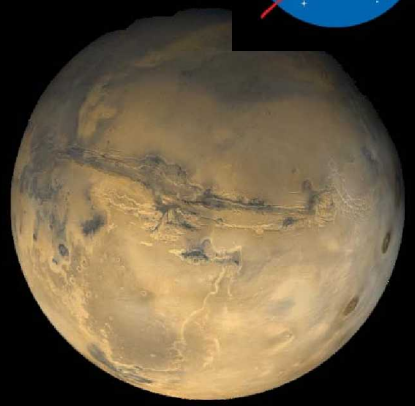
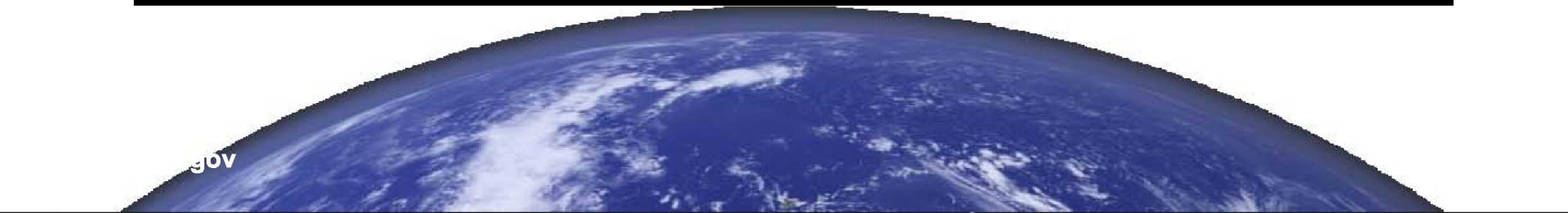
National Aeronautics and Space Administration



NASA's CONSTELLATION PROGRAM:
MILESTONES TOWARD THE FRONTIER

Jeffrey M. Hanley
Lawrence D. Thomas, PhD
Jennifer L. Rhatigan, PhD, PE
Tony J. Boatright



