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Panel Session IV - NASA's Utilization of Expandable Launch Vehicles

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Space Congress 2004

NASA's Utilization of Expendable Launch Vehicles

Steve Francois, Program Manager
NASA Launch Services Program
April 2004



Historical Perspective

- Post Challenger, NASA instituted a Mixed Fleet Launch Strategy and consistent with law and policy transitioned to acquisition of commercial launch services for missions that did not require unique capabilities of the Space Shuttle
- Since 1990, the majority of NASA's free flyer/robotic spacecraft have been launched on Pegasus, Delta II, and Atlas ELV launch systems
- Although Pegasus and Delta II - class capability remains a key niche for NASA, future requirements for Delta IV/Atlas V capability, both of which NASA has under contract today are being considered

	CY90-CY03	CY04-CY11
Scout	6	0
Pegasus	12	7
Taurus	0	5
Delta II	28	31
Atlas Centaur E/II/II	14	0
Titan II/III/IV	6	0
Delta IV/Atlas V	0	11
To be assigned	N/A	5
Other	2	0

Notes:
 • Figures only reflect NASA Primary Payloads
 • CY04-CY11 contains planning figures - subject to change
 • Future Exploration Initiative architecture decisions may increase CY04-CY11 figures

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Past ELV Upgrades

- NASA's unique requirements have driven ELV upgrades in the past:
 - Delta II Star 37 upper stage
 - Pegasus performance upgrade to Pegasus XL
 - SLC 3E Atlas IIAS Launch Capability
 - Delta II 10L Fairing
 - Atlas IIA 3m Payload Fairing widening to 4m
 - Atlas IIA 4m Payload Fairing 3ft Extension
 - Centaur Strengthening for Heavy Payloads
 - Atlas IIA TDRSS Transmitter
 - Centaur Long Coast Kit
 - Delta II Dual Payload Attach Fitting (DPAF)
 - Delta II 7920 Heavy performance enhancement
 - Delta II Star 48 Break-up System

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Future ELV Upgrades/Capabilities

- No specific upgrade initiatives are currently planned for the Pegasus and Delta II fleets, other than continuous improvement and mission unique modifications
- The new Exploration Initiative may drive the need for capabilities beyond the current ELV capabilities
- Past/on-going NASA studies on ELV Upgrades focus in three areas:
 - Reliability Enhancements
 - Human Rating
 - Performance Enhancements

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ELV Reliability Enhancements

- Initial Studies performed by NASA, Boeing and Lockheed Martin in 2003
 - Focused on Delta IV and Atlas V families
 - Documented on baseline design reliability and methodology
 - Identification of single point failures within existing ELV designs
 - Proposed reliability enhancements
- NASA is exploring the possibility to invest in reliability upgrades that will enhance the entire fleet, as opposed to one-of-a-kind modifications
- Potential Reliability Enhancements under consideration for further study
 - RL-10 engine - benefits to both launch systems' upper stages
 - RD-180 - Atlas V booster engine
 - RS-68 - Delta IV booster engine
 - Fault tolerance upgrades where feasible/practical
 - Initiatives to increase design margins/robustness
 - Potential benefits in process enhancements
- Plans for future study/requirements development under review

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Human Rating

- LSP and the Launch Contractors formed a team to support the Orbital Space Plane (OSP) requirements development and preliminary design efforts throughout CY03 and early CY04
 - Initial studies were performed for OSP over a very short period of time
 - Focus on Unique requirements, especially human rating
 - Existing ELV compliance with human rating guidelines is feasible, but very challenging
- Preliminary Studies identified some areas warranting further assessment to support human rating compliance for ELV's:
 - Fault tolerance enhancements (both flight and ground)
 - Unique Analysis: FMEA/CIL, Hazard Analysis, Blast Models, Abort trajectories, Aerodynamics, Probabilistic Risk Assessment (PRA)
 - Custom mechanical and electrical/data interfaces
 - Launch Vehicle Health Monitoring (LVHM) system
 - Human Access/Emergency Egress at Launch Complex
 - Modifications to Flight Termination Systems
- On-going/Future Work:
 - Documenting results from OSP Studies - assessing applicability to CEV
 - Next steps to be developed with Space Flight and Space Exploration Enterprises

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ELV Performance Enhancements

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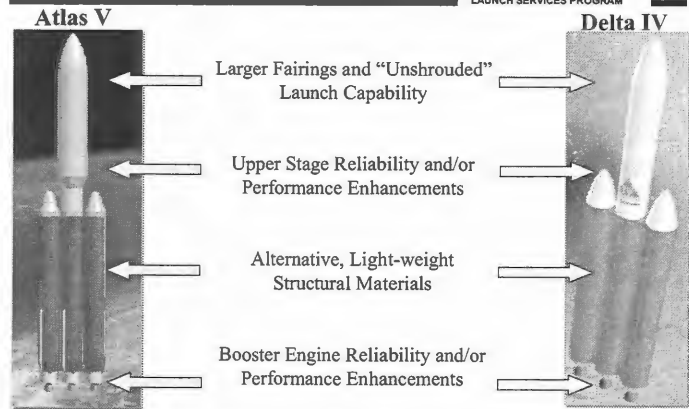
- Past/on-going NASA studies to explore ELV performance enhancements for Jupiter Icy Moons Orbiter (JIMO) and other potential Exploration missions
- Enhancement possibilities include the following areas:
 - Larger diameter fairings
 - Higher thrust upper stage propulsion
 - Higher thrust booster propulsion
 - Lighter weight materials
 - New combinations of solid and liquid core stages
- Some proposed enhancements drive secondary impacts to existing infrastructure:
 - Launch Complex – major modification or new Pad
 - Transportation equipment
 - Manufacturing and Test facilities
 - Ground Processing facilities
- NASA seeks to leverage from existing technology and use spiral development approach to minimize risk
 - LSP is working with HQ, Customers, and Launch Service Contractors to balance costs of ELV capabilities and associated development -vs.- required Spacecraft capabilities to optimize cost, schedule and acceptable technical risk
 - Where crew may be involved, safety is paramount
- On-going/Future Work:
 - Initiated follow on studies with LMA and Boeing to characterize growth paths for current systems



Various ELV Possibilities to Meet Future Exploration Needs

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We must deal with the new unique requirements with an integrated approach



Summary

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- LSP is leveraging from successful history on proven domestic ELV fleets to minimize risk in future endeavors
- LSP is also maintaining a pulse on new launch technologies and emerging companies as they may apply to NASA's future needs
- NASA's new Exploration Initiative is driving the study and evaluation of several transportation options (current expendable, shuttle derivatives, clean sheet).
- The ELV approach will focus on an integrated launch solution, relying on a combination of reliability, performance and safety (human rating) upgrades to the existing ELV designs.
- Agency decisions over the next 12 to 18 months offer exciting opportunities for space transportation utilizing ELV's

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