National Aeronautics and Space Administration

SLS/Orion: Design and Development

Presented to the Defense and Aerospace Test and Telemetry Summit

William H. Gerstenmaier | April 26, 2016

Exploration Systems Development

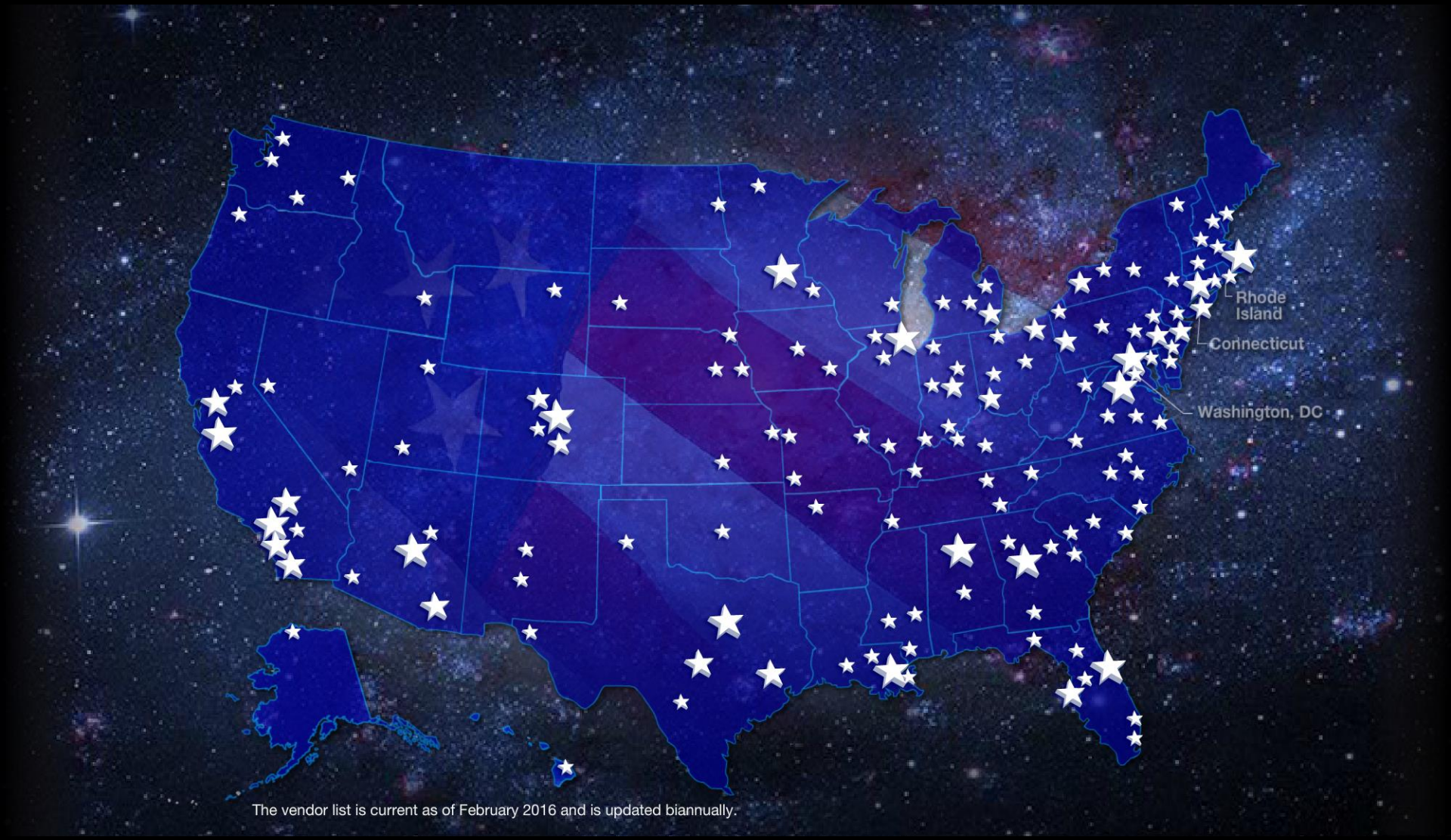
Beginning human exploration beyond LEO as soon as practicable helps secure our future in space.