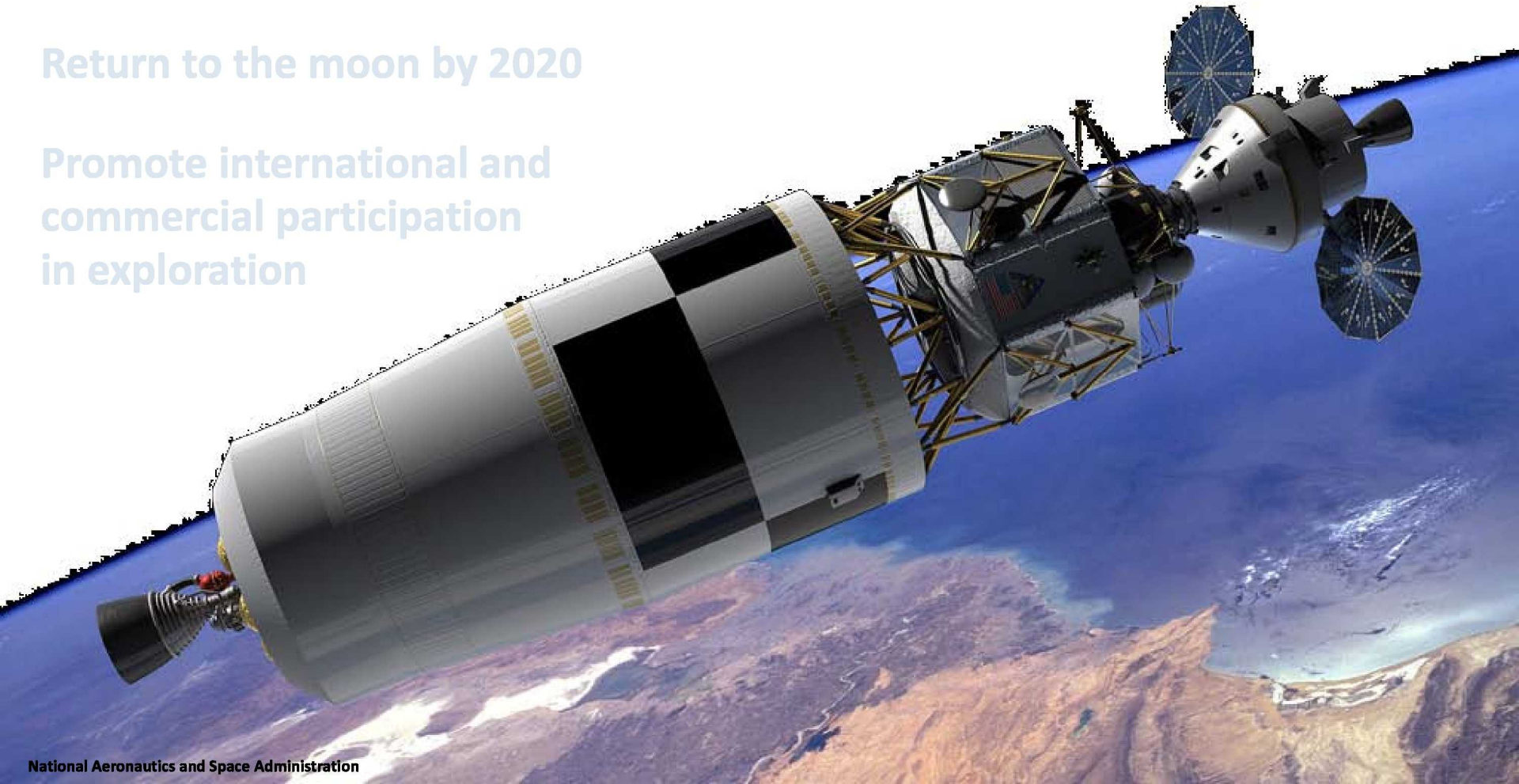
NASA's Plan for Space Exploration

Safely fly the Space Shuttle and complete the International Space Station

Develop and fly the Orion crew exploration vehicle by 2015

Return to the moon by 2020

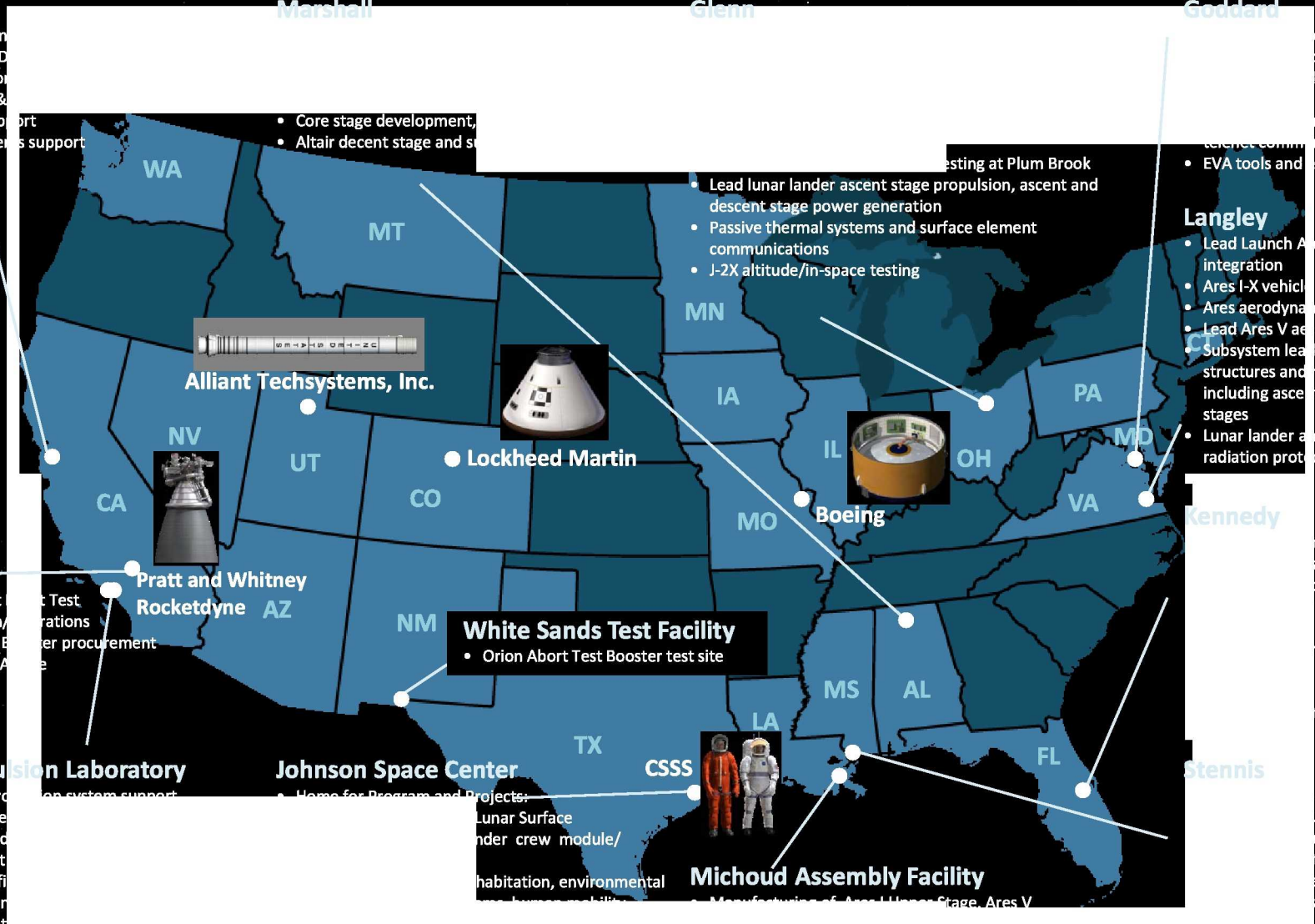
Promote international and commercial participation in exploration



National Aeronautics and Space Administration

Components of the Constellation Program

Constellation Content Across the Nation



Ames

- Lead Therm
  Advanced D
- Ares mission
- Software &
  Control sup rt
- Lunar syste s support

Marshall

- Core stage development,
- Altair decent stage and s

Glenn

- esting at Plum Brook
- Lead lunar lander ascent stage propulsion, ascent and descent stage power generation
- Passive thermal systems and surface element communications
- J-2X altitude/in-space testing

Goddard

equirements for
argo carriers
for lunar

nd surface
nications

- EVA tools and quipment

Langley

- Lead Launch A ort System integration
- Ares I-X vehicl integration
- Ares aerodyna nics lead
- Lead Ares V ae odynamics
- Subsystem lea for lunar lander structures and mechanisms including asce t and descent stages
- Lunar lander a d lunar surface radiation prot ction

Dryden

- Lead Abort t Test Integration/ rations
- Abort Test B er procurement
- Flight Test A e

Jet Propulsion Laboratory

- Thermal pro
- Lunar lande design; guid life support
- Lead specifi
- Environmen surface syst communica

Johnson Space Center

- Home for Program and Projects:

Lunar Surface
nder crew module/

habitation, environmental

Kennedy

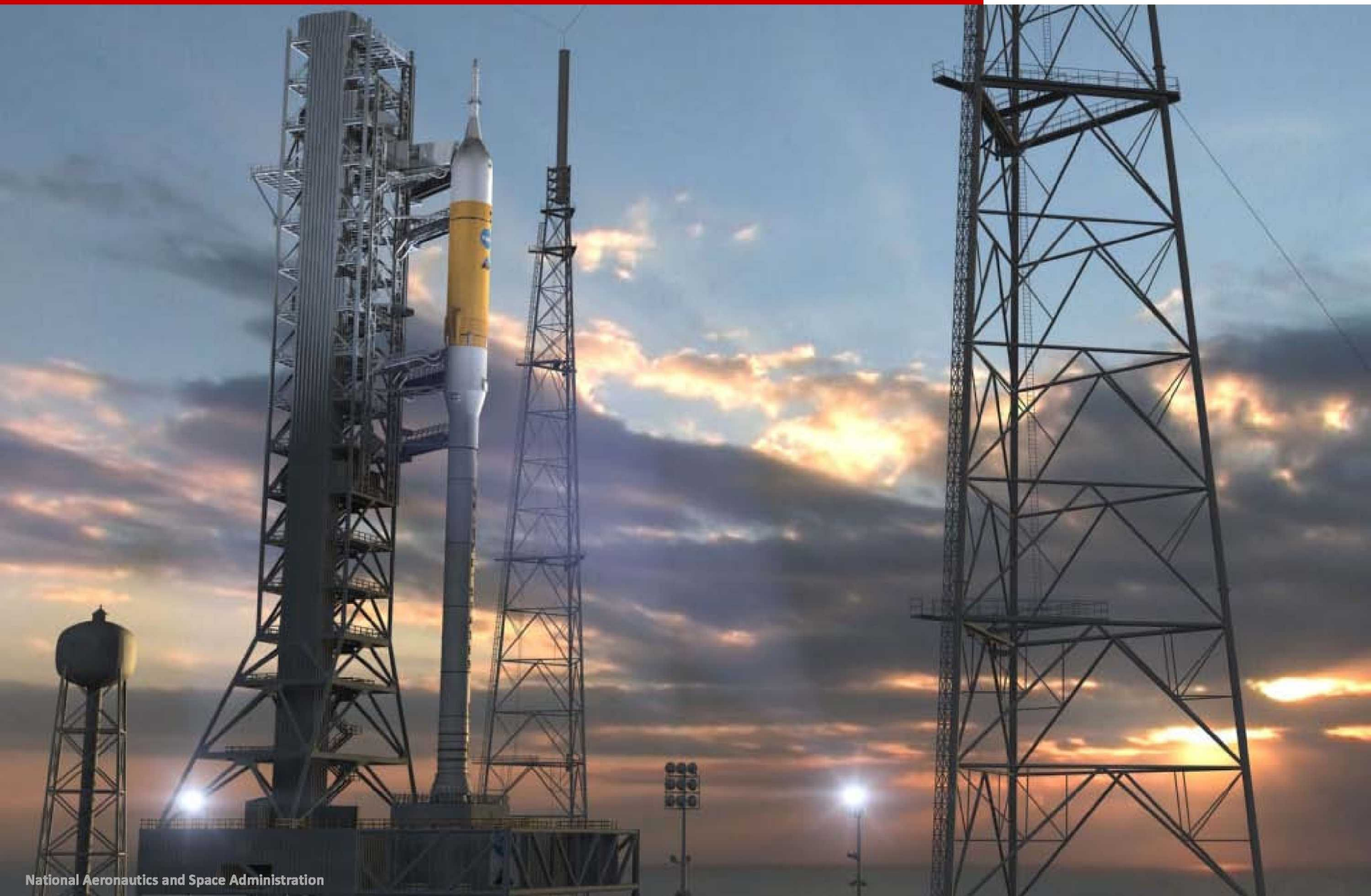
nd Ops Project
sing
ons
tions
ground
human lunar

urface in-situ
tion systems

Stennis

on testing
uid rocket
ge testing at
titude
evelopment and
ting for upper

Ares



National Aeronautics and Space Administration

Ares I DM-1 Test

The successful test firing of the 5-segment Ares I solid rocket motor, Development Motor-1 (DM-1), was conducted September 10, 2009.

Engineers will use the measurements collected from 650 sensors to evaluate the performance of the motor.

Factors baselined in the test include:

- Acoustics
- Structural loading
- Internal pressure variations, plotted over the course of the burn

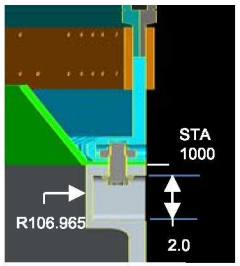
Status: DM-1 Test

Successfully Completed September 10

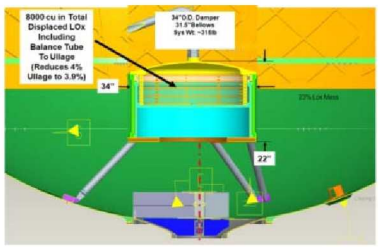
National Aeronautics and Space Administration

Status: Thrust Oscillation

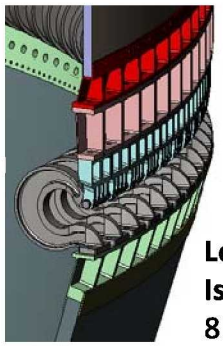
Baselined and On-Ramp Thrust Oscillation Mitigations



