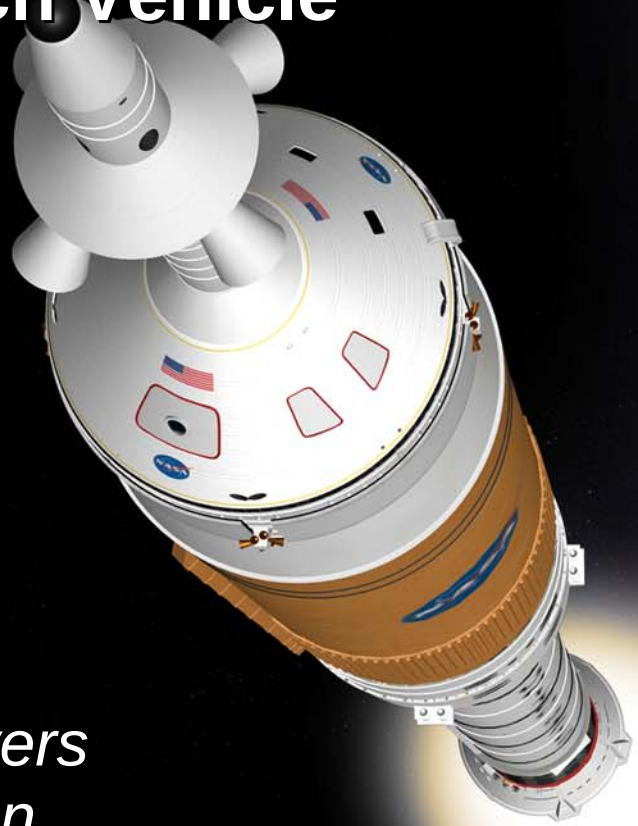
Operational Concept for the NASA Constellation Program's Ares I Crew Launch Vehicle



Joel Best
Dr. Greg Chavers
Lea Richardson
Craig Cruzen
Engineering Directorate
NASA Marshall Space Flight Center
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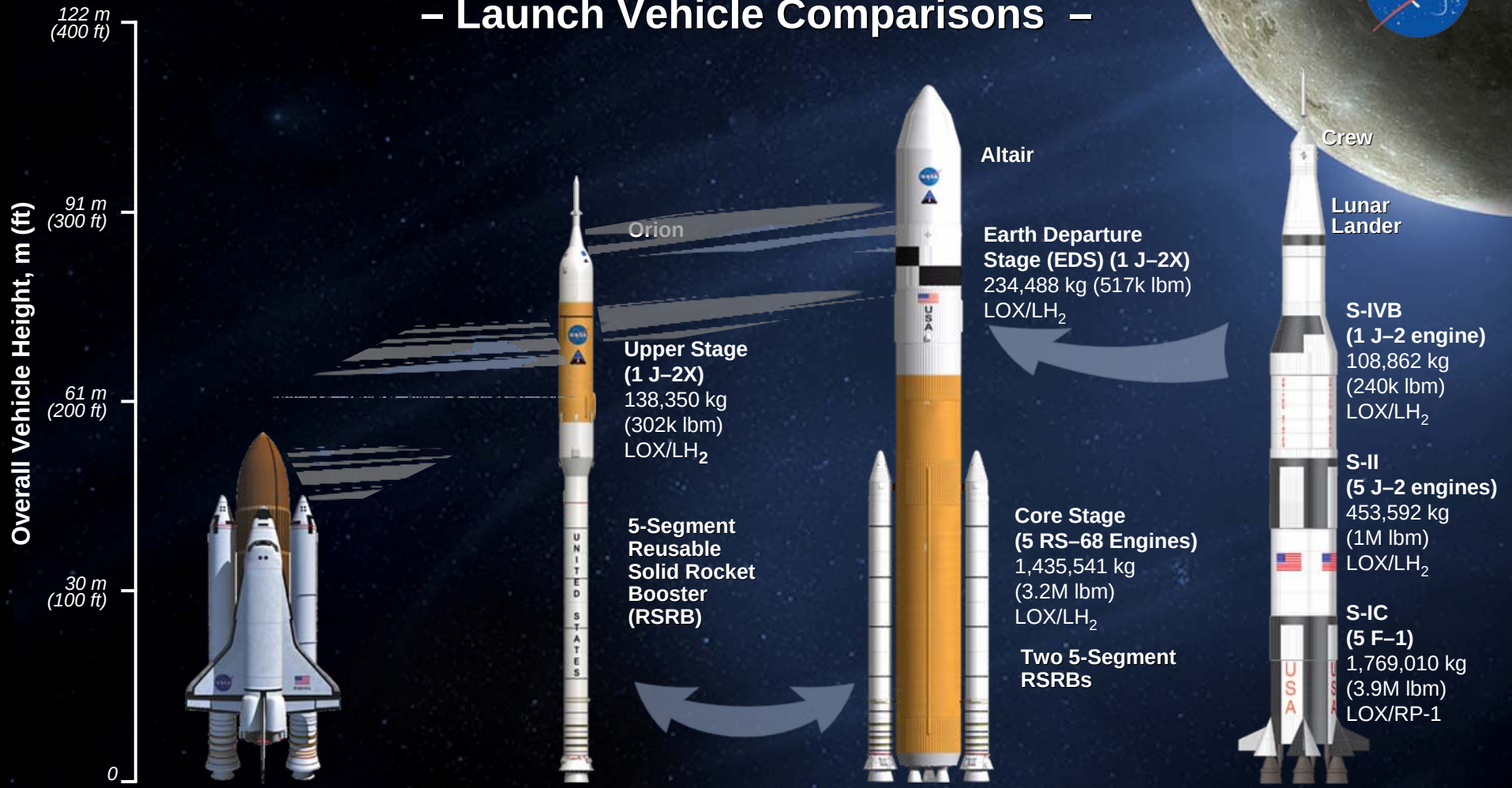
Agenda

