National Aeronautics and Space Administration

Ares V: A National Launch Asset for the 21st Century

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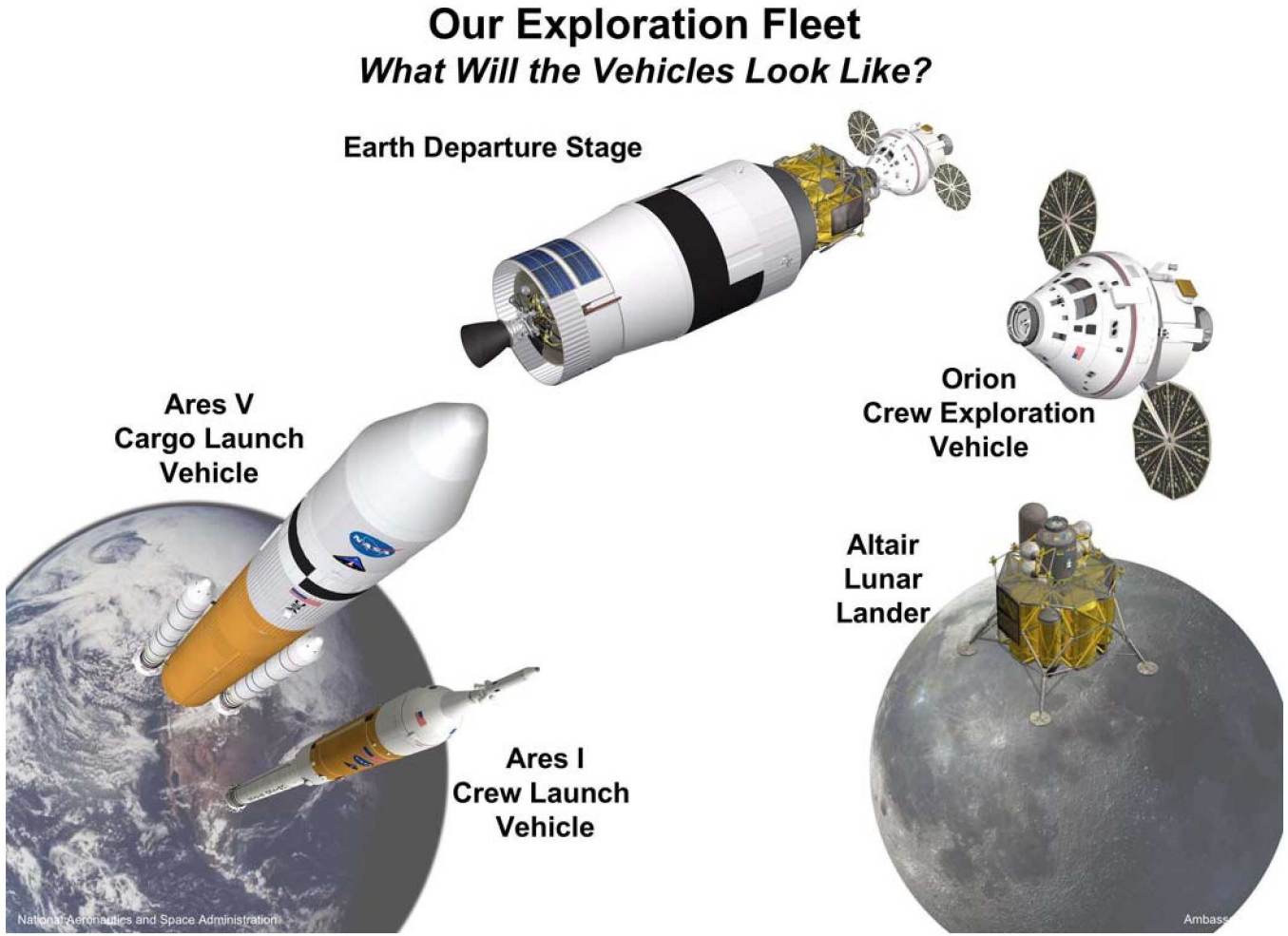
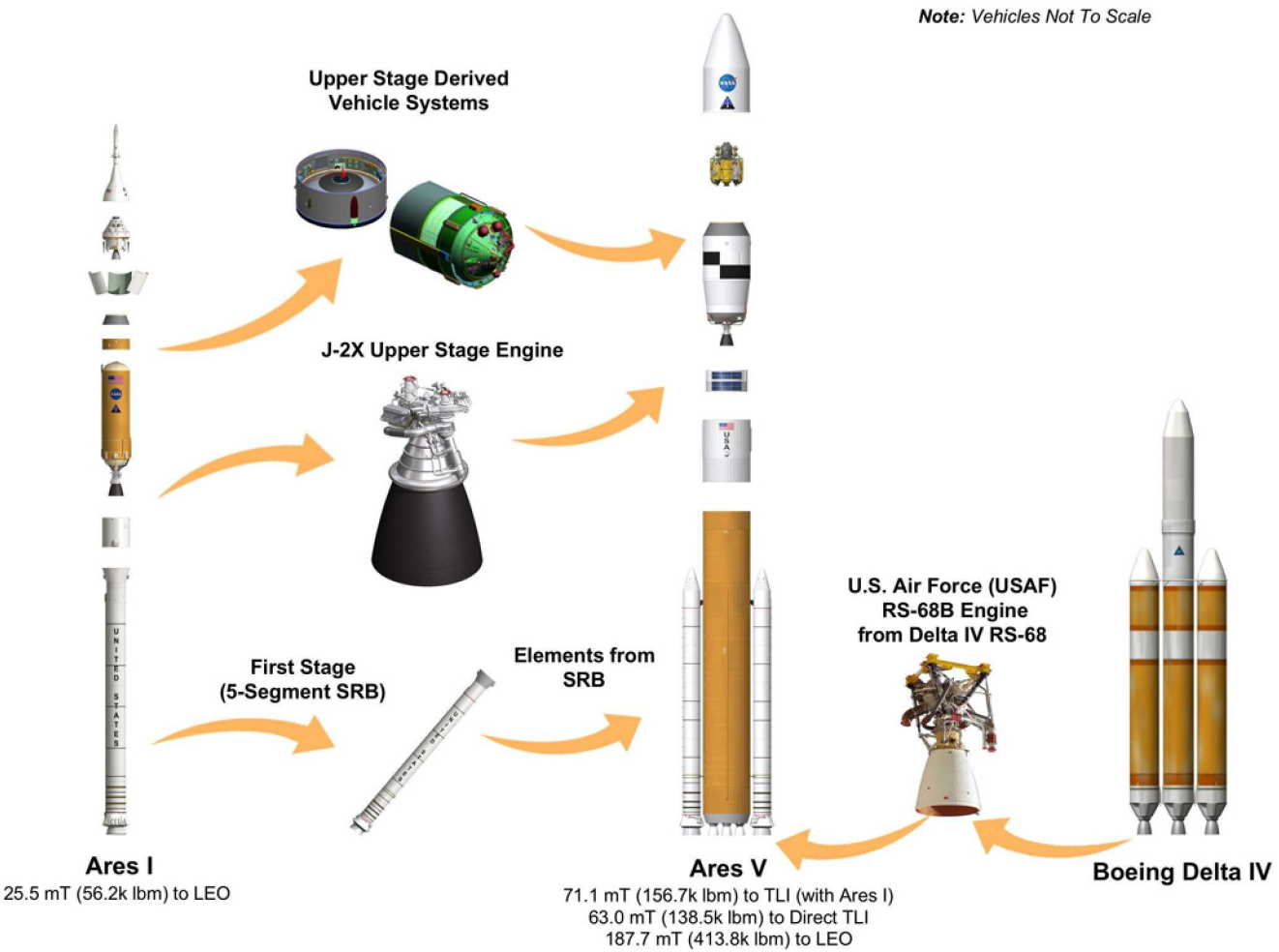
Introduction

