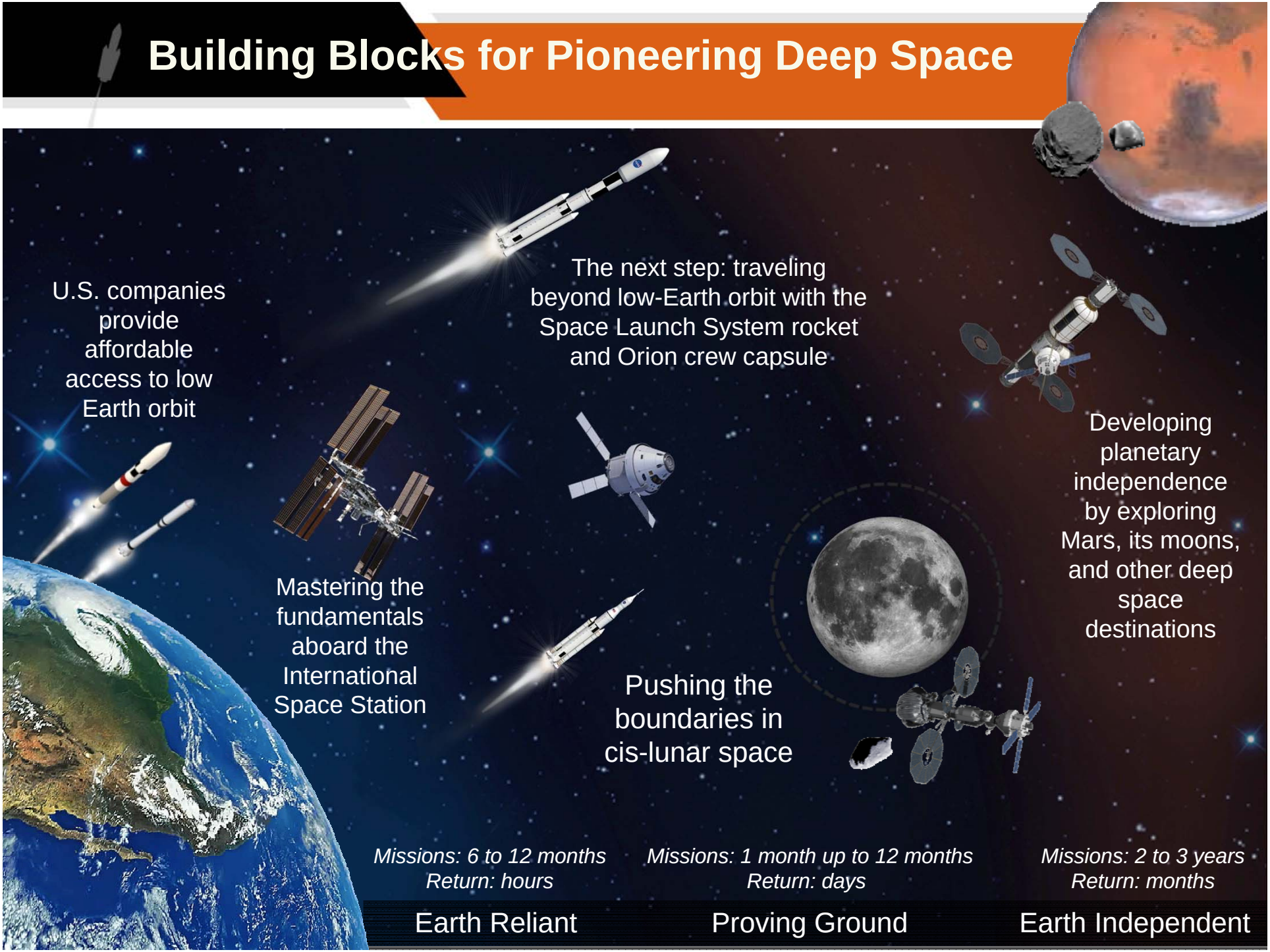
SPACE LAUNCH SYSTEM

SLS Capabilities

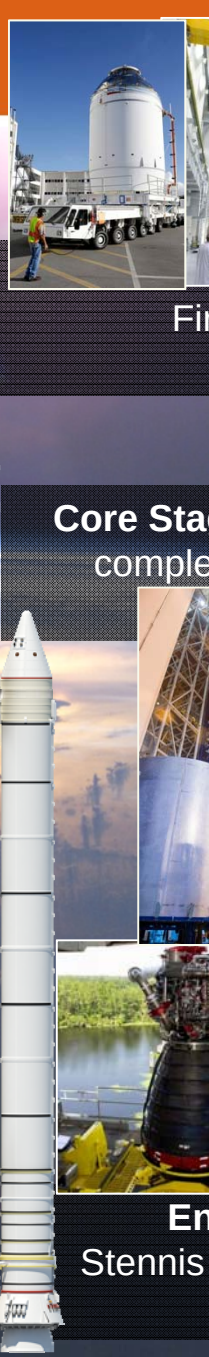
for the Mirror Technology Days Workshop
November 20, 2014

Angie Jackman
SLS Payload Integration

Building Blocks for Pioneering Deep Space



Recent Progress



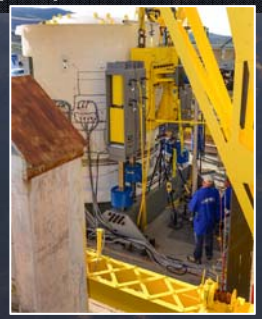
Launch Vehicle Stage Adapter: Contract awarded in February 2014.

MPCV-to-Stage Adapter: First flight hardware currently in Florida for Exploration Flight Test-1 in Fall 2014.

Avionics: Avionics “first light” marked in January 2014; currently testing most powerful flight system computer processor ever.

Core Stage: Initial confidence barrels and domes completed; Vertical Assembly Center activation completed in Sept. 2014.

Boosters: Forward Skirt test completed May 2014; preparations underway for QM-1.



Engines: Preparing for RS-25 testing at at Stennis Space Center; renovations underway to B-2 stand.

SLS Milestones Schedule

2011	2012	2013	2014	2015	2016	2017–18
MCR ✓	SRR/SDR ✓	PDR ✓	KDP-C ✓	CDR	DCR	SAR Launch Availability

Formulation

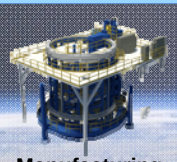
Implementation

SLS Design Chosen

Booster Development Test

Engines Delivered to Inventory

Wind Tunnel Testing



Manufacturing Tooling Installation

Production of First New Flight Hardware

Main Engine Test-Firing

ICPS Production Begins

Orion Flight Test

STA Production Begins

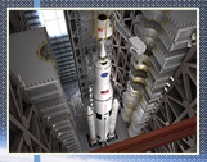
Booster Qualification Tests

Core Stage Structure Testing

Core Stage Assembly

Booster Assembly at KSC

Core Stage Test-Firing



Vehicle Stacking at KSC

Internal Launch Readiness

Concept Studies	Concept & Technology Development	Preliminary Design & Technology Completion	Final Design & Fabrication	System Assembly, Integration & Test, Launch & Checkout

MCR: Mission Concept Review	CDR: Critical Design Review
SRR: System Requirements Review	DCR: Design Certification Review
SDR: System Definition Review	SAR: System Acceptance Review
PDR: Preliminary Design Review	FRR: Flight Readiness Review
KDP-C: Key Decision Point	

www.nasa.gov/sls

SLS Enables Options for Mars Exploration

Delta-V

Enables Mars missions; enables faster transits for robotic science and precursor missions

