Ares V: Current Status and Future Capabilities

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AIAA Space 2009
September 14-17, 2009
Ares V Elements
Current Point-of-Departure

Earth Departure Stage (EDS)
- One Saturn-derived J-2X LOX/LH₂ engine (expendable)
- 33 ft diameter stage
- Aluminum-Lithium (Al-Li) tanks
- Composite structures, instrument unit, and interstage
- Primary Ares V avionics system

Core Stage
- Six Delta IV-derived RS-68B LOX/LH₂ engines (expendable)
- 33 ft diameter stage
- Composite structures
- Al-Li tanks

Solid Rocket Boosters
- Two recoverable 5.5-segment PBAN-fueled, steel-case boosters (derived from current Ares I first stage)
- Option for new design

Gross Liftoff Mass: 8,167.1K lbm
Performance to TLI: 157K lbm
Integrated Stack Length: 381.1 ft
Ares I and Ares V Commonality

- **Upper Stage-Derived Vehicle Systems**
- **J-2X Upper Stage Engine**
- **First Stage (5-Segment RSRB)**
- **Elements from Ares I Range: full stage to case/nozzle/booster systems**
- **U.S. Air Force RS-68B from Delta IV RS-68**

- **Builds Up Flight Reliability on the Smaller Vehicle Earlier**
- **Lowers Life Cycle Cost**

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
- $4.256B 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

2005
- 220 Concepts Evaluated
- Ares I ATP

2006
- 320 Concepts Evaluated
- Orion ATP

2007
- 730 Concepts Evaluated
- Ares I SRR

2008
- 460 Concepts Evaluated
- Orion SRR
- Ares I SDR
- Ares V MCR

National Aeronautics and Space Administration
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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
Architecture Flexibility
Enables New Science Applications

“Exciting new science may be enabled by the increased capability of Ares V. The larger launch mass, large volume, and increased C3 capability are only now being recognized by the science community.”
— National Academy of Science’s “Science Opportunities by NASA’s Constellation Program”

“It is very clear from the outset that the availability of the Ares V changes the paradigm of what can be done in planetary science.”
— Workshop on Ares V Solar System Science

At 5.7 mT, the Cassini spacecraft is the largest interplanetary probe and required a C3 of 20 km²/s² and several planetary flyby ‘gravity assist’ manoeuvres. Ares V can support about 40 mT for this same C3.

Cassini spacecraft ~ to scale for comparison

Ares V will have the largest payload volume capability of any existing launch system

HST 2.4-m
JWST 6.5-m
8-9 m
16+ m

Ceres
C3 = 40 km²/s²
1.3 yrs

Ceres
C3 = 20 km²/s²
40 mT

Cassini spacecraft

Jupiter
C3 = 80 km²/s²
2.7 yrs

Saturn
C3 = 106 km²/s²
6.1 yrs

Uranus
C3 = 127 km²/s²
15.8 yrs

Neptune
C3 = 136 km²/s²
30.6 yrs

Mars
C3 = 9 km²/s²
9 mos

Large Payload Volume and Lift Capability

Current Capability
Ares V Enabled Capability
(>10x Collection Area)
Range of Architecture Options Enabled

A Few Examples (Payload to TLI)

- Baseline (71 mT with Ares I)
- Common First Stage with Ares I (68 mT with Ares I)
- Crew Capability using Ares I Upper Stage with Ares V Core (35 mT)
- Crew Capability (45–51 mT)
- Advanced Solid First Stage (75 mT with Ares I)
- Single Launch Capability (55–63 mT)
Ares V Summary

- NASA has begun preliminary concept work on vehicle. Over 1,700 alternatives investigated since ESAS
- Focused on design of EDS, payload shroud, core stage, and RS-68 core stage engines
- Recent point of departure update following the Lunar Capability Concept Review
  - Adds additional performance margin using an additional RS-68
  - Adds half segment on the first stage boosters
- Shroud size dictated by eventual size of Altair lunar lander
- Also investigating alternate uses for Ares V not related to human space exploration
  - Astronomy applications (e.g., large aperture telescopes)
  - Deep space missions
  - DoD applications
  - Other applications