- Building on a Foundation of Proven Technologies
- Ares I Elements
- Orion Crew Exploration Vehicle
- Ares V Elements
- Key Ares I Operational Requirements
- Overall Ares I Operational Flow
- Example of Key Driving Requirement
- Operational Concept
- Summary

Building on a Foundation of Proven Technologies
– Launch Vehicle Comparisons –



Space Shuttle
Height: 56.1 m (184.2 ft)
Gross Liftoff Mass:
2,041,166 kg (4.5M lbm)

25 MT (55k lbm)
to Low Earth Orbit (LEO)

Ares I
Height: 99.1 m (325 ft)
Gross Liftoff Mass:
907,185 kg (2.0M lbm)

25.6 MT (56.5k lbm)
to LEO

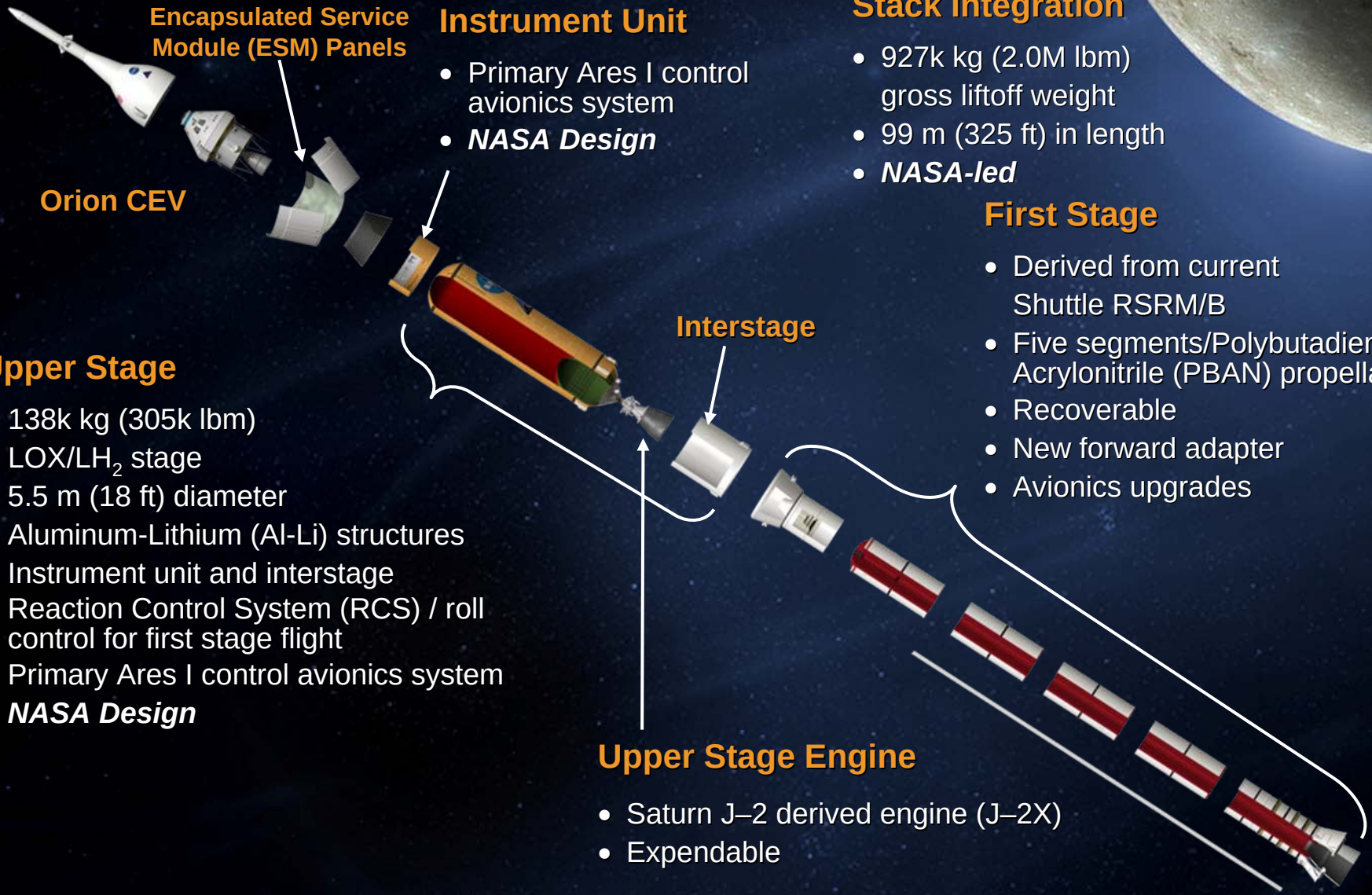
Ares V
Height: 109.7 m (360 ft)
Gross Liftoff Mass:
3,374,910 kg (7.4M lbm)

63.6 MT (140.2k lbm) to TLI (with Ares I)
55.9 MT (123k lbm) to Direct TLI
~143.4 MT (316k lbm) to LEO

Saturn V
Height: 110.9 m (364 ft)
Gross Liftoff Mass:
2,948,350 kg (6.5M lbm)

45 MT (99k lbm) to TLI
119 MT (262k lbm) to LEO

Ares I Elements



Instrument Unit

- Primary Ares I control avionics system
- ***NASA Design***

Stack Integration

- 927k kg (2.0M lbm) gross liftoff weight
- 99 m (325 ft) in length
- ***NASA-led***

First Stage

- Derived from current Shuttle RSRM/B
- Five segments/Polybutadiene Acrylonitrile (PBAN) propellant
- Recoverable
- New forward adapter
- Avionics upgrades

Upper Stage

- 138k kg (305k lbm) LOX/LH_2 stage
- 5.5 m (18 ft) diameter
- Aluminum-Lithium (Al-Li) structures
- Instrument unit and interstage
- Reaction Control System (RCS) / roll control for first stage flight
- Primary Ares I control avionics system
- ***NASA Design***

