National Aeronautics and Space Administration

NASA's Space Launch System Overview

Todd May, Manager
Space Launch System (SLS) Program
NASA Marshall Space Flight Center

Space Launch System

October 2012

Advancing the U.S. Legacy of Human Exploration

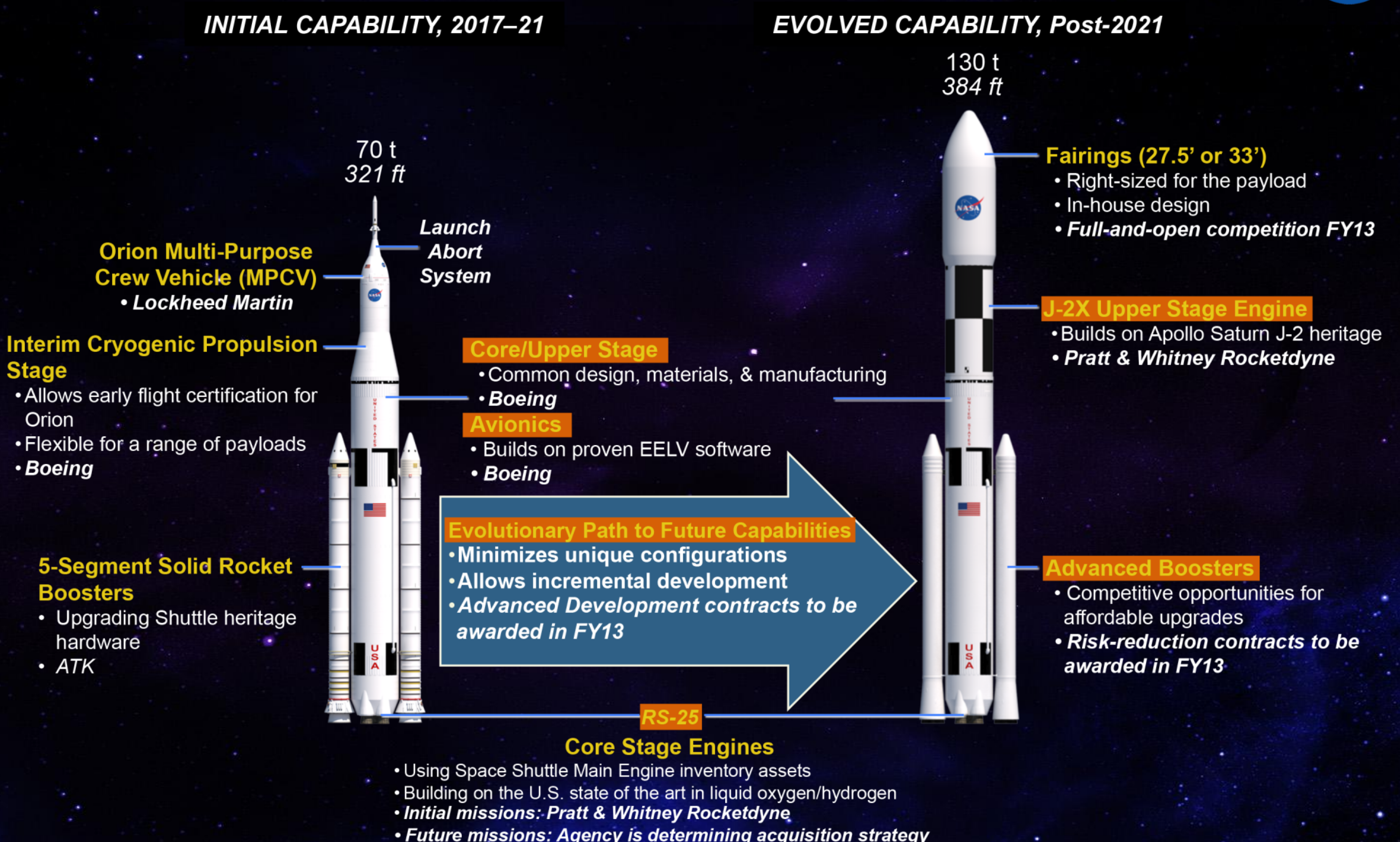
The Future of Exploration

"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.*"

"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 on the U.S. Infrastructure



Working with Industry Partners to Develop America's Heavy-Lift Rocket

The Road to First Flight in 2017

NASA Life Cycle Phases	Approval for Formulation	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	KDP A ✔	KDP B ✔	KDP C	EFT-1 Launch; KDP D	KDP E; EM-1 Launch	EM-2 Launch; KDP F	
Human Space Flight Project Reviews	Mission Concept Review ✔ 2011	System Requirements Review/ System Definition Review ✔ 2012	**FOCUSED TOWARD** Preliminary Design Review 2013	Critical Design Review 2015	System Integration Review 2016; 2017 Flight Readiness Review	2021	

CDR: Critical Design Review

EM-1: Exploration Mission 1

EFT-1: Exploration Flight Test 1

FRR: Flight Readiness Review

KDP: Key Decision Point

MCR: Mission Concept Review

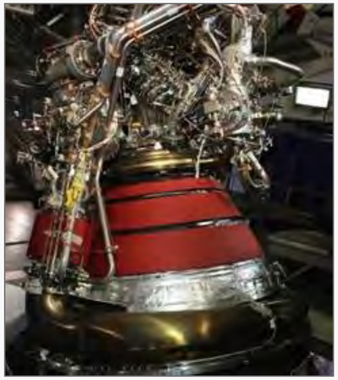
PDR: Preliminary Design Review

SIR: System Integration Review

SDR: System Definition Review

SRR: System Requirements Review

Delivering Products and Progress Today



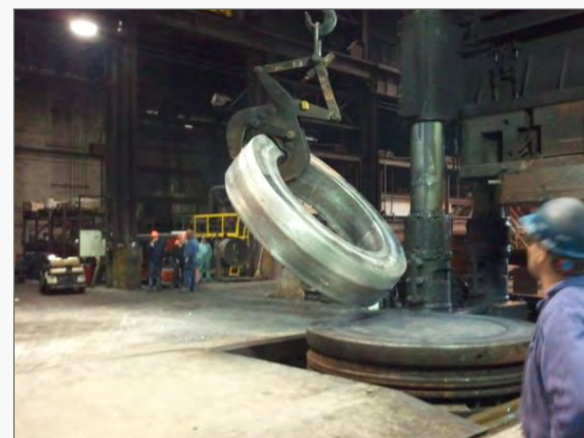
J-2X Upper Stage Engine Development and
RS-25 Core Stage Engine Inventory
Stennis Space Center, MS

Subscale Solid Rocket Motor Firing and Avionics Testbed
Marshall Space Flight Center, AL

5-Segment Solid Rocket Booster Firing, Promontory, UT

Stages Materials and
Manufacturing Studies
Marshall Space Flight Center, AL

MPCV/Stage Adapter Design and Development
For Exploration Flight Test-1 in 2014
Marshall Space Flight Center, AL