Smooth OML w/ softened Orion Adapter



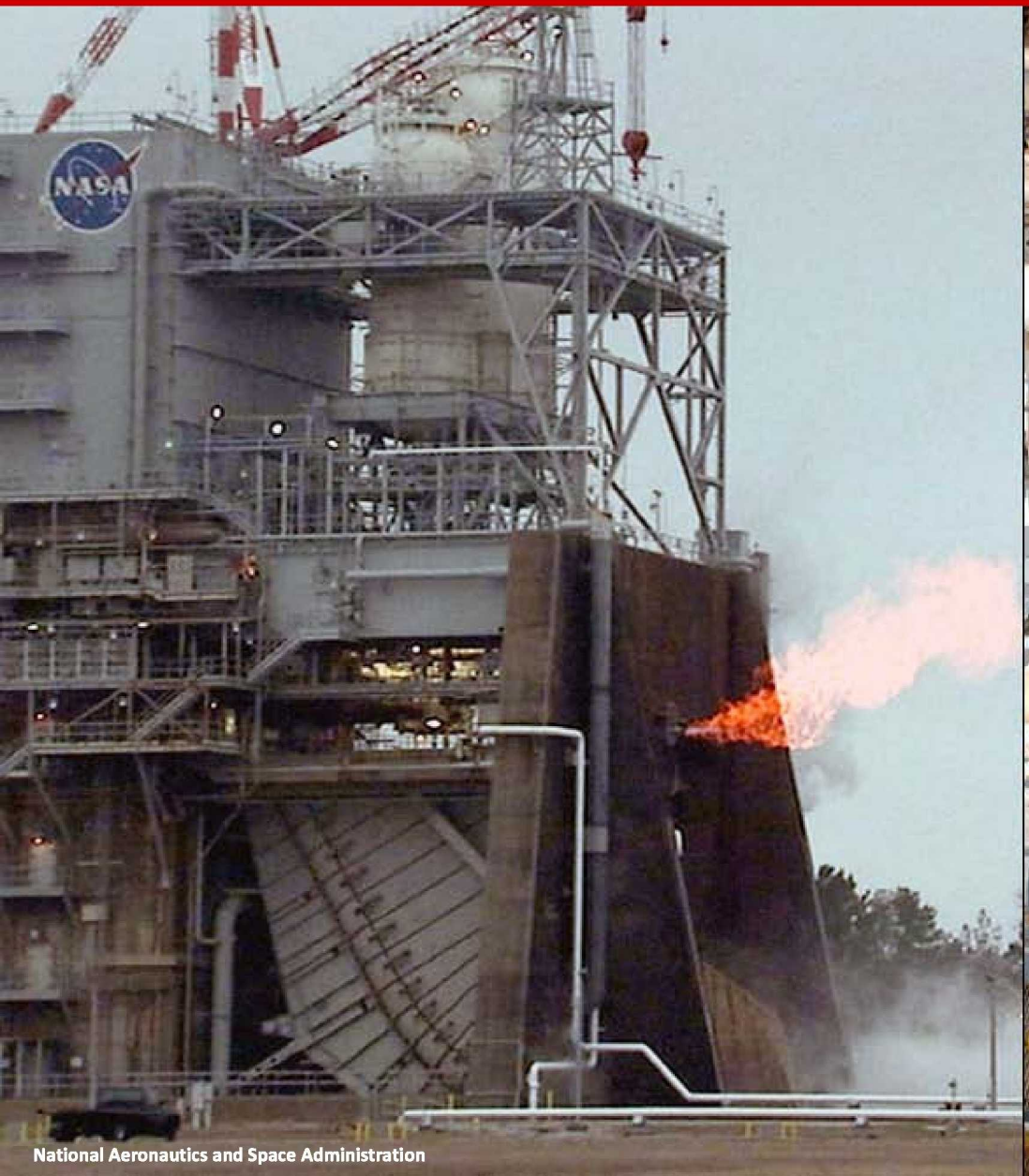
LOX damper
(proposed on-ramp in 12/09)



Lower Plane Isolator
8M lbf/in

Status: J2-X Engine Test

Second Stage Engine for the Ares Rocket



National Aeronautics and Space Administration

Status: J2-X Engine Test

A-3 Test Stand – Transfer Docks Completed

National Aeronautics and Space Administration

Ares I-X

The Ares I-X is the first major assessment of the crew launch vehicle.

The objectives of the suborbital flight test include:

Assessment of ground facilities and operations at KSC

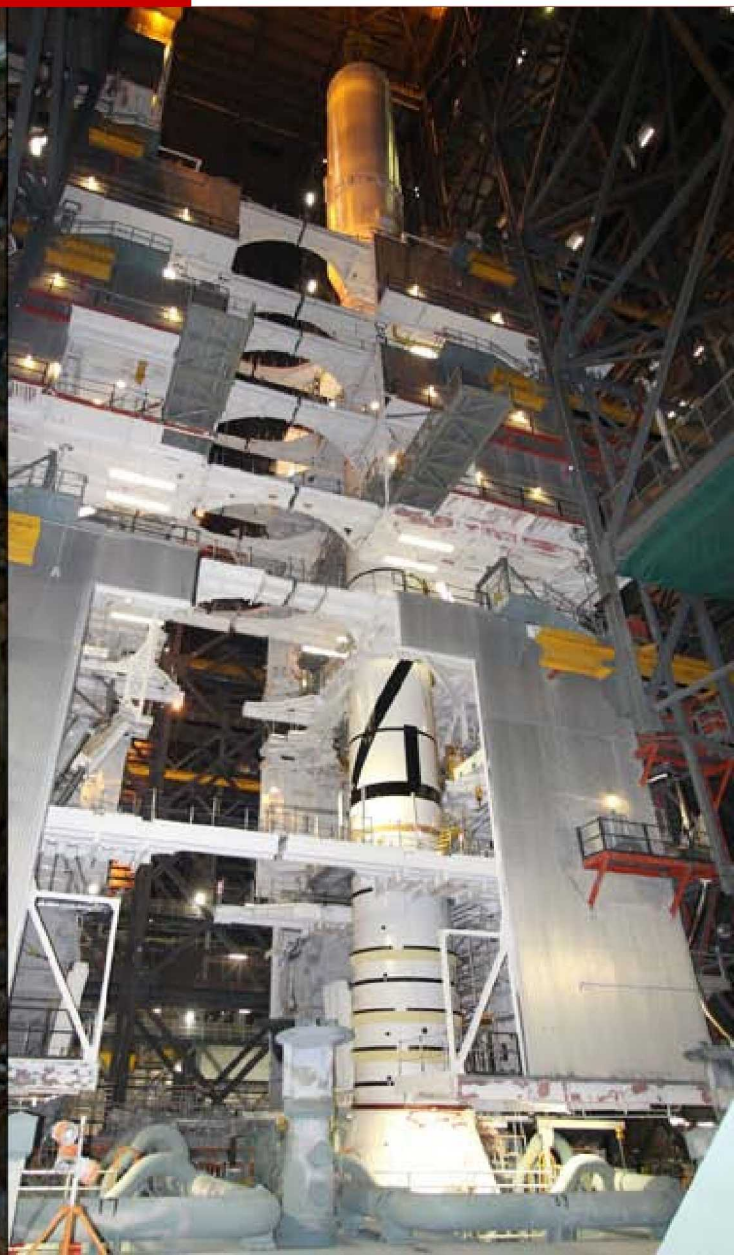
Verification of design effectiveness

Critical data-gathering regarding in-flight safety and stability

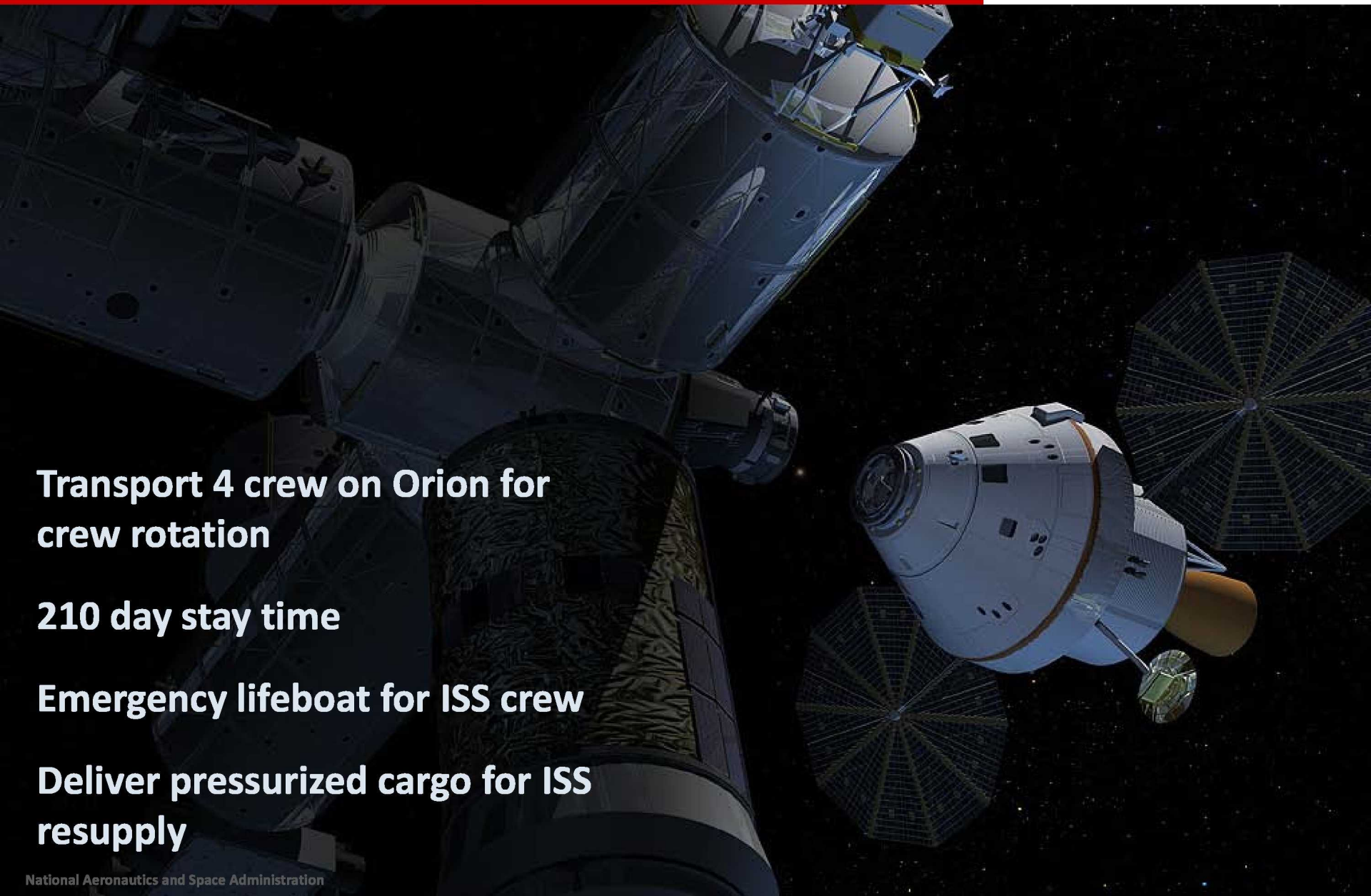
Evaluation of the 327-foot integrated stack, which includes a simulated crew module and Launch Abort System, during ascent