Space Launch System

Ground Systems Development & Operations

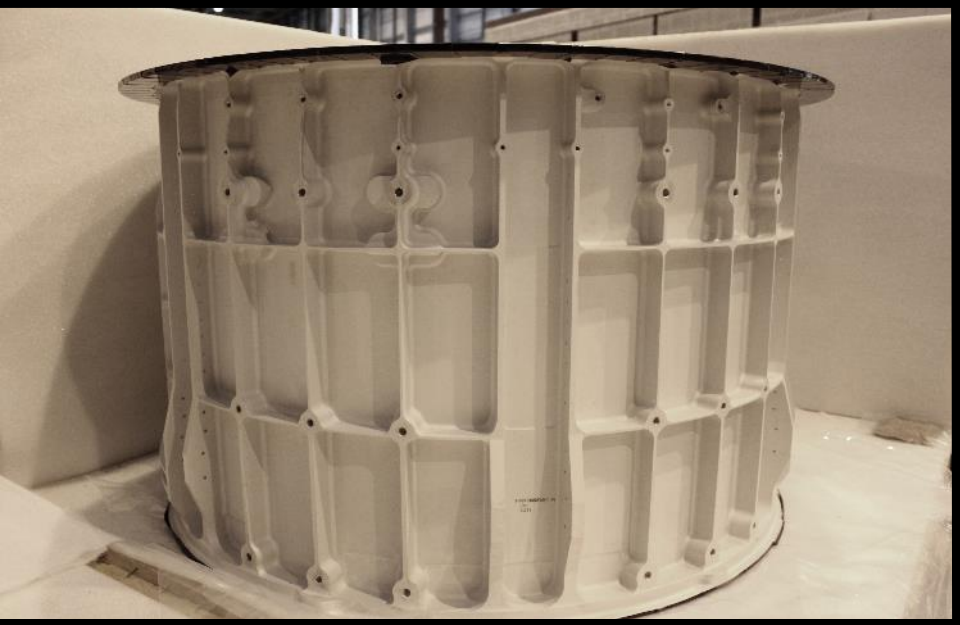
Orion Spacecraft

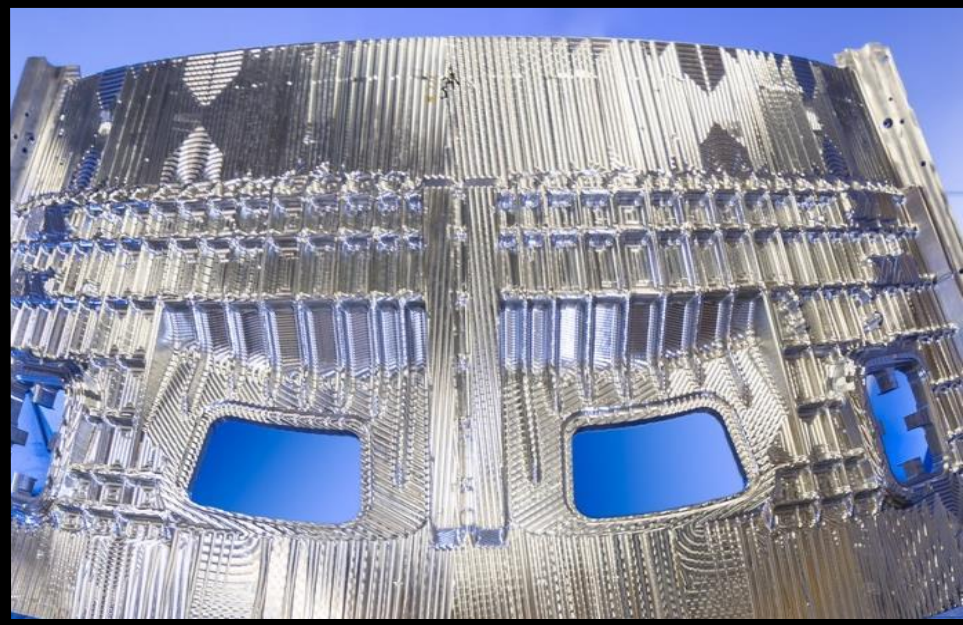
ESD Partners & Suppliers in America



ESD Partners & Suppliers in Europe


ORION
PROGRESS TOWARDS EXPLORATION MISSION-1





UTILIZING OUR NATION'S TOP MACHINE SHOPS

EM-1 CREW MODULE PRESSURE VESSEL WELDING

MICHOUD ASSEMBLY FACILITY, NEW ORLEANS, LOUISIANA

EM-1 CREW MODULE PRESSURE VESSEL

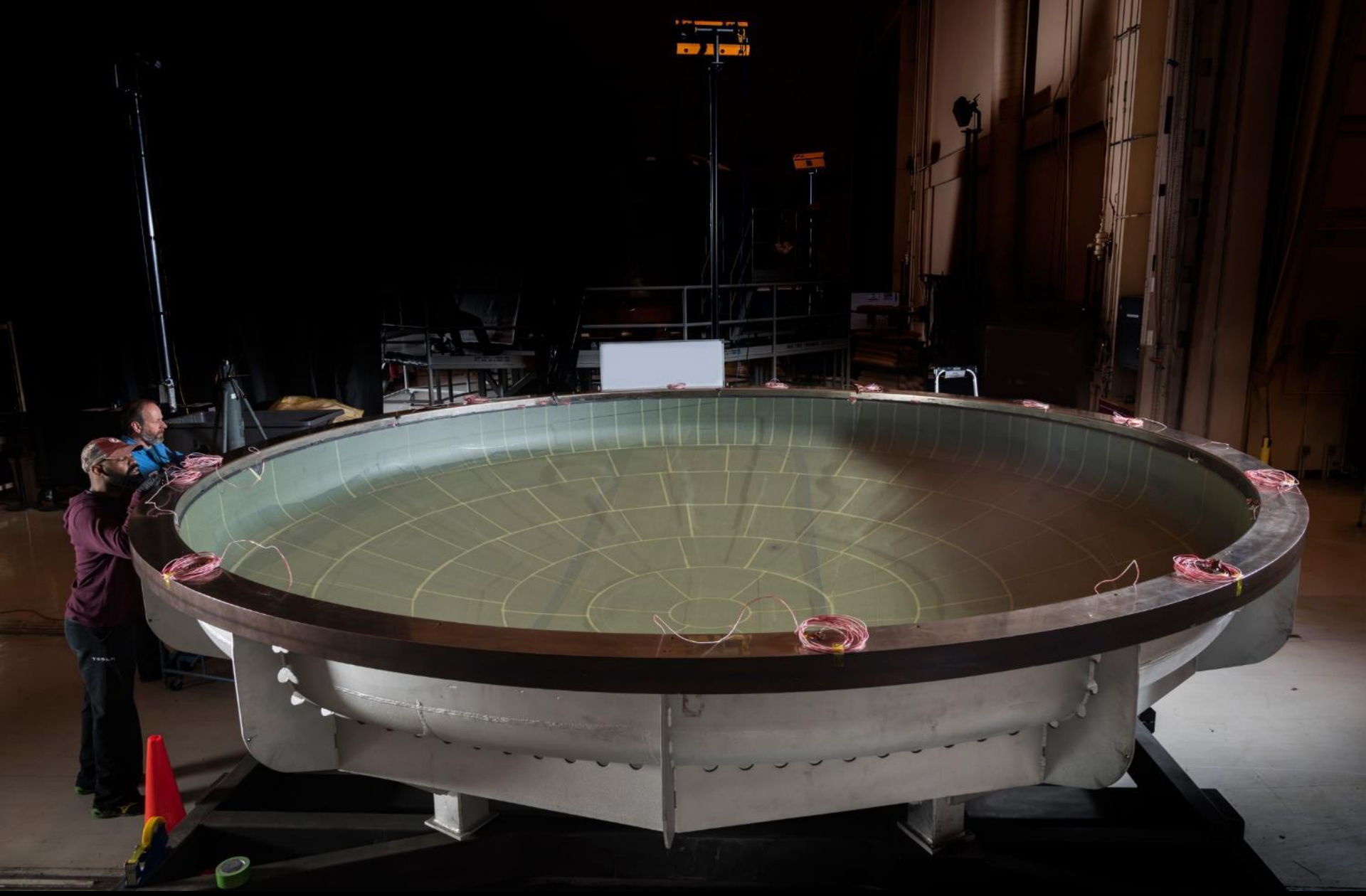
OPERATIONS AND CHECKOUT BUILDING, KENNEDY SPACE CENTER, FLORIDA

EM-1 LAUNCH ABORT SYSTEM

ORBITAL ATK, UTAH

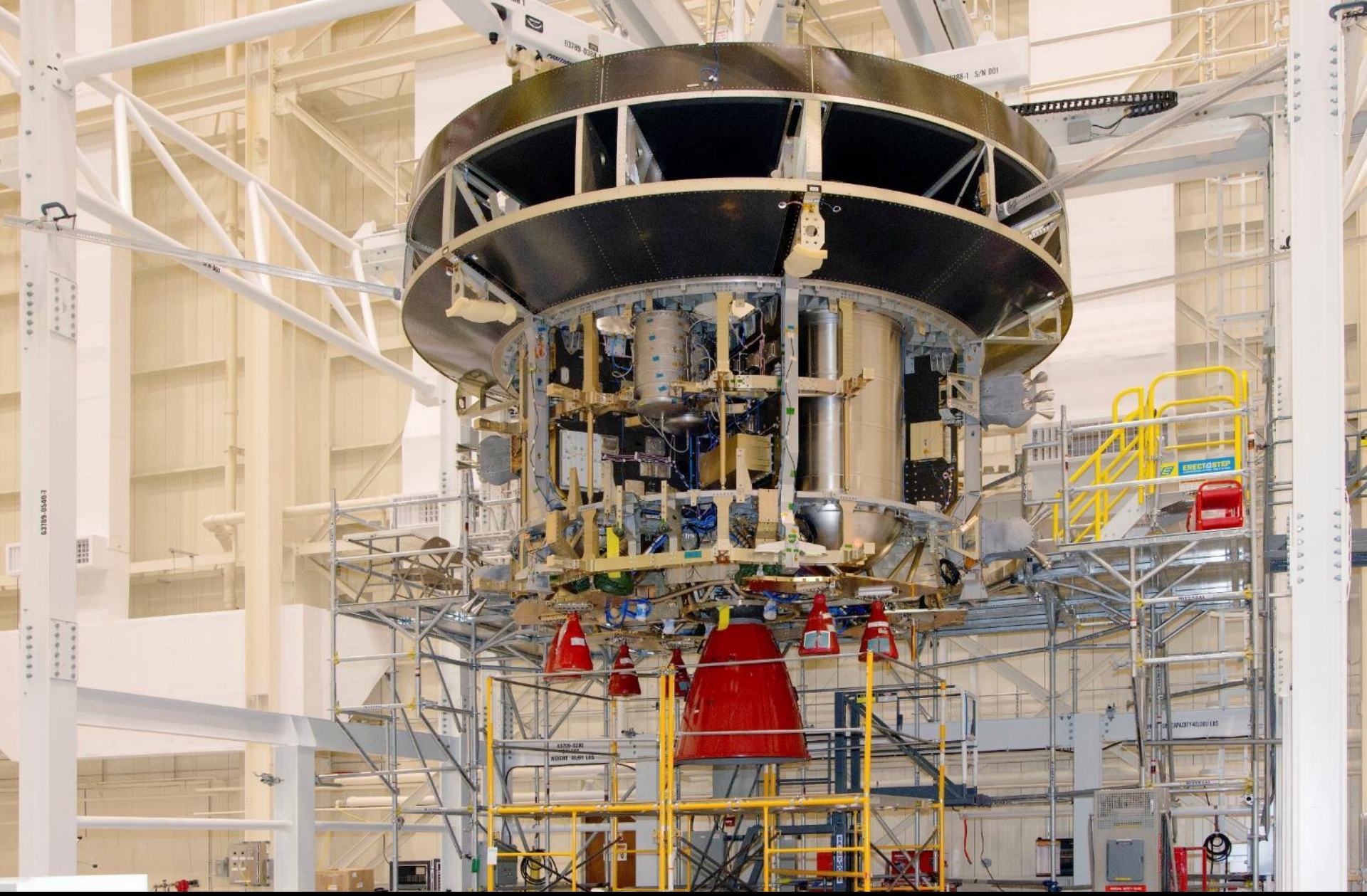
HEAT SHIELD MANUFACTURING DEVELOPMENT UNIT

