National Aeronautics and Space Administration

NASA's Space Launch System:
State of the Rocket

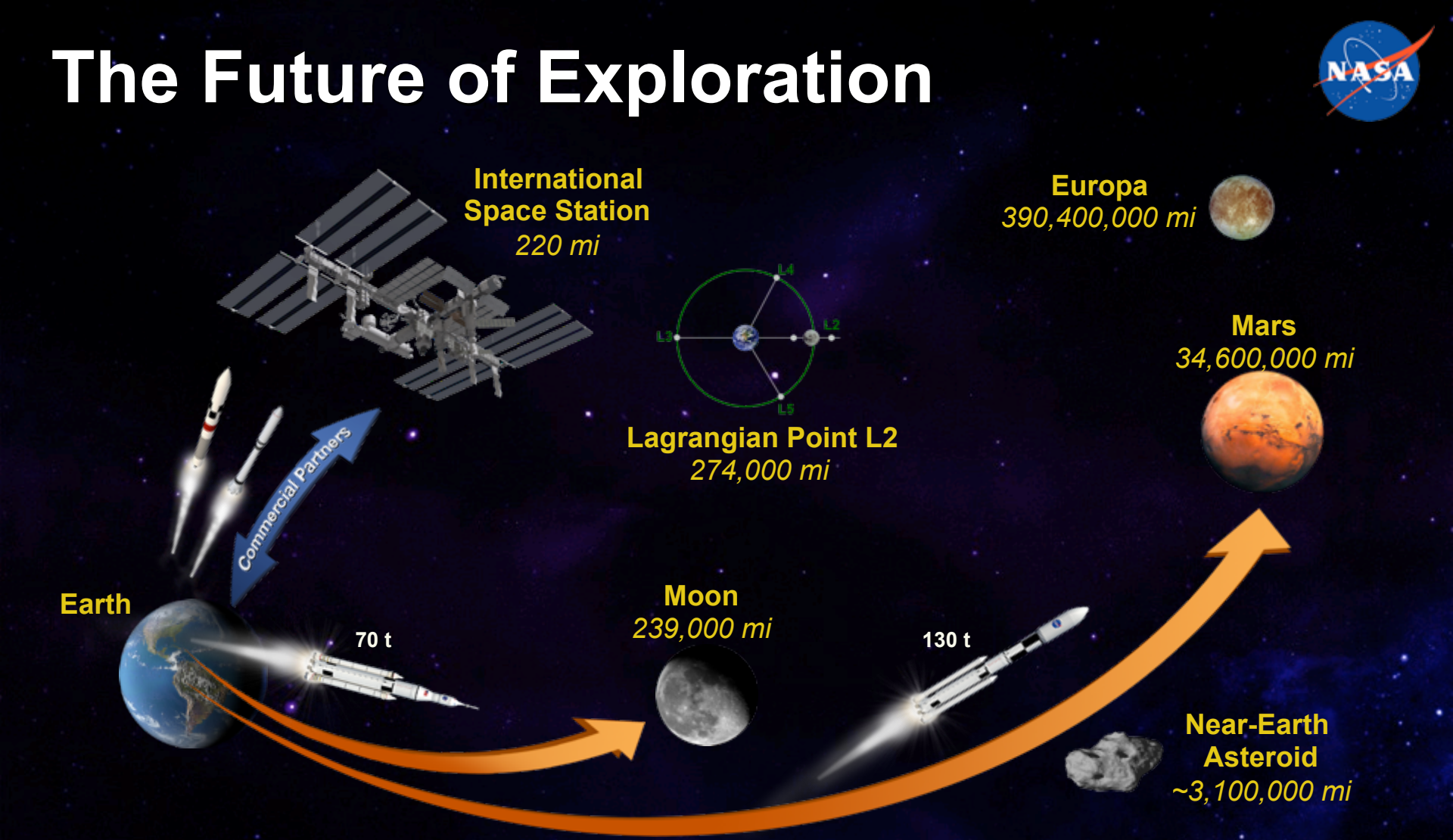
Todd May
SLS Program Manager
April 30, 2013






