NASA Constellation Program (CxP) Key Driving Requirements and Element Descriptions for International Architecture Working Group (IAWG) Functional Teams Human Transportation Cargo Transportation

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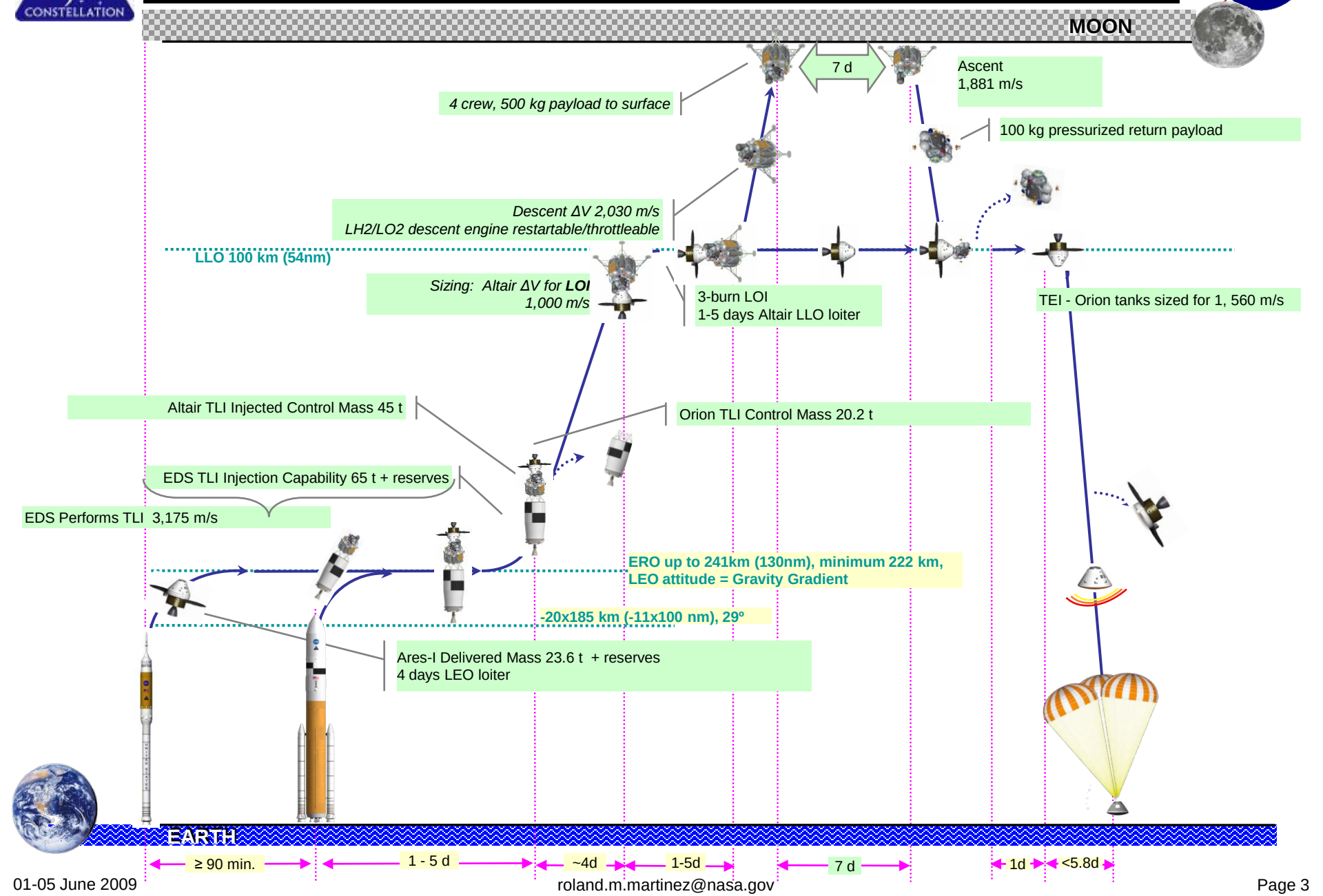
NASA Constellation Crew Mission Concept