Status: Ares I-X Test Flight

Assembly of the Ares I-X rocket is complete and the vehicle is powered up



Orion Crew Module



Transport 4 crew on Orion for crew rotation

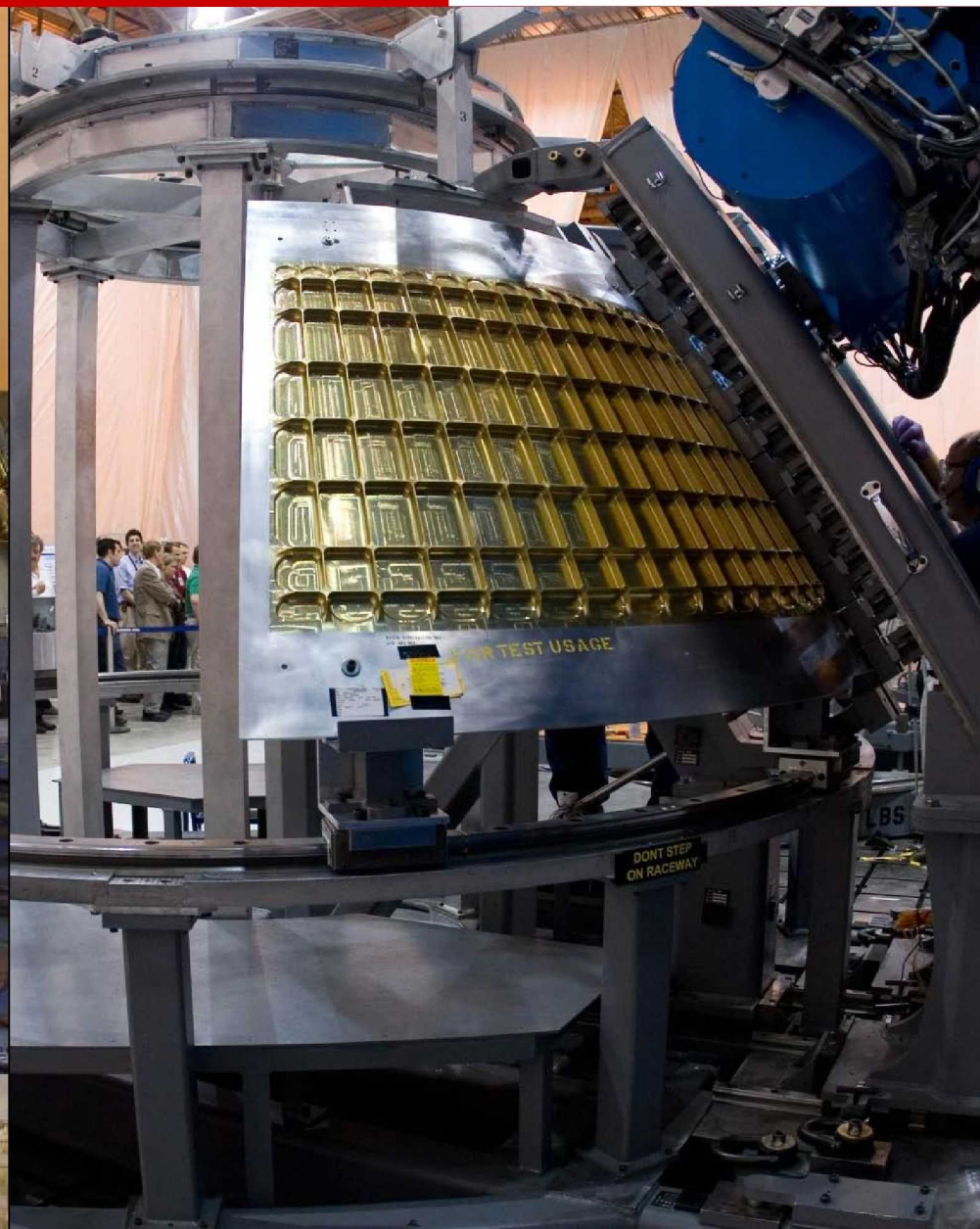
210 day stay time

Emergency lifeboat for ISS crew

Deliver pressurized cargo for ISS resupply

Status: Orion Crew Module

First Weld – Orion Ground Test Article



Status: Orion Crew Module

Post-landing Orion Recovery Test

Launch Abort System

Orion's Launch Abort System provides a safe, reliable method to move the crew out of danger in the event of emergency.

The Pad Abort 1 Test demonstrates:

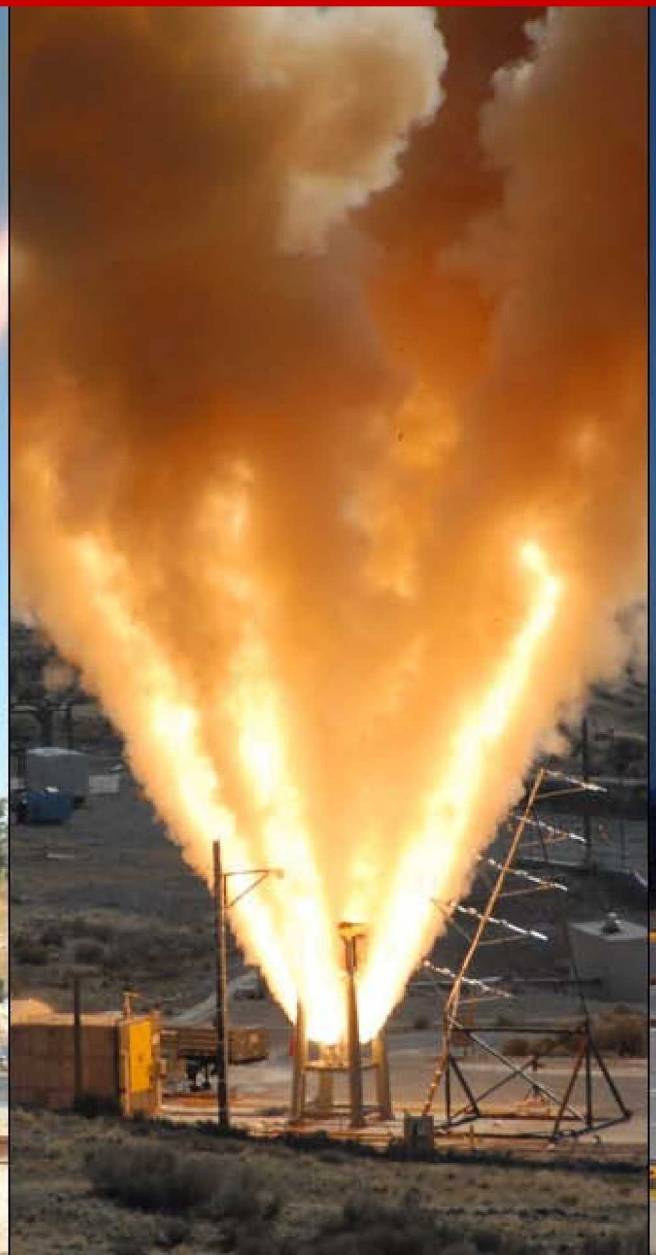
First in-flight of the Launch Abort System solid rocket motors, a coordinated operation

