ATLS-07-10416

United Launch Alliance

RESPONSE TO REQUEST FOR INFORMATION FOR COMMERCIAL SPACE TRANSPORTATION SERVICES

September 2007

TABLE OF CONTENTS

EXECUTIVE SUMMARY

United Launch Alliance is pleased to provide this response to the Request for Information for Commercial Space Transportation Services. We are committed to work with NASA to ensure our nation's ability to safely, reliably, and affordably service the ISS and deliver critical science payloads. Specifically, we recommend that:

- NASA pursue an Acquisition Strategy that includes multi-year procurement of launch services. This will provide the most affordable launch solution for NASA while preserving competition for new entrants. A multi-year procurement would allow:
  - Firm launch service orders to establish a credible business case so private industry can invest and bid affordably.
  - Stability for the industrial base and more favorable pricing.
  - Flexibility to consider new service providers as they become certified.
- NASA procure launch services separately from transfer vehicles and perform the end-to-end service integration in order to provide the best value, reliability, flexibility, insight and control to NASA. Separated Launch Services and Transfer Vehicle contracts will:
  - Provide NASA with the maximum manifest and integration flexibility between launch vehicles and transfer vehicles to optimize ISS operations.
  - Allow use of NASA's proven LV Certification and Mission Assurance practices that have led to 100% launch vehicle success.
  - Allow use of proven contractual terms and conditions for commercial launch services. Unique terms and conditions for transfer vehicles should be developed independently.
  - Accommodate certification of emerging launch and transfer vehicle providers and the subsequent contractual on-ramping of the new entrants.
  - Enable ISS Cargo missions to be combined together with other NASA launches (SMD, TDRS, GOES, etc) for maximum order-quantity discounting.
  - Maintain NASA expertise in end-to-end integration of ISS Cargo acquisition and delivery services and maintains critical skills in the Shuttle to Orion transition gap.
- NASA's current launch service policies regarding risk mitigation and insight have proven effective and should be retained:
  - Focus on proven vehicles, launch operations, and mission integration experience has resulted in 100% mission success across all payload classes.
  - NASA-managed launch services currently exist that are compatible with all existing transfer vehicles (including ATV, HTV and Progress) as well as all conceptual transfer vehicles currently in design for expendable launch
  - Complementary systems engineering process and in-line participation of experienced NASA personnel in launch vehicle activities provides the highest level of insight and lowest risk

Figure 1: United Launch Alliance provides flight-proven launch vehicles with demonstrated performance, reliability and schedule assurance

OVERVIEW

United Launch Alliance (ULA) is pleased to respond to the Request for Information for Commercial Space Transportation Services. This response continues ULA's commitment to NASA to provide proven, flight certified launch services of unmatched reliability. ULA was created to provide reliable, cost-efficient spacecraft launch services for the United States Government. The 50 years of Atlas and Delta heritage embodied within ULA includes over 1,270 flights.

ULA also represents a combined commercial investment in expendable launch vehicle design, test and development of over $5B within the last decade, along with a similar investment by the U.S. Government. This investment resulted in the proven, reliable and versatile families of Atlas and Delta expendable launch vehicles. ULA launch vehicles provide the Government and Commercial customers the widest range of configurations and accommodations matching virtually any size of payload to nearly