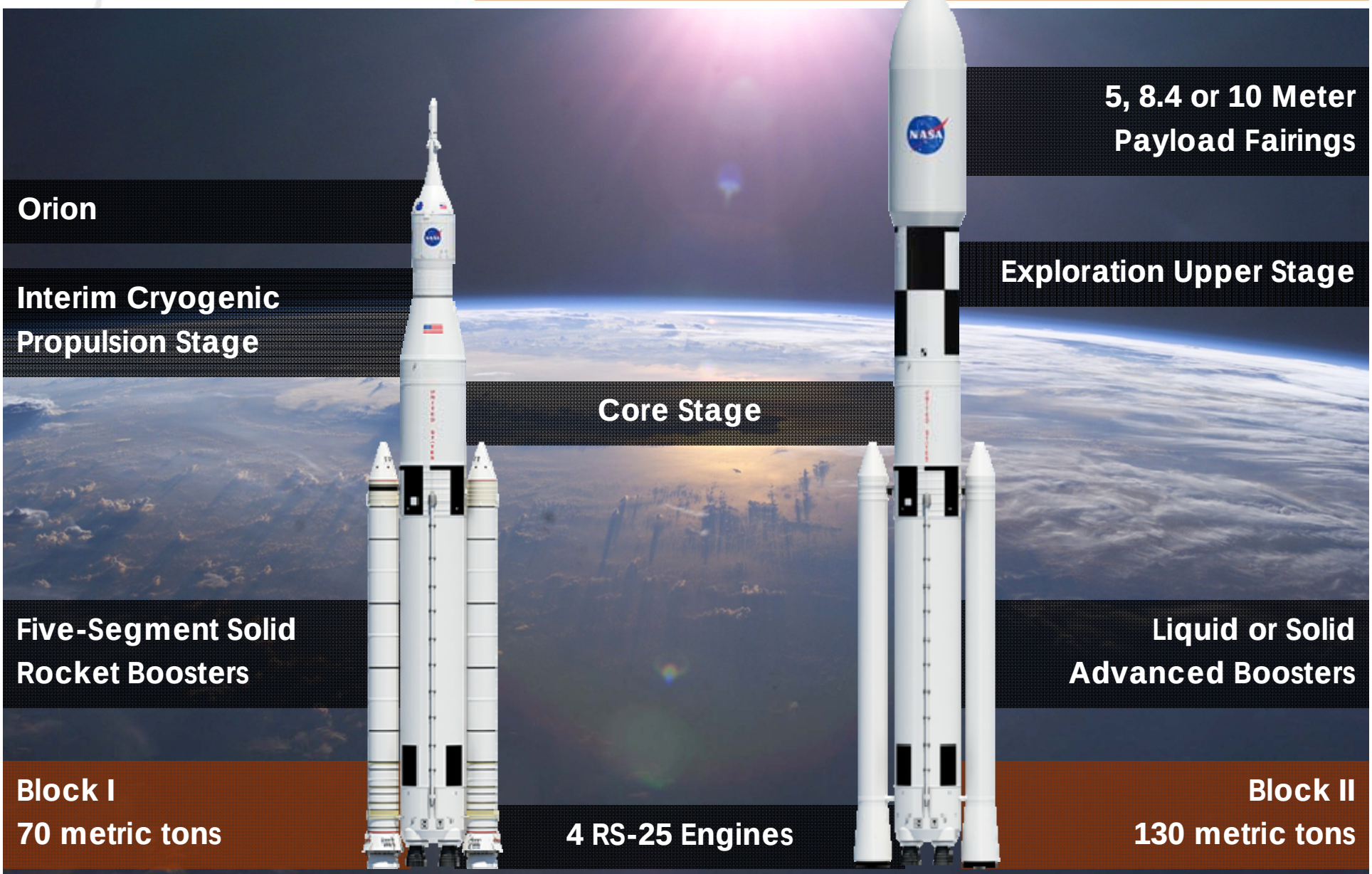
Mass

Enables efficient assembly of massive systems with minimum number of launches, reducing complexity and risk