Parachute landing system

Successful pathfinder for Orion system integration and ground operations procedures

Status: Launch Abort System

Testing the LAS motors



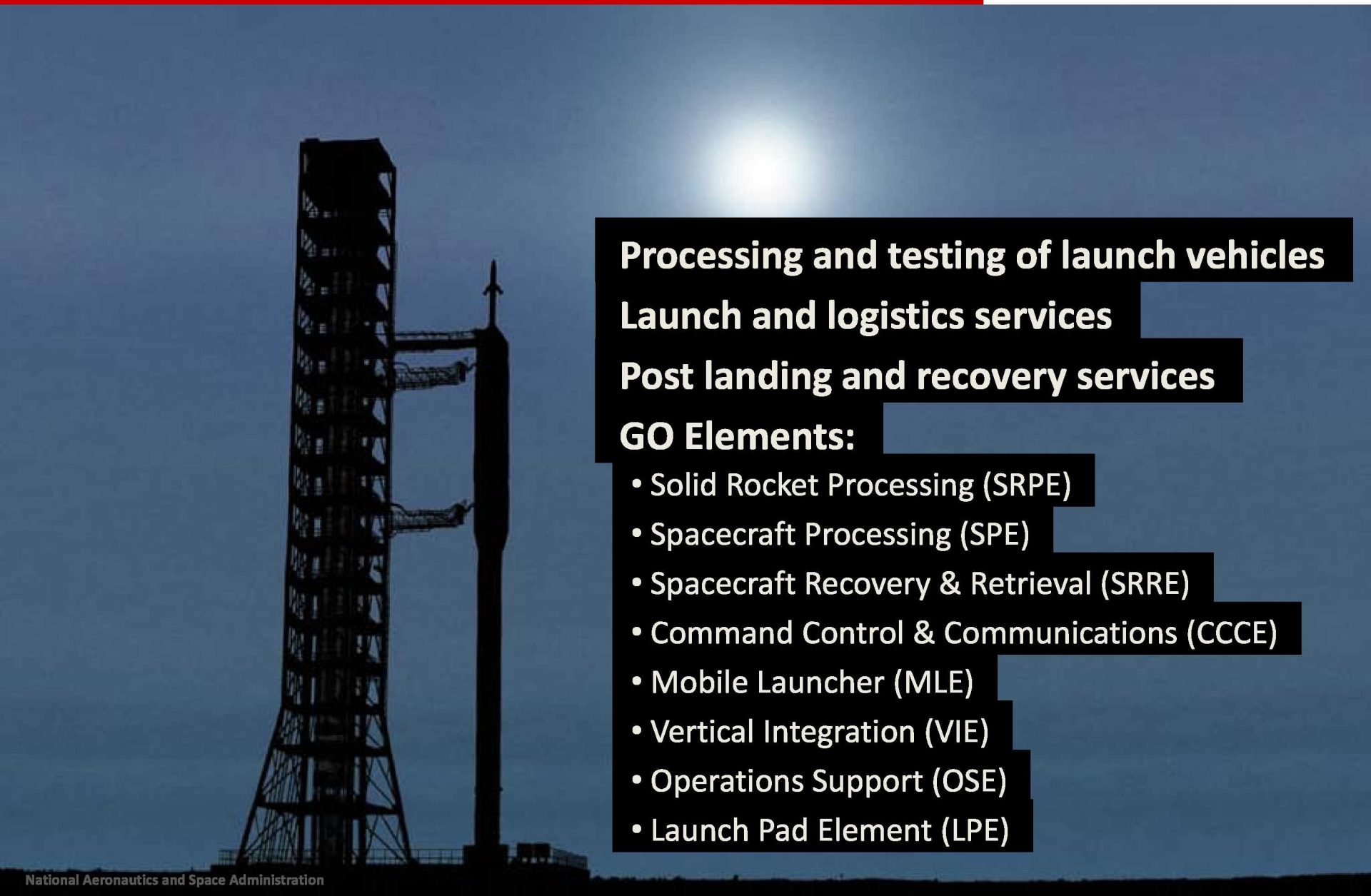
Status: Launch Abort System

Pad Abort Test 1 (PA-1)