- The NASA Ares Projects Office is developing the launch vehicles to move the United States and humanity beyond low earth orbit
- Ares I is a crewed vehicle, and Ares V is a heavy lift vehicle being designed to launch cargo into LEO and transfer cargo and crews to the Moon
- This is a snapshot of development. Ares V is early in the requirements formulation stage of development pending a planned authority to proceed (ATP) from NASA in late 2010.
- The Ares V vehicle will be considered a national asset, opening new worlds and creating unmatched opportunities for human exploration, science, national security, and space business
- My goal today is to update you on the status of the Ares V vehicle

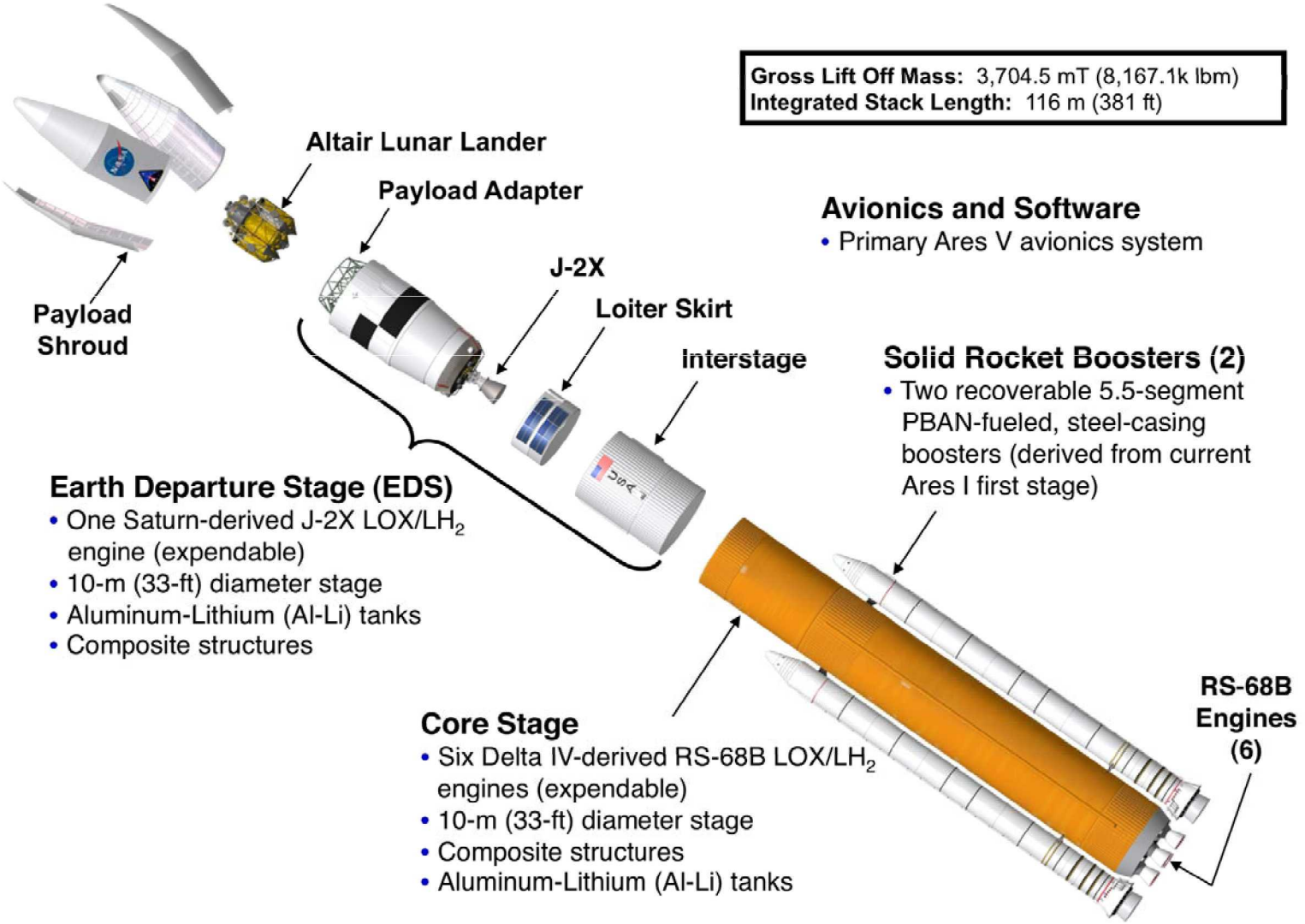
