 2018.
- Spaceport Command and Control System (SCCS) version 5.0 development completed in September 2018.



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/Outlook	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 completed in August 2018. 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"> Delayed. Liquid oxygen tank completion currently forecast for FY2019 Q1.
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. Mobile Launcher (ML) rolled into VAB in September 2018 to begin integrated V&V testing.
Deliver Orion EM-2 Crew Module pressure vessel to the Kennedy Space Center (KSC)	FY 2019 Q1	Green	⇒	<ul style="list-style-type: none"> Successfully completed. Crew Module pressure vessel delivered to KSC in August 2018. CM primary structure installation underway.
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"> At KSC in September 2018, Crawler-Transporter 2 (CT-2) rolled the Mobile Launcher (ML) to Launch Complex 39B (LC-39B) for water suppression and environment control system fit checks, then from LC-39B to the Vehicle Assembly Building (VAB) for the start of integrated verification and validation (IV&V) testing. Construction on main flame deflector is complete.
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. Hot-fire is scheduled to occur in FY19, with schedule risk for continued first-time operations.
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. The crew module test article completed acoustics testing at Plum Brook Station in September. Jettison and abort motors shipped to KSC and mating underway.





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.



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.