First Adapter Ring Forging,
ATI/Ladish, Cudahy, WI

SLS Small Business Goals

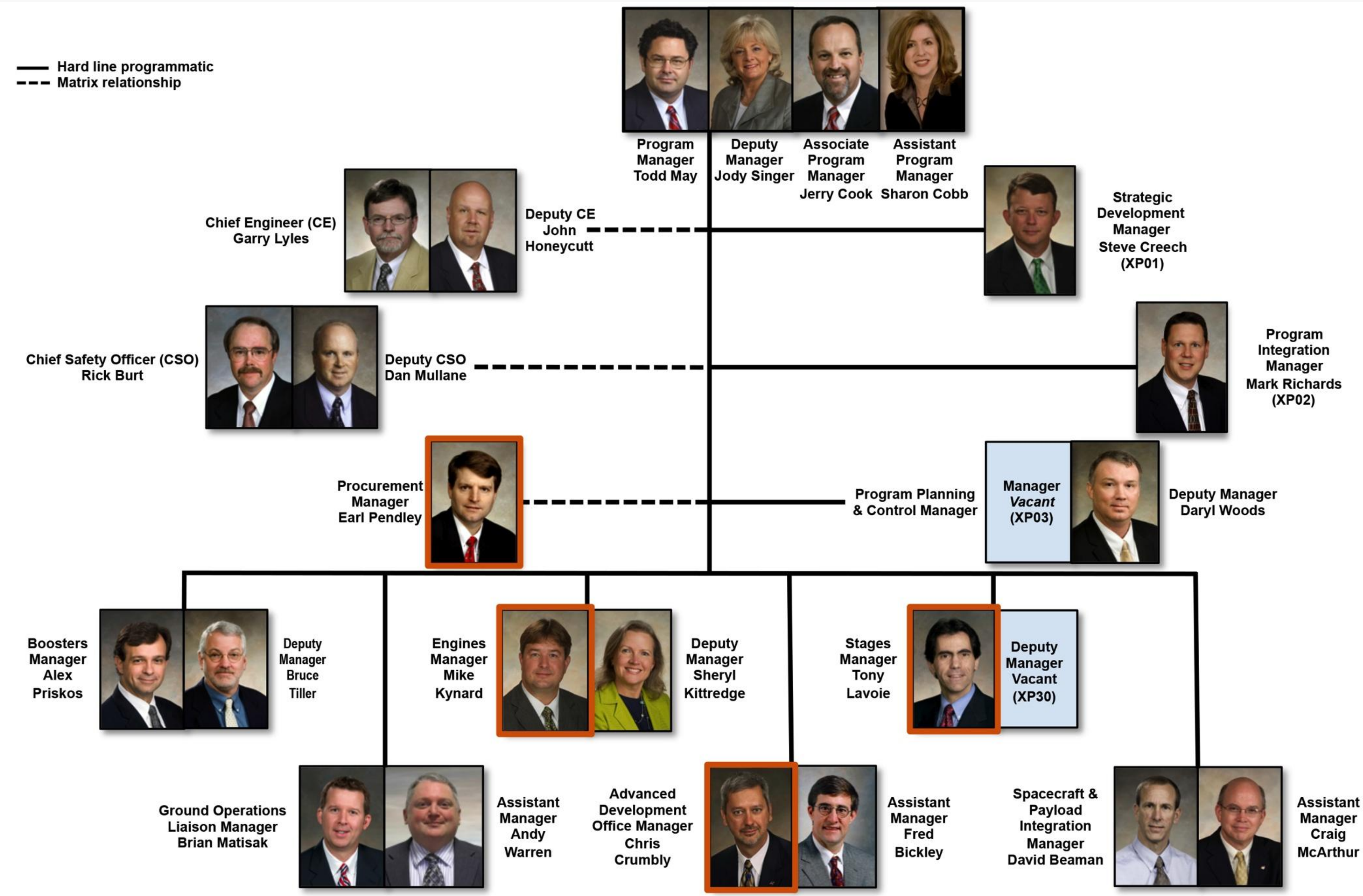
- **NASA's Small Business Policy (NASA Policy Directive 5000.2C) has been assessed for SLS requirements:**
  - Stages
  - Engines
  - Advanced Booster NASA Research Announcement (NRA)
  - Advanced Development NRA
  - Interim Cryo-Propulsion Stage
- **Subcontracting plan goals for existing contracts are 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

NASA Mentor-Protégé Agreement

July 2012

SLS Program Office at Marshall Space Flight Center



A National Infrastructure Asset

Space Launch System Summary

- ***Vital to NASA's mission and America's space goals***
- **Safe, affordable, and sustainable solution for space science and exploration**
- **Opens doors to discovery, technology, and economic expansion**
- **Evolvable, flexible configuration**
- **Employs available assets and advanced hardware in development**
- **Engages the Nation's aerospace experience base and unique infrastructure**
- **Offers near-term and long-range opportunities for small businesses**

Launching 2017

- **Contact: Earl Pendley**
  - Phone: 256-544-2949
  - email: george.e.pendley@nasa.gov

For More Information

www.nasa.gov/sls

www.twitter.com/nasa_sls

www.facebook.com/nasasls

National Aeronautics and Space Administration

NASA's Space Launch System Stages Overview

Tony Lavoie, Manager
SLS Stages Element
NASA Marshall Space Flight Center

Space Launch System

October 2012

Building on the U.S. Infrastructure

INITIAL CAPABILITY, 2017–21

70 t
321 ft

EVOLVED CAPABILITY, Post-2021

130 t
384 ft

Core/Upper Stage
- Common design, materials, & manufacturing
- ***Boeing***

Avionics
- Builds on proven EELV software
- ***Boeing***

Working with Industry Partners to Develop America's Heavy-Lift Rocket

SLS Commonalities

70 ton Payload (Block 1)

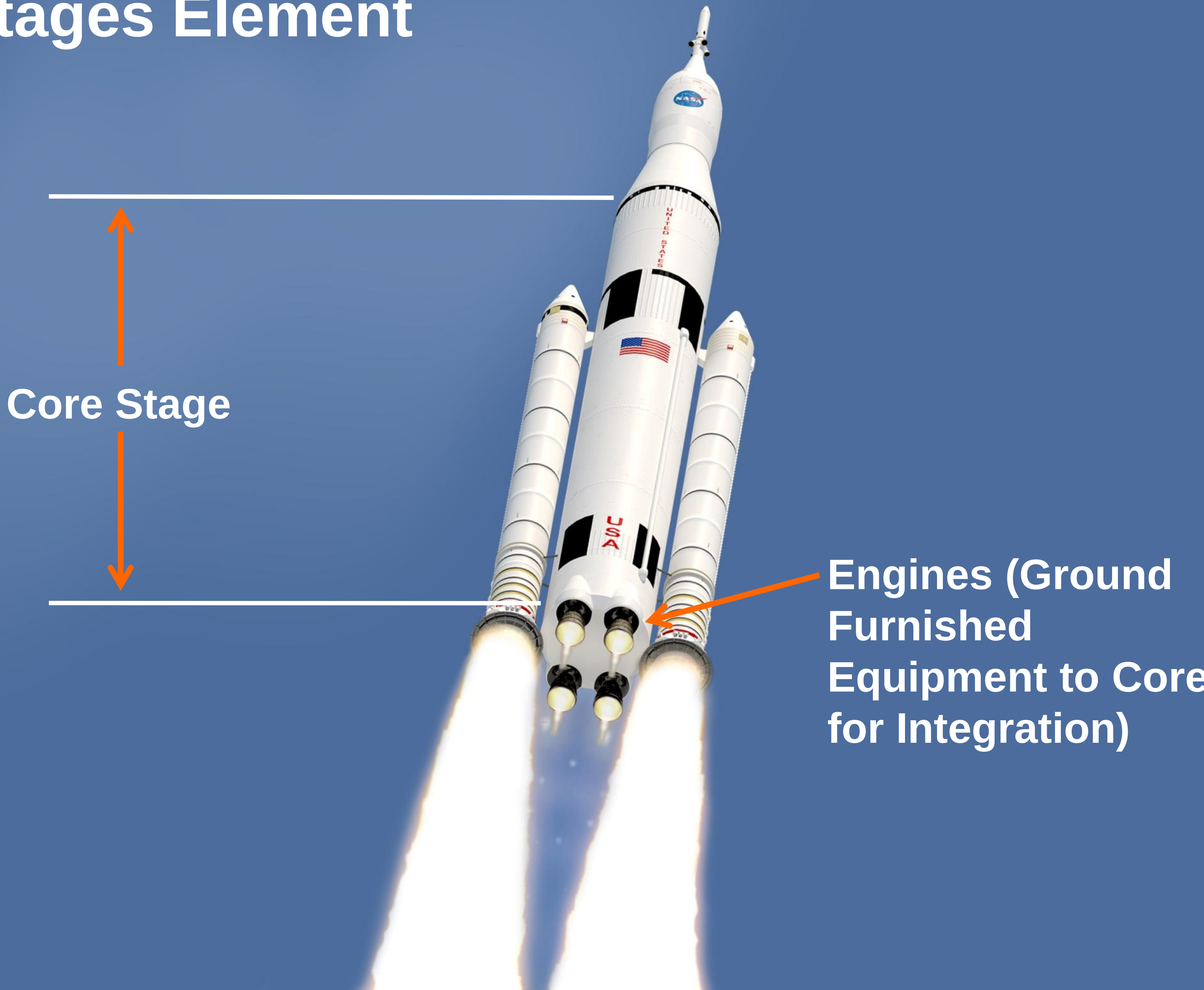
Core Stage work directly applies to Upper Stage:

- Same diameter (27.5 ft.) and basic design
- Manufacturing facilities, tooling, materials, and processes/practices
- Workforce
- Supply chain/industry base
- Transportation logistics
- Ground systems/launch infrastructure
- Propellants

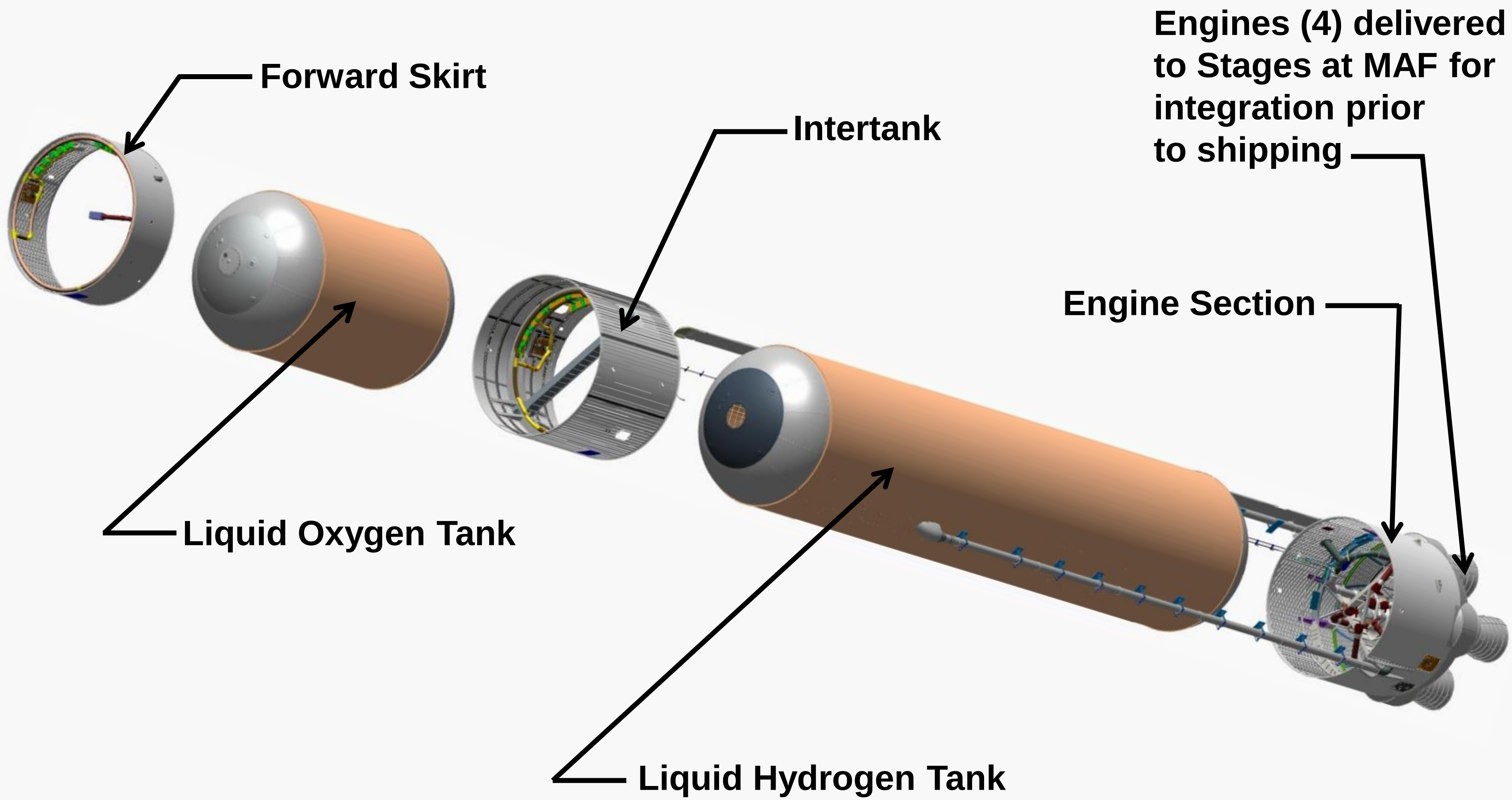
130 ton Payload (Block 2)

RS-25 Core Stage Engines

Stages Element

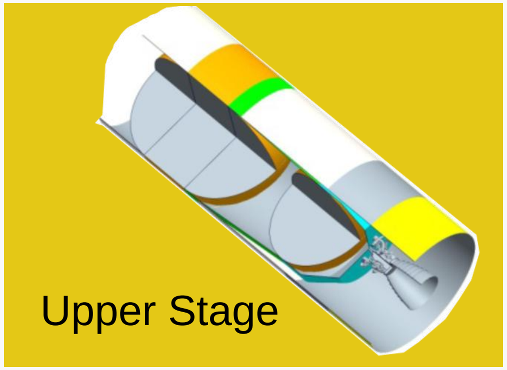


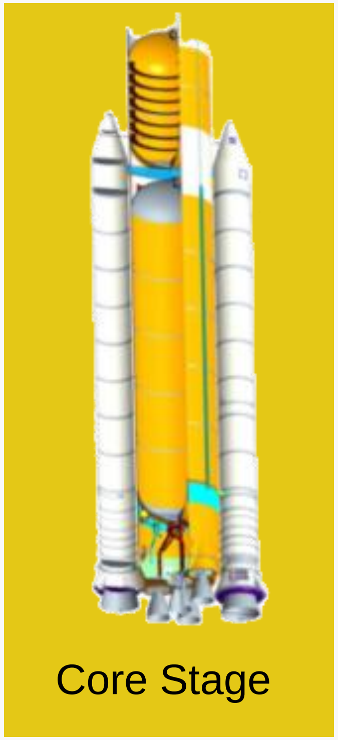
Stages Element



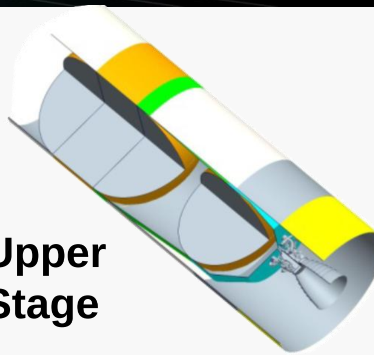
Stages Element

- **Manages:**
  - Core Stage
  - Upper Stage (as funding is available)
  - Avionics
  - SLS Program-level delegated integration tasks
- **Has contracted to Boeing as Prime**
  - Development (and 2 flight units) of the Core
  - Scope and authority for Upper Stage (as funding is available)
  - Planning and assessing Core and Upper Stage synergy for affordability
  - Performs Program-level integration tasks (Element control)
- **Also manages some in-house efforts**
  - Stennis Space Center B2 Stand green-run testing preps and ops
  - Structural Test Article facility preps and testing (MSFC)
  - Certain ground-support equipment items (transportation and handling)
  - Certain avionics (Flight Instrumentation boxes, camera systems)
- **Some avionics functions are provided by the SLS Program**
  - Vehicle flight software
  - System Integration Lab/Software Integration Test Facility (MSFC)

