Going Boldly Beyond: Progress on NASA’s Space Launch System

Jody Singer, Deputy Manager
Space Launch System (SLS) Program

NASA Marshall Space Flight Center
February 21, 2013
The Space Launch System [will] be the backbone of its manned spaceflight program for decades. It [will] be the most powerful rocket in NASA’s history…and puts NASA on a more sustainable path to continue our tradition of innovative space exploration.

President Obama’s Accomplishments for NASA
May 22, 2012
Advancing the U.S. Legacy of Human Exploration
Building on the U.S. Infrastructure

**INITIAL CAPABILITY, 2017–21**

- **Orion Multi-Purpose Crew Vehicle (MPCV)**
  - Lockheed Martin
- **Launch Abort System**
  - Orbital Sciences Corp.
- **Interim Cryogenic Propulsion Stage**
  - Early flight certification for Orion
  - Flexible for a range of payloads
  - Boeing
- **5-Segment Solid Rocket Boosters**
  - Upgrading Shuttle heritage hardware
  - ATK
- **Core Stage Engines**
  - Using Space Shuttle Main Engine inventory assets
  - Building on the U.S. state of the art in liquid oxygen/hydrogen
  - Initial missions: Pratt & Whitney Rocketdyne
  - Future missions: Agency is determining acquisition strategy

**EVOLVED CAPABILITY, Post-2021**

- **130 t 384 ft**
- **Fairings (27.5’ or 33’)**
  - Right-sized for the payload
  - Received industry input in FY13
- **J-2X Upper Stage Engine**
  - Builds on Apollo Saturn J-2 heritage
  - Pratt & Whitney Rocketdyne
- **Advanced Boosters**
  - Competitive opportunities for affordable upgrades
  - Risk-reduction contracts awarded in FY13

**Evolutionary Path to Future Capabilities**

- Minimizes unique configurations
- Allows incremental development
- Advanced Development contracts awarded in FY13

**Working with Industry Partners to Develop America’s Heavy-Lift Rocket**
SLS Driving Objectives

◆ Safe
- Human-rated to provide safe and reliable systems for human missions
- 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 exploration missions
  - Provides back-up capability for crew/cargo to ISS
- Evolved capability: 105 t and 130 t, post-2021
  - Offers large volume for science missions and payloads
  - Modular and flexible, right-sized for mission requirements
Initial Exploration Missions (EM)

EM-1 in 2017
- Un-crewed circumlunar flight – free return trajectory
- Mission duration ~7 days
- Demonstrate integrated spacecraft systems performance prior to crewed flight
- Demonstrate high speed entry (~11 km/s) and thermal protection system prior to crewed flight

EM-2 no later than 2021
- Crewed lunar orbit mission
- Mission duration 10–14 days
The Road to First Flight in 2017

We don’t do a good job… pointing out the monumental effort that has gone into this Program…. I don’t think anyone would have thought in September [2011] that this Program might be this far so fast.

Leroy Cain, Chair
Independent Standing Review Board
(NASA Space Shuttle Program Flight Director)
NASA Directorate Program Management Council
June 29, 2012
SLS: A Year of Accomplishments

- Systems Engineering and Integration SLS model undergoes wind tunnel testing at Langley Research Center, Nov 2012.
- J-2X power pack assembly hot fire test at Stennis Space Center, Nov 2012.
- Multi-Purpose Crew Vehicle Stage Adapter (MSA) Pathfinder Hardware at Marshall Space Flight Center, June 2012.
- Kennedy Space Center Complex 39B ready for a 2017 SLS launch (artist’s concept).
- Qualification Motor 1 casting at ATK, Oct 2012.

System Requirements Review/System Definition Review Completed
Marshall’s Michoud Assembly Facility (MAF)

◆ SLS Stages Element
  - Manufacturing Core Stage and Upper Stage
  - Manufacturing Instrument Ring
  - Integrating Engines with Core and Upper Stages

◆ Building key parts of the Orion multipurpose crew vehicle (MPCV)
  - Composite components of the Crew Module, Service Module, and Launch Abort System
  - Crew Module and Service Module primary structure

◆ Suppliers and subcontractors at MAF can collocate with their customers
  - Utilize the same world-class infrastructure, equipment, and services
  - Significantly reduce logistics cost and delivery time by sharing common space

www.nasa.gov/sls
SLS Contractor Support

270 Subcontracts in 34 States

2011 Data

- Engaging the U.S. Aerospace Industry
- Strengthening Sectors such as Manufacturing
- Advancing Technology and Innovation

www.nasa.gov/sls
SLS Small Business Goals

◆ NASA’s Small Business Policy (NASA Policy Directive 5000.2C) has been assessed for SLS requirements:
  • Stages
  • Engines
  • Interim Cryo-Propulsion Stage
  • Advanced Booster NASA Research Announcement (NRA)
  • Advanced Development NRA

◆ Subcontracting plan goals for existing contracts are being updated via negotiations.

