

National Aeronautics and Space Administration



America's New Rocket: Space Launch System

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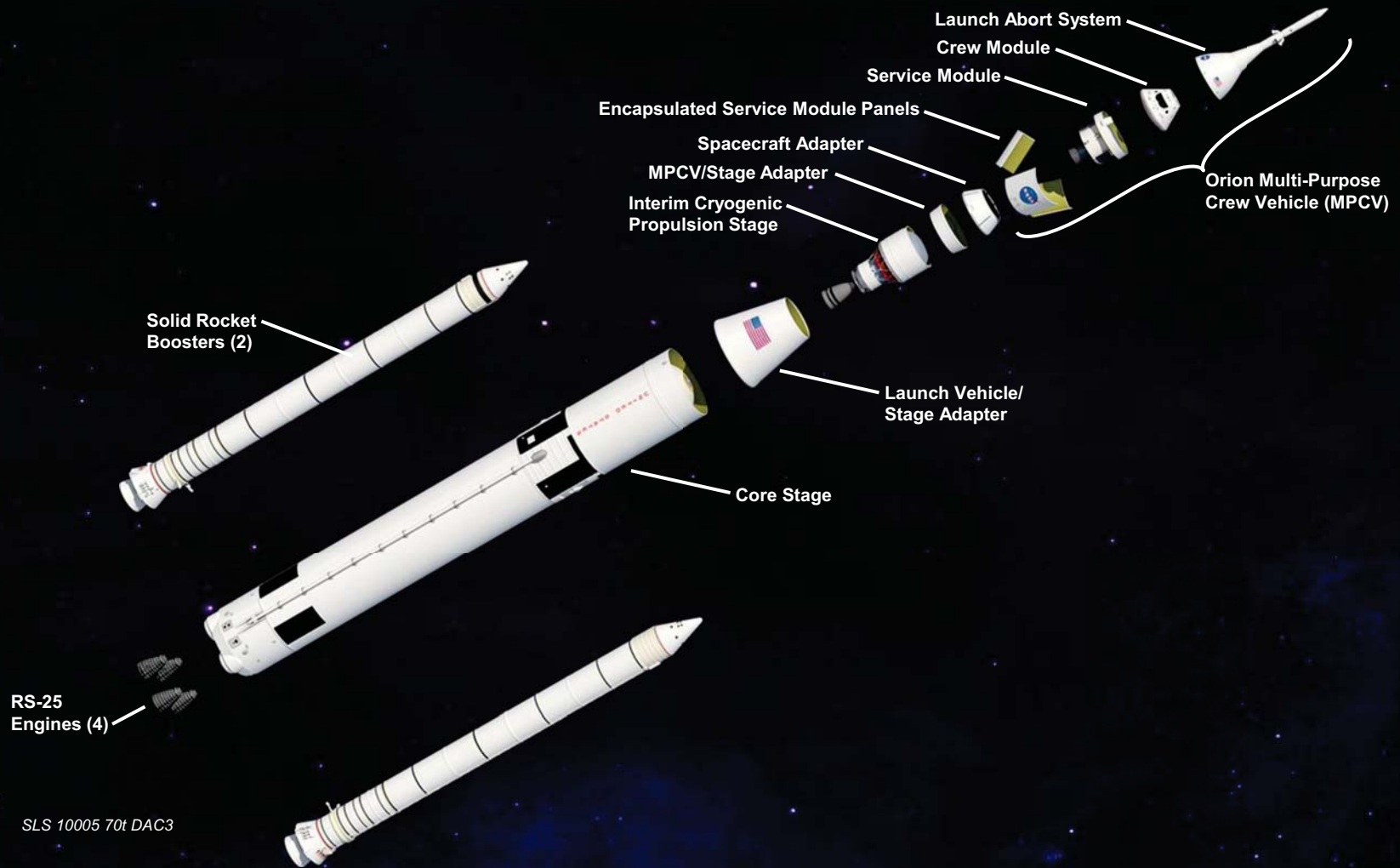