Upper Stage Engine

- Saturn J–2 derived engine (J–2X)
- Expendable

Orion Crew Exploration Vehicle

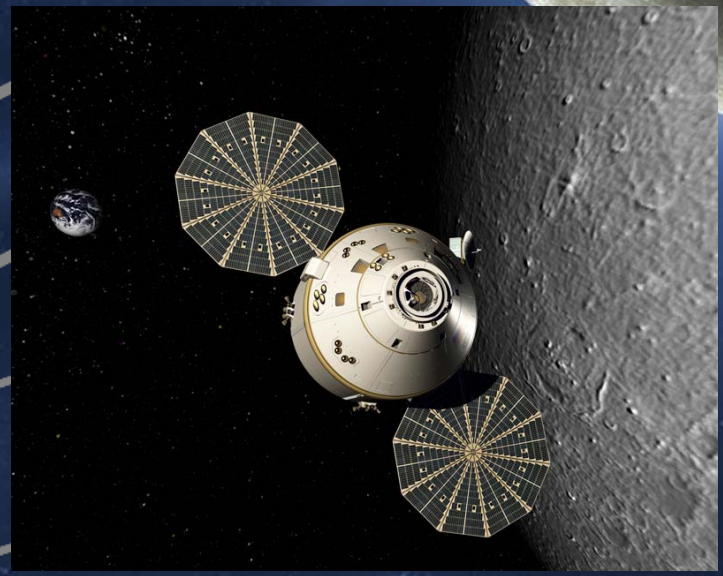
Launch Abort System

Attitude Control Motor
(Eight Nozzles)

Canard Section
(Stowed Configuration)

Jettison Motor
(Four Aft, Scarfed Nozzles)

Abort Motor
(Four Exposed, Reverse Flow Nozzles)



Crew Module

Service Module

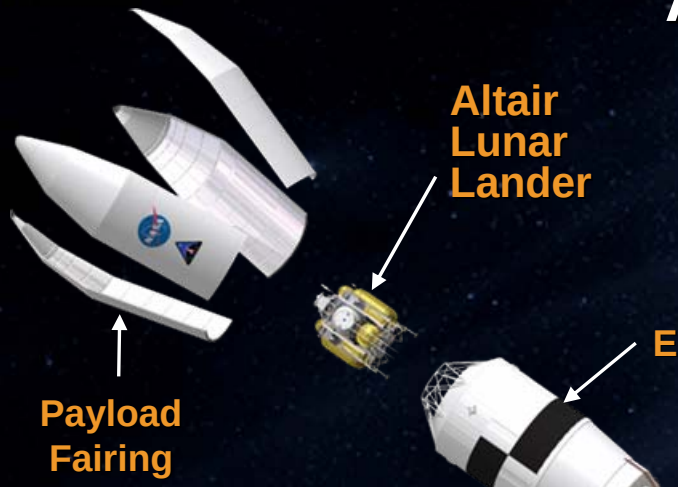
Encapsulated Service Module (ESM) Panels

Spacecraft Adapter

Volume: 10.8 m^3 (380 ft^3)
- 80% larger than Apollo

Diameter: 5 m (16.5 ft)