Volume

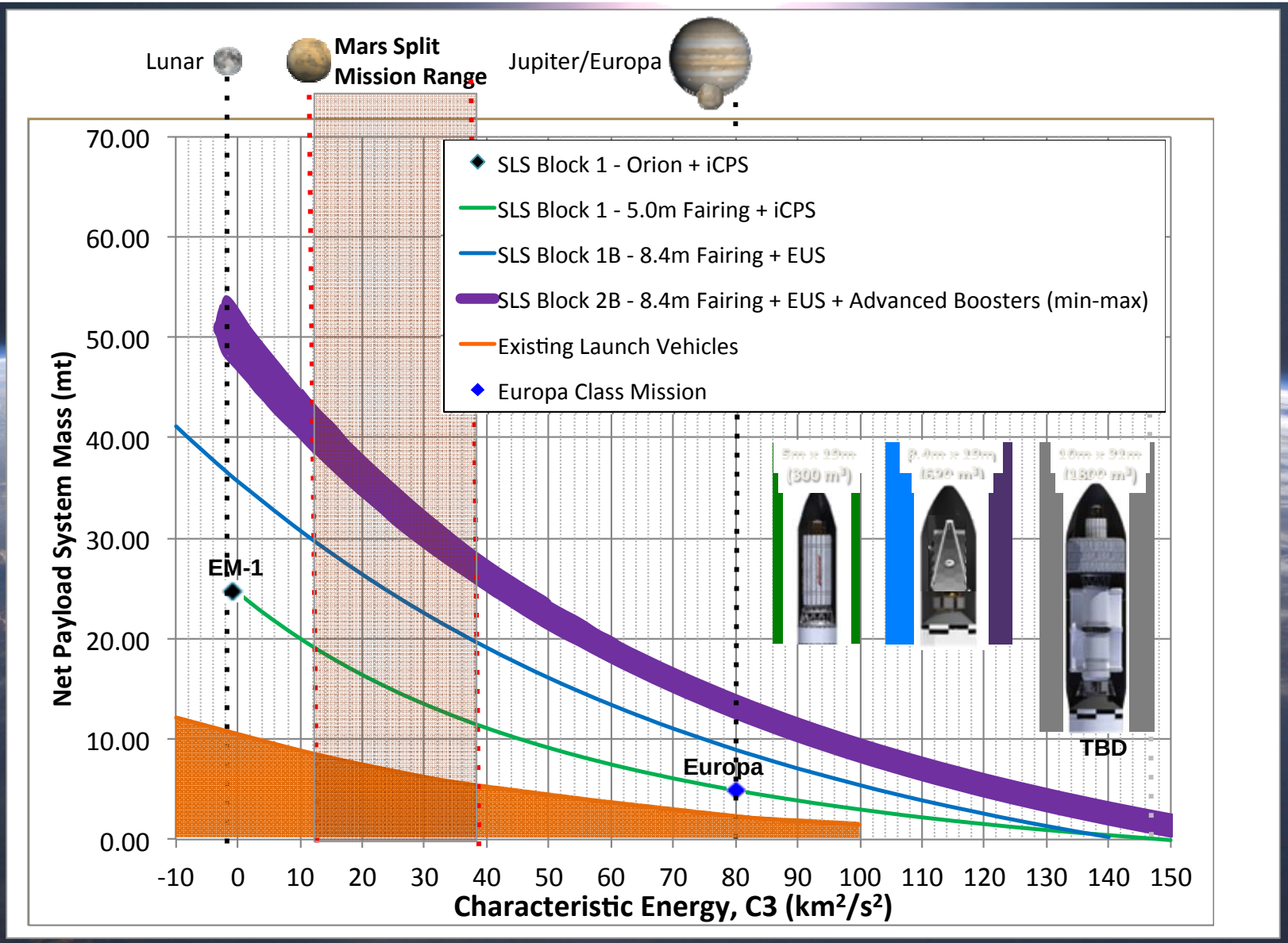
Provides the capacity needed for launch of large systems needed for proving ground missions and human exploration of Mars; enables new concepts for robotic science and precursor missions