NASA's Exploration Fleet



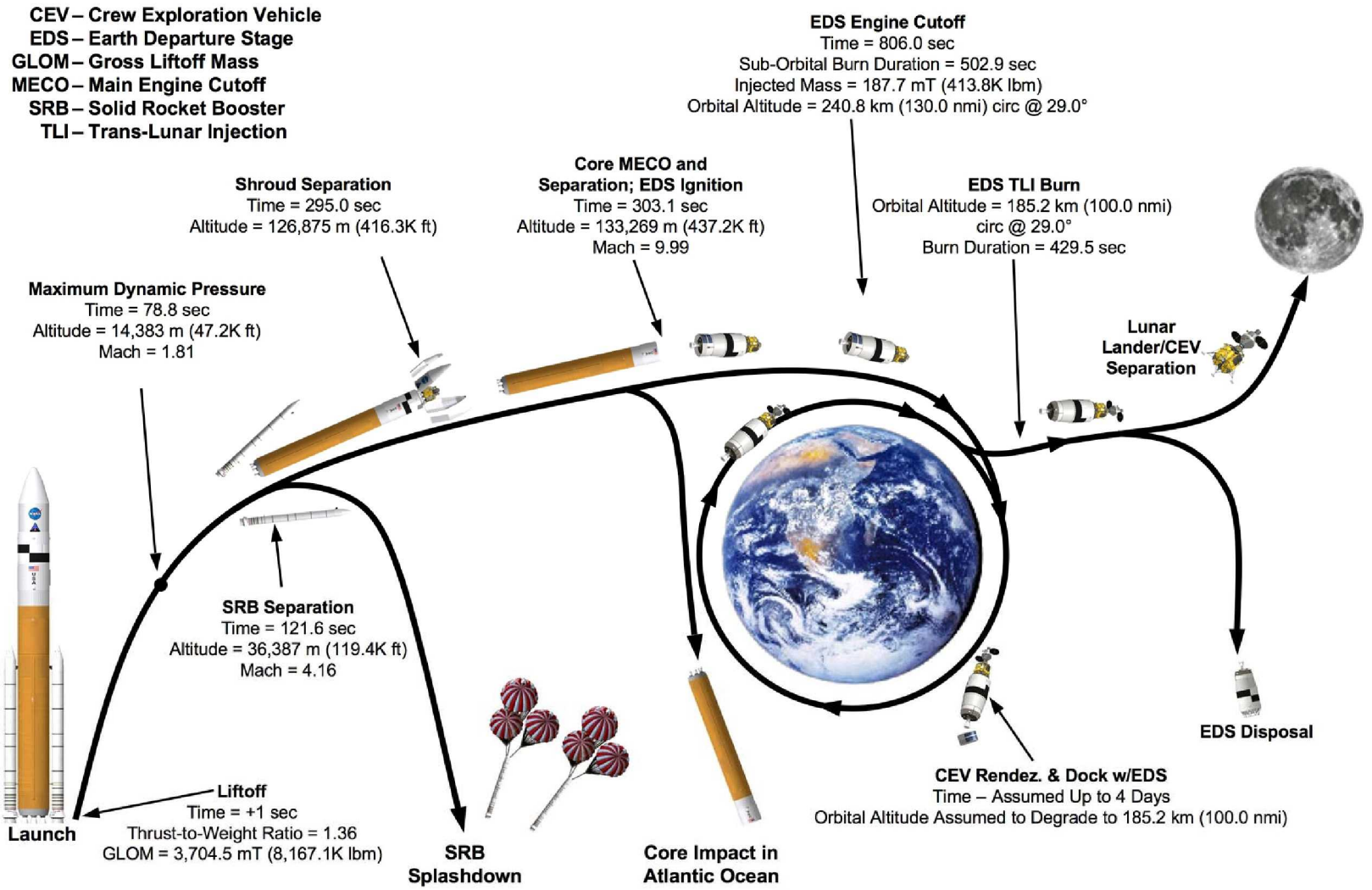
Ares Vehicles: Commonality and Heritage Hardware



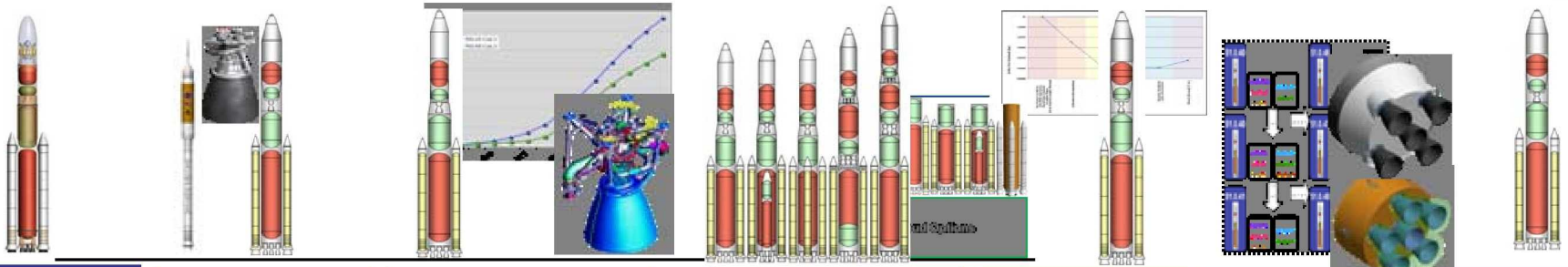
LCCR/MCR-Approved Point-of-Departure



Ares V Launch Profile For Lunar Mission



ESAS (2005) to LCCR (2008) Major Events



Original ESAS Capability

- *45.0 mT Lander*
- *20.0 mT CEV*
- *No Loiter in LEO*
- *8.4m OML*
- *5 SSMEs / 2J2S*

CY-06 Budget Trade to Increase

- Ares I / Ares V Commonality
- Ares I : 5 Seg RSRB / J2-X instead of Air-Start SSME
- Ares V: 1 J2-X

Detailed Cost Trade of SSME vs RS-68

- ~$4.25B Life Cycle Cost Savings for
- 5 Engine Core
- Increased Commonality with Ares I Booster
- 30-95 Day LEO Loiter Assessed