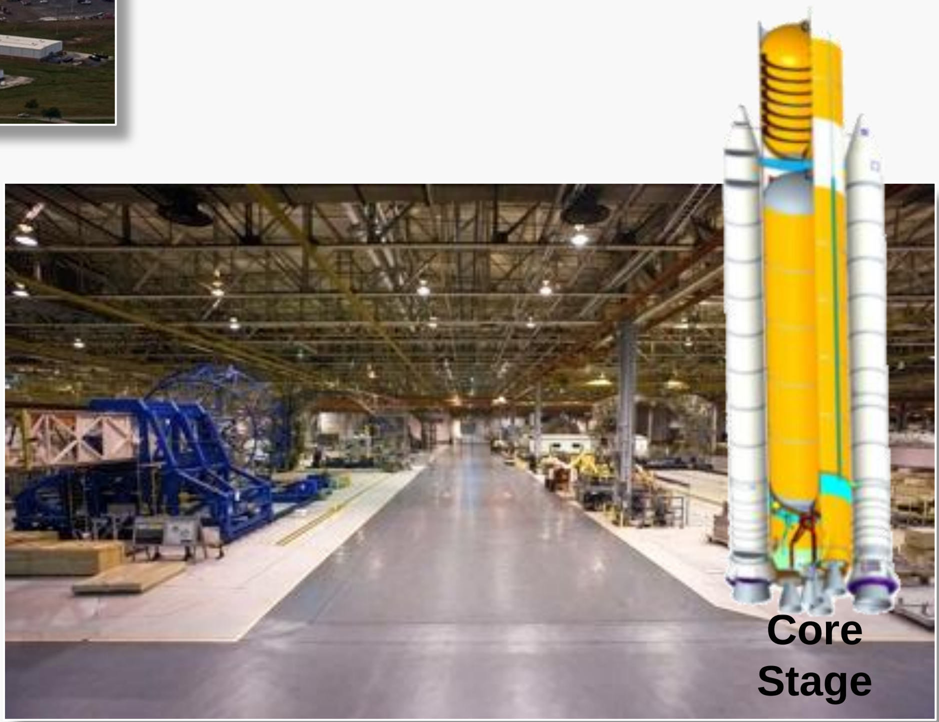




Marshall Space Flight Center's Michoud Assembly Facility



Upper Stage

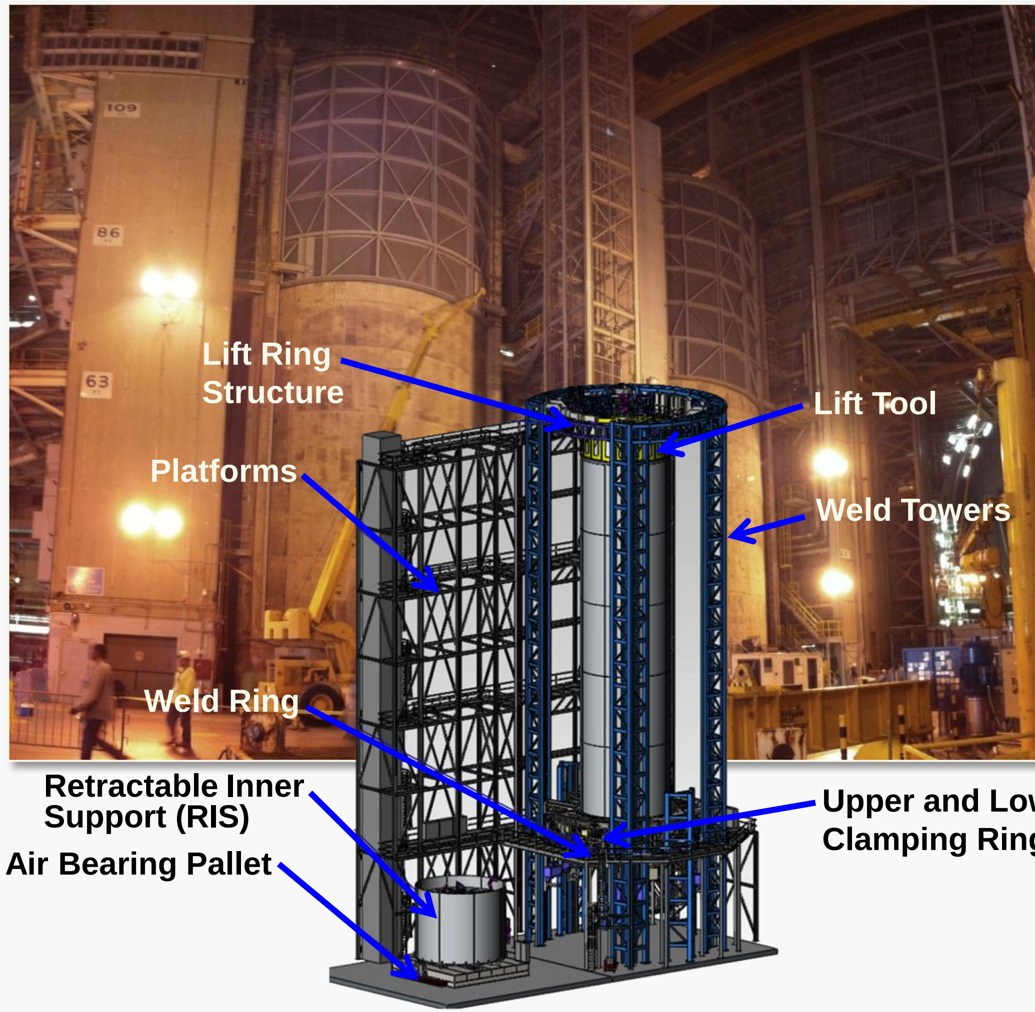


Core Stage

One-of-a-Kind Infrastructure Asset

Marshall Space Flight Center's Michoud Assembly Facility

Vertical Weld Center

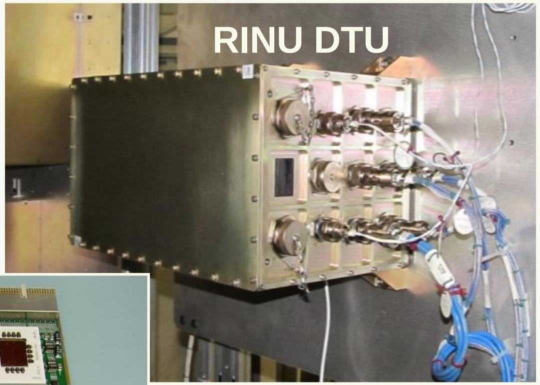


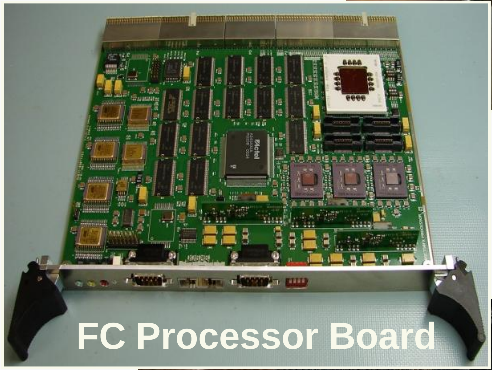
Vertical Assembly Center

Tooling and Equipment

Core Stage Avionics Subsystem Requirements

- **Avionics Subsystem Allocated Functions**
  - Host Flight Software
  - Route Data
    - GSDO to FSW, FSW to Boosters, Engines to FSW, TVC to CTN, etc.
  - Store Energy
  - Distribute Power
  - Produce Navigation & Flight Control Data
  - Produce Range Safety Tracking Data
  - Execute Flight Termination commands
  - Produce Motion Imagery
  - Produce OFI, EFI, DFI Data
  - Produce Propellant Level Measurements
  - Provide Telemetry
  - Accept Software Configuration Changes
  - Synchronize Processes and Data
  - Time Stamp Data
- **73 "Black Box" Functional Requirements**
- **30 Design Constraint, 11 Environmental, 4 Suitability, 12 Interface Requirements**





Space Launch System Stages Summary

- Managing Core Stage, Upper Stage, Avionics, and some integration tasks
- Prime contractor Boeing on board and making progress
- Pursuing affordability synergies between the core stage and the upper stage
- Using the unique facilities resident at NASA, such as MAF manufacturing capabilities and SSC test stands

Launching 2017

- Contact: Earl Pendley
  - Phone: 256-544-2949
  - email: george.e.pendley@nasa.gov