SLS Evolutionary Approach



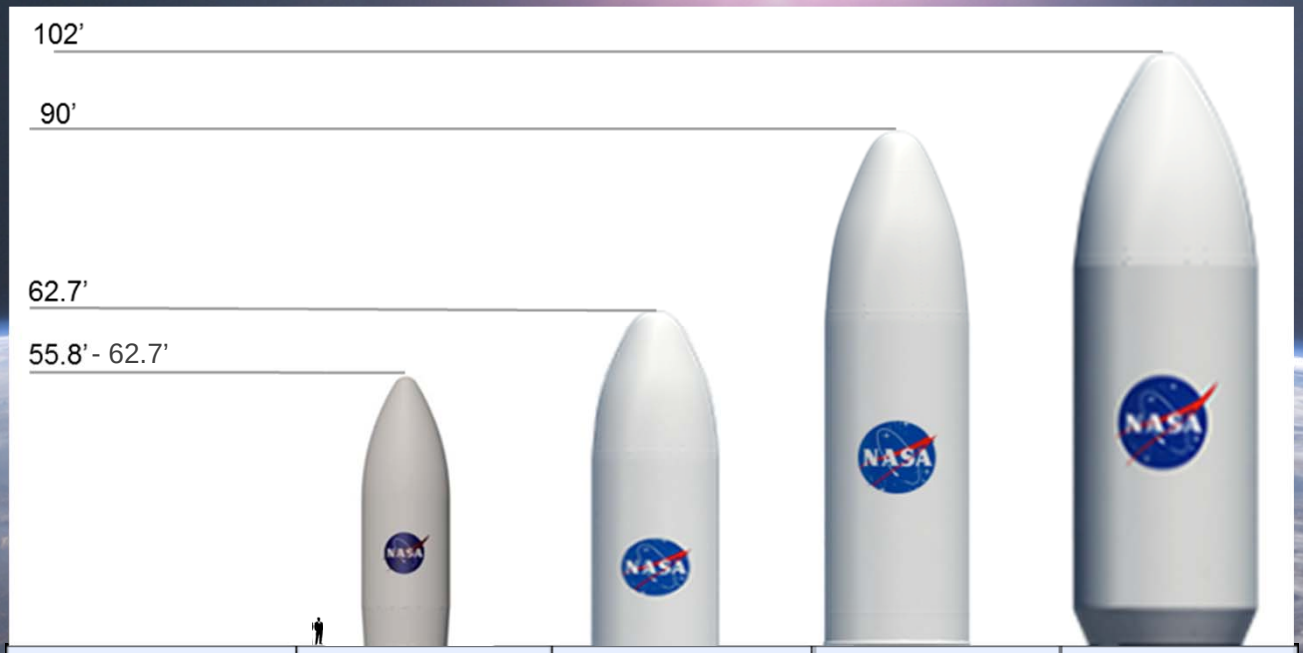
SLS Characteristic Energy

NOTIONAL – Based on current vehicle performance estimates



SLS Payload Fairing Summary

NOTIONAL – Based on current fairing concepts



	5m Class	8.4m Short	8.4m Long	10m
Overall Length X Diameter	**17-19 m (long) (55.8’-62.7)**	**19.1 x 8.4 m (62.7’ x 27.6’)**	**27.4 x 8.4 m (90’ x 27.6’)**	**31.1 x 10 m (102’ x 33’)**
Useable diameter	4.6 m (15’)	7.5 m (24.6’)	7.5 m (24.6’)	9.1 m (29.9’)
Useable volume	~250 m3 (8,828 ft3)	620 m3 (21,880 ft3)	985 m3 34,800 ft3	1,651 m3 58,300 ft3

Universal Stage Adaptor and Co-Manifested Payload Capability

NOTIONAL – Based on current USA concepts

USA POD Concept

Useable volume
~ 400 m3 (14,100 ft3)

USA POD Mission Concept

Orion
w/extra SM

Secondary Payload Capability Creates Unique Partnership Opportunities

- Eleven 6U/12U payload locations
- 6U volume/mass is the current standard (14 kg payload mass)

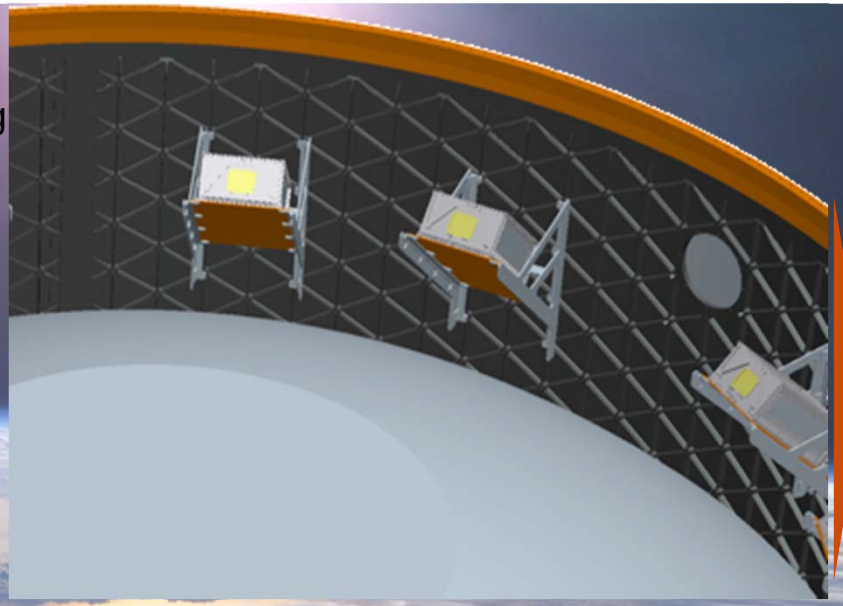
- Payloads will be “off” from roll-out through Orion separation and payload deployment