IDAC 3 Trade Space

- Lunar Architecture Team 1/2 (LAT) Studies
- Mission Delta V's increased
- Increase Margins From TLI Only to Earth through TLI
- Loiter Penalties for 30 Day Orbit Quantified

EDS Diameter Change from 8.4m to 10m

- Lunar Architecture Team 1/2 (LAT) Studies
- Lunar /Mars Systems Benefits
- Tank Assembly Tooling Commonality

Incorporate Ares I Design Lessons Learned / Parameters

- Core Engine / SRB Trades to Increase Design Margins
- Increase Subsystem Mass Growth Allowance (MGA)

Recommended Option

- *6 Core Engines*
- *5.5 Segment PBAN*

Updated Capability

- 45.0t Lander
- 20.2t CEV
- ~6t Perf. Margin
- 4 Day LEO Loiter
- Ares I Common MGAs
- Booster Decision Summer 2010

220 Concepts Evaluated

320 Concepts Evaluated

730 Concepts Evaluated

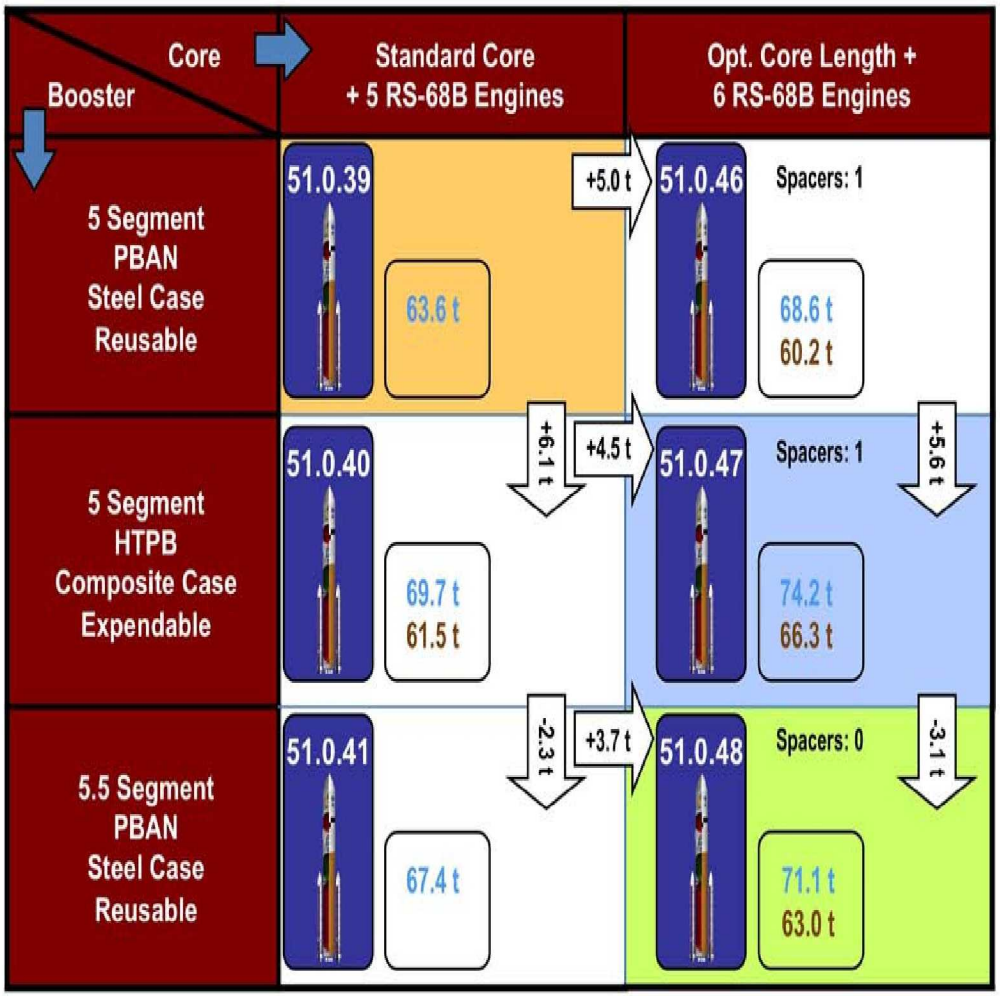
460 Concepts Evaluated

2005 | 2006 | 2007 | 2008

Ares I ATP | Orion ATP | Ares I SRR | Orion SRR | Ares I SDR | Ares V MCR

Approved for Public Release; Distribution is Unlimited

LCCR Trade Space



Common Design Features
Composite Dry Structures for Core Stage, EDS & Shroud
Metallic Cryo Tanks for Core Stage & EDS
RS-68B Performance: Isp = 414.2 s Thrust = 797K lbf @ vac
J-2X Performance: Isp = 448.0 s Thrust = 294K lbf @ vac
Shroud Dimensions: Barrel Dia. = 10 m Usable Dia. = 8.8 m Barrel Length = 9.7 m