LOCKHEED MARTIN, LITTLETON, COLORADO



EM-1 HEAT SHIELD CARRIER STRUCTURE

LOCKHEED MARTIN, SUNNYVALE, CALIFORNIA



SERVICE MODULE STRUCTURAL TEST ARTICLE

GLENN RESEARCH CENTER PLUM BROOK STATION, OHIO

SERVICE MODULE STA SOLAR ARRAY TEST

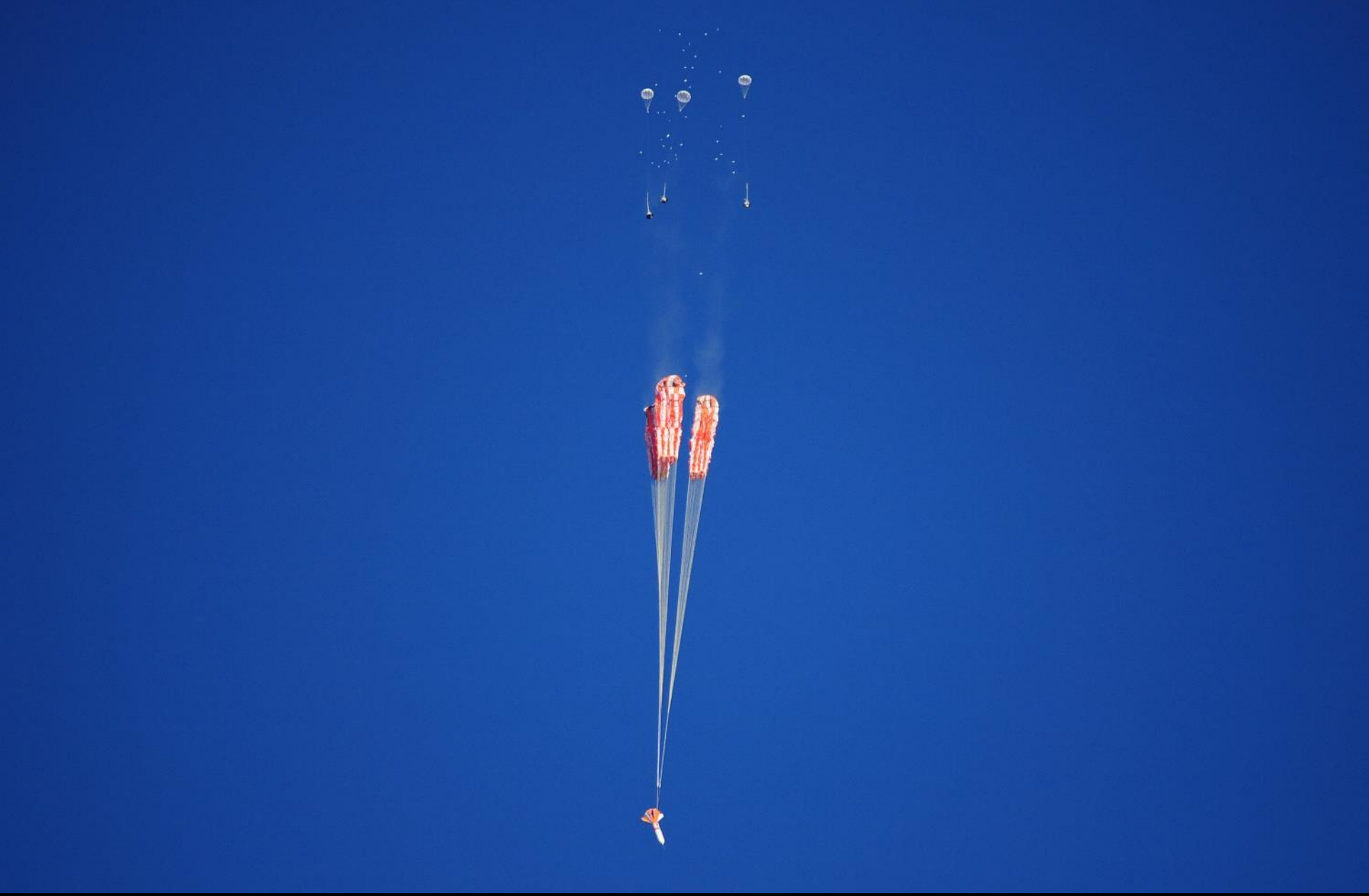
GLENN RESEARCH CENTER PLUM BROOK STATION, OHIO

