Sheri Kittredge  
Deputy Manager, SLS Engines Element  
*NASA’s Vision and SLS Missions*
“To reach for new heights... and reveal the unknown so that what we do and learn will benefit all humankind.”

• Extend and sustain human activities across the solar system.
• Expand scientific understanding of the Earth and the universe in which we live.

NASA 2011 Strategic Plan

SLS Launches in 2017
Mars: Ultimate human destination in the next decades

Planetary Exploration
- Mars
- Solar System

Exploring Other Worlds
- Low-Gravity Bodies
- Full-Capability Near-Earth Asteroid Missions
- Phobos / Deimos

Into the Solar System
- Lunar Surface
- Initial Near-Earth Asteroid Missions
- Interplanetary Space

Extending Reach Beyond LEO
- Cislunar Space
- Lunar Flyby & Orbit
- High-Earth Orbit / Geostationary Orbit

Initial Exploration Missions
- International Space Station
- Space Launch System
- Orion Multi-Purpose Crew Vehicle
- Ground Systems Development & Operations
- Commercial Spaceflight Development

SLS — Going Beyond Earth’s Orbit In 2017

Incremental steps to steadily build, test, refine, and qualify capabilities that lead to affordable flight elements and a deep space capability

NASA’s Capability-Driven Framework

Space Launch System:
130t configuration

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The Future of Exploration

“This expanded role for the private sector will free up more of NASA’s resources to do what NASA does best — tackle the most demanding technological challenges in space, including those of human space flight beyond low-Earth orbit.”

— John P. Holdren, Science and Technology Assistant to the President
The White House, May 22, 2012

“My desire is to work more closely with the human spaceflight program so we can take advantage of synergy. We think of the SLS as the human spaceflight program, but it could be hugely enabling for science.”

— John Grunsfeld, Associate Administrator
NASA Science Mission Directorate
Nature, Jan 19, 2012
Building a National Infrastructure Asset

For Beyond-Earth Orbit Exploration
Pursuing Affordability Solutions

- Lean, Integrated Teams with Accelerated Decision Making
- Robust Designs and Margins
- Risk-Informed Government Insight/Oversight Model
- Right-Sized Documentation and Standards
- Evolvable Development Approach
- Hardware Commonality

Sustainability through Life-Cycle Affordability

Focuses on the Data Content and Access to the Data
Building on Heritage Hardware and Facilities

- J-2X Engine Test Firing/Space Shuttle Main Engine Testing
  - Stennis Space Center

- Payloads
  - Goddard Space Flight Center

- Standing Review Board
  - Cross-Agency

- Orion Integration
  - Johnson Space Center

- Fairing Design and Analysis
  - Glenn Research Center

- Ground and Launch Operations
  - Kennedy Space Center

- Manufacturing and Transportation
  - Michoud Assembly Facility

- Wind Tunnel Testing
  - Langley Research Center

- Physics-Based Analysis
  - Ames Research Center

- MCR Success Criteria

- Upper Stage J-2X Engine Injector Firing
  - Marshall Space Flight Center

- Smartly Selecting the Most Efficient Infrastructure

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SLS Program Life Cycle

**NASA Life Cycle Phases**

**Approval for Formulation**

**FORMULATION**

**Approval for Implementation**

**IMPLEMENTATION**

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**First Flight 2017**

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NASA Research Announcements (NRAs)

- **Advanced Booster Engineering and Risk Reduction**
  - Industry Day – December 15, 2011
  - Competition via NRA released - February 2012
  - Advanced Booster Proposals Received – April 2012
  - **Contract Award – October 2012**

- **Advanced Development**
  - Industry Day – February 15, 2012
  - Competition via NRA released - March 20, 2012
  - Authority to Proceed for “In-House” Work – April 19, 2012
  - Advanced Development Industry Proposals Received – April 2012
  - **Contract Award – October 2012**

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SLS: Being Built Today in the USA!

- First ring forging prepared for Orion Stage Adapter, Cudahy, WI, April 2012.
- Stages Industry Day at Michoud Assembly Facility, New Orleans, Nov 2011.
- Solid Rocket Booster development motor test, Promontory, Utah, Sep 2011.
- KSC is preparing Launch Complex 39B for SLS/Orion operations, 2012.
- Installing the J-2X powerpack in test stand at SSC.
- J-2X Upper Stage Engine powerpack test, Stennis Space Center (SSC), MS, Feb 2012.
- Meeting with Space Campers at U.S. Space & Rocket Center, Huntsville, AL, Feb 2012.
Education & Public Outreach

- Pass the Torch Lecture at U.S. Space & Rocket Center
  February 2, 2012
- National Space Symposium with Dr. Tyson
  April 16 – 19, 2012
- Student Launch Projects
  April 19, 2012
- Shuttle Discovery Celebration at Udvar-Hazy
  April 19 – 22, 2012
- Space Ops 2012
  June 11 – 15, 2012
- Shuttle Enterprise Celebration at Intrepid with Leland Melvin
  July 19 – 22, 2012
NASA’s Space Launch System