Initial LCCR Study Reference

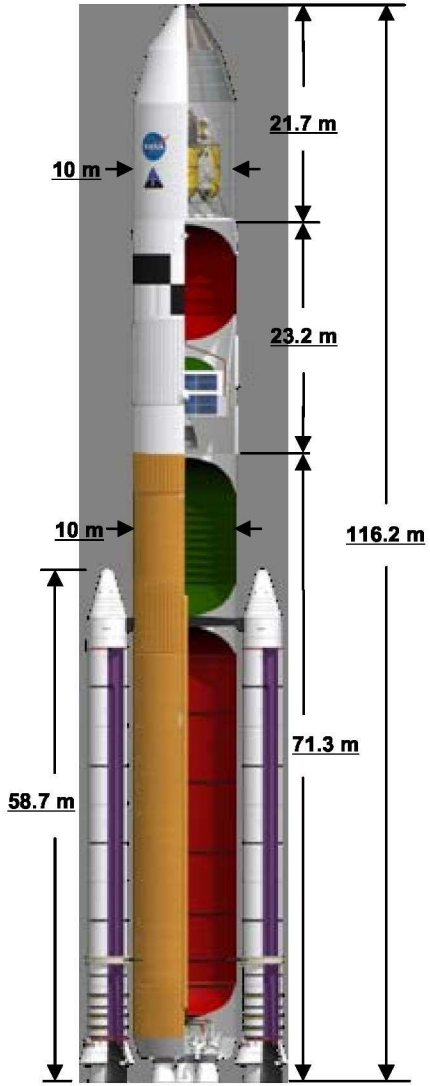
Alternative New POD

Recommend for New POD

1.5 Launch TLI Capability

Cargo TLI Capability

Approved New Point of Departure
- Vehicle 51.00.48 -



NOTE: These are MEAN numbers

- **Vehicle 51.00.48 approved**
  - 6 Engine Core, 5.5 Segment PBAN Steel Case Booster
  - Provides Architecture Closure with Margin
  - High Commonality with Ares I
- **Vehicle 51.00.47 with Composite HTPB Booster Retained as Ares V Option**
  - Final Decision on Ares V Booster at Constellation Lunar SRR (June 2010)
  - Additional Performance Capability if needed for Margin or requirements
  - Allows for competitive acquisition environment for booster
  - Fund key technology areas: composite cases, HTPB propellant characterization

Ares V Utilization: A National Asset

Saturn V Apollo 15		Ares V Reference 51.00.39	
363.0	STACK HEIGHT (ft)	360.5	
6,495,000	GLOW (lb)	7,440,326	
309,787	LEO INSERTION MASS (lbm)	372,616	Target Orbit: 130 nmi Circ. @ 29°
143,981	TLI INSERTION MASS (lbm)	195,464	
686	MAX Q (psf)	623	
4.00	MAX GRAVITATIONAL LOAD (g)	3.90	
24,914	DRY MASS (lbm), EDS STAGE	50,144	no interstage
230,000	TOTAL THRUST (lbf, vac), EDS STAGE	294,000	
0.87	THRUST / WEIGHT, EDS STAGE	0.43	
AL 2014	TANK MATERIAL, EDS STAGE	AL-LI 2195	
LOX/LH2	PROPELLANT TYPE, EDS STAGE	LOX/LH2	
424.0	ENGINE Isp (sec, vac), EDS STAGE	448.0	
23.0	STAGING MACH #, EDS STAGE	9.1	
Earth Orbit	MECO ALTITUDE (nmi), EDS STAGE	131.6	
TLI	STAGING ALTITUDE (nmi), TLI STAGE	TBD	
88,000	DRY MASS (lbm), 2nd STAGE		no interstage
1,150,000	TOTAL THRUST (lbf, vac), 2nd STAGE		
1.05	THRUST / WEIGHT, 2nd STAGE		
AL 2014	TANK MATERIAL, 2nd STAGE		
LOX/LH2	PROPELLANT TYPE, 2nd STAGE		
424.0	ENGINE Isp (sec, vac), 2nd STAGE		
19.4	STAGING MACH #, 2nd STAGE		
96.1	STAGING ALTITUDE (nmi), 2nd STAGE		
305,232	DRY MASS (lbm), 1st STAGE	296,952	no interstage
7,765,000	TOTAL THRUST (lbf, vac), 1st STAGE	3,985,000	108%
1.20	THRUST / WEIGHT, 1st STAGE	1.32	after booster separation
AL 2219	TANK MATERIAL, 1st STAGE	AL-LI 2195	
LOX/RP1	PROPELLANT TYPE, 1st STAGE	LOX/LH2	
304.0	ENGINE Isp (sec, vac), 1st STAGE	414.2	
7.0	STAGING MACH #, 1st STAGE	8.8	
40.5	STAGING ALTITUDE (nmi), 1st STAGE	76.0	
	BURNOUT MASS (lbm), RSRB	221,175	per booster
	TOTAL THRUST (lbf, vac), RSRB	7,143,948	
	THRUST / WEIGHT, IGNITION + 1.0 SEC	1.34	vehicle with boosters
	TANK MATERIAL, RSRB	STEEL	
	PROPELLANT TYPE, RSRB	PBAN	262-07 Trace
	ENGINE Isp (sec, vac), RSRB	272.8	
	STAGING MACH #, RSRB	3.8	
	STAGING ALTITUDE (nmi), RSRB	20.5	

89.6 x 91.5 nmi @ 29.7°

** Most numbers for Saturn V reference the Apollo 15 Mission; ACO 09-FEB-2007

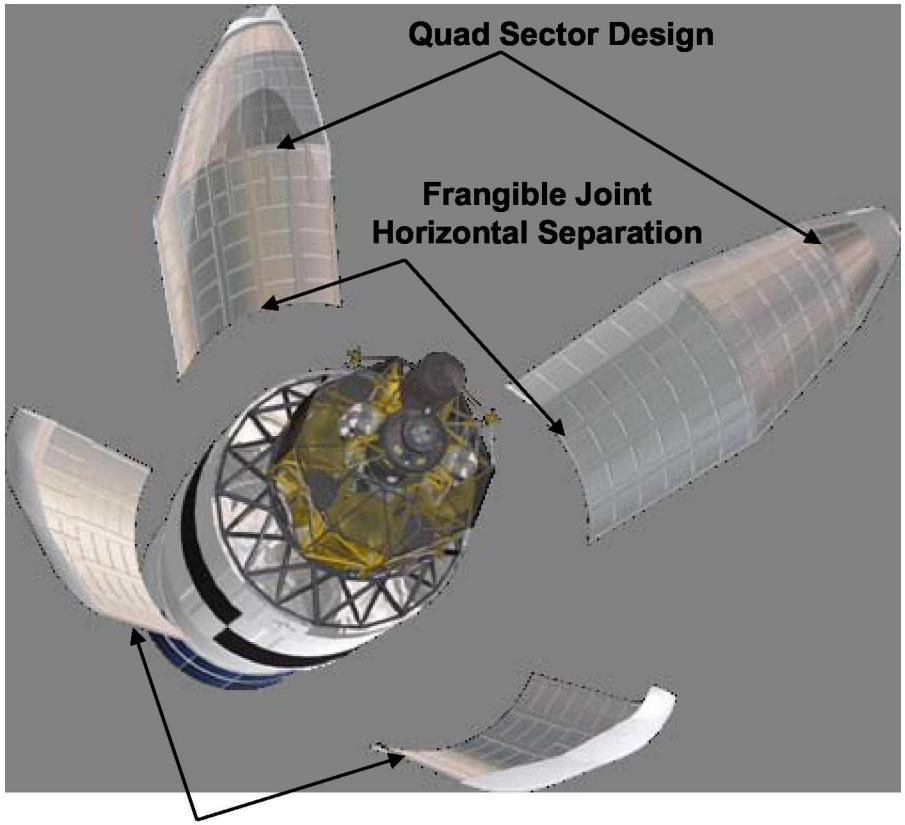
** Numbers for Ares V reference the 51.00.39 mission; ACO 10-JAN-2008