National Aeronautics and Space Administration

NASA's Space Launch System Engines Overview

Mike Kynard, Manager
SLS Engines Element
NASA Marshall Space Flight Center

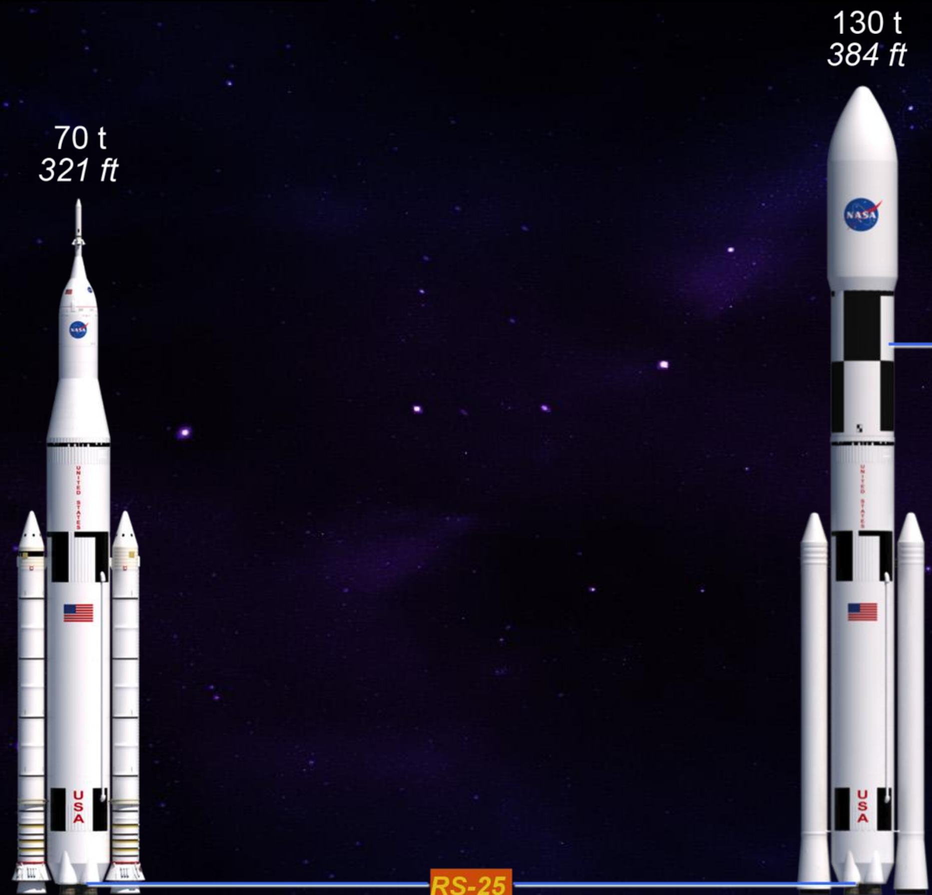
Space Launch System

October 2012

Building on the U.S. Infrastructure

INITIAL CAPABILITY, 2017–21

EVOLVED CAPABILITY, Post-2021



J-2X Upper Stage Engine

- Builds on Apollo Saturn J-2 heritage
- ***Pratt & Whitney Rocketdyne***

RS-25

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***

Working with Industry Partners to Develop America’s Heavy-Lift Rocket

RS-25 Core Stage Engine: In Stock

Core Stage Engine	*Existing RS-25 Inventory*	*New Build RS-25*
Propellant	LO2/LH2	LO2/LH2
Throttle Range	65%-109% RPL	65%-111% RPL
Avg Thrust @ max power (vac)	512,185 lbs	521,700 lbs
Min Isp @ max power (vac)	450.8	450.8
Engine Mass (each)	7,816	NTE 8,156
Nom, Range MR	6.043, 5.85-6.1	6.043, 5.85-6.1
Size	96” x 168"	96” x 168"

RS-25 Power Level (PL) Terminology

104.5% Nominal existing inventory flight certified PL

109.0% Max existing inventory flight certified PL

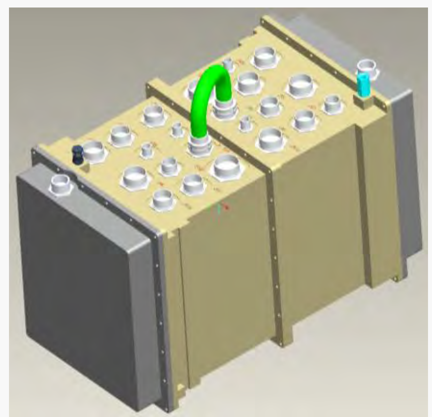
111.0% Max existing inventory ground test demonstrated PL

J-2X Controller Design Reuse

SSME Engine Controller Unit

- Re-use of SSME software design/code approaches
  - 90% of AHMS Code
- Re-use of RTVMS accel signal cond. Circuits - 90%

RS-25 baseline design will support electrical and mechanical interfaces for both SSME and J-2X engines.

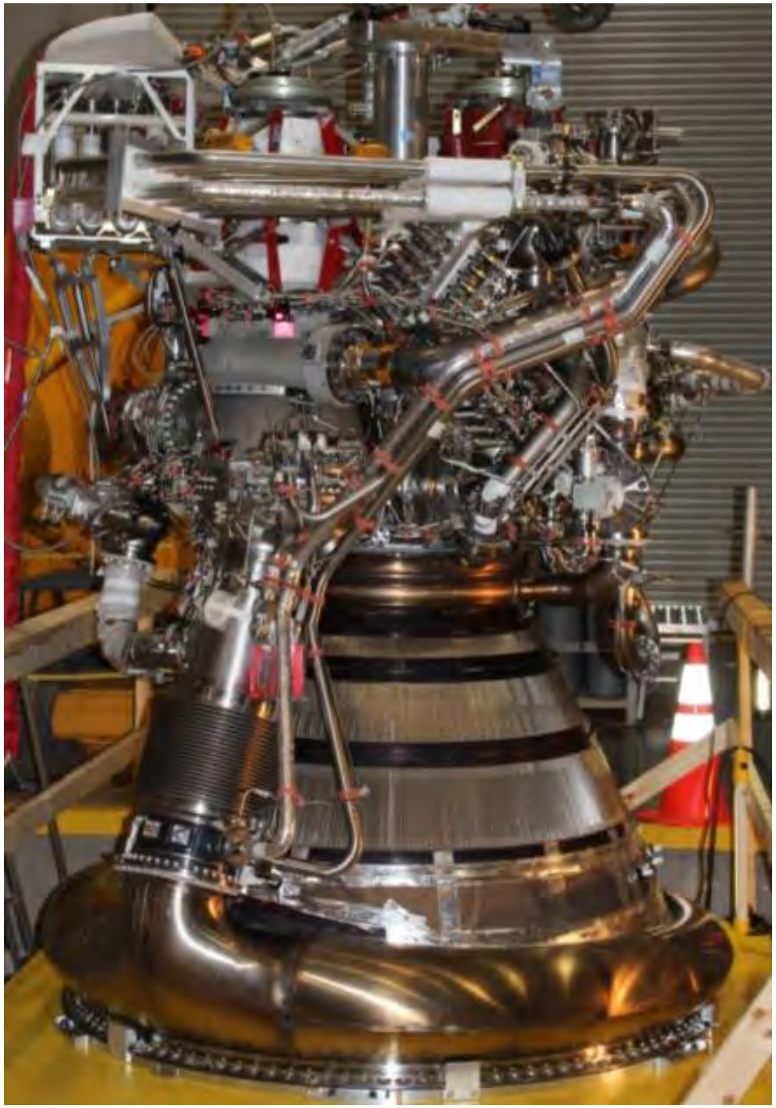


J-2X Engine Controller

- 50-60% re-use of J-2X electrical circuit designs
- 40% re-use of J-2X software design/code