SERVICE MODULE STA ACOUSTIC TESTING

GLENN RESEARCH CENTER PLUM BROOK STATION, OHIO

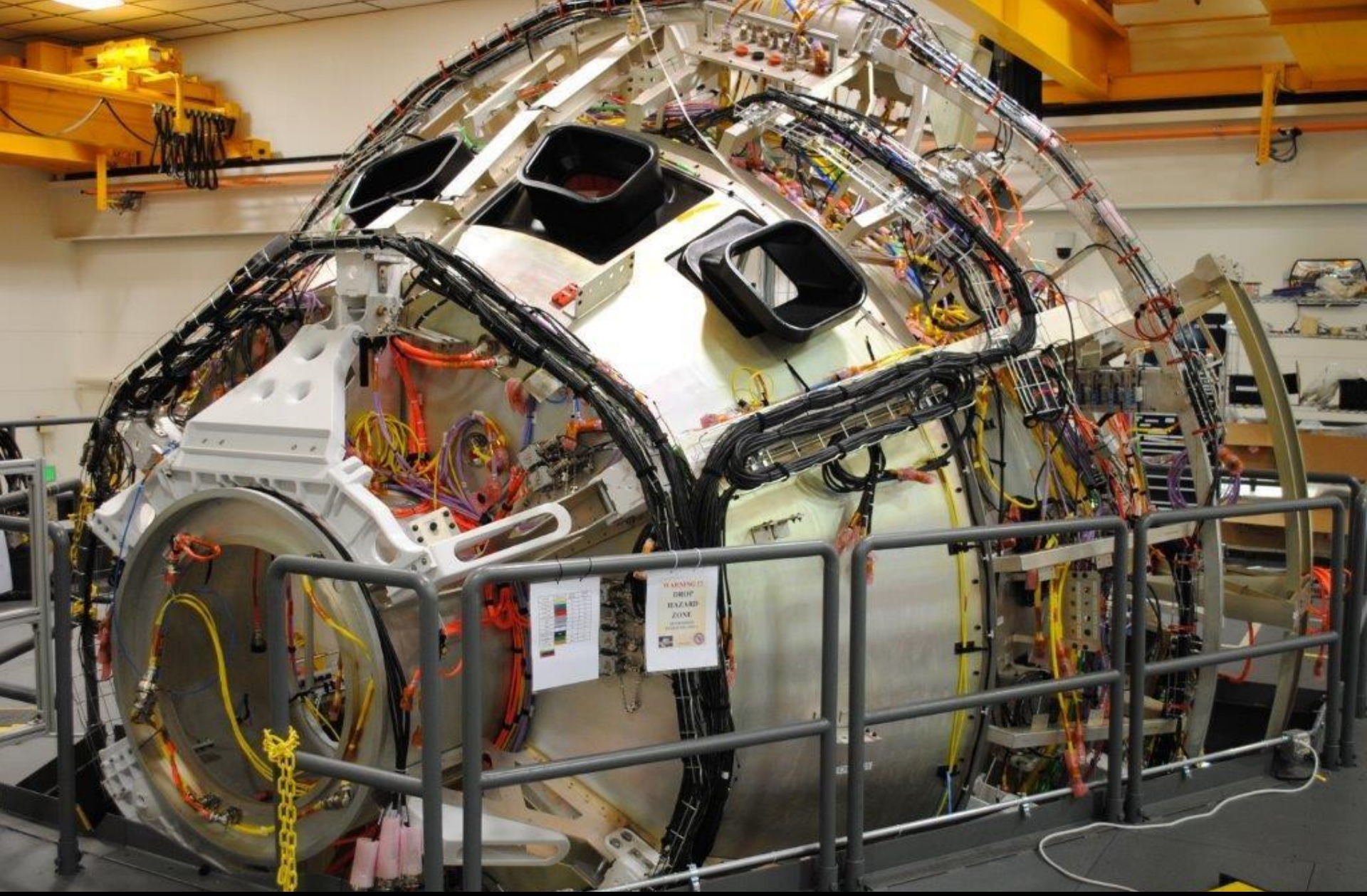
WATER DROP TESTS

LANGLEY, RESEARCH CENTER, VIRGINIA



PARACHUTE DROP TESTS

YUMA, ARIZONA



INTEGRATED TEST LAB

LOCKHEED MARTIN, LITTLETON, COLORADO

CREW COCKPIT EVALUATION

JOHNSON SPACE CENTER, HOUSTON, TEXAS

National Aeronautics and Space Administration

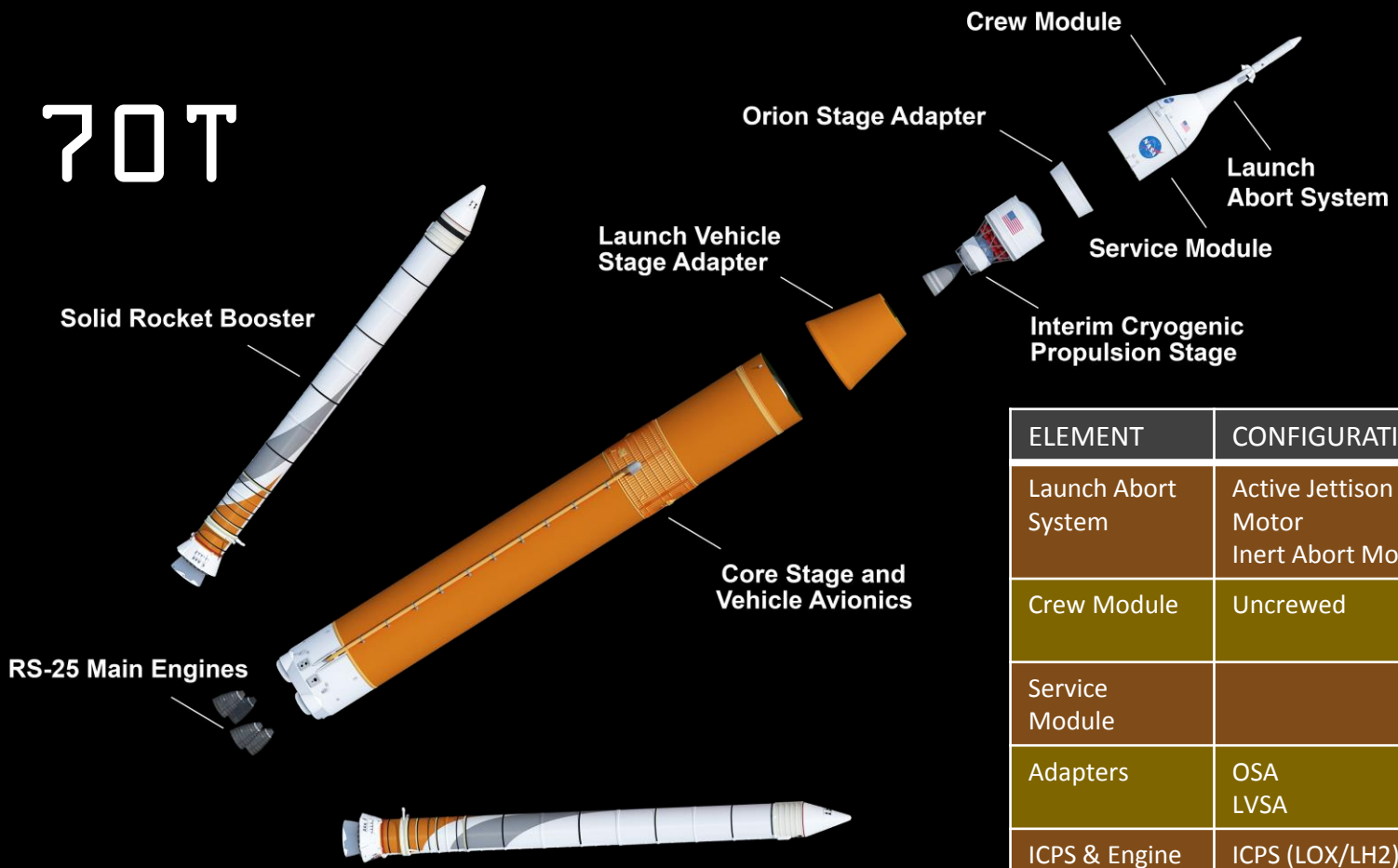
SLS

PROGRESS TOWARD EXPLORATION MISSION-1

www.nasa.gov/sls