Payload Shroud Point Of Departure

Point of Departure (Biconic)

Leading Candidate (Ogive)

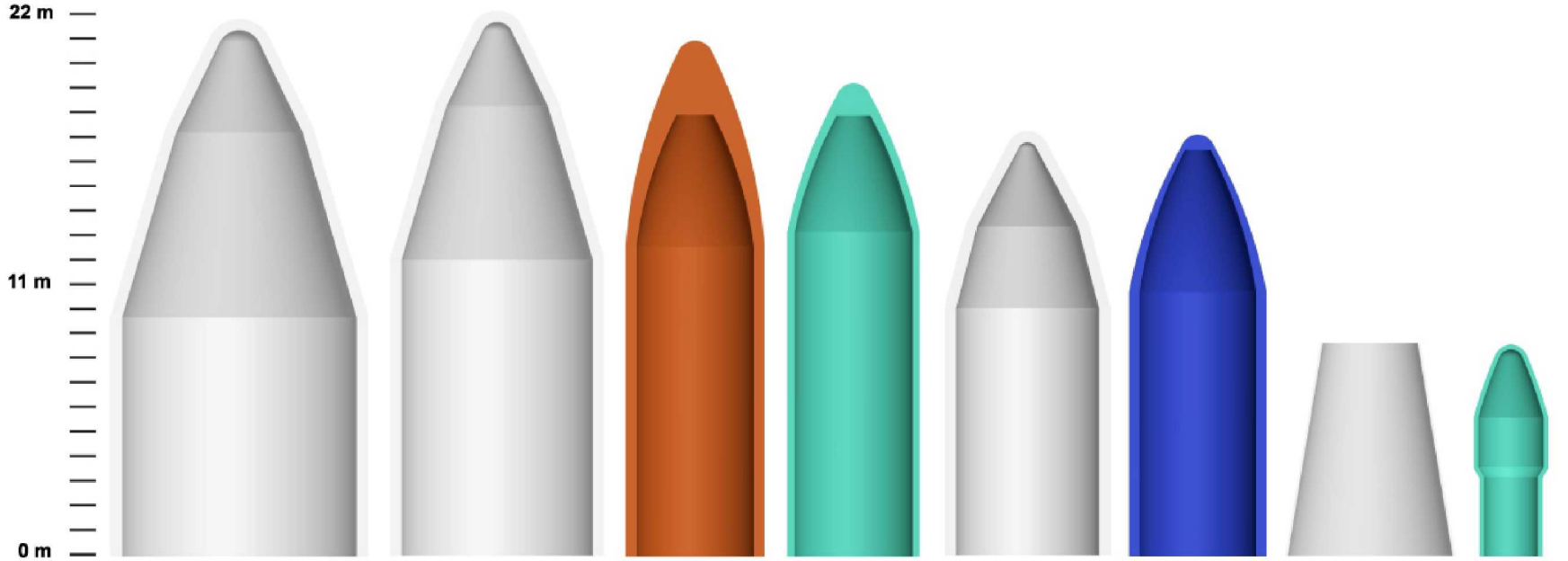
Mass: 9.1 mT (20.0k lbm)
POD Geometry: Biconic
Design: Quad sector
Barrel Diameter: 10 m (33 ft)
Barrel Length: 9.7 m (32 ft)
Total Length: 22 m (72ft)



- Composite sandwich construction (Carbon-Epoxy face sheets, Al honeycomb core)
- Painted cork TPS bonded to outer face sheet with RTV
- Payload access ports for maintenance, payload consumables and environmental control (while on ground)

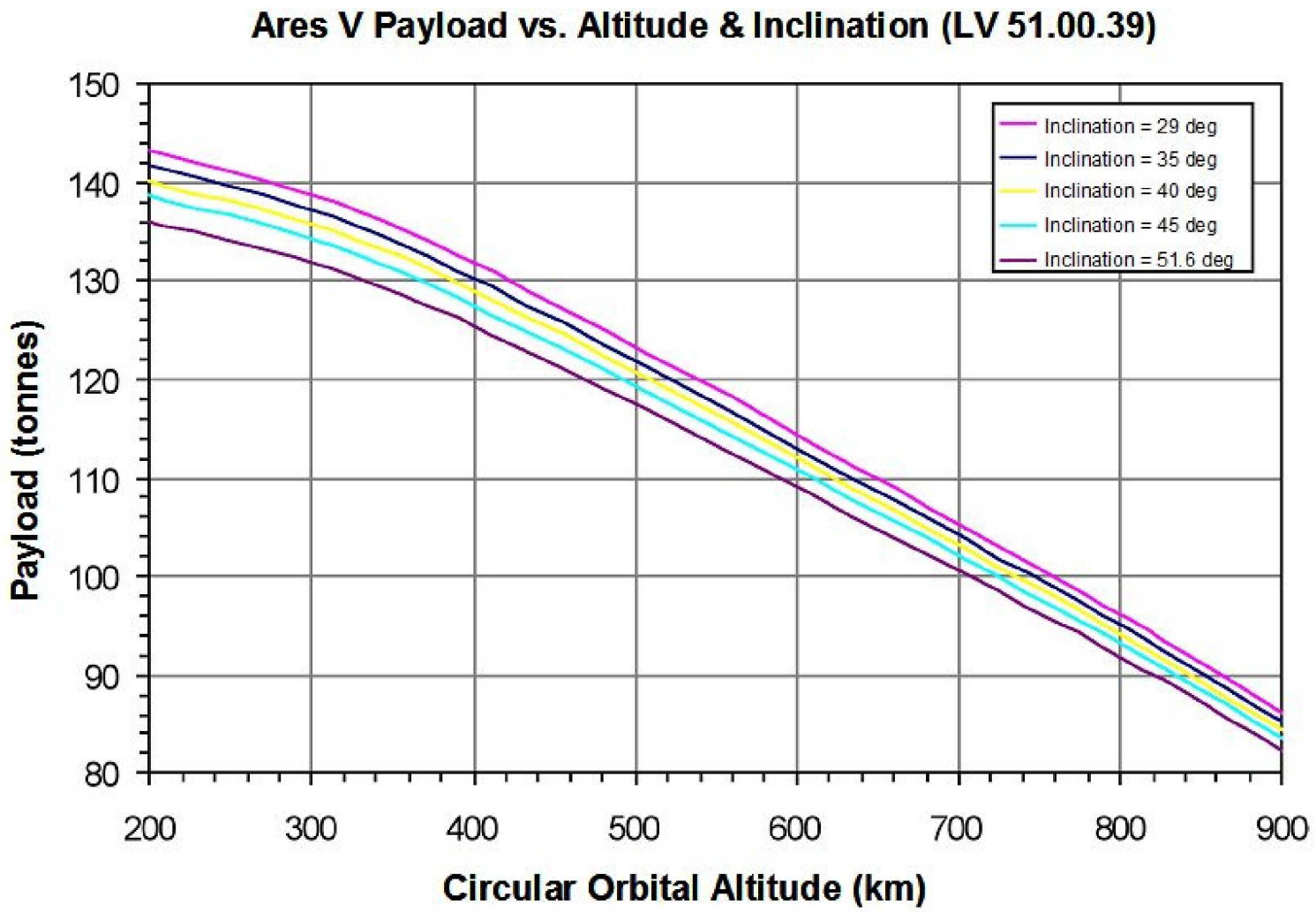
Thrust Rail Vertical Separation System
Payload umbilical separation