Mission Key Driving Requirements

Lunar Sortie Design Reference Mission



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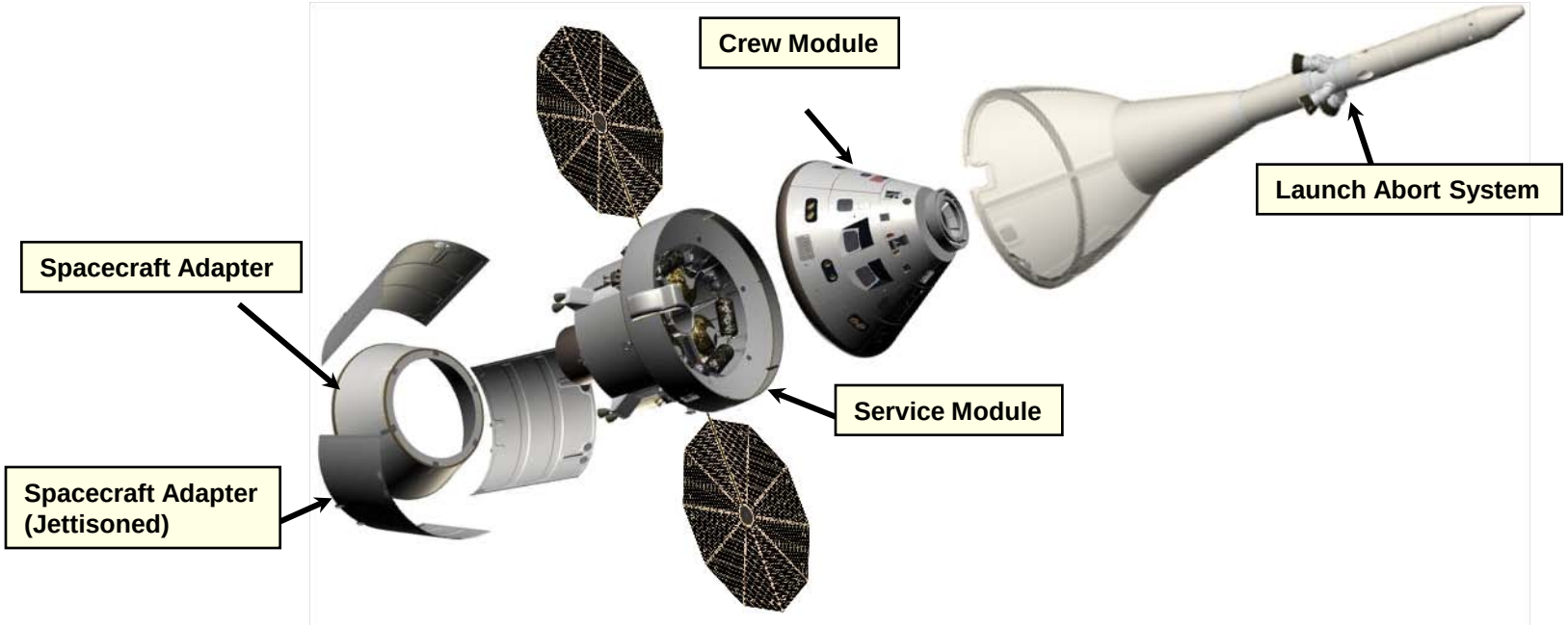
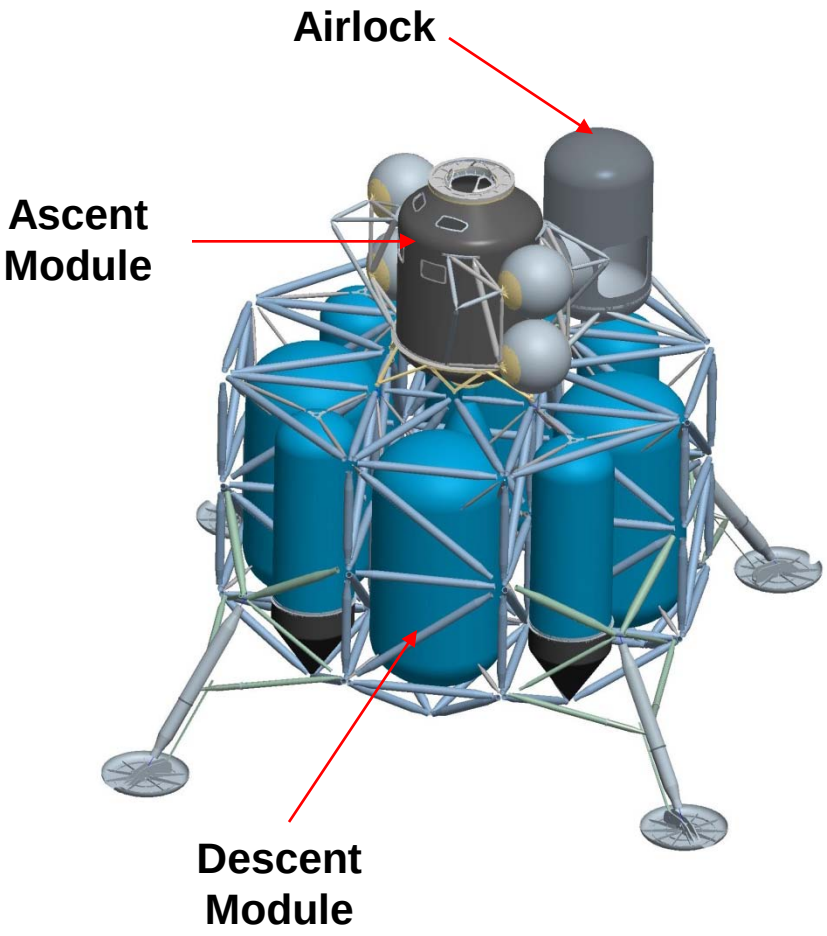
Orion Crew Exploration Vehicle