Powering the Future of Exploration

The Future of Exploration



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

Asteroid Retrieval Mission

2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

Asteroid Detection, Characterization & Selection Segment

SST

PS-2

GEO-hosted payload detection

Enhanced ground assets & Initial candidates

Final target selection

Asteroid Redirection Segment

THIS SEGMENT TIMELINE NOTIONAL- SUBJECT TO CHANGE AS MISSION CONCEPT EVOLVES

Mission Launch & SEP Demo

Asteroid Rendezvous & Capture

Asteroid Maneuver to Cis-lunar Space

Orion & SLS Crewed Asteroid Exploration Segment

Test flight of Orion in Earth orbit

EM-1: Un-crewed Orion test beyond the Moon

EM-2: First crewed launch of SLS-Orion

www.nasa.gov/sls

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)

RS-25 Engines at Stennis Space Center Oct 2012, shown with future RS-25 Test Stand A1

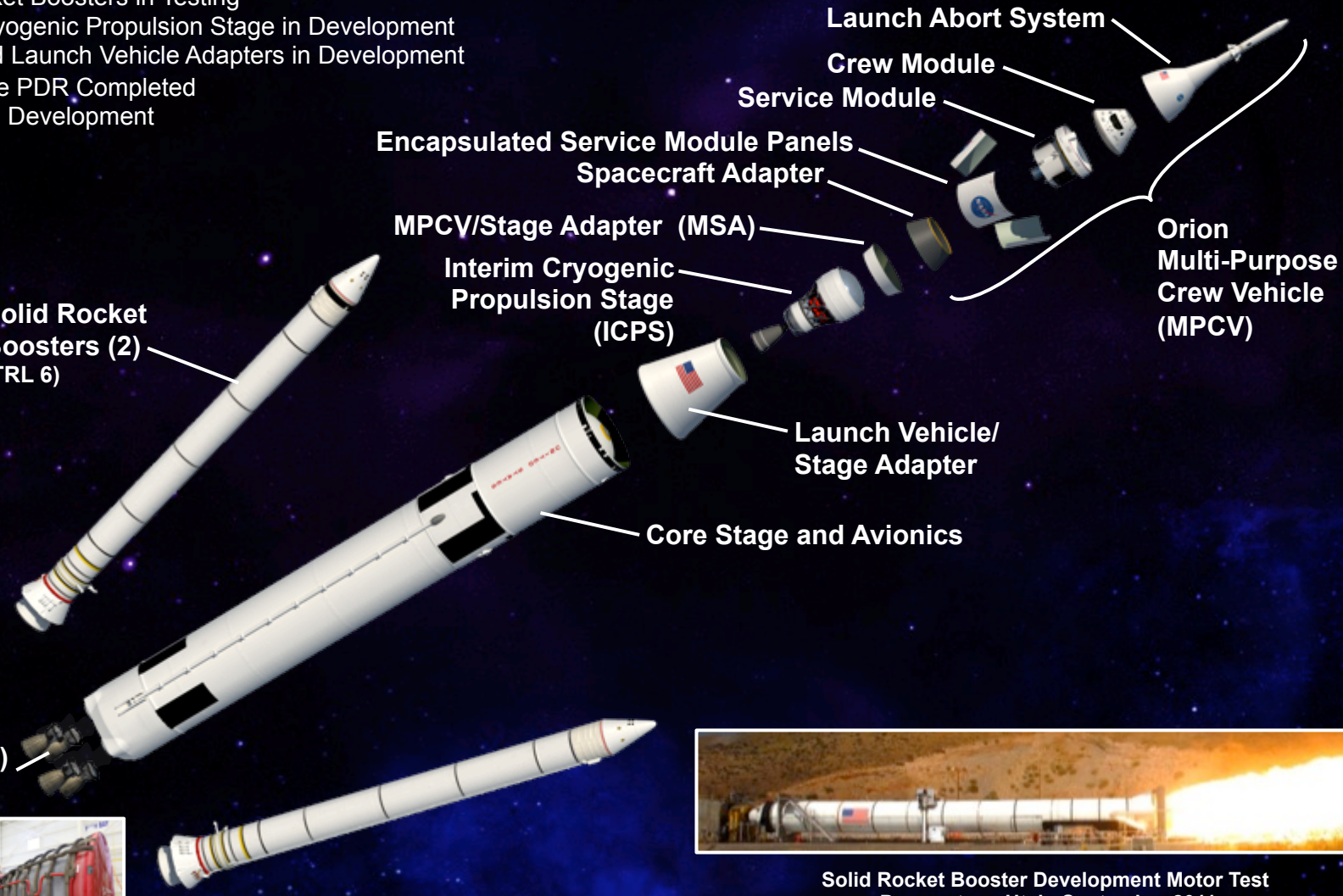
F-1 engine gas generator hot fire test at Marshall Space Flight Center, Jan 2013 – technology development for an optional Advanced Booster concept