Space Launch System



May 27, 2014

70 Metric Ton Expanded View



70 Metric Ton Challenges



Solid Rocket Boosters

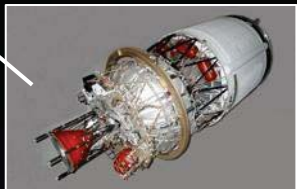


MPCV/Stage Adapter



Orion Multi-Purpose Crew Vehicle

Launch Vehicle/Stage Adapter



Interim Cryogenic Propulsion Stage



Boosters Avionics



RS-25 Main Engines



Core Stage and Vehicle Avionics



Doing Things Differently — Getting Results

Human Exploration

NASA's Path to Mars



EARTH RELIANT

MISSION: 6 TO 12 MONTHS
RETURN TO EARTH: HOURS

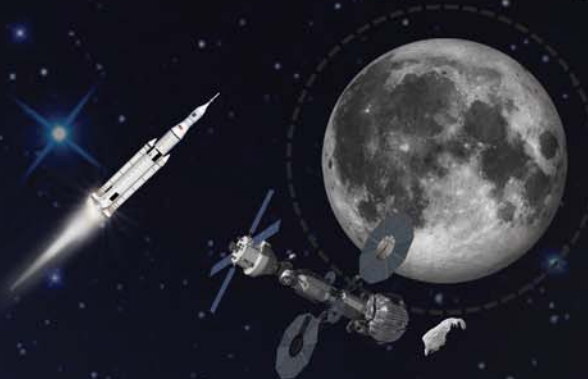


Mastering fundamentals
aboard the International
Space Station

U.S. companies
provide access to
low-Earth orbit

PROVING GROUND

MISSION: 1 TO 12 MONTHS
RETURN TO EARTH: DAYS



Expanding capabilities by
visiting an asteroid redirected
to a lunar distant retrograde orbit

The next step: traveling beyond low-Earth
orbit with the Space Launch System
rocket and Orion spacecraft



MARS READY

MISSION: 2 TO 3 YEARS
RETURN TO EARTH: MONTHS



Developing planetary independence
by exploring Mars, its moons and
other deep space destinations

SLS Driving Objectives



◆ Safe

- Human-rated to provide safe and reliable systems
- Protecting the public, NASA workforce, high-value equipment and property, and the environment from potential harm

◆ Affordable

- Maximum use of common elements and existing assets, infrastructure, and workforce
- Constrained budget environment
- Competitive opportunities for affordability on-ramps

◆ Sustainable

- Initial capability: 70 metric tons (t), 2017–2021
 - Serves as primary transportation for Orion and human exploration missions
- Evolved capability: 105 t and 130 t, post-2021
 - Offers large volume for science missions and payloads
 - Reduces trip times to get science results faster
 - Minimizes risk of radiation exposure and orbital debris impacts