◆ SLS provides topics to the Small Business Innovation Research (SBIR) Program:
  • Link to the NASA SBIR website is listed on all solicitations
    – http://sbir.gsfc.nasa.gov/SBIR/SBIR.html

◆ For all incentive approaches, small business utilization performance is evaluated:
  • Mentor/Protégé Program is included

Targeting Robust Small Business Partnerships Through Various Channels
SLS Acquisition Summary

- SLS contract activity continues to evolve per the initial acquisition strategy

- Acquisition strategy meets key SLS requirements of safety, affordability, and evolvable performance

- SLS continues to work closely with NASA’s Office of Small Business Programs to maximize opportunities for all parts of the Agency’s socio-economic programs

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Launching 2017
NASA’s Space Launch System
Advanced Development Overview

Chris Crumbly
SLS Advanced Development Manager
February 21, 2013
Building on the U.S. Infrastructure

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  - Flexible for a range of payloads
  - Boeing

- **5-Segment Solid Rocket Boosters**
  - Upgrading Shuttle heritage hardware
  - ATK

- **Core/Upper Stage**
  - Common design, materials, & manufacturing
  - Boeing Avionics
    - Builds on Ares software
    - Boeing

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www.nasa.gov/sls
Three-Phase Booster Development

Advanced Booster Design, Development, Test, and Evaluation (DDT&E)
- Scope: Follow-on procurement for DDT&E of a new booster
- Date: RFP target is FY15
- Capability: Evolved at 130 t
- Contract: Full and Open Competition (Liquids or Solids)

Advanced Booster Engineering Demonstration and/or Risk Reduction NRA
- Scope: Award contracts that reduce risks leading to an affordable Advanced Booster that meets the evolved capabilities of SLS and enable competition by mitigating targeted Advanced Booster risks to enhance SLS affordability
- Date: Contracts awarded Oct 1, 2012
- Capability: Leading to 130 t
- Contract: NRA Demonstrating Specific Technologies and Affordability Risk Reduction for Advanced Boosters
  - Liquid Rocket Boosters or Solid Rocket Boosters

Booster Fly-out for Early Flights through 2021
- Scope: Build two 5-segment SRB Flight Sets
- Date: In progress
- Capability: Initial 70–100 t
- Contract: Mod to Ares contract with ATK

Moving Forward from Initial to Evolved Capability
The Advanced Booster Engineers Demonstration and Risk Reduction (ABEDRR) effort will reduce risks and enable competition, leading to an affordable Advanced Booster that meets the evolved capabilities of SLS and enable competition.
F-1B Risk Reduction
Affordable Upper Stage Engine

- Partnership between NASA and U.S. Air Force to support the development of an affordable upper-stage engine that could reduce launch costs for Evolved Expendable Launch Vehicles and could potentially provide an alternative for the SLS cryogenic propulsion stage.
A Nationwide Endeavor

Map showing various companies and universities involved in space exploration and technology. Companies include Northrop Grumman, ATK, Boeing, Moog, Exquadrum, Ball Aerospace & Technologies Corp., Pratt & Whitney, Dynetics, and universities such as MIT, Michigan, Penn State, Maryland, and Auburn University.
In addition to contracts with industry and academia, NASA is conducting research within the agency into new technologies to increase SLS affordability, reliability and performance.

SLS is using selective laser melting to manufacture engine components.
NASA’s Space Launch System

- NASA’s Space Launch System is implementing an evolvable configuration approach to system development in a resource-constrained era
  - Legacy systems enable non-traditional development funding and contribute to sustainability and affordability
  - Limited simultaneous developments reduce cost and schedule risk
  - Phased approach to advanced booster development enables innovation and competition, incrementally demonstrating affordability and performance enhancements
  - Advanced boosters will provide performance for the most capable heavy lift launcher in history, enabling unprecedented space exploration benefiting all of humanity

Launching in 2017

For More Info: www.nasa.gov/sls

Preliminary Design Review 2013
For More Information

www.nasa.gov/sls
www.twitter.com/nasa_sls
www.facebook.com/nasasls