Qualification Motor 1 casting at ATK Oct 2012

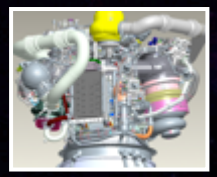
System Requirements Review/System Definition Review Completed

SLS 70t Expanded View

Hardware Progress:
- RS-25 Core Stage Engines In Stock
- Solid Rocket Boosters in Testing
- Interim Cryogenic Propulsion Stage in Development
- MPCV and Launch Vehicle Adapters in Development
- Core Stage PDR Completed
- Avionics in Development

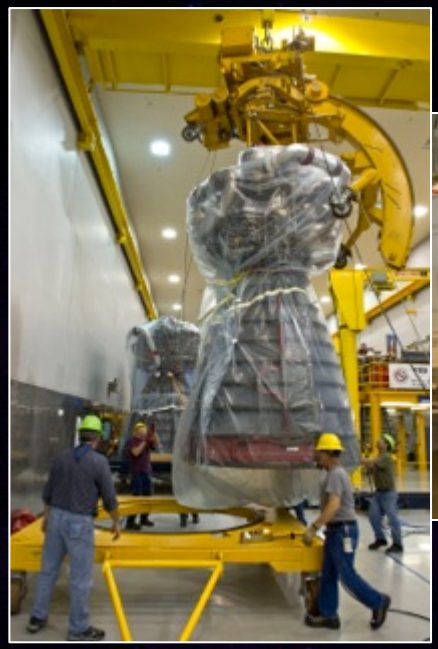


RS-25/J-2X Engine Control Unit



Solid Rocket Booster Development Motor Test
Promontory, Utah, September 2011

Core Stage RS-25s In Inventory



- Inventory at Stennis Space Center for first four flights of SLS
- New common engine controller derived from J-2X development
- Manufacturing trials for new RS-25 production begin in FY14