Flexible Architecture Configured for the Mission

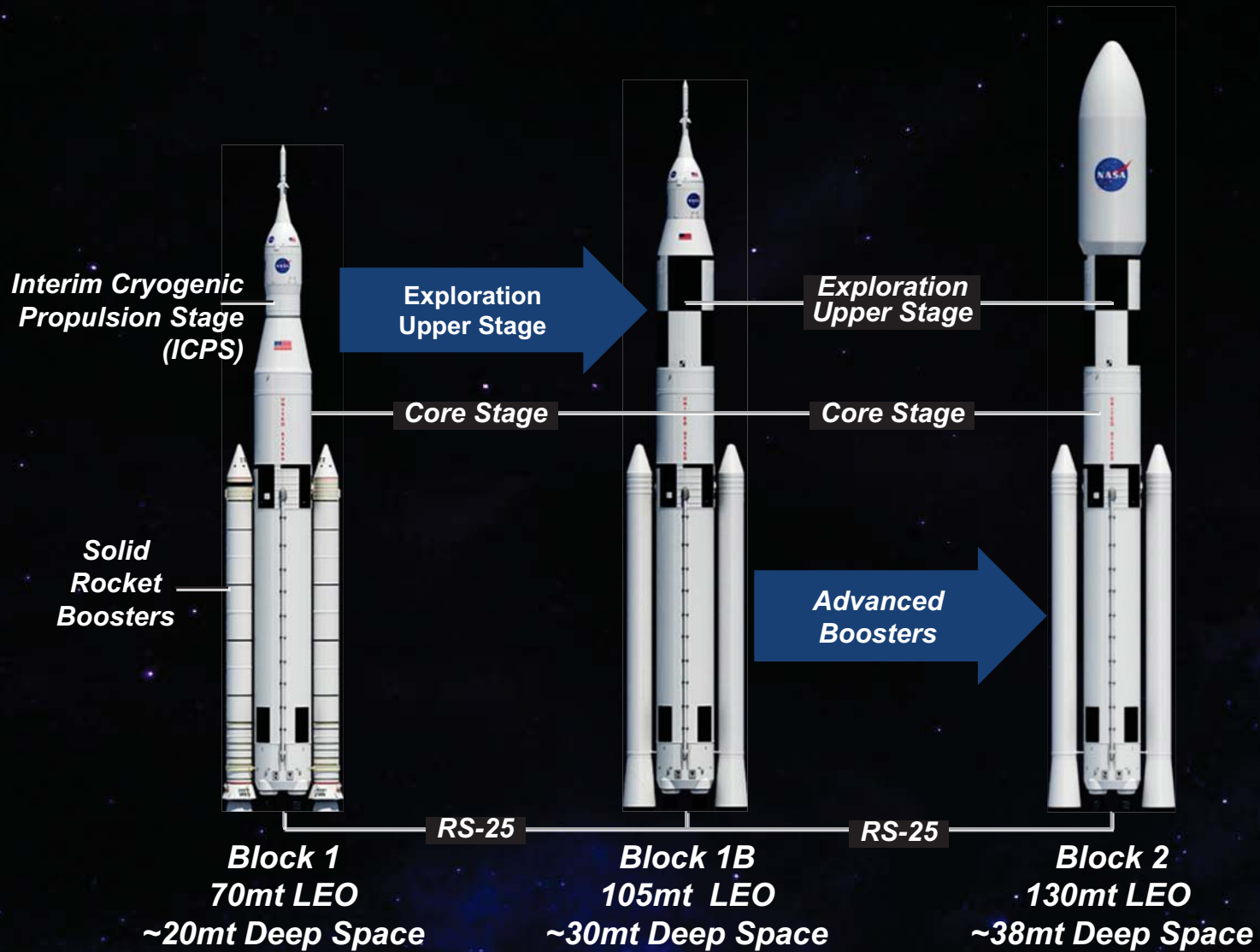
Principle of Building SLS Capabilities



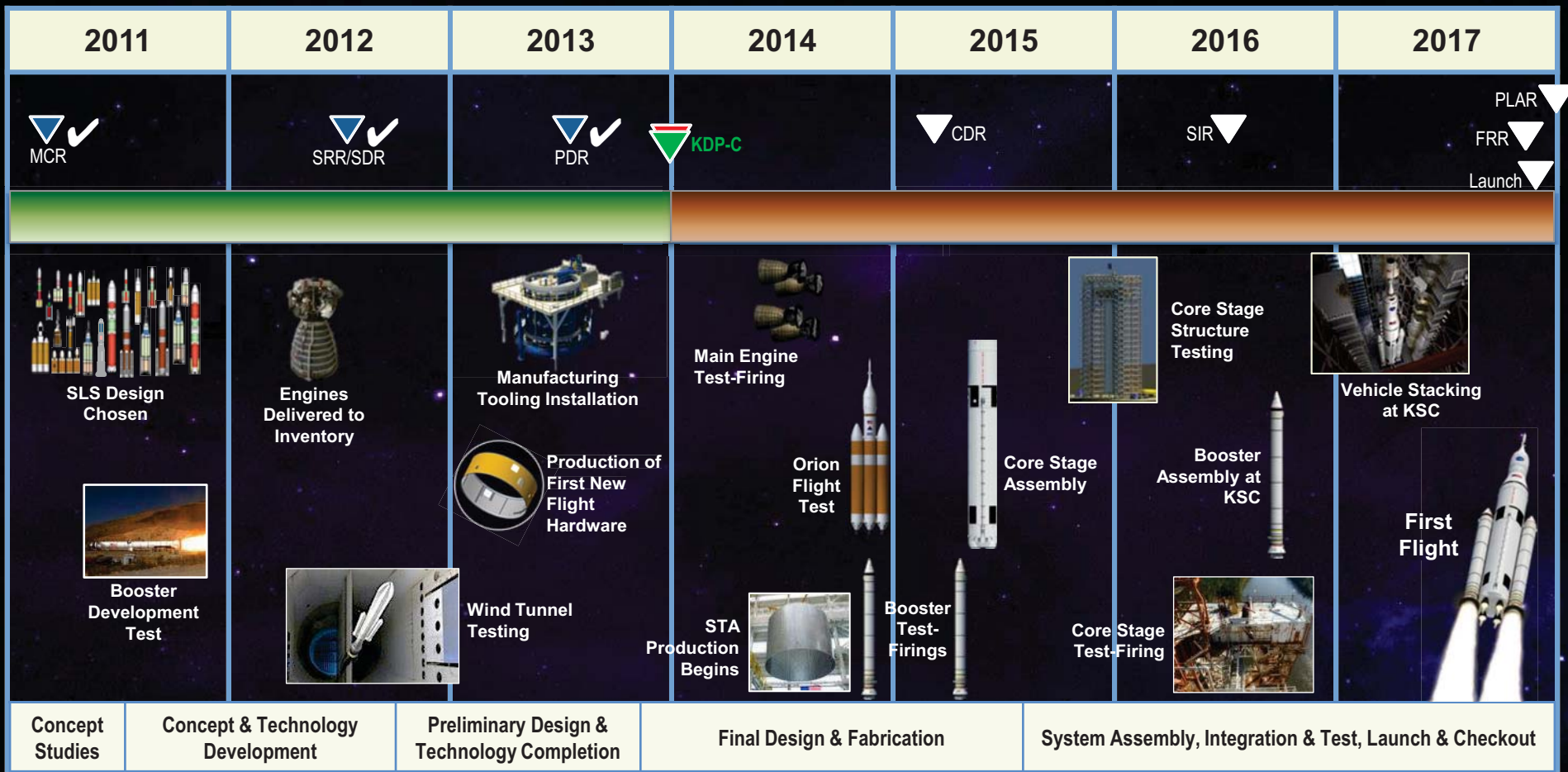
Six key strategic principles to provide a sustainable program:

1. Executable with current budget with modest increases
2. Application of high Technology Readiness Level (TRL) technologies for near term, while focusing research on technologies to address challenges of future missions
3. Near-term mission opportunities with a defined cadence of compelling missions providing for an incremental buildup of capabilities for more complex missions over time
4. Opportunities for US Commercial Business to further enhance the experience and business base learned from the ISS logistics and crew market
5. Multi-use Space Infrastructure
6. Significant International participation, leveraging current International Space Station partnerships

SLS Commonality and Evolution



SLS Development Schedule



MCR: Mission Concept Review	CDR: Critical Design Review
SRR: System Requirements Review	SIR: System Integration Review
SDR: System Definition Review	FRR: Flight Readiness Review
PDR: Preliminary Design Review	PLAR: Post-Launch Asses. Review

SLS Life-Cycle Milestones