Exploration Mission-1 Vehicle Configuration

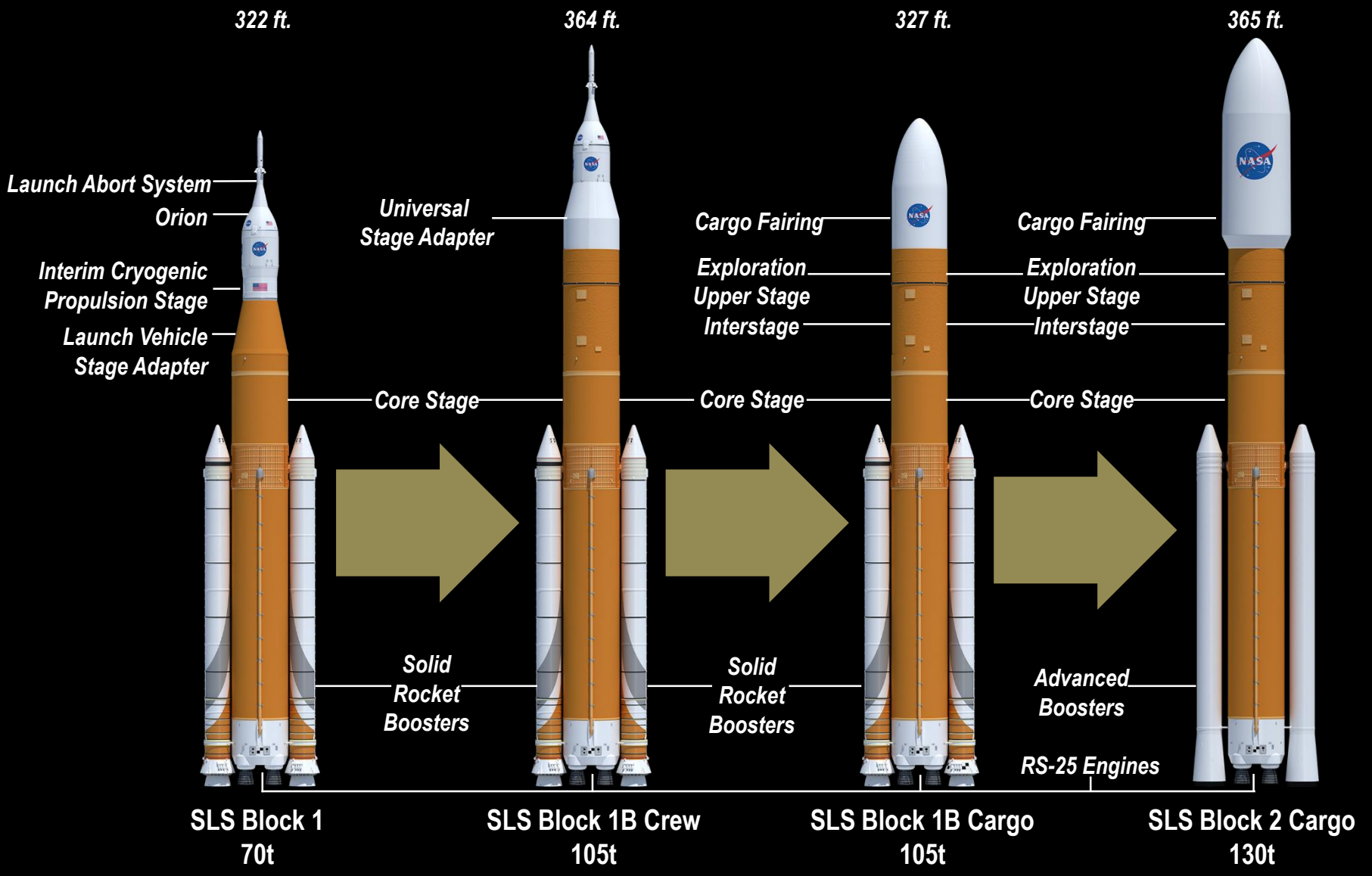
70T



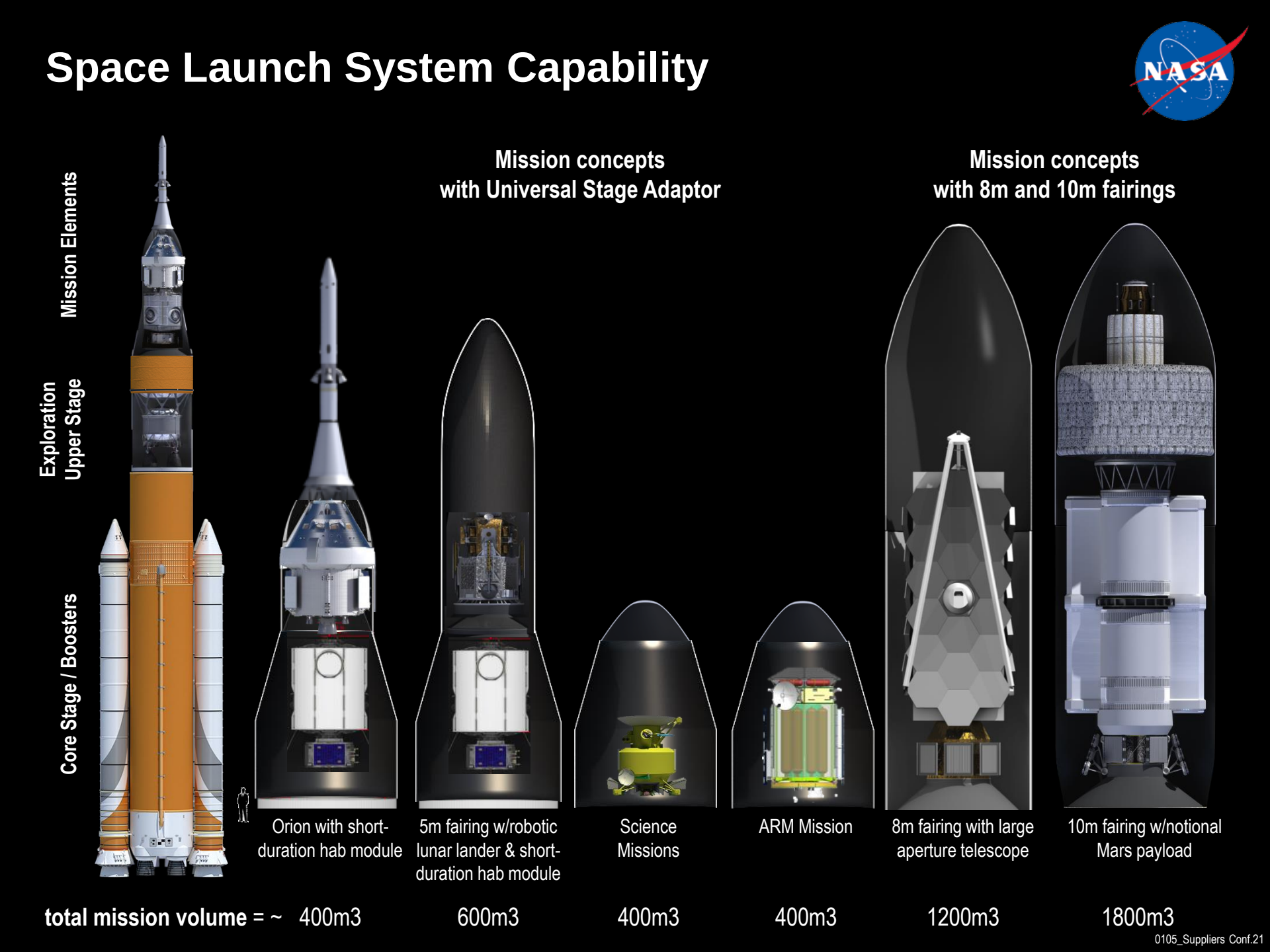
ELEMENT	CONFIGURATION	SUPPLIER
Launch Abort System	Active Jettison Motor Inert Abort Motor	Lockheed Martin
Crew Module	Uncrewed	Lockheed Martin
Service Module		ESA
Adapters	OSA LVSA	NASA MSFC Teledyne Brown
ICPS & Engine	ICPS (LOX/LH2) with RL-10B Engine	ULA Aerojet-Rocketdyne
Core Stage	LOX/LH2	Boeing
Core Stage Engines	Four RS-25's Engines	Aerojet-Rocketdyne
Boosters	Two 5-segment	Orbital-ATK