5-Segment Solid Rocket Booster

Qualification Motor Casting, July 2012

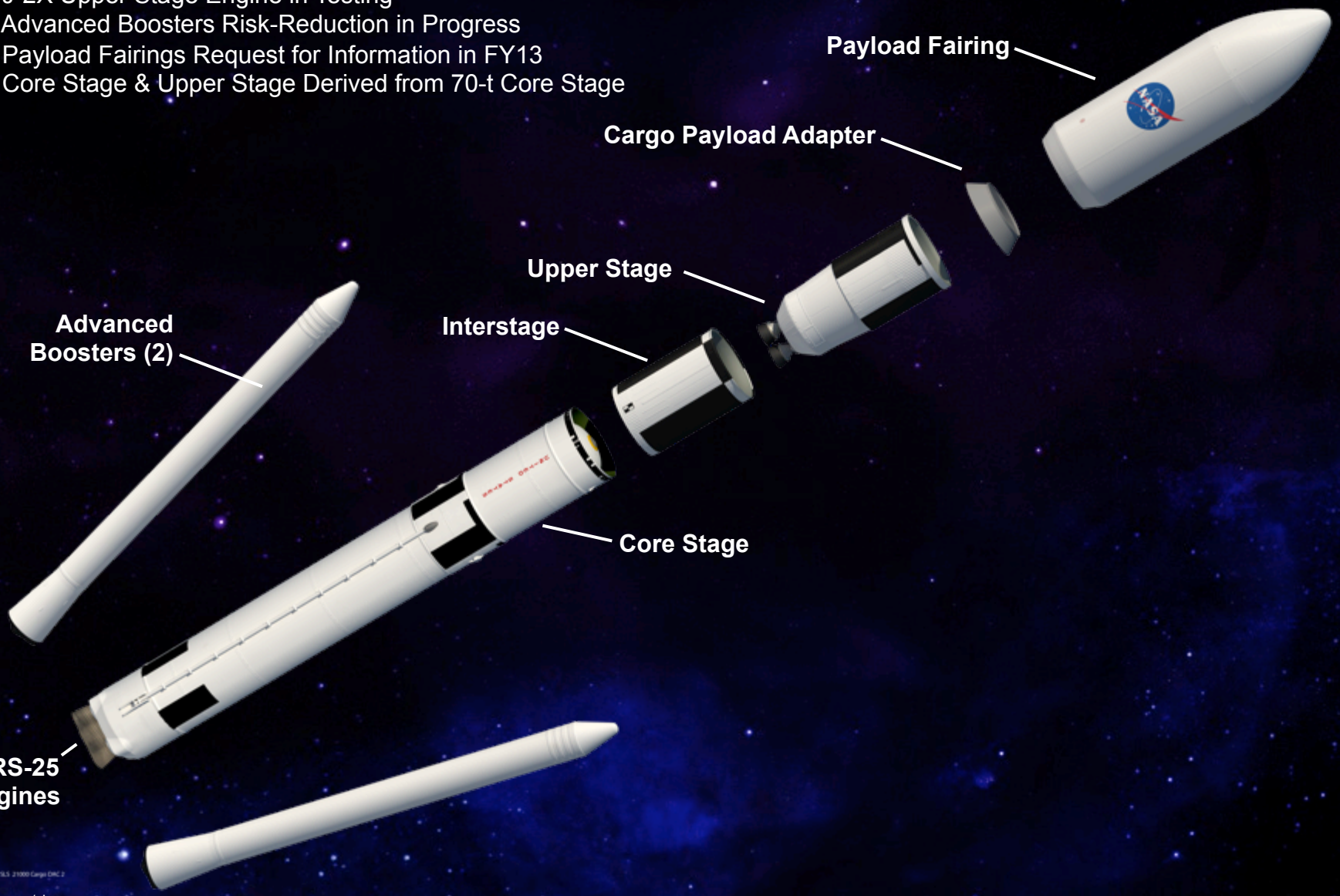
Development Motor Test 3
September 8, 2011
ATK Promontory, Utah