The Ares V Shroud Compared

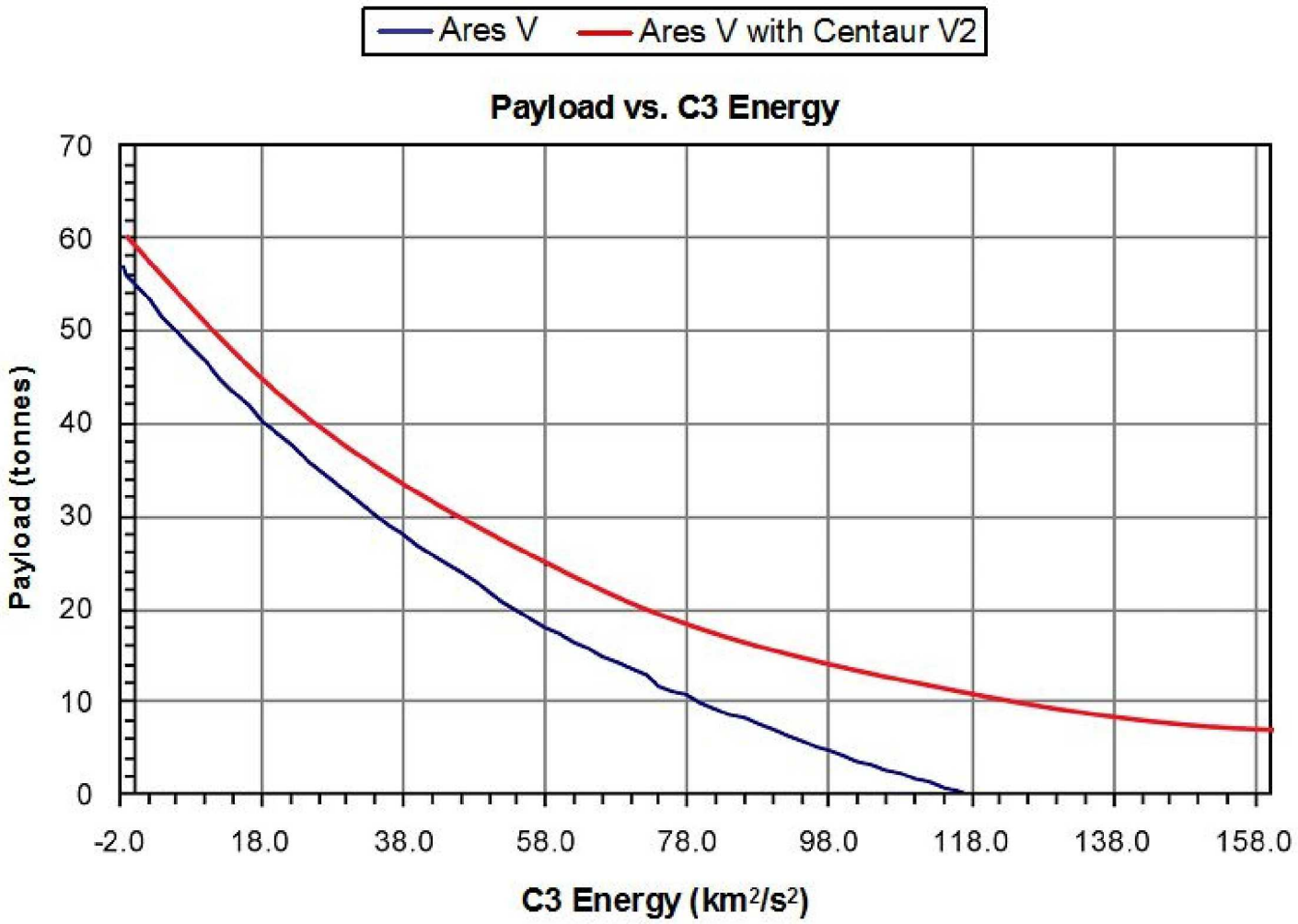


Ares V	Ares V	Atlas V	Delta IV	Skylab	Ariane	Apollo SLA	Delta II
10 x 9.7	8.4 x 12	5.4 x 12.4	5.1 x 13	6.5 x 10	5.4 x 10.6	6.6/5.6	3 x 4.2
~561 m^2	~493 m^2	~311 m^2	~277 m^2	~305 m^2	~254 m^2	~142 m^2	~63 m^2