Height: 322 feet tall
Weight: 5.75 million pounds
Thrust: 8.8 million pounds at lift-off

Space Launch System

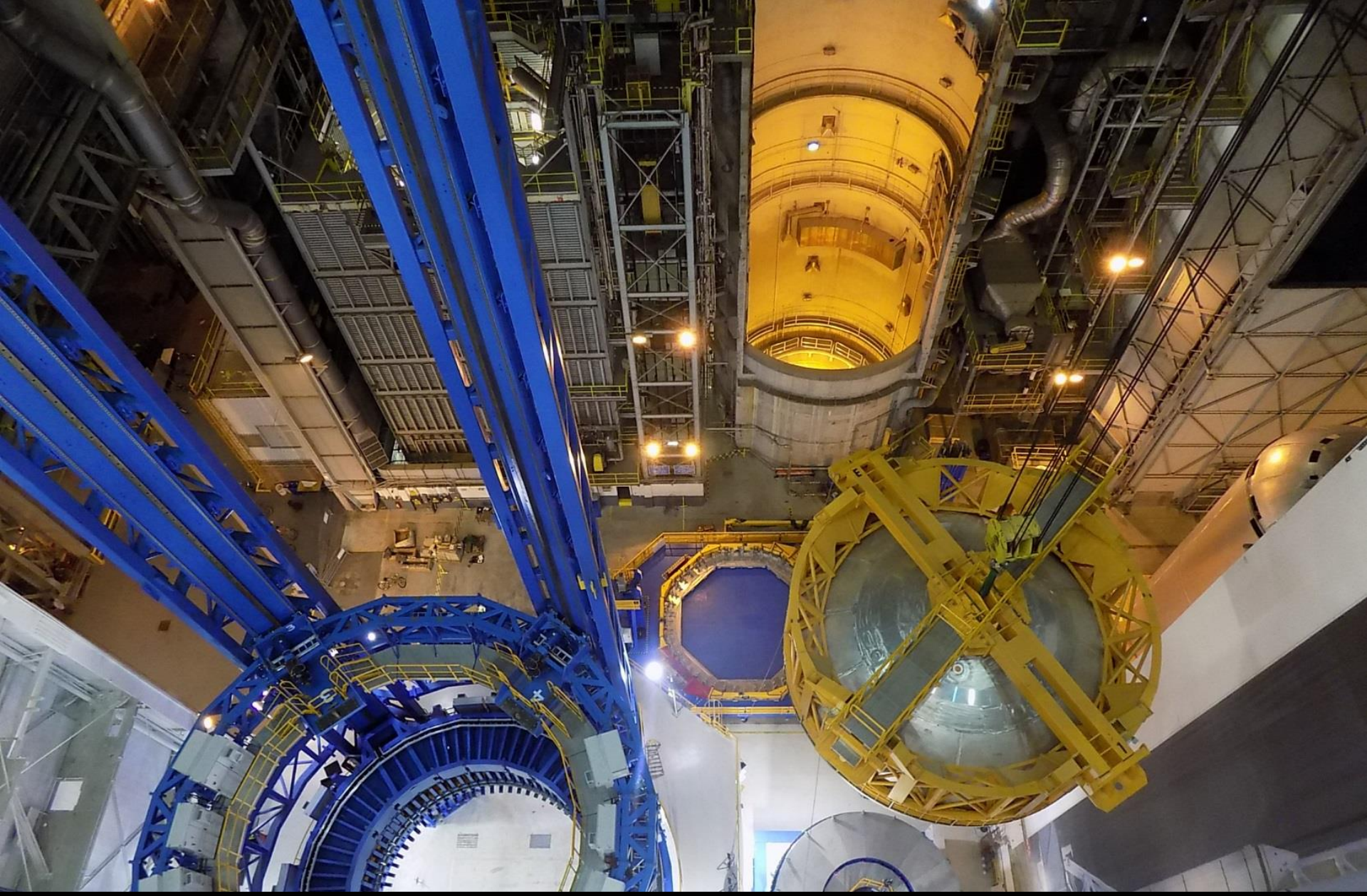


Space Launch System Capability



SLS AVIONICS

MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALABAMA



SLS CORE STAGE

MICHOUD ASSEMBLY FACILITY, NEW ORLEANS, LOUISIANA

LOX CONFIDENCE ARTICLE WELD COMPLETE

MICHOUD ASSEMBLY FACILITY, NEW ORLEANS, LOUISIANA

LAUNCH VEHICLE ADAPTER

MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALABAMA

B-2 TEST STAND