SSME and J-2X Provide a Great Foundation for RS-25

J-2X Upper Stage Engine: In Development

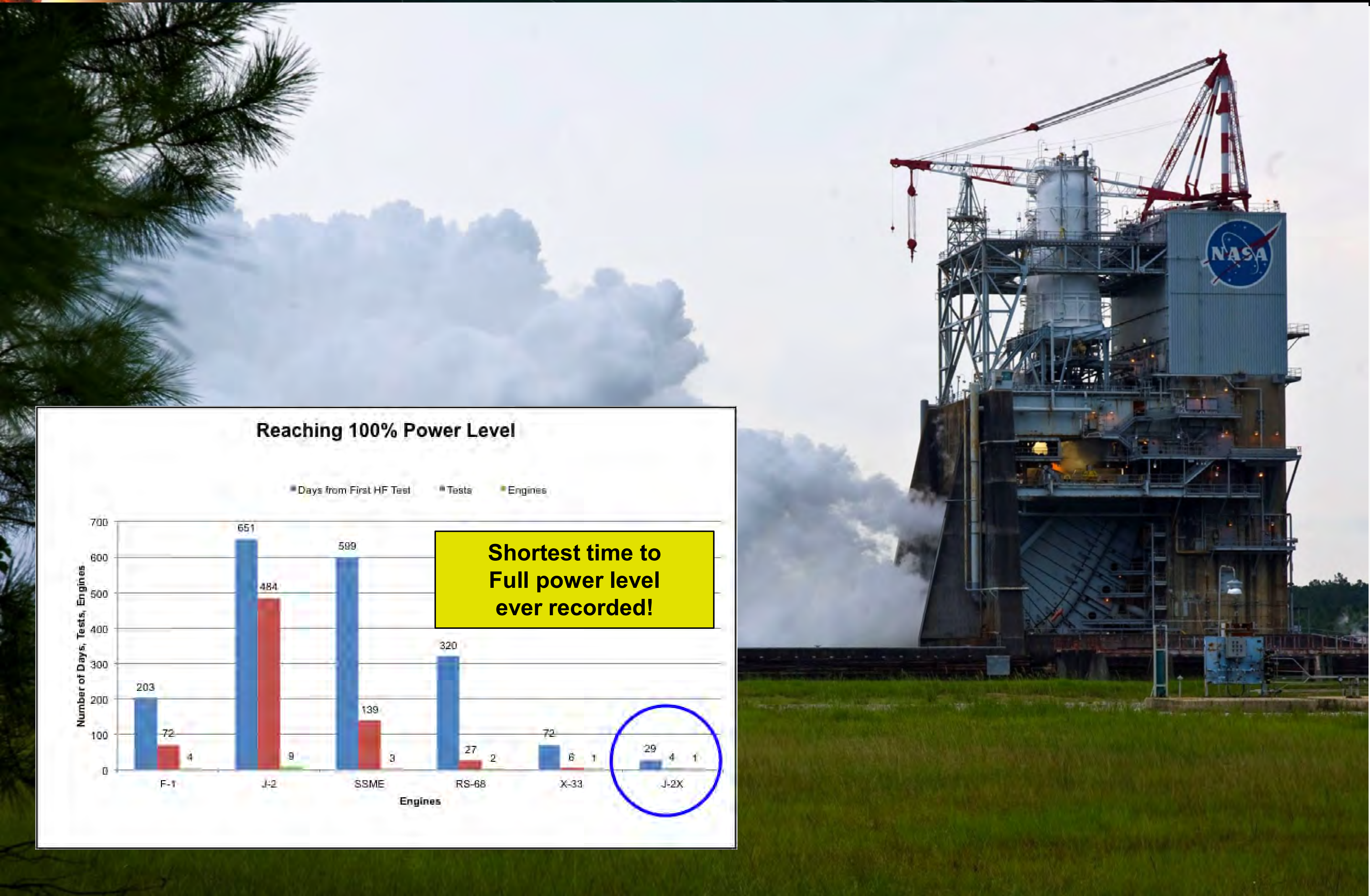


Cycle	Gas Generator
Thrust, vac (klbs)	294 (285K*)
Isp, vac (sec)	448 (436*)min
Pc (psia)	1,337
Mixture Ratio	5.5
Area Ratio	92 (59*)
Weight (lbm)	5,450 max
Secondary Mode MR	4.5
Secondary Mode PC	~82%
Restart	Yes
Operational Starts	8
Operational Seconds	2,600
Length (in), Max	185
Exit Dia (in), Max	120

** With short nozzle extension*

J-2X Upper Stage Engine Accomplishments

6,879 *total seconds on E10001 and PPA-2*



Space Launch System Liquid Engines Summary

- **Supporting initial and evolved SLS configurations**
- **RS-25 engines on hand to support first four flights, including Orion in 2017 and 2021**
- **J-2X testing in progress at Stennis Space Center – finishes 2015**
- **Common controller to integrate RS-25 engine with newer systems**
- **New technologies to improve testing and lower the cost of future units**
  - SLM and Structured Light
- **Contact: Earl Pendley**
  - Phone: 256-544-2949
  - email: george.e.pendley@nasa.gov

Launching 2017

National Aeronautics and Space Administration

NASA's Space Launch System Advanced Development Overview

Chris Crumbly, Manager
SLS Advanced Development Office
NASA Marshall Space Flight Center

Space Launch System

October 2012

Building on the U.S. Infrastructure

INITIAL CAPABILITY, 2017–21

70 t
321 ft

Evolutionary Path to Future Capabilities

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

EVOLVED CAPABILITY, Post-2021

130 t
384 ft

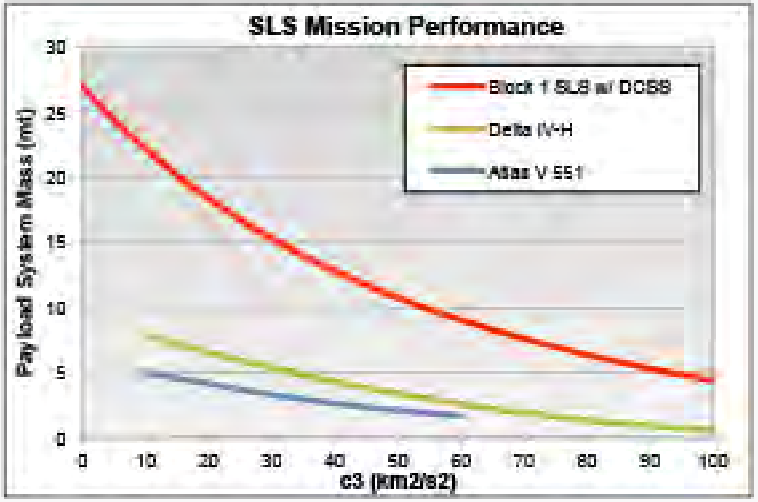
Advanced Boosters

- Competitive opportunities for affordable upgrades
- ***Risk-reduction contracts to be awarded in FY13***

Working with Industry Partners to Develop America's Heavy-Lift Rocket

Benefits of the SLS for Payloads

- **Greater volume and mass capability/margin**
  - Increased design simplicity
  - Fewer origami-type payload designs needed to fit in the fairing



- **Single launch of multiple elements means fewer launches, deployments, and critical operations**
  - Increased mission reliability and confidence
  - Reduced risk
- **High-energy orbit and shorter trip times**
  - Less expensive mission operations
- **Increased lift capacity and payload margin**
  - Reduced risk