Key Performance Parameters

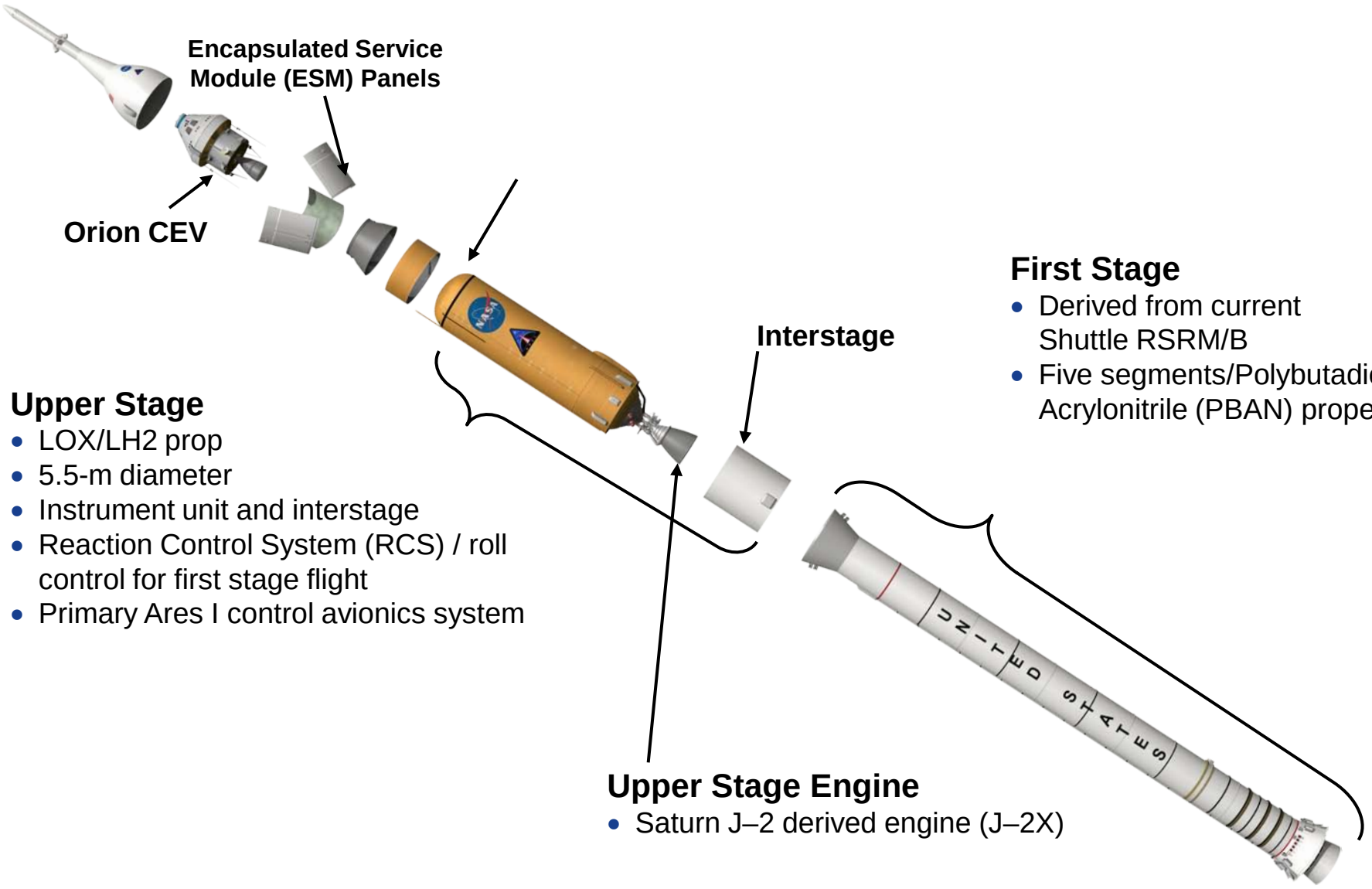
SM Tank Sizing ΔV: 1,560 m/s
TLI Control Mass: 20.2 t

Altair Vehicle Architecture



- **Three Primary Elements**
  - Descent Module
    - Provides propulsion for TCMs, LOI, and powered descent
    - Provides power during lunar transit, descent, and surface operations
    - Serves as platform for lunar landing and liftoff of ascent module
  - Ascent Module
    - Provides propulsion for ascent from lunar surface after surface mission
    - Provides habitable volume for four during descent, surface, and ascent operations
    - Contains cockpit and majority of avionics
  - Airlock
    - Accommodates two crew per ingress / egress cycle
    - Connected to ascent module via short tunnel
    - Remains with descent module on lunar surface after ascent module liftoff

Ares I Elements



Upper Stage

- LOX/LH2 prop
- 5.5-m diameter
- Instrument unit and interstage
- Reaction Control System (RCS) / roll control for first stage flight
- Primary Ares I control avionics system