STENNIS SPACE CENTER, MISSISSIPPI

RS-25 ENGINE

STENNIS SPACE CENTER, MISSISSIPPI

RS-25 ENGINE TESTING

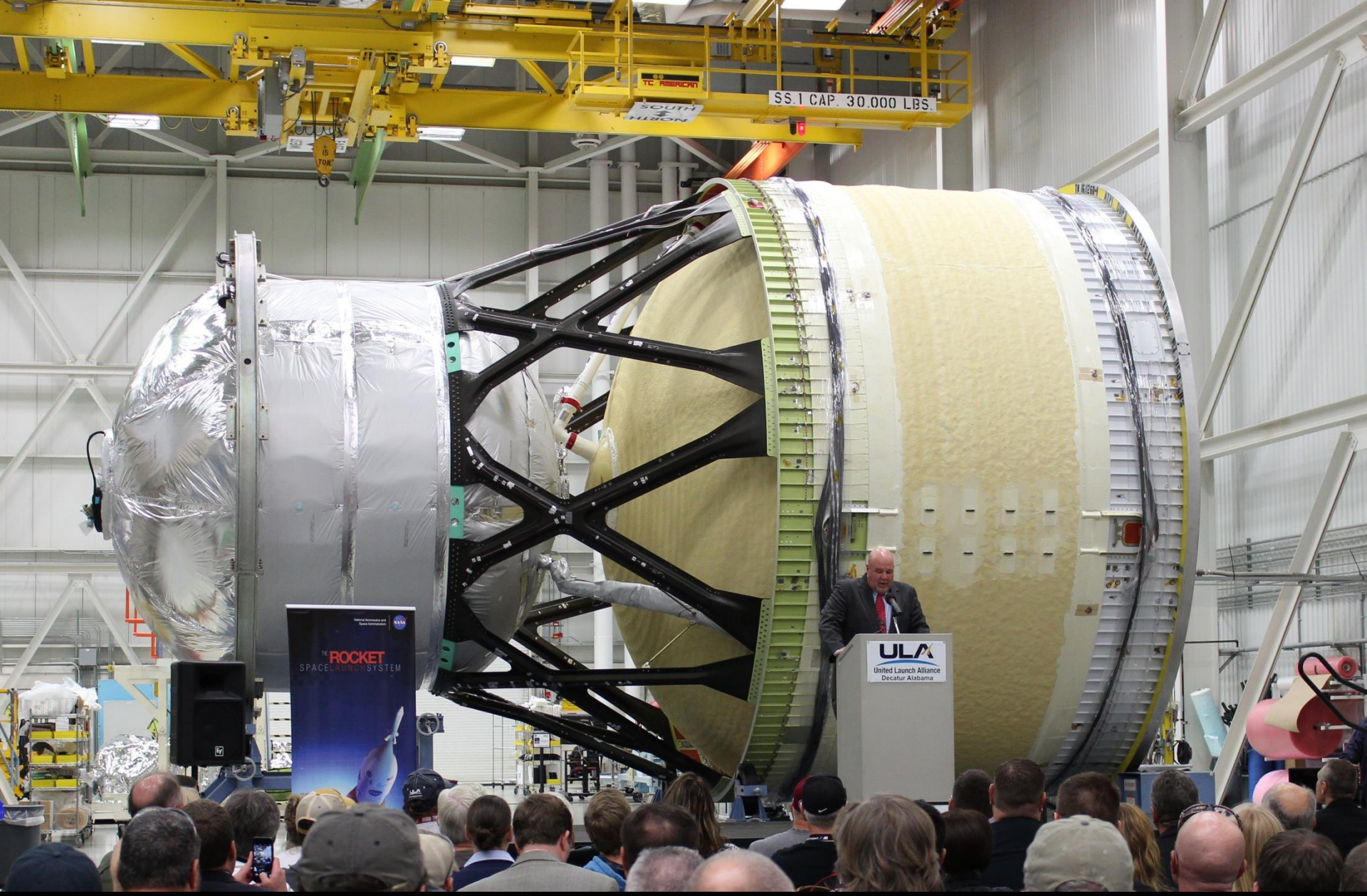
STENNIS SPACE CENTER, MISSISSIPPI

BOOSTER

ORBITAL ATK, PROMONTORY, UTAH

BOOSTER QUALIFICATION MOTOR TEST-1

ORBITAL ATK, PROMONTORY, UTAH



INTERIM CRYOGENIC PROPULSION STAGE

UNITED LAUNCH ALLIANCE, DECATUR, ALABAMA

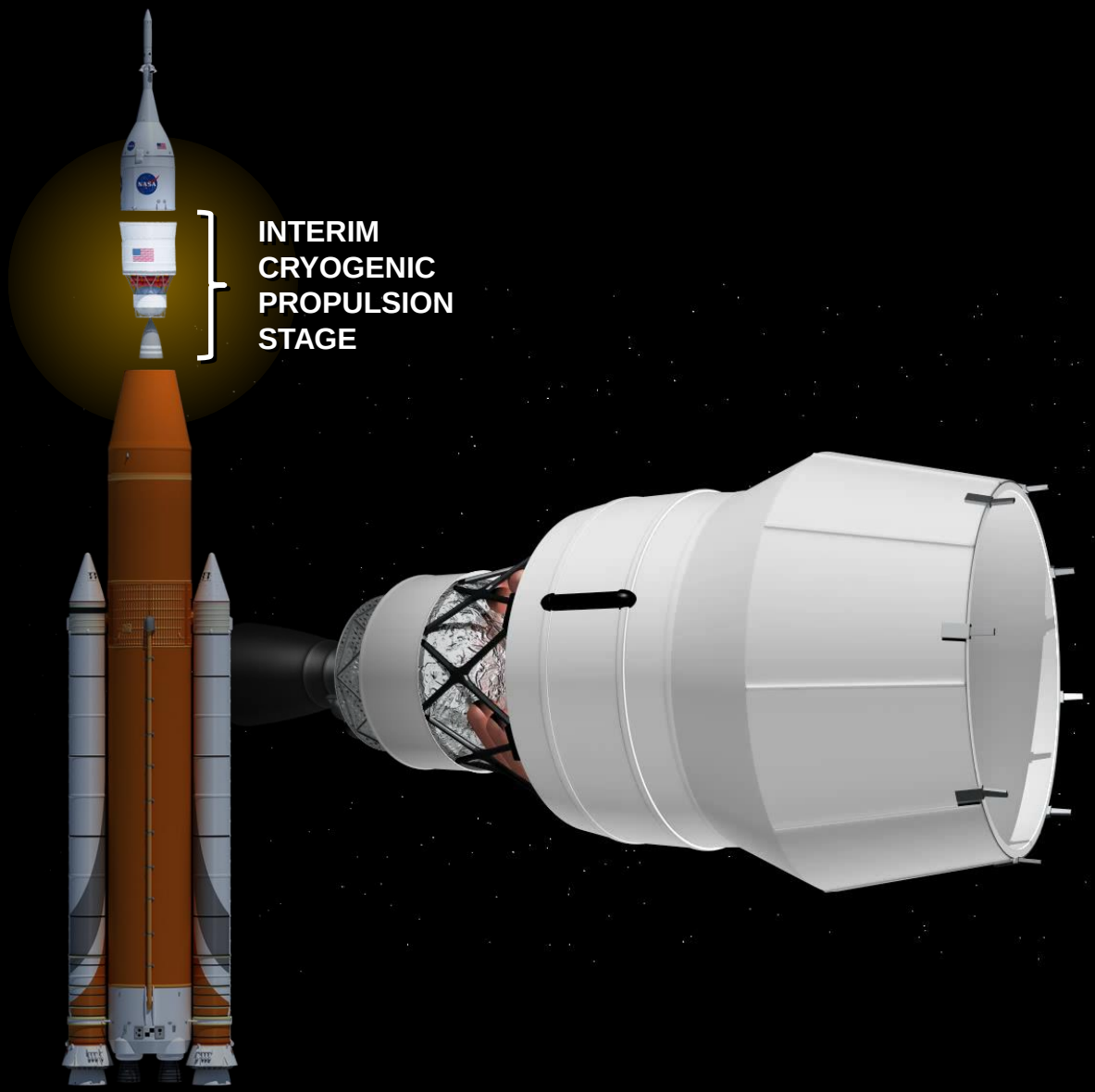
PEGASUS BARGE

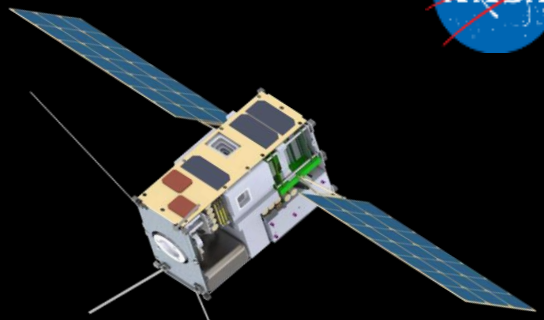
STENNIS SPACE CENTER, BAY ST. LOUIS, MISSISSIPPI