NASA Life Cycle Phases	Approval for Formulation ▼			Approval for Implementation ▼		IMPLEMENTATION	
Program Life Cycle Phases	Pre-Phase A: Concept Studies	Phase A: Concept & Technology Development	Phase B: Preliminary Design & Technology Completion	Phase C: Final Design & Fabrication	Phase D: System Assembly, Int. & Test, Launch & Checkout	Phase E: Operations & Sustainment	Phase F: Closeout
Program Life Cycle Gates and Major Events	Key Decision Point A ▼ ✓	KDP B ▼ ✓	KDP C ▼	EFT-1 Launch ▼	KDP D ▼	EM-1 Launch ▼	KDP F ▼
Human Space Flight Project Reviews	MCR ▼ ✓	SRR/SDR ▼ ✓	PDR ▼ ✓	CDR ▼	SR ▼	FRR ▼	
	2011	2012	2013	2015	2016	2017	2021

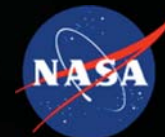
FOCUSED TOWARD



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Meeting Technical, Budget, and Schedule Commitments

SLS Nationwide Team



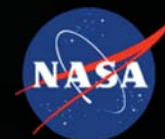
2013 Data

- ◆ Engaging the U.S. Aerospace Industry
- ◆ Strengthening Sectors such as Manufacturing
- ◆ Advancing Technology and Innovation for Deep-Space Exploration

 NASA Facilities
 NASA Centers

Working with over 400 Contractors in 42 States

Recent Accomplishments



Launch Vehicle Stage Adapter: Contract awarded in Feb. 2014 to Teledyne Brown Engineering.