Ares V Elements

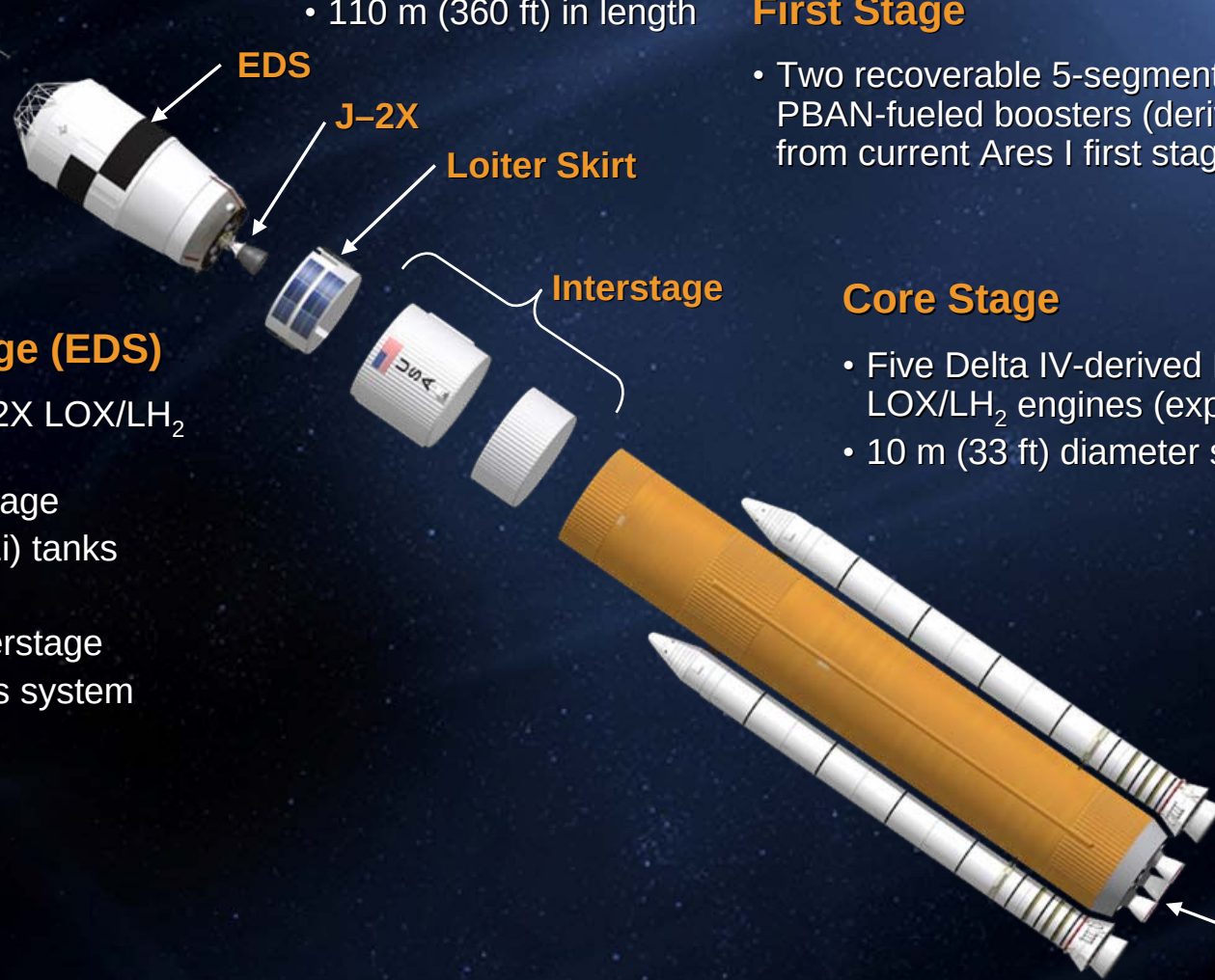


Stack Integration

- 3.4M kg (7.4M lbm) gross liftoff weight
- 110 m (360 ft) in length

First Stage

- Two recoverable 5-segment PBAN-fueled boosters (derived from current Ares I first stage)



Earth Departure Stage (EDS)

- One Saturn-derived J–2X LOX/LH_2 engine (expendable)
- 10 m (33 ft) diameter stage
- Aluminum-Lithium (Al-Li) tanks
- Composite structures
- Instrument unit and interstage
- Primary Ares V avionics system

Core Stage

- Five Delta IV-derived RS–68 LOX/LH_2 engines (expendable)
- 10 m (33 ft) diameter stage