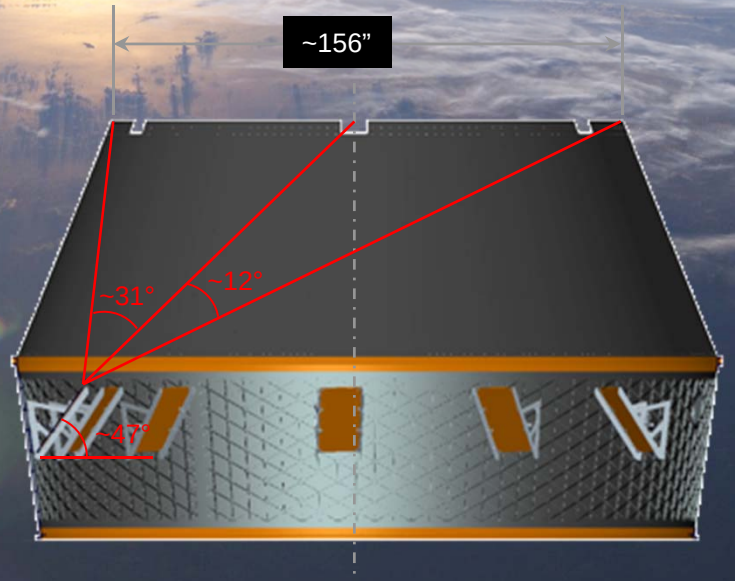
- Payload Deployment System Sequencer; payload deployment will begin with pre-loaded sequence following MPCV separation and ICPS disposal burn

- Payload requirements captured in Interface Definition and Requirements Document

Advanced Exploration Systems candidate EM-1 payloads include:

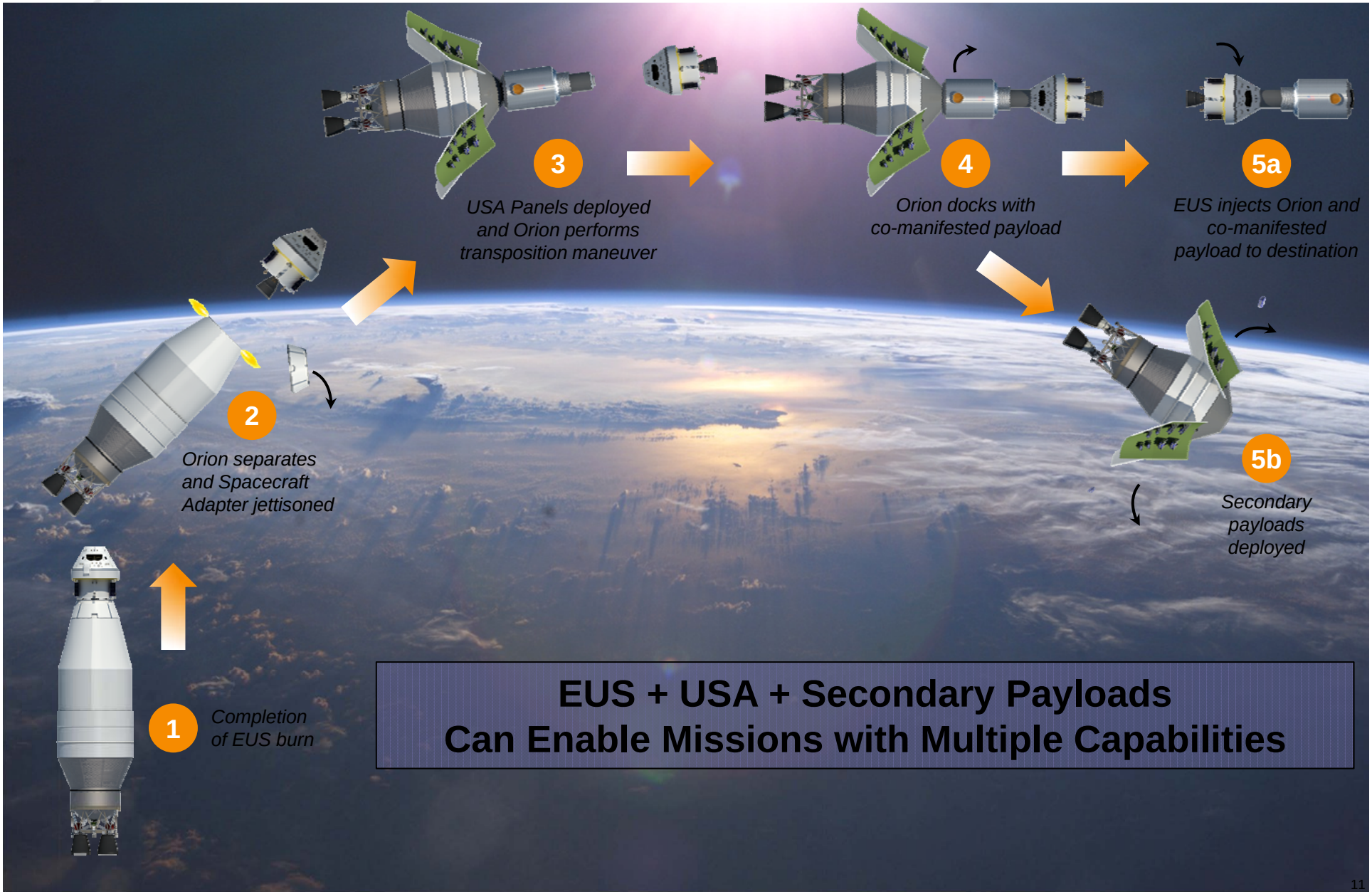
- BioSentinel: Study radiation-induced DNA damage of live organisms in cislunar space; correlate with measurements on ISS and Earth.
- Lunar Flashlight: Locate ice deposits in the moon’ permanently shadowed craters
- Near Earth Asteroid (NEA) Scout: Flyby/rendezvous and characterize one NEA that is a candidate for a human mission.