Ares V Payload vs. Altitude and Inclination



Ares V Payload Mass vs. C3 Energy

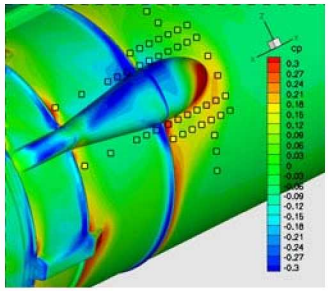


Ares V Performance for Selected Trajectories

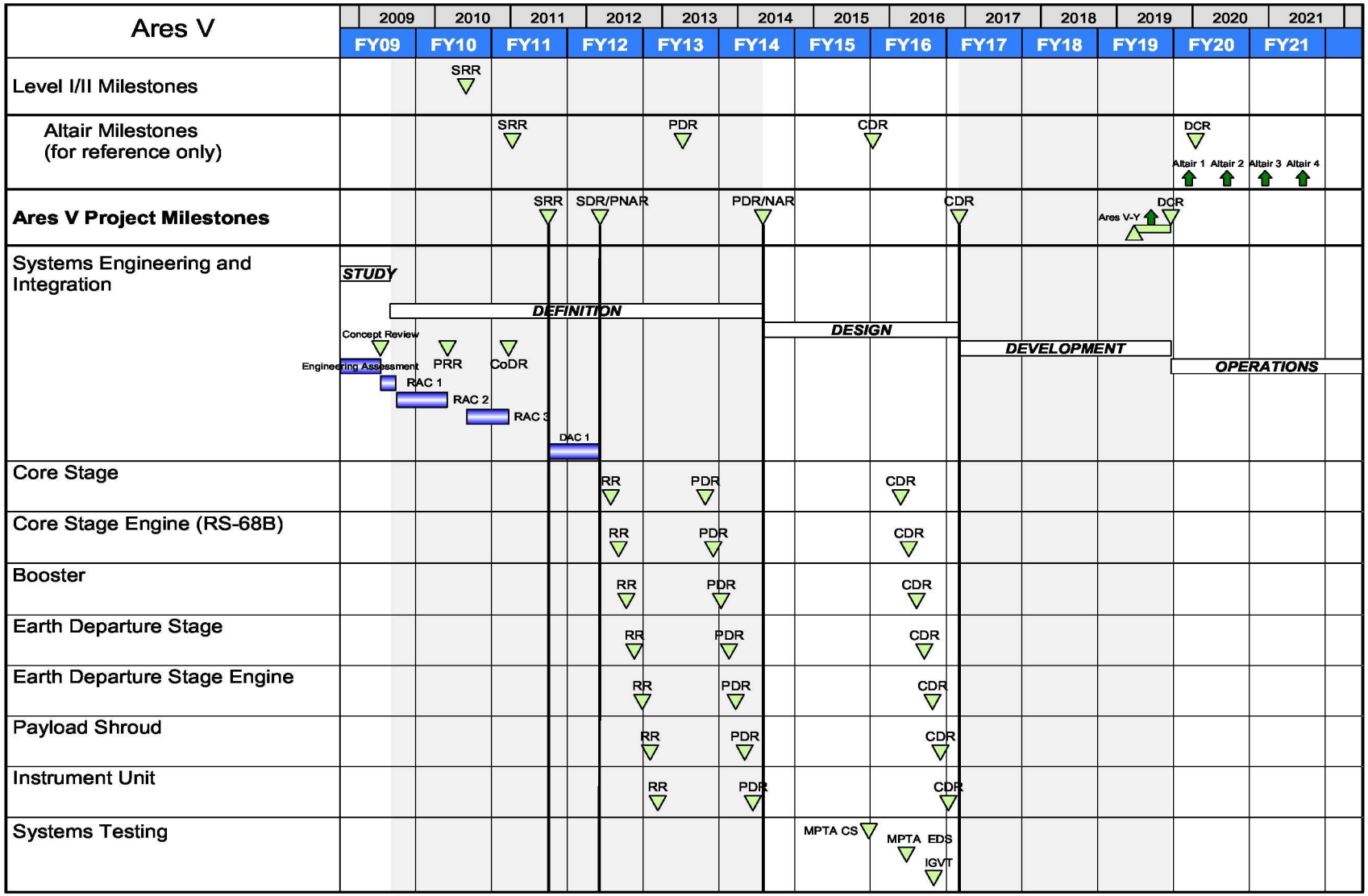
Mission Profile	Target	Constellation POD Shroud		Extended Shroud	
		Payload (lbm)	Payload (mt)	Payload (lbm)	Payload (mt)
1) LEO (@29° inclination)	241 x 241 km	315,000	143	313,000	142
2) GEO	Transfer DV 14,100 ft/s	77,000	35	76,000	34.5
3) Cargo Lunar Outpost (TLI Direct), Reference	C3 of -1.8 km^2/s^2	126,000	57	125,000	57
4) Sun-Earth L2 Transfer Orbit Injection	C3 of -0.7 km^2/s^2	124.000	56.5	123,000	56
5) Earth-Moon L2 Transfer Orbit Injection	C3 of -1.7 km^2/s^2	126,000	57.0	125,000	57
6) GTO Injection	Transfer DV 8,200 ft/s	153,000	69.5	152,000	69
7) Mars Cargo (TMI Direct)	C3 of 9 km^2/s^2	106,000	48	105,000	48

Current Activities

- Ares V concept definition/requirements development industry proposals
- Structural test approach
- Structural test articles
- Ares V-Y flight test objectives
- Ares V aerodynamic characterization
- Manufacturing, test, and launch facilities
- Core Stage and EDS propulsion test approach and facilities assessment
- Technology prioritization
- Ares V Cost threat risk assessment
- Ares V performance risk assessment



Ares V Planning Calendar



Conclusions

- Ares V current concept (51.00.48) exceeds Saturn V mass capability to trans lunar injection by almost 40% alone or almost 60% with Ares I
- This concept vehicle can meet current Human Lunar Return requirements with ~6 mT of Margin
- 2009 activities focused on refining vehicle and operational concept, refining requirements, working with potential non-Constellation users to understand vehicle/payload benefits and design issues
- Ares V is sensitive to loiter time, attitude, power, and altitude requirements, in addition to payload performance