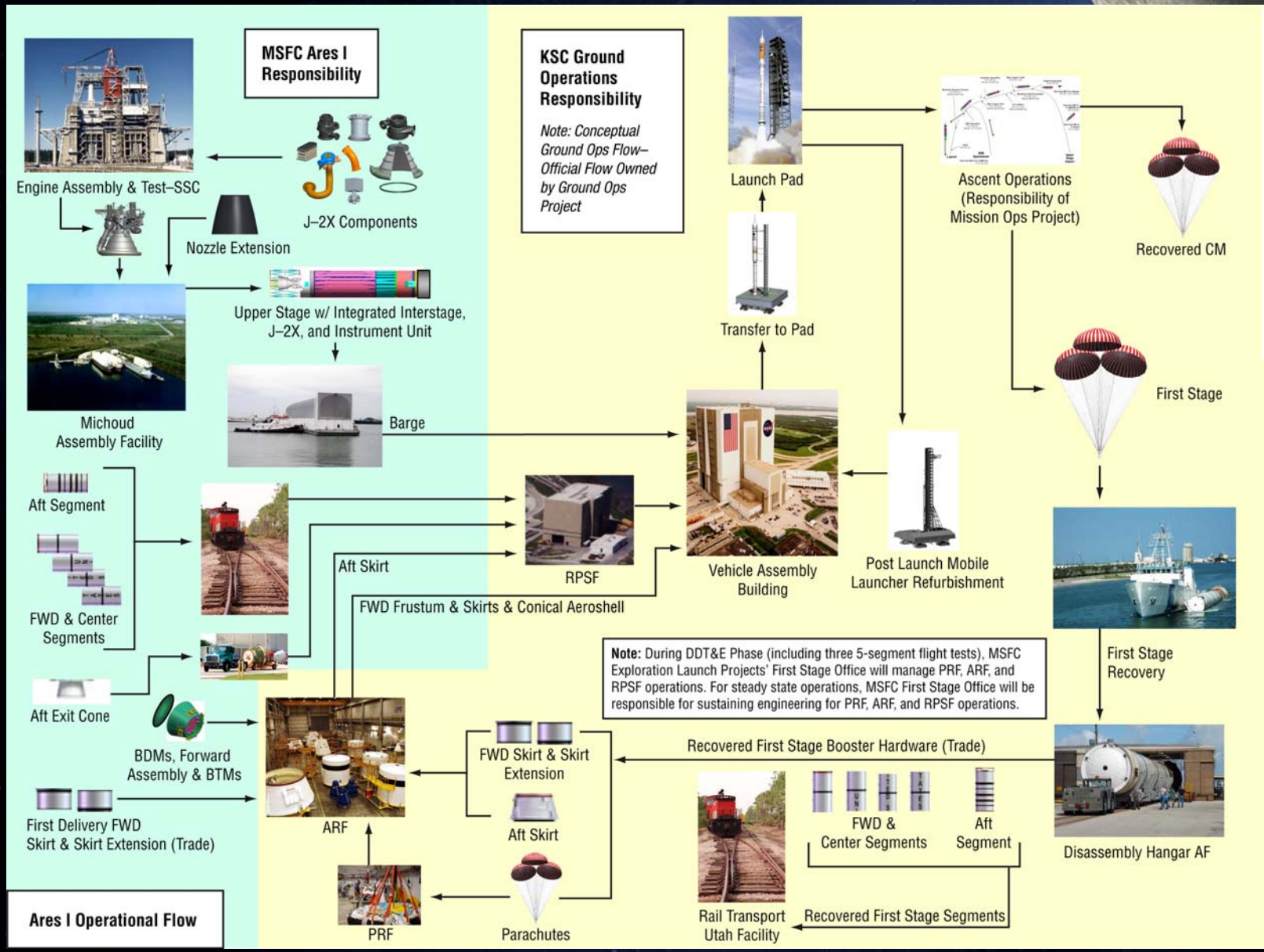
Vehicle 51.0.34

Key Ares I Operational Requirements

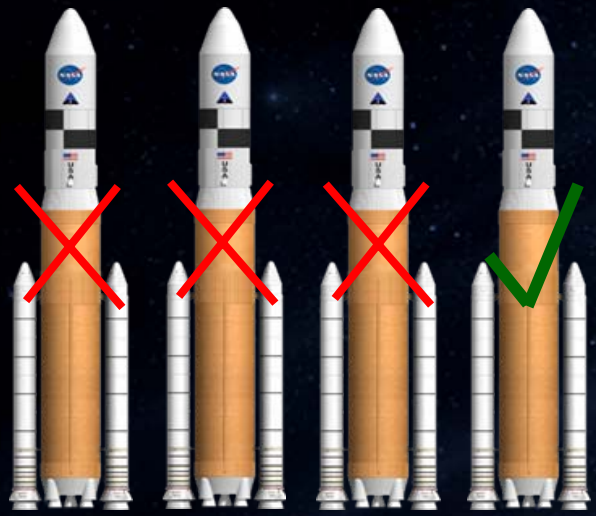
- Processed, integrated, and launched within 45 days.
- Capable of 6 launches per year.
- Interchangeable between International Space Station and Lunar missions.
- Launch probability not less than 95% due to natural environments and monthly weather conditions, during the period beginning with the decision to load cryogenic propellants and ending with the close of the day-of-launch window for the initial planned attempt.
- Probability of launching, beginning with decision to load cryogenic propellants, of not than 98% (excluding weather).
- Minimize launch pad processing time such that the Ares I is ready for launch within 7 days from arrival at the launch pad.
- Capable of a 24-hour turnaround following a launch scrub for a minimum of 7 consecutive days to support the 7-day lunar launch window.

Design in robustness and capabilities for operational solutions to off-nominal operations.