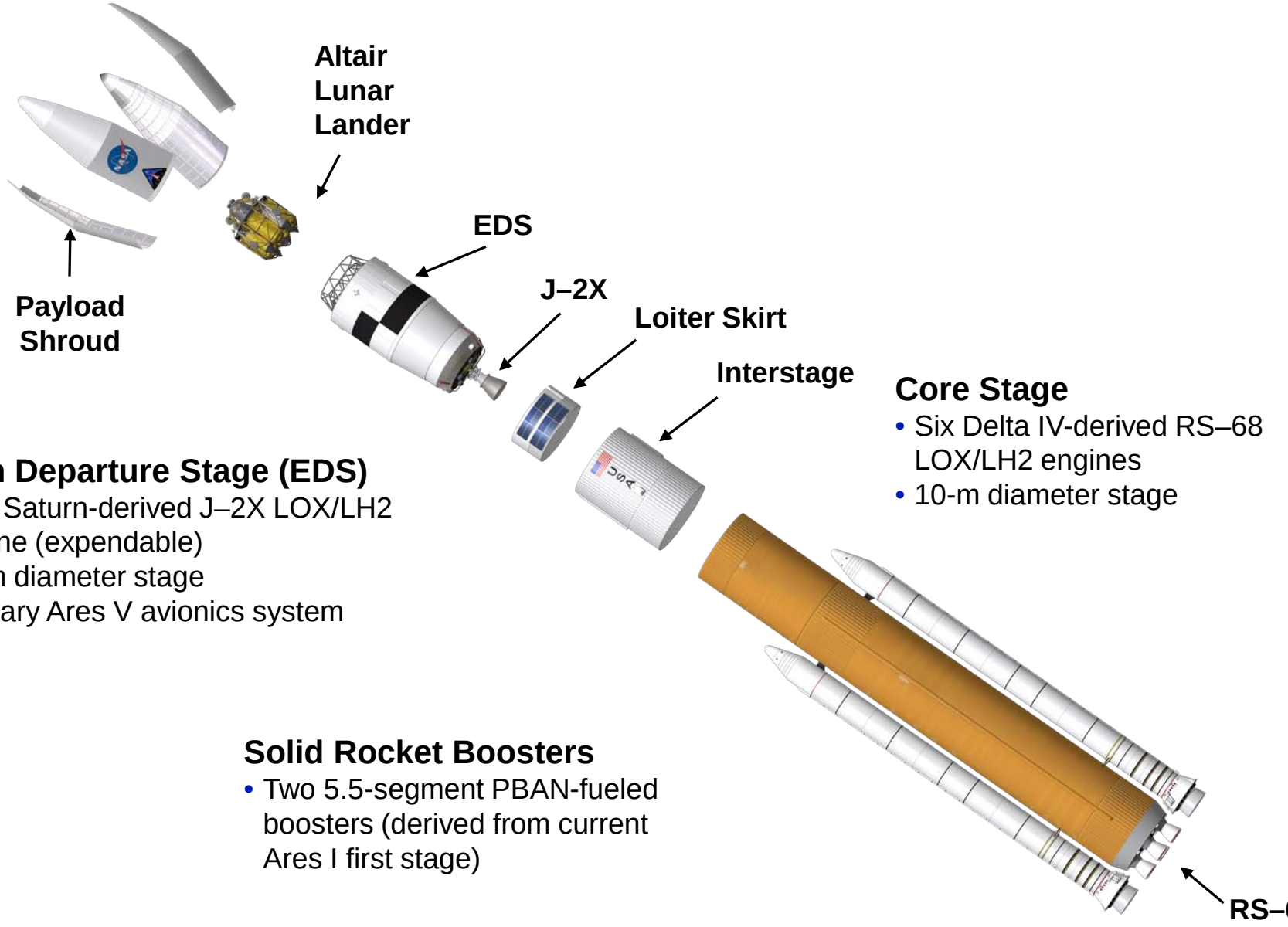
First Stage

- Derived from current Shuttle RSRM/B
- Five segments/Polybutadiene Acrylonitrile (PBAN) propellant

Upper Stage Engine

- Saturn J–2 derived engine (J–2X)

Ares V Elements



Earth Departure Stage (EDS)

- One Saturn-derived J–2X LOX/LH2 engine (expendable)
- 10-m diameter stage
- Primary Ares V avionics system