Co-Manifested Payload Operations

NOTIONAL – Based on mission concept



EUS + USA + Secondary Payloads
Can Enable Missions with Multiple Capabilities

Summary

- **SLS is a building block for exploration beyond LEO**
  - Block 1 configuration enables early lunar-vicinity flight tests opportunities with highest C3
  - Evolved configurations significantly enhance lunar-vicinity capabilities and enable human missions to Mars.
- **SLS is currently on schedule for launch readiness.**
  - Agency baseline commitment completed in August 2014, proceeding to CDR.
  - Qualification and flight hardware production online representing all SLS elements.
- **SLS capabilities open options for exploration in cis-lunar space, to Mars, and beyond by reducing risks and minimizing total architecture costs**
  - **High-energy** reduces trip times
  - **Heavy-lift** capability minimizes in-space assembly
  - **Large payload volumes** with both fairings (8.4 and 10 meter) and USA allow for single-launch of outsized exploration hardware and options for co-manifesting
  - **Secondary payload capability** beyond LEO for all missions is enabling and provides partnership opportunities

Back-Up

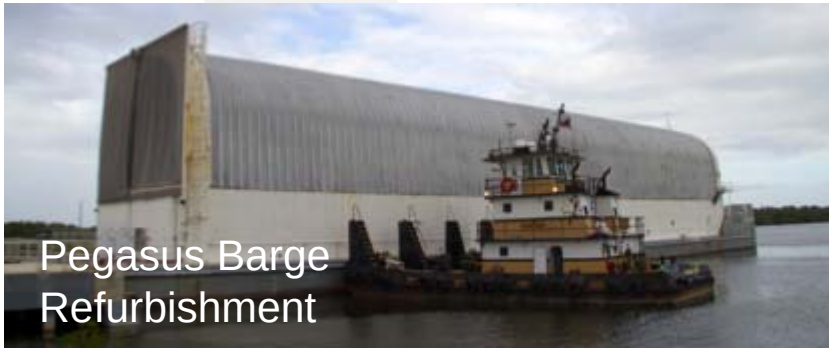
Looking Forward


RS-25 Testing


LVSA Production

Structural Test Article Welding


Test Stand Completion


Pegasus Barge Refurbishment


Qualification Motor Testing