Status: Launch Abort System

Crew Module Mockup being transported to White Sands for Pad Abort I Test

Ground Operations



Processing and testing of launch vehicles

Launch and logistics services

Post landing and recovery services

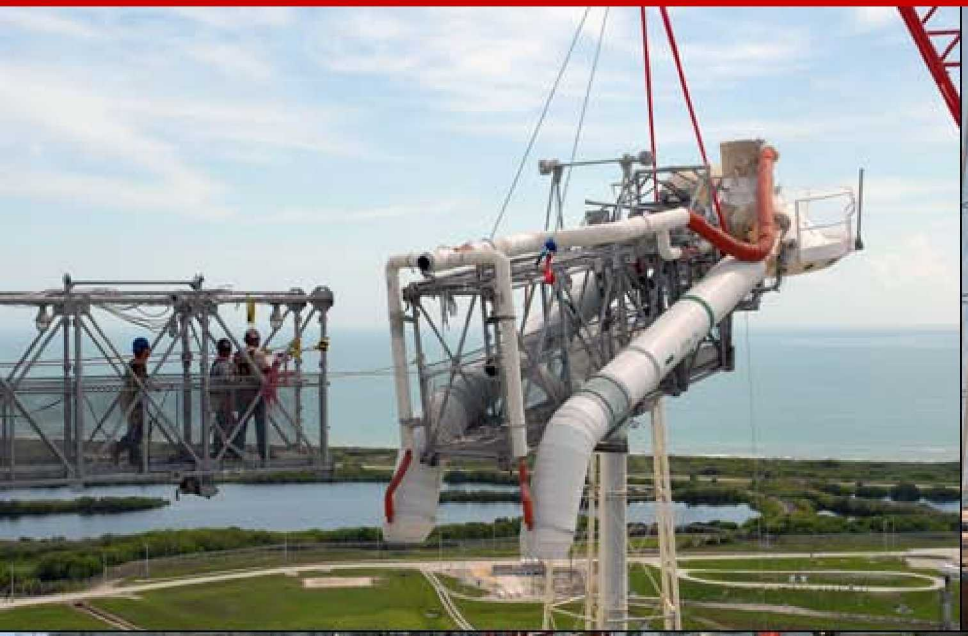
GO Elements:

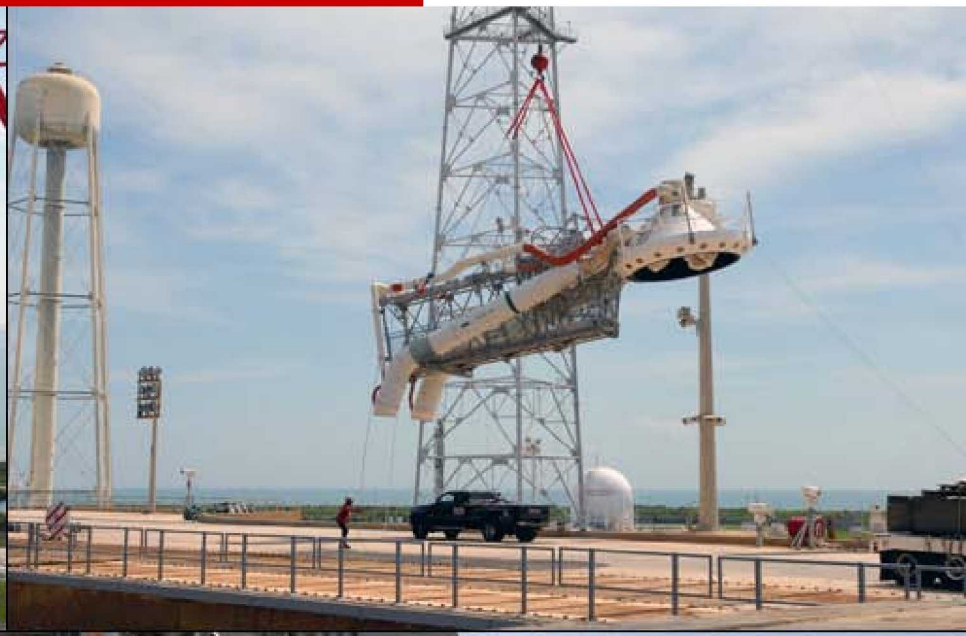
- Solid Rocket Processing (SRPE)
- Spacecraft Processing (SPE)
- Spacecraft Recovery & Retrieval (SRRE)
- Command Control & Communications (CCCE)
- Mobile Launcher (MLE)
- Vertical Integration (VIE)
- Operations Support (OSE)
- Launch Pad Element (LPE)

Status: Ares Firing Room

Status: Launch Pad 39B

Conversion as the launch site for Constellation Program's Ares I-X





Status: Launch Pad 39B

Lightning Protection System for Ares/Orion Launches

Status: Launch Pad 39B

Vehicle Stabilization System Nears Completion

National Aeronautics and Space Administration

Status: Ares Mobile Launch Platform

Construction is under way at KSC

Mission Operations

Operations infrastructure

Facilities, simulators, trainers, workstations, networks, software, documentation

Operations products

Flight procedures

Flight rules

Operations Teams

MO Elements

Mission Control Center

Constellation Reconfiguration

Constellation Training Facility

Neutral Buoyancy Lab

Space Vehicle Mockup

Status: Virtual Mission

Lessons learned to refine processes for real Constellation missions

National Aeronautics and Space Administration

International Partnership Focus Areas

Status of Key ISECG Working Groups

NASA is leading a key ISECG working group, the International Architecture Working Group (IAWG)

NASA is Co-lead (with JAXA) of the ISECG International Objectives Working Group

Lunar Architecture Field Testing

2009 Desert RATS (Research And Technology Studies) activity

National Aeronautics and Space Administration

The Next Giant Step

We must build to go beyond low Earth orbit.

We are designing new vehicles using lessons learned to minimize cost, technical, and schedule risks.

To reach for Mars and beyond we must first return to the Moon.

The team is making good progress.

"The [Constellation] program comes pretty close to performing as NASA advertised it would," said former NASA astronaut Sally Ride, who chaired a Committee subgroup that conducted independent cost assessments of current and proposed scenarios. "NASA's planning and development phase of Constellation was actually pretty good," she added, citing the Aerospace Corporation findings.

We leave as we came and, God willing, as we shall return, with peace and hope for all mankind.

Eugene Cernan,
Commander of the last Apollo Mission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