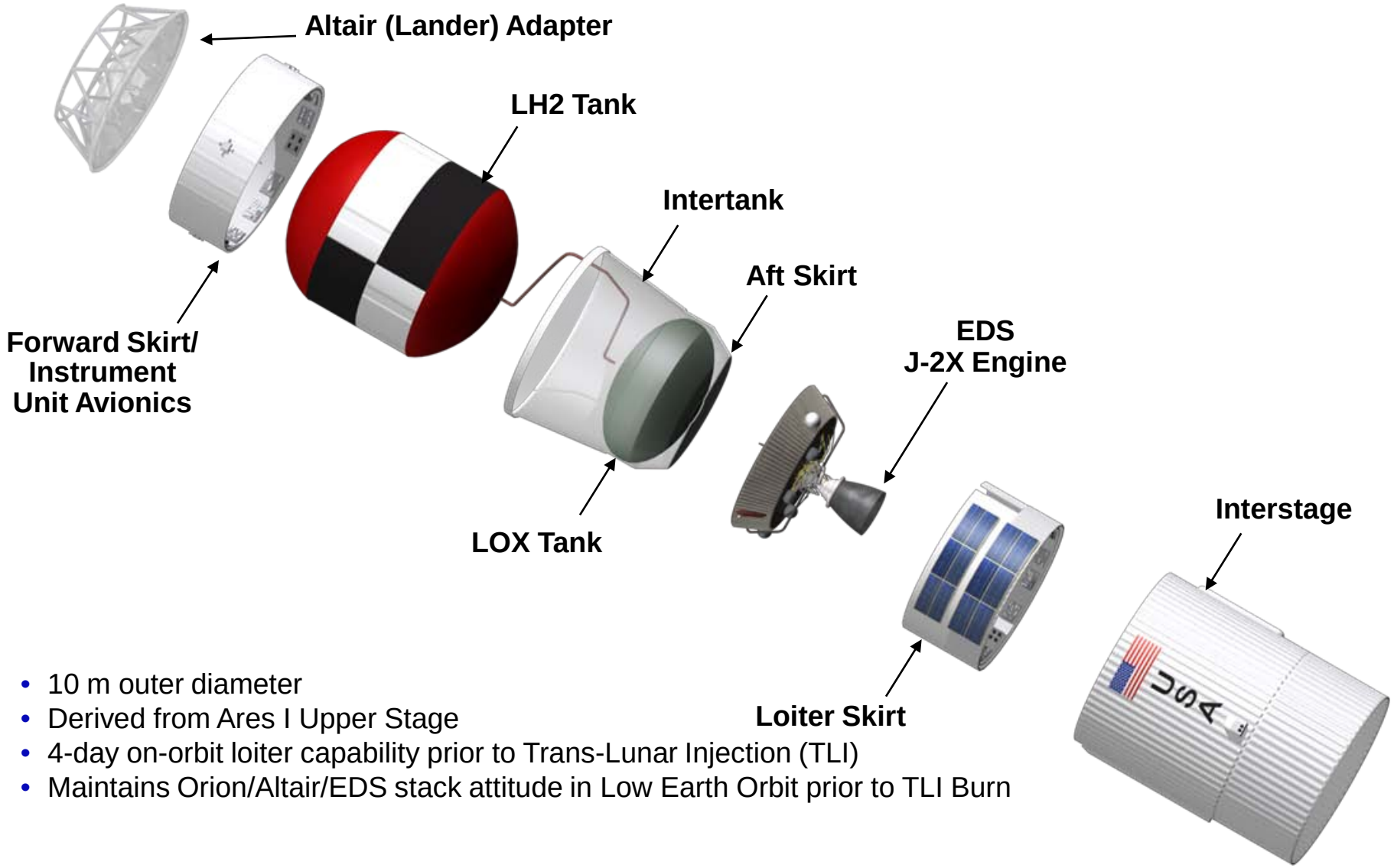
Core Stage

- Six Delta IV-derived RS–68 LOX/LH2 engines
- 10-m diameter stage

Solid Rocket Boosters

- Two 5.5-segment PBAN-fueled boosters (derived from current Ares I first stage)

Ares-V Earth Departure Stage Design Concept



- 10 m outer diameter
- Derived from Ares I Upper Stage
- 4-day on-orbit loiter capability prior to Trans-Lunar Injection (TLI)
- Maintains Orion/Altair/EDS stack attitude in Low Earth Orbit prior to TLI Burn