Overall Ares I Operational Flow



Example of Key Driving Requirement: Consecutive Launch Attempts for Ares I

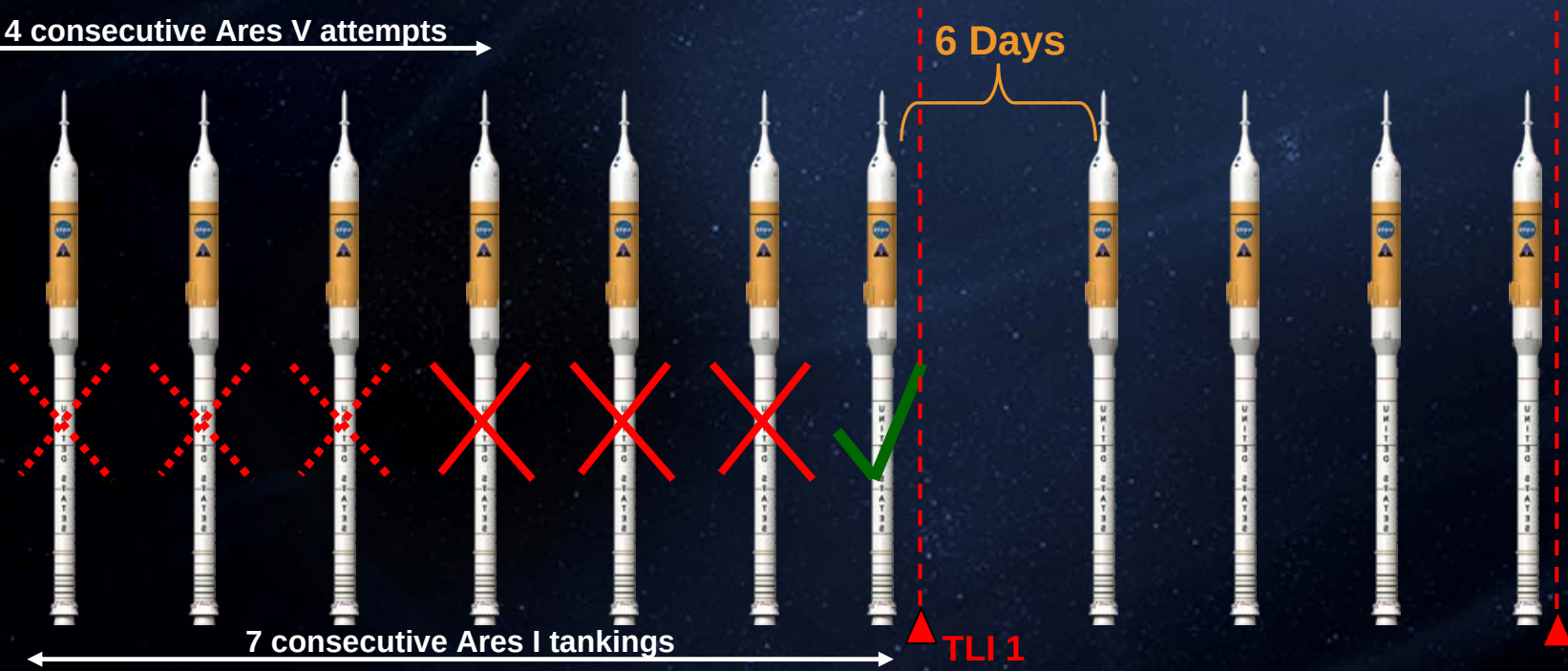


4 consecutive Ares V attempts

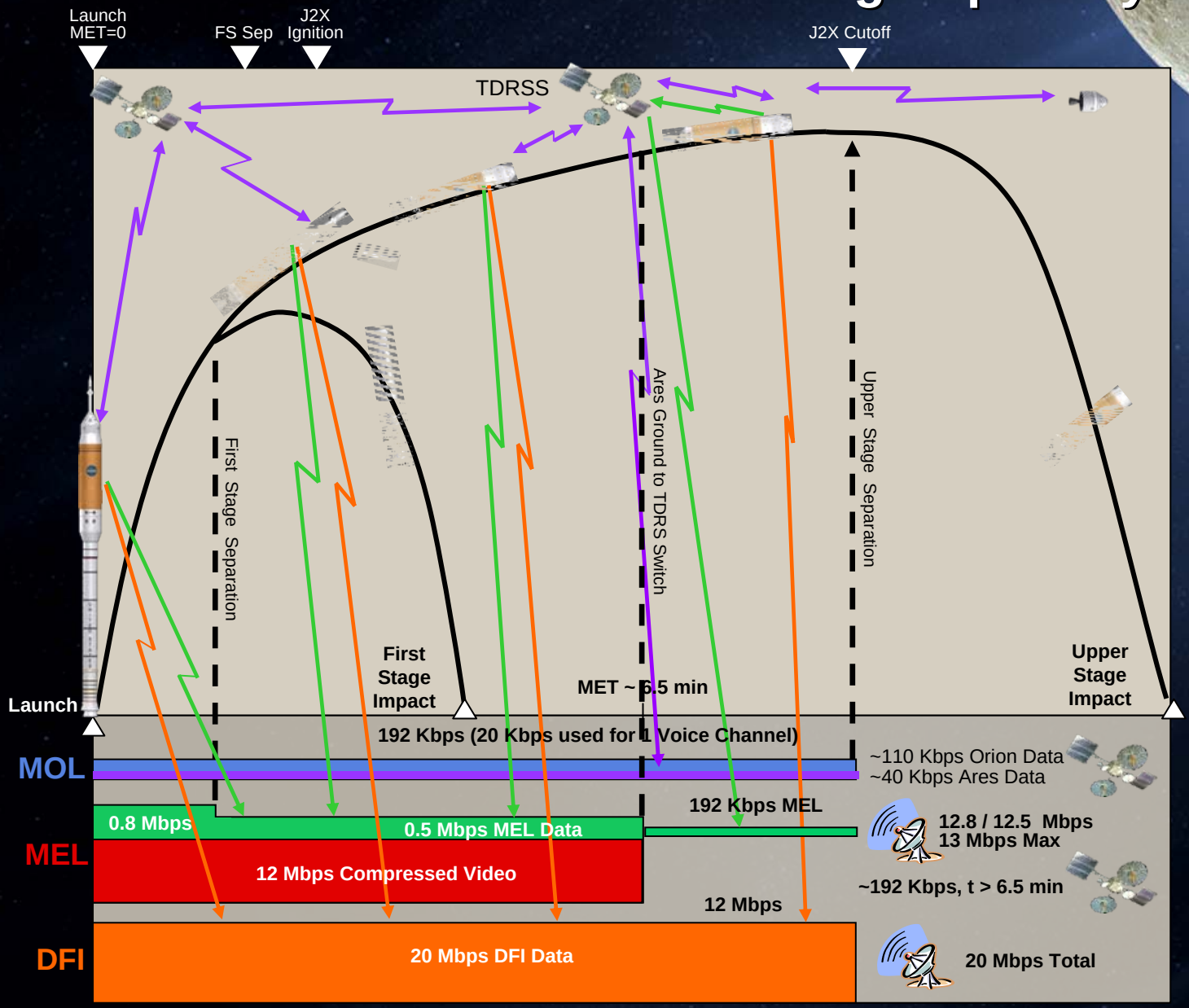
Legend

- = Scrubbed Ares V attempt
- = Launched Ares V
- = Tanked/scrubbed Ares I due to Ares V launch scrub

- **Ares I must tank for each Ares V launch attempt, plus for each of its own attempts after a successful Ares V launch, leading to a potential for 7 consecutive tankings of the Ares I before the missed Trans-Lunar Injection (TLI) window.**
- **Goal is to maximize launch attempts for TLI opportunity.**



Operational Concept: Communications and Tracking Capability



Data Link Rates

Summary

- Ares I design brings together innovation and new technologies with established infrastructure and proven heritage hardware to achieve safe, reliable, and affordable human access to space.
- NASA has 50 years of experience from Apollo and Space Shuttle.
- The Marshall Space Flight Center's Mission Operations Laboratory is leading an operability benchmarking effort to compile operations and supportability lessons learned from large launch vehicle systems, both domestically and internationally.
- Ares V will be maturing as the Shuttle is retired and the Ares I design enters the production phase.
- More details on the Ares I and Ares V will be presented at SpaceOps 2010 in Huntsville, Alabama, U.S.A., April 2010.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