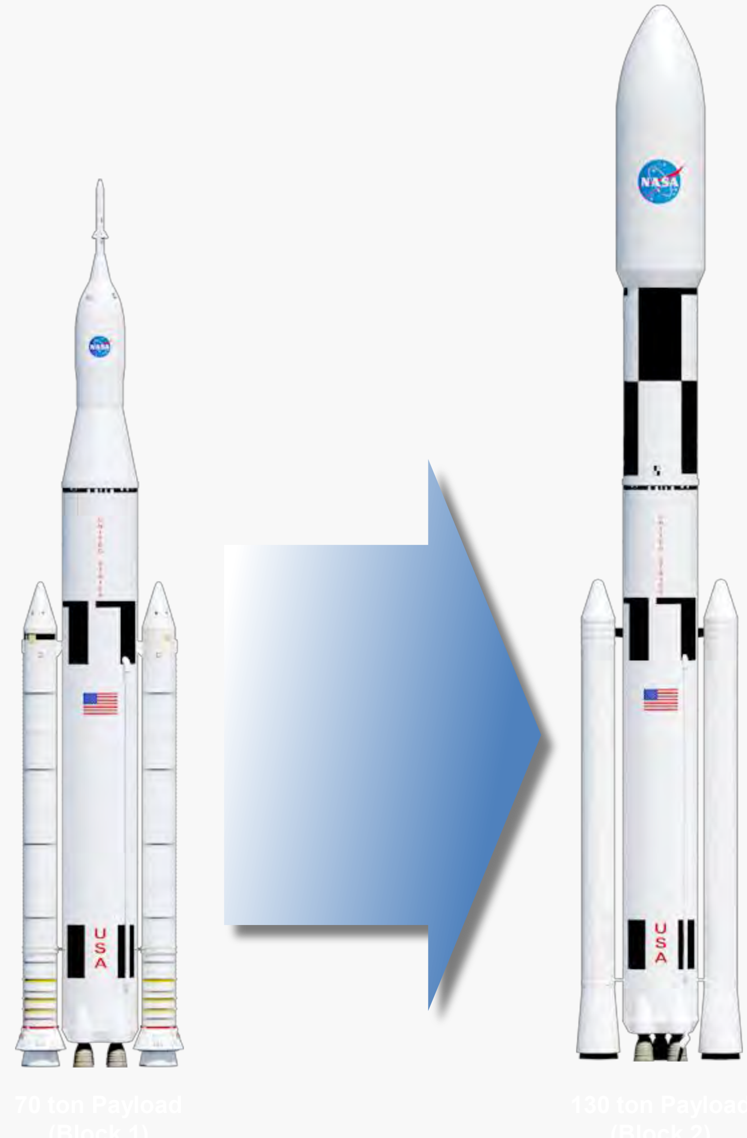
SLS Boosters Overview

◆ Initial Booster Configuration

- Two flights (2017 and 2021)
- Utilizes existing hardware/contracts
  - ATK prime contractor
- Heritage hardware/design
  - Forward structures
  - Metal cases
  - Aft skirt
  - Thrust Vector Control
- Upgraded hardware/design
  - Expendable design
  - New avionics
  - Asbestos-free insulation
  - Five-segment solid rocket motor
    - Additional segment
    - Increased performance
    - Unique thrust-time profile

◆ Evolved Booster Configuration

- Used in flights beyond 2021
- Design, Development, Test & Evaluation (DDT&E) will be awarded by a competitive procurement
- Improved performance by either liquid or solid propulsion



Three-Phase Booster Development Approach

Full and Open Competition

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)

Full and Open Competition

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: ***Issue draft NRA Dec 12, 2011; award targeted for 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

Advanced Booster Contracts Overview

- **Northrop Grumman: Subscale Composite Tanks (awarded)**
  - Develop an automated in-situ manufacturing system that utilizes out-of-autoclave curing for composite tanks
- **Aerojet: Full-scale Combustion Stability Demonstration (in negotiation)**
  - Demonstrate high-performance booster using an oxygen-rich staged combustion cycle
- **Dynetics: Booster Risk-Reduction Tasks (awarded)**
  - F-1 Engine: Full-scale, production-like hardware testing
  - Structures: Simpler materials, design, and manufacturing processes
- **ATK: Integrated Booster Static Test (awarded)**
  - Identify and address technical challenges for a composite booster with redesigned forward and aft structures and nozzle, and improved manufacturing processes

Advanced Development NASA Research Announcement (NRA) Overview

- Evolutionary development strategy for SLS allows for incremental progress within constrained budgets through the solicitation of innovative development concepts from both industry and academic institutions
- Objectives to improve affordability, reliability, or performance in several key topic areas: Concept Development, Trades, and Analyses; Propulsion; Manufacturing, Structures, and Materials; and Avionics and Software
- 85 proposals submitted were compliant
- Evaluation criteria: (1) Relevance to NASA Objectives, (2) Intrinsic Merit, and (3) Price
- In FY13, budget negotiations will be initiated on those selections that have the highest priority

Sample of Organizations Selected for Proposal Negotiations

http://www.nasa.gov/home/hqnews/2012/sep/HQ_12-333_SLS_Advanced_Development_Proposals.html

Space Launch System Advanced Development Summary

- **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 2017

- **Contact: Earl Pendley**
  - Phone: 256-544-2949
  - email: george.e.pendley@nasa.gov

National Aeronautics and Space Administration

NASA's Space Launch System Acquisition Overview

Earl Pendley, Manager
SLS Procurement Office
NASA Marshall Space Flight Center

Space Launch System

October 2012

Path to the SLS Acquisition Plan

- The NASA Authorization Act of 2010 (PL 111-267, Oct. 11, 2010) requires that NASA deliver a Space Launch System with at least 70 t of initial capability and 130 t of evolved capability.
- The President's FY12 Budget Request includes funding for SLS.
- The FY11 Appropriation Act includes funding for SLS.
- NASA selected an architecture in June 2011 to meet the Authorization Act.
- NASA conducted an Agency-level SLS Acquisition Strategy meeting in July 2011.
- NASA conducted Procurement Strategy Meetings in mid-September 2011.
- Acquisition process is proceeding.

This rocket is key to implementing the plan laid out by President Obama and Congress in the bipartisan 2010 NASA Authorization Act.
— NASA Administrator Charles Bolden
September 14, 2011

SLS Acquisition Strategy Fulfills Legislative and Executive Branch Direction and Law

Key SLS Requirements

- **Affordability**
  - Flat annual budget profile
  - Existing contracts and assets used for initial capability
    - Significant hardware investments maximized
    - Significant portions of the supply chain in place
    - Work can begin earlier, engaging the U.S. aerospace workforce
    - Less design, development, test, and evaluation (DDT&E) risk and costs
    - Contract types to move to more objective incentive structures
- **Performance Margin**
  - Initial near-term capability of 70 t, evolvable to 130 t
  - Modular flexible architecture that may be configured for mission needs
  - Significant National capability
- **Evolvable**
  - Competitions for technology infusions and vehicle upgrades for future capability

SLS Will Be Safe, Affordable, and Sustainable

Building on the U.S. Infrastructure

INITIAL CAPABILITY, 2017–21

70 t
321 ft

Orion Multi-Purpose Crew Vehicle (MPCV)
- ***Lockheed Martin***

Launch Abort System

Interim Cryogenic Propulsion Stage
- Allows early flight certification for Orion
- 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 proven EELV software
- ***Boeing***

Evolutionary Path to Future Capabilities
- **Minimizes unique configurations**
- **Allows incremental development**
- ***Advanced Development contracts to be awarded in FY13***

EVOLVED CAPABILITY, Post-2021

130 t
384 ft

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***

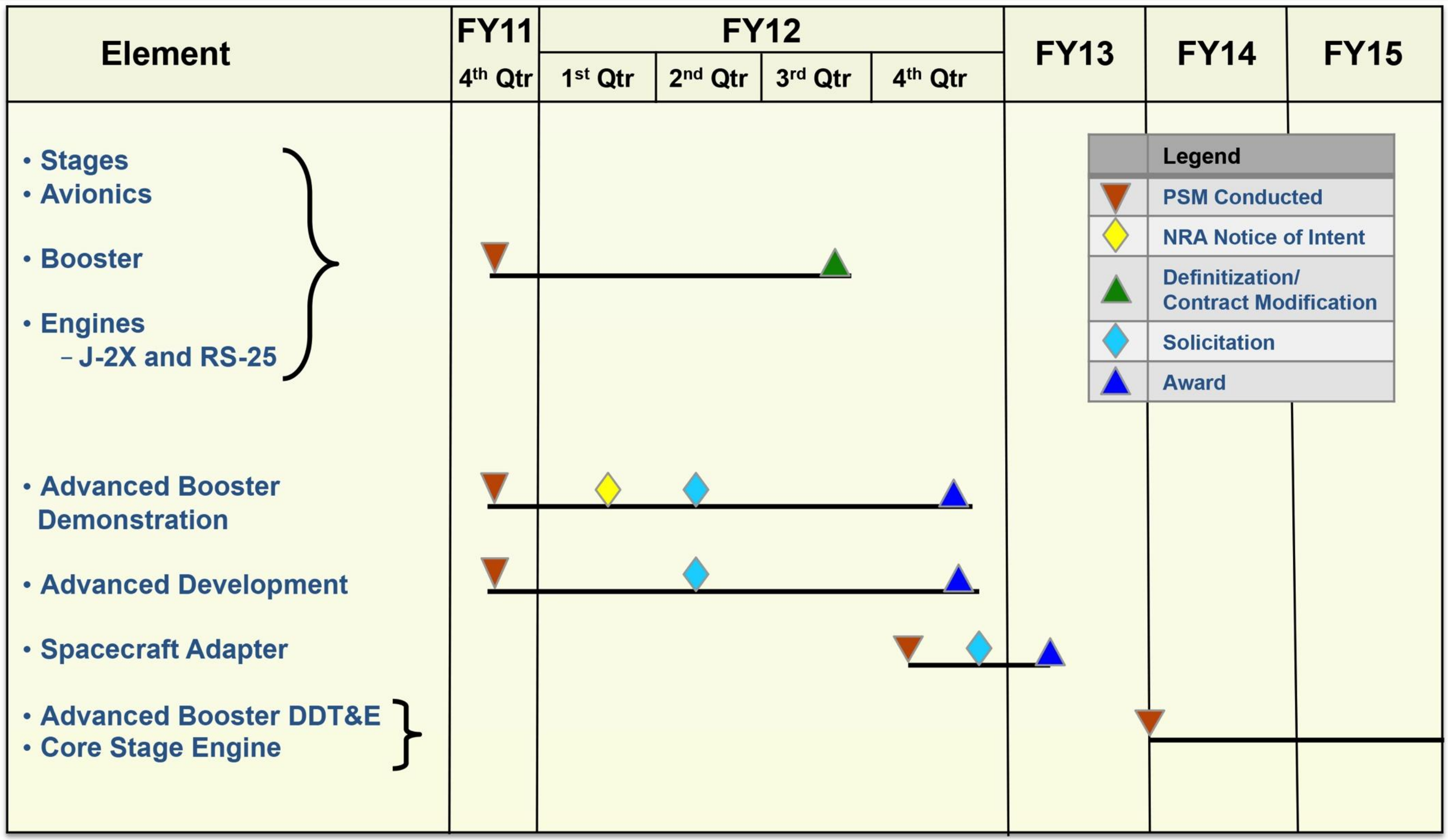
Advanced Boosters
- Competitive opportunities for affordable upgrades
- ***Risk-reduction contracts to be awarded in FY13***