- Vital to NASA’s exploration strategy and the U.S. space agenda
- Key tenets: safety, affordability, and sustainability
- Partnerships with NASA Headquarters, Orion, Ground Operations, and other NASA Centers
- Prime contractors on board, work is in progress
- Competitive opportunities for innovations that affordably upgrade performance
- Completed System Requirements Review / System Definition Review

For More Info:
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Launching in 2017

Safe, Affordable, Sustainable
Building on the U.S. Infrastructure

**INITIAL CAPABILITY, 2017–21**
- **Orion Multi-Purpose Crew Vehicle (MPCV)**
  - Lock heed Martin
- **Interim Cryogenic Propulsion Stage**
  - Allows early flight certification for Orion
  - Flexible for a range of payloads
  - **Boeing**
- **Core/Upper Stage**
  - Common design, materials, & manufacturing
  - **Boeing**
  - Avionics
  - Builds on proven EELV software
  - **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

**EVLVED CAPABILITY, Post-2021**
- **Fairings (27.5' or 33')**
  - Right-sized for the payload
  - In-house design
  - Full-and-open competition 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 to be awarded in FY13
- **Evolutionary Path to Future Capabilities**
  - Minimizes unique configurations
  - Allows incremental development
  - **Advanced Development contracts to be awarded in FY13**

- **Launch Abort System**
- RS-25
- **Working with Industry Partners to Develop America’s Heavy-Lift Rocket**

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SLS Lean Systems Engineering & Integration Model

- Benchmarked against diverse practices
  - Design-to-cost
  - Front-loaded product development
  - Using R&D and Knowledge Funnel approach to drive innovation and cost savings
  - Organized to balance functional expertise and cross-functional integration
  - Integrating suppliers in the product development system
  - Accelerated decision-making
  - Fewer control boards
  - Continuous Improvement
    - Contractor initiated processes to reduce contract value
    - Value-stream mapping
  - Supply Chain Management
    - Commonality
    - Simple targets and metrics for improving cost performance
  - Focus on early prototyping and testing

- Benchmarked companies: 3M, ATK, Boeing, HP, IDEO, Nucor, P&G, Raytheon, Toyota, and Commercial Crew providers

Focused on Safety, Affordability, and Sustainability
Systems Engineering & Integration

- Early wind tunnel testing completed
- Analyses and documents completed in support of SRR / SDR
- Scale Model Acoustic Testing completed for RS-25
- Environments and loads defined
Top Accomplishments – Stages/Avionics

Completed Orbiter Vehicle 103 MPS hardware removal – March 2012

Redundant Inertial Navigation Unit – Completed initial integration with flight software – December 2011

Stages manufacturing demos and tooling preparation for friction stir welding – April 2012

Avionics Test Beds delivered to MSFC – May 2012

Core Stage SRR completed – June 2012

Stages Industry Day at MAF – November 2011
Top Accomplishments - Boosters

- Development Motor Test 3
  - September 8, 2011
  - Promontory, Utah

- Subscale SRM Test @ MSFC
  - March 14, 2012

- SRM Value Stream Mapping
  - Completed
  - March 2012

- Avionics Flight Control Test-1
  - March 2012
  - Promontory, Utah

- Qualification Motor First Cast
  - July 16, 2012
  - Promontory, Utah

- Booster Readiness Review Completed
  - August 28, 2012

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Top Accomplishments - Engines

- J-2X PowerPack-2 testing began at SSC February 2012
- Final RS-25 core stage engines transported from KSC to SSC April 9, 2012
- 550-sec J-2X E10001 test @ SSC July 13, 2012
- 1,350 sec PowerPack-2 test @ SSC July 24, 2012
- Common engine controller SRR May 1-2, 2012

◆ Upcoming events in FY13:
  - RS-25 Engine controller unit PDR – October 2012
  - Complete J-2X E10001 test series – December 2012
  - Assemble J-2X E10002 – October 2012
  - Assemble J-2X E10003 – December 2012
David Beaman
Manager, Spacecraft & Payload Integration Office
Spacecraft & Payload Integration and Exploration Flight Test (EFT)-1 Status
EFT-1
- Orion boosted to high-Earth orbit by Delta Cryogenic Second Stage, which will be modified to become Interim Cryogenic Propulsion Stage
- First test of SLS flight hardware

MPCV/Stage Adapter
- Structural connection between the launch vehicle and spacecraft systems
- Designed once, flown multiple times
Exploration Flight Test-1 (2014)
Mission Overview
Exploration Flight Test-1 in 2014
MPCV Stage Adapter

First ring forging, ATI/Ladish, Cudahy, WI
April 2012

EFT-1 MPCV Stage Adapter
Design Review in March 2012
NASA’s Space Launch System

- *On track for a 2017 first flight*
- Key tenets: safety, affordability, and sustainability
- Progress being made on all elements of the vehicle
- Prime contractors on board, work being done across the country
- Completed System Requirements Review / System Definition Review, now working toward Preliminary Design Review in 2013
- Flight hardware being tested on EFT-1 in 2014

For More Info:
www.nasa.gov/sls
Somewhere, something incredible is waiting to be known.
— Carl Sagan