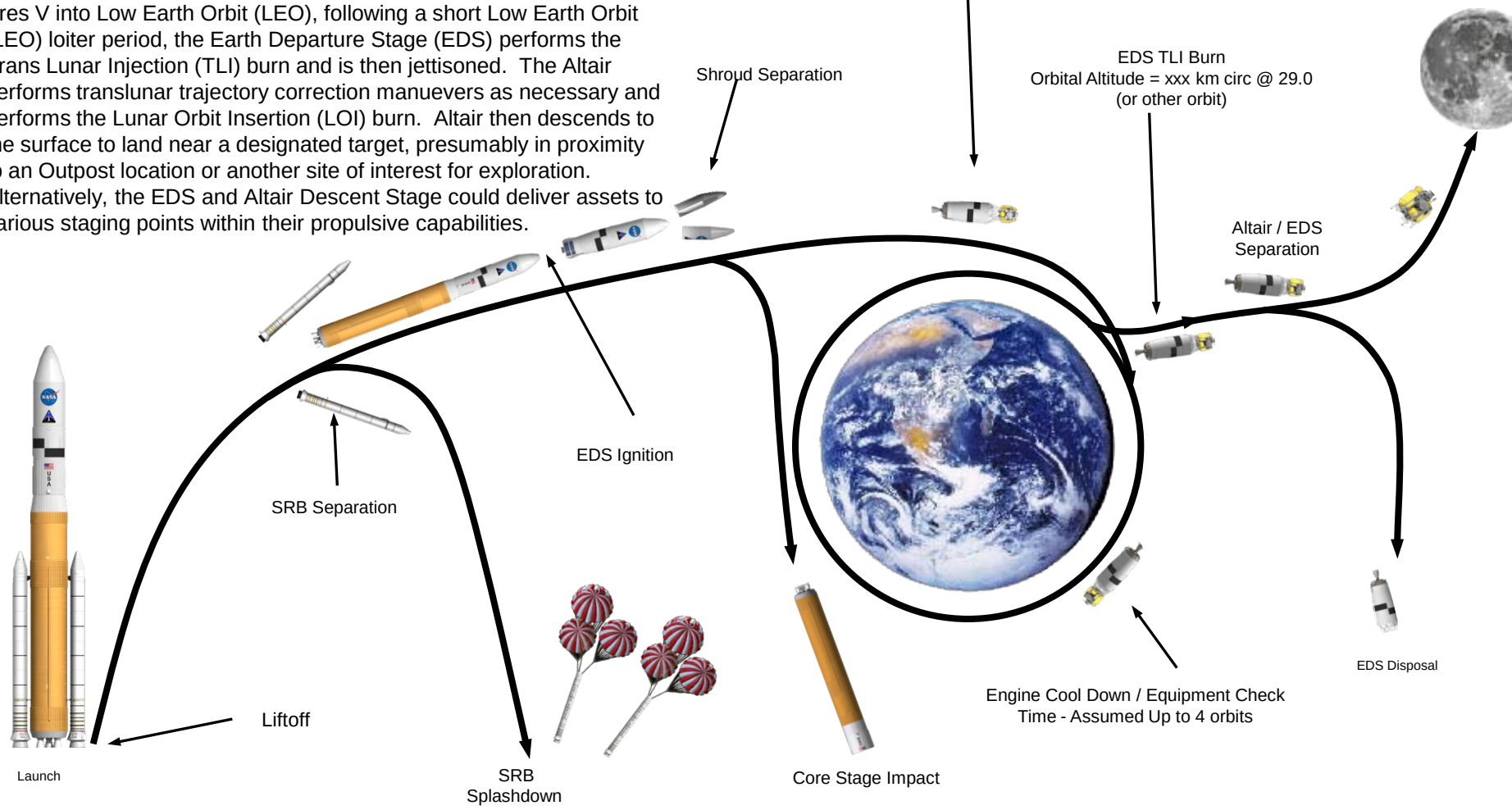
Crew Mission Parameters

Reference human transportation mission		NASA
Number of crew to lunar surface		4
Number of crew to lunar orbit		4
Access		Global
Duration at lunar surface		7
Major assumption		
Timeframe to be started		2020
Human launcher	Capability (t)	Ares-I (22-24t)
	Orbit (km)	-20km x 185 km at 29 deg
Cargo launcher	Capabilityn (t)	Ares-V (65-70t)
	Orbit (km)	241km circular
Injection orbit type		LEO->LTO
Launch site		KSC
Concept key parameters		
Number of launch per mission to surface		2
Number of mission per year		2
Crew Vehicle	Weight (t)	20.2 t at TLI
	Hab Volume (m3)	10
	Propellant	MMH/NTO
	Payload (kg)	100kg return
	Cabin Pressure (atm)	65.4-103 kPA
	Type of docking	LIDS
	Type of communication	In Trade
Human Lander	Weight (t)	45 t at TLI
	Hab Volume (m3)	10
	Propellant	LO2/LH2
	Payload (kg)(to surface)	500
	Payload (kg) (from surface)	100
	Cabin Pressure (atm)	TBD
	Type of docking	LIDS
	Type of communication	In Trade
Orbit Transfer Vehicle	Weight (t)	280
	Propellant	LO2/LH2
	Thrust (kN)	858-1058
	Type of docking	None
	Type of communication	In Trade
Earth Landing location		Western U.S. Coast/Pacific
In Space Support System		Inspace Comm satellites in trade. TDRSS GPS
Ground Support System		KSC/Eastern Range MCC-Houston Comm and Tracking Recovery system

NASA Constellation Cargo Mission Concept

NASA Constellation Cargo Mission

The NASA Constellation uncrewed cargo mission delivers cargo to any designated location on the lunar surface (or other staging point) in a single mission. This capability is used to deliver surface infrastructure needed for lunar outpost construction, to provide periodic logistics resupply to support a continuous human lunar presence, and potentially deliver other assets to various locations. In the nominal mission mode, the Altair lunar lander is launched on Ares V into