RS-25

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***

Working with Industry Partners to Develop America’s Heavy-Lift Rocket

Procurement Schedule



On Track for First Flight in 2017

SLS MAF Contracts

- **Stages**
  - Core and Upper Stages to be built at MAF
  - Significant tooling investment in place
  - Construction of Facilities work is beginning
- **MSFCOC-Jacobs Engineering**
  - Provides operations and maintenance for MAF
  - Includes robust opportunities for commercial tenants

SLS Recent Contract Announcements

- **Advanced Booster**
  - Four contractors selected
  - Three contracts awarded
- **Advanced Development**
  - Twenty three selections (Industry and Academia)
- **Interim Cryogenic Propulsion System (ICPS)**
  - Letter contract awarded

SLS Small Business Goals

- **The NASA MSFC Small Business Specialist has performed a NASA Policy Directive 5000.2C uniform methodology assessment for the appropriate SLS requirements:**
  - Stages
  - Engines
  - Advanced Booster
  - Advanced Development
  - ICPS
- **Subcontracting plan goals for existing contracts will be updated via negotiations.**
- **Small business utilization performance is evaluated on both incentive fee and award fee contracts.**
  - Mentor/Protégé Program will be included
- **SLS will provide topics to the Small Business Innovation Research (SBIR) Program.**
  - Link to the NASA SBIR website will be listed on all solicitations
    - http://sbir.gsfc.nasa.gov/SBIR/SBIR.html

Targeting Robust Small Business Partnerships Through Various Channels

SLS Acquisition Summary

- The SLS contract activity continues to evolve per our initial acquisition strategy.
- The acquisition strategy meets key SLS requirements of *safety, affordability, and evolvable performance.*
- SLS will continue to work closely with NASA's Office of Small Business Programs to maximize opportunities for all parts of the Agency's socio-economic programs.
- Contact information: Earl Pendley
  - Phone: 256-544-2949
  - email: george.e.pendley@nasa.gov

Launching 2017

Michoud Assembly Facility (MAF)
SLS Industry Day

Robert Champion, Deputy Director
Michoud Assembly Facility

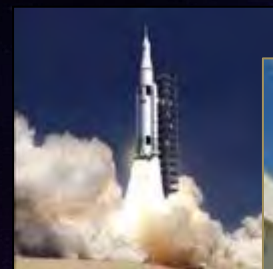
Space Launch System

October 2012

Marshall Space Flight Center's Michoud Assembly Facility (MAF)

Background

- Field site for Marshall Space Flight Center
- NASA Programs -- SLS Stages and Orion Structure
- Unique large scale manufacturing capabilities
- National Center for Advanced Manufacturing
- Site comprises 832 acres, with over 2M square feet of manufacturing space (43 acres under one roof) and 900k square feet of office space
- Conveniently located and accessible:
  - Less than 5 miles from intermodal rail stations
  - Deep-water port
  - Less than 1 mile from interstate highway
  - Convenient to lakefront airport



MAF Transformation update

- Single- to multi-project facility to support NASA and commercial tenants
- Established Facility Pricing Policy, SAA and EUL Authority
- Reduced facility operations costs by more than 30% since FY 10
- Increased commercial revenue by 35 % in FY 12
- NASA Capital Investments $43M
- Post Katrina Improvements $67M

One-of-a-Kind Infrastructure Asset

Innovative New Business Model

- **Multiple NASA Programs**
  - Space Shuttle External Tank (retired)
  - Ares Upper Stage(transitioned)
  - Orion MPCV
  - Space Launch System (SLS)
- **Turn-Key Manufacturing**
  - Infrastructure
  - Laboratories
  - Equipment
  - Support
- **Site Services/Demand Services**
  - Security
  - Fire Protection
  - Hurricane Hardening
  - Facility Maintenance
  - Medical/Gym
  - Roads/Grounds/Janitorial
  - Reproduction
  - Photography/Video support
  - Conference Rooms
  - Event Support/Catering
  - Exchange/Credit Union
- **Current population on-site is ~2600**
  - Does not include headcount for transient work (< 1year agreement, construction, etc.)
- **Executed 12 new Space Act Agreements (SAA) with 37 mods to existing SAAs representing $15.5M**
  - Represents a direct reduction of operational costs by ~16% for FY12
  - Additional SAAs and EULs in work for FY12

MAF Manufacturing Capabilities

- Automated Fiber Placement Machines
- Multi-axis Machining Centers
- Advanced Friction Stir Welding
- Non-Destructive Evaluation

$62M State of Louisiana Investment


Interior Shots of MAF

- Laboratories, Metrology, Clean Rooms
- Pneumatic, Cryogenic and Mechanical Testing
- Machining, Heat Treat Ovens, Autoclave

Michoud Tenants

MAF has Established a Multi-User Environment

CRESCENT UNMANNED SYSTEMS, LLC

BIG EASY STUDIOS

VIVACE CORPORATION

DCAA

LSU

NCAM

UNO

GEOCENT

bp

BLADE DYNAMICS

USDA

BOEING

LOCKHEED MARTIN

JACOBS

DCMA

Increased Commercial Revenue 35% in FY12

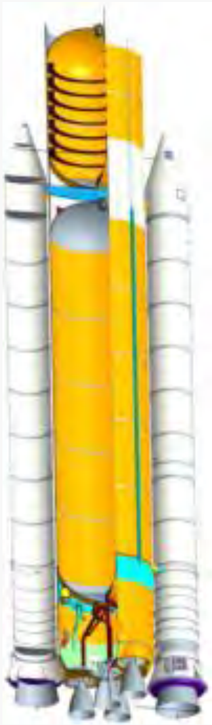
MAF Priorities

- Ensure the Safe, Effective, on schedule manufacture, assembly, and delivery of the SLS and Orion components.
- Reduce the Operating cost of MAF to NASA Programs and Projects. This will be done by both increasing tenant revenue and reducing the operating cost.
- Operate the site in a way that meets tenants needs and complies with state and federal regulations and makes it affordable.

MAF Is Building America's New Launch System

- **MAF team is working with the SLS Stages Element**
  - Manufacturing Core Stage and Upper Stage
  - Manufacturing Instrument Ring
  - Integrating Engines with Core and Upper Stages
- **MAF team is building key parts of Orion/MPCV**
  - Composite components of the Crew Module, Service Module, and Launch Abort System
  - Crew Module and Service Module Primary structure
- **Suppliers and subcontractors to SLS elements located at MAF can collocate with their customer**
  - Utilize the same world-class infrastructure, equipment, and services
  - Significantly reduce logistics cost and delivery time by sharing common space
- **SLS and Orion are an anchor tenants, Excess capacity remains available**
  - Commercialization strategy **WILL CONTINUE**
  - Manufacturing, assembly, warehouse, and green space are available

Orion/MPCV



Core Stage

For More Information

www.nasa.gov/sls