STRUCTURAL TEST STANDS

MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALABAMA

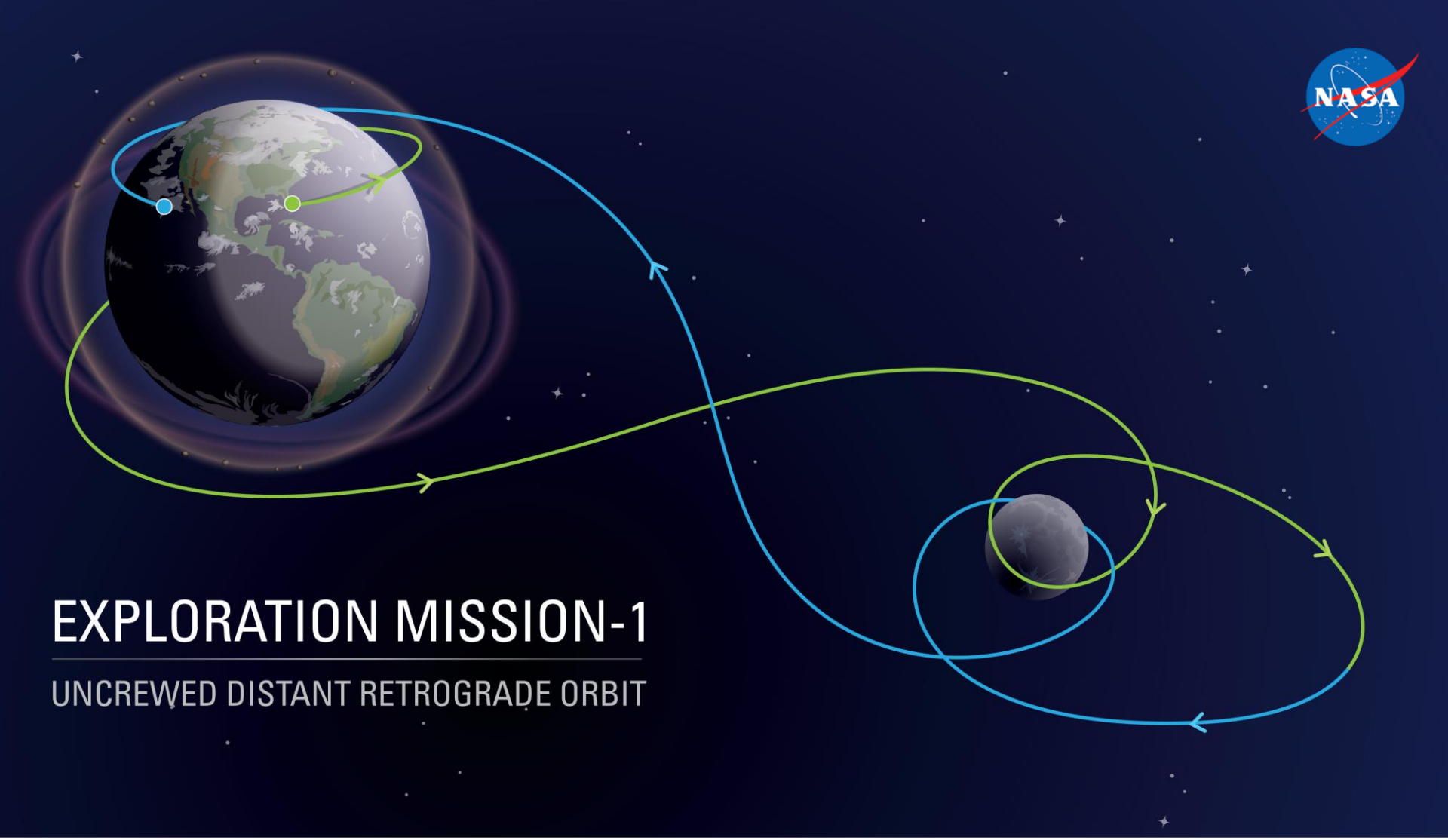
Secondary Payloads





13 CUBE SATS SELECTED TO FLY ON EM-1

- Lunar Flashlight
- Near Earth Asteroid Scout
- Bio Sentinel
- LunaH-MAP
- CuSPP
- Lunar IceCube
- Skyfire
- JAXA SLSLIM
- ESA ArgoMoon
- JAXA EQUULEUS
- STMD Centennial Challenge Winners



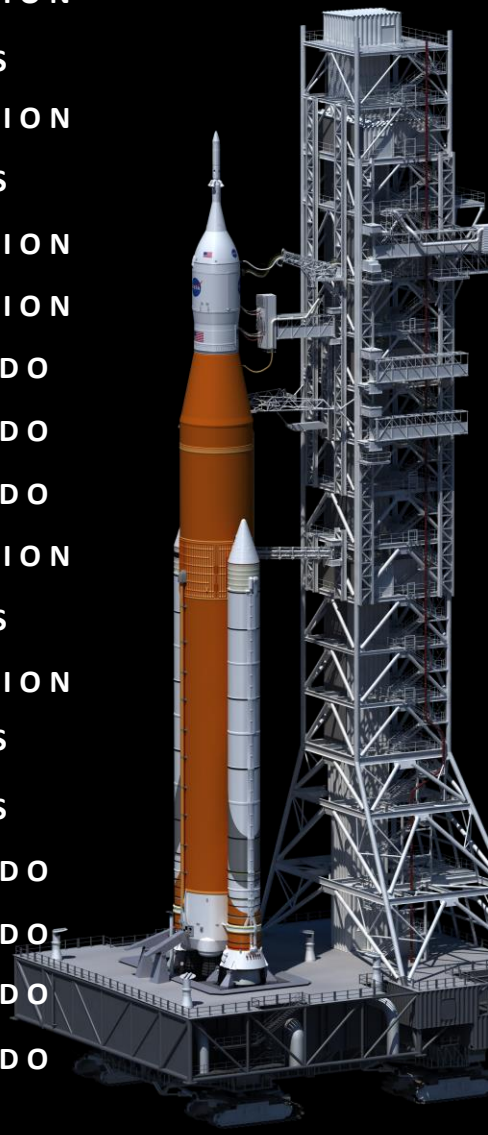
Targeted launch November 2018

Exploration Mission-1 Animation

Building Exploration Mission-1

ESD PROGRAM MILESTONES

2/2016	Crew Module Pressure Vessel on Dock at Kennedy Space Center, FL ✓	ORION
5/2016	Booster Qualification Motor 2 Test at Promontory, UT	SLS
9/2016	Crew Module Propellant Pressure Proof Test	ORION
12/2016	RS-25 Flight Engine Deliveries Complete to Michoud, New Orleans, LA	SLS
1/2017	European Service Module Delivery to Kennedy Space Center, FL	ORION
1/2017	Crew Module Initial Power On at Kennedy Space Center, FL	ORION
3/2017	Vehicle Assembly Building High Bay 3 Construction Complete	GSDO
3/2017	Launch Pad Flame trench Construction Complete	GSDO
5/2017	Mobile Launcher Ground Support Equipment Installation Complete	GSDO
7/2017	Crew Module and Service Module Mate at Kennedy Space Center, FL	ORION
8/2017	Core Stage Integration Complete at Michoud, New Orleans, LA	SLS
9/2017	Crew/Service Module Ship to Plum Brook Station for Thermal Vacuum Testing	ORION
10/2017	Core Stage Shipped to Stennis Space Center, MS	SLS
11/2017	Core Stage Green Run Hotfire Test at Stennis Space Center, MS	SLS
1/2018	Booster Stacking in Vehicle Assembly Building	GSDO
4/2018	Core Stage stacking with Boosters in Vehicle Assembly Building	GSDO
6/2018	Orion mating with SLS in Vehicle Assembly Building	GSDO
8/2018	Wet Dress Rehearsal at Launch Pad	GSDO
11/2018	EM-1 LAUNCH	



Summary

- There is a tremendous amount of development underway in building America's deep space human flight systems
- This work is broad in scope and uses facilities from around the world
- Obviously, data and data systems are playing a key role in this development
  - Data in the form of drawings and specification is essential
  - Test data is shipped immediately from the test site to all users
  - The telemetry systems and avionics systems designs and operations will be critical to ensure these vehicles flying safely
- Data and information is crucial to hardware development and operations