Avionics: Flight software developed by Boeing tested at Armstrong using F-18 in Nov. 2013; avionics "first light" marked in Jan. 2014 at Marshall.



Boosters: Thrust Vector Control test conducted by ATK in Oct. 2013; preparations under way for first qualification motor test.



Multi-Purpose Crew Vehicle-to-Stage Adapter: First flight hardware delivered to ULA for Exploration Flight Test-1 in Fall 2014.

Core Stage: Initial confidence barrels and domes completed by Boeing; tooling installation to be completed at MAF in July 2014.



Engines: Thrust frame adapter fitted to Stennis A-1 stand; Aerojet-Rocketdyne RS-25 testing begins July 2014.



Substantial Progress Toward Exploration Mission 1

Orion-to-Stage Adapter for EFT-1 and EM-1



First Flight Hardware Delivered for Exploration Flight Test 1

Building to Exploration Mission-1 (EM-1)



ACCOMPLISHMENTS

- 09/2011 Tested Booster Development Motor ✓
- 07/2012 Delivered RS-25 Engines to Inventory ✓
- 07/2013 Competed Preliminary Design Review ✓
- 10/2011 - 12/2013 Tested SLS Wind Tunnel Models ✓
- 07/2013 Completed First Confidence Barrel Section Welding ✓
- 10/2013 Completed Thrust Vector Control Test ✓
- 11/2013 Conducted Adaptive Augmenting Control Flight Test ✓
- 12/2013 Completed LOX Forward Dome Manufacturing Demo ✓
- 1/2014 Conducted Avionics "First Light" in Integration Facility ✓
- 02/2014 Shipped Multi-Purpose Crew Vehicle Stage Adapter for EFT-1 ✓

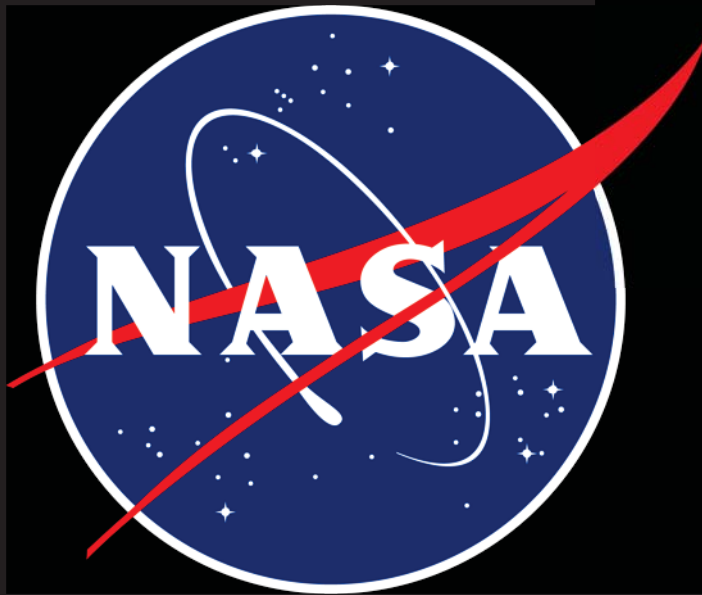


WHAT'S NEXT

- 07/2014 Complete Manufacturing Tooling Installation
- 07/2014-15 Test Main Engines, Boosters , & Core Stage Structure
- 07/2015 Complete the SLS Critical Design Review
- 06/2016 Assemble the Core Stage Assembly and Test Fire
- 07/2017 Stack the SLS Vehicle
- 12/2017 Transport SLS from the VAB to the Launch Pad



December 2017 EM-1 Launches from KSC



“Man cannot discover
new oceans
unless he has the
courage to lose
sight of the shore.”



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the journey**

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