Low Earth Orbit (LEO), following a short Low Earth Orbit (LEO) loiter period, the Earth Departure Stage (EDS) performs the Trans Lunar Injection (TLI) burn and is then jettisoned. The Altair performs translunar trajectory correction manuevers as necessary and performs the Lunar Orbit Insertion (LOI) burn. Altair then descends to the surface to land near a designated target, presumably in proximity to an Outpost location or another site of interest for exploration. Alternatively, the EDS and Altair Descent Stage could deliver assets to various staging points within their propulsive capabilities.



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Cargo Mission Parameters

Reference cargo mission				
Class		Very Large	Very Large	Very Large
Final destination		LEO	LLO	Surface
		Not in Baseline	Not in Baseline	Baseline Element
Agency		NASA	NASA	NASA
Launch info				
Nb launch per mission		1	1	1
Nb dissimilar launch vehicle		1	1	1
Launch vehicle a		Ares-V	Ares-V	Ares-V
Launch vehicle b				
Injection orbit type		LEO Circular	LEO Circular	LEO Circular
injection orbit inclination (deg)		29	29	29
injection orbit apogee altitude (km)		185-241 km	185-241 km	185-241 km
injection orbit perigee altitude (km)		185-241 km	185-241 km	185-241 km
Perfo (kg)		TBS	TBS	50000-55000
Staging location		LEO	LEO	LEO
Concept key parameters				
Cargo Performance (kg)		TBS	TBS	10000-15000
Available cargo volume (m)		TBD	TBD	860 m^3
Flight frequency (per year)		2	2	2
Availability (date)		2020	2020	2020
Global access		Yes	Yes	Yes
Reliability (loss of mission)		1/TBD	1/TBD	1/TBD
Heigth of payload deck above surface (m)		N/A	N/A	6-7
Precision landing (m) unaided		N/A	N/A	100-500
Mission duration from launch (days)		N/A	N/A	5-20
Surface stay (day)		TBD	TBD	TBD
Services Provided	Off-loading	No	No	No
	Power	Possible	Possible	Possible

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