5-Segment Solid Rocket Booster

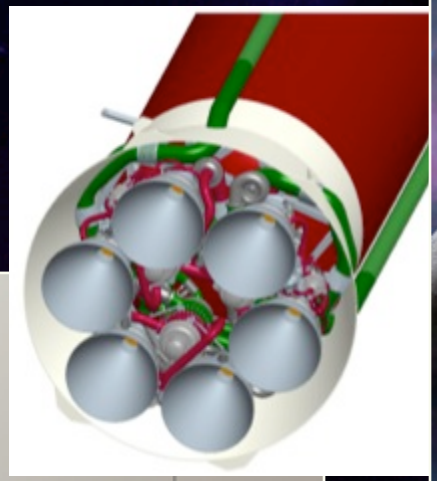
Interim Cryogenic Propulsion Stage

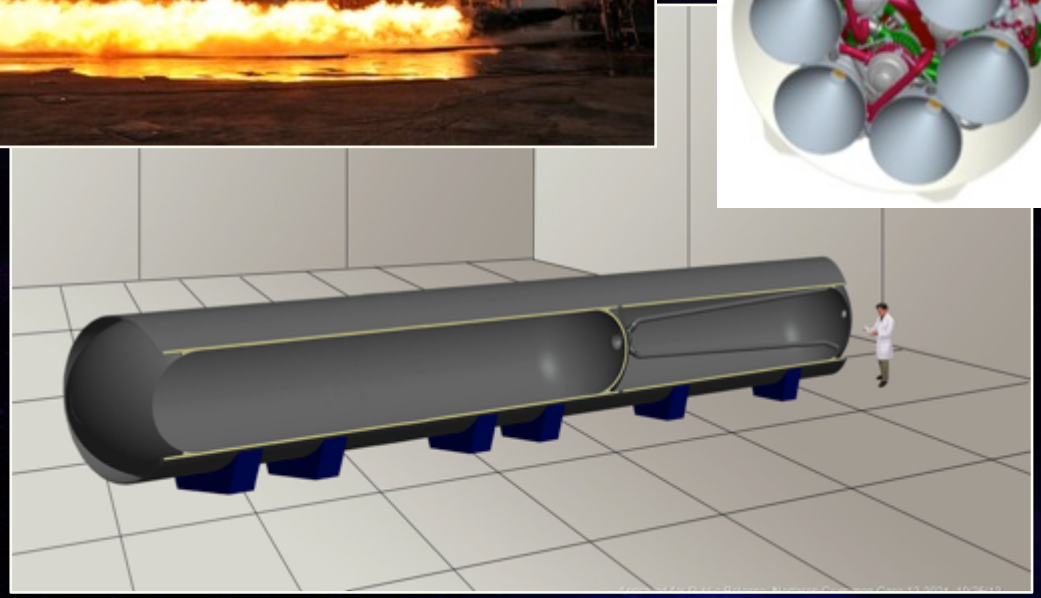
SLS 130t Expanded View

Hardware Progress:
- J-2X Upper Stage Engine in Testing
- Advanced Boosters Risk-Reduction in Progress
- Payload Fairings Request for Information in FY13
- Core Stage & Upper Stage Derived from 70-t Core Stage



Advanced Booster Research

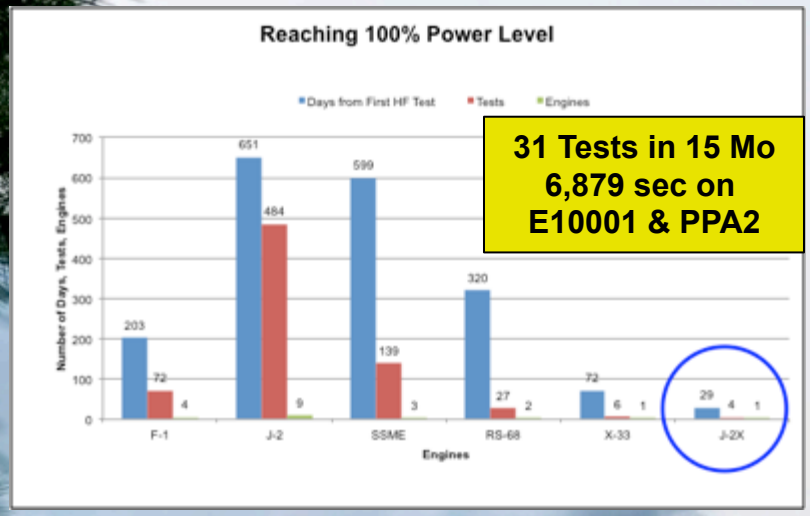




The Advanced Booster Engineers Demonstration and Risk Reduction (ABEDRR) effort will reduce risks and enable competition, leading to an affordable Advanced Booster that meets the evolved capabilities of SLS and enable competition.

F-1B Risk Reduction

J-2X Upper Stage Engine: In Testing



31 Tests in 15 Mo
6,879 sec on
E10001 & PPA2

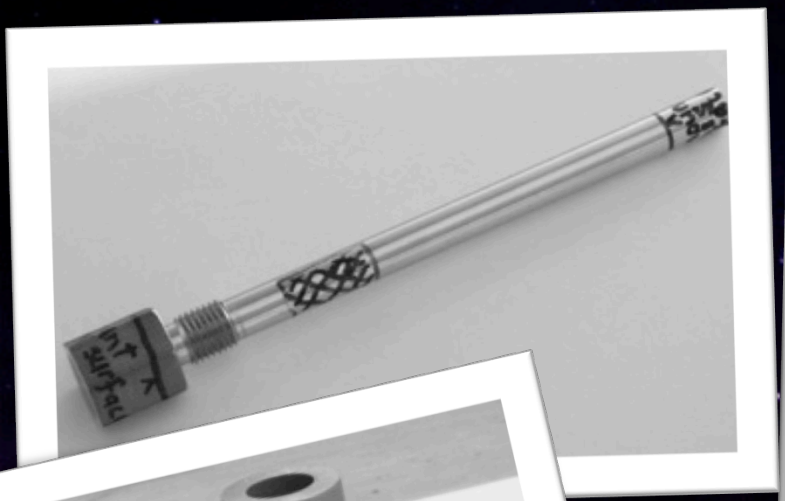
Successful engine research effort:

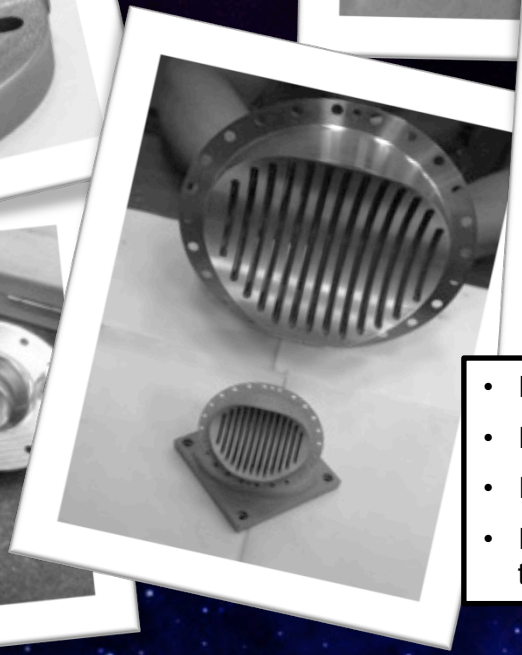
- **Yielded new Common Engine Controller**
- **Testing includes Selective Laser Melting component.**

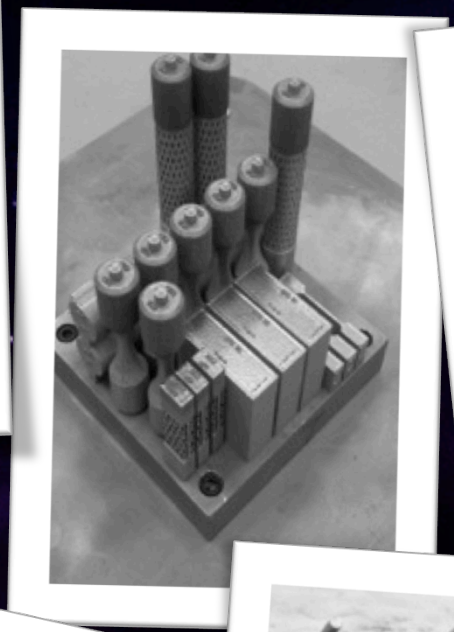
Shortest Time to Full Power Level Ever Recorded

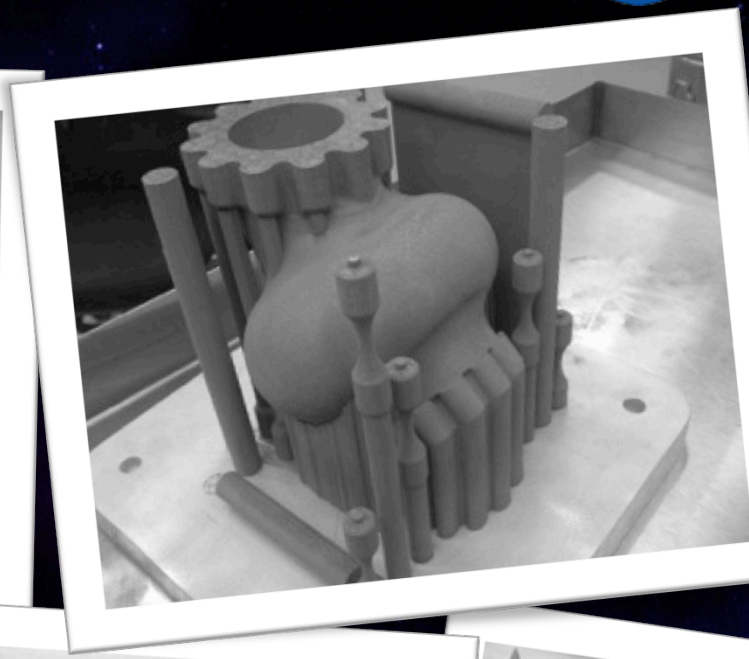
J-2X Upper Stage Engine

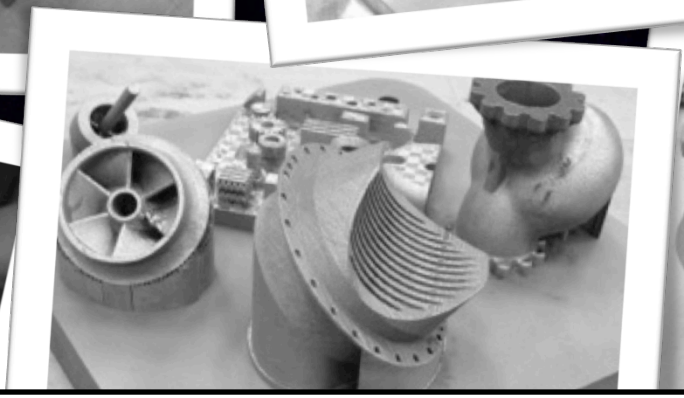
Selective Laser Melting





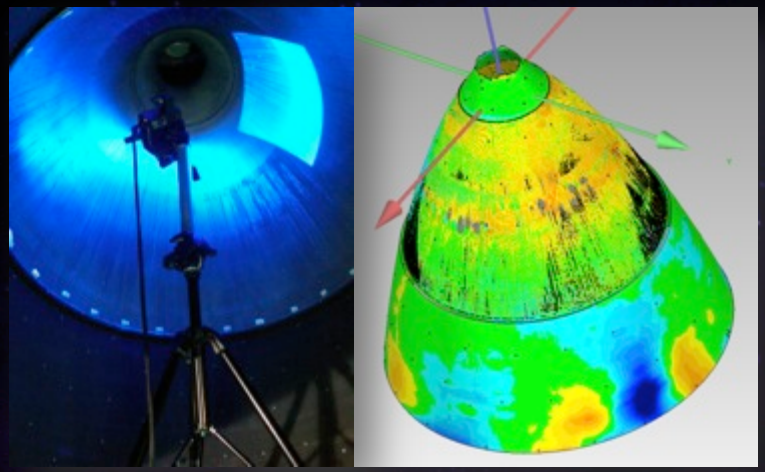




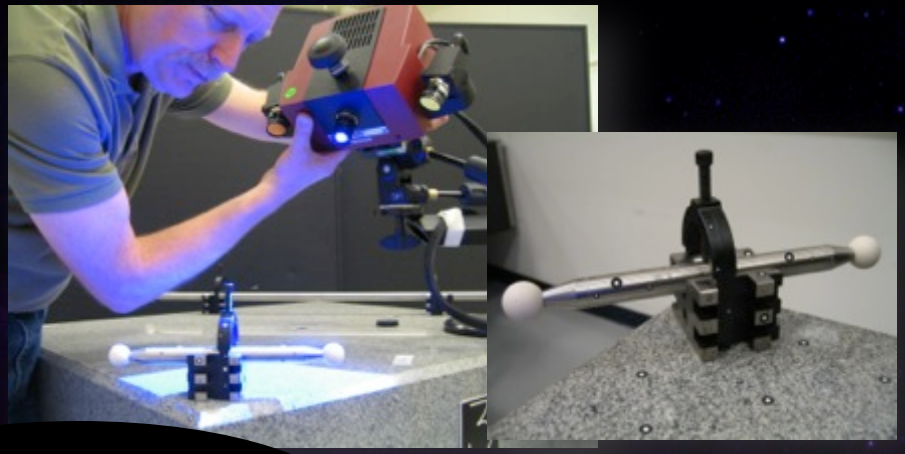


- Machine installed in 4707 September 2012
- MSFC is participating with other agencies to develop standards
- First SLM part fired on J-2X in March 2013.
- MSFC is building parts for many different applications and working toward having a part on the 1st SLS flight

Structured Light Scanning Development

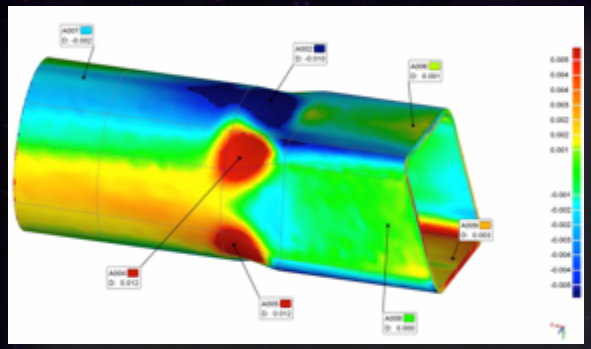


Replaced difficult measurements with scanning to help **reduce performance uncertainty** (throat and exit areas)

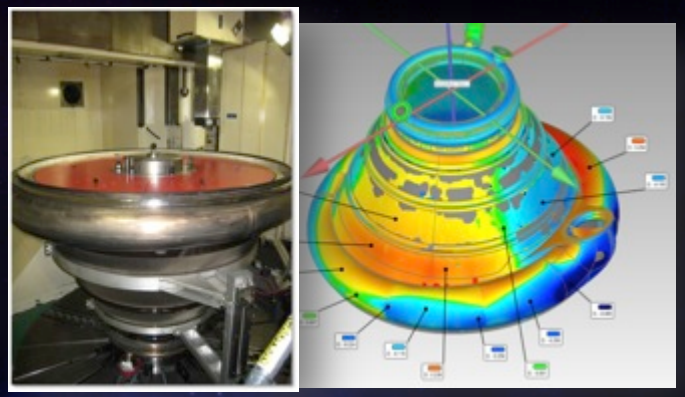


Training and Implementing as a new technique for Rocketdyne Personnel

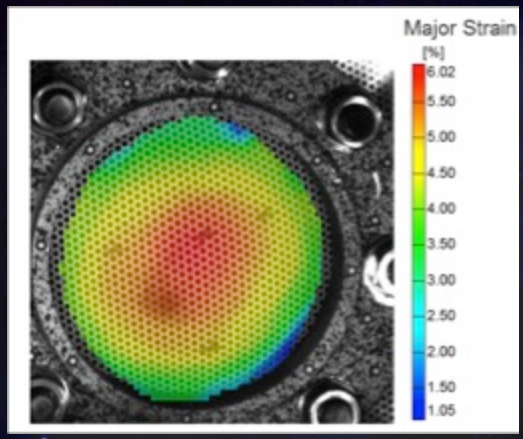
Completing study to advance structured light as a quality acceptance tool. **Implementing > 5:1 time savings**



Structured Light Introduced to Sub-tier Vendors to modify tube dies to **integrate supply chain** (i.e. reduce turn around time for nozzle assembly)



Structured Light Used to **Generate Machining Code** and Match Machine at PWR



Developing new optical techniques to augment traditional engine measurements

Reducing the Development Cycle for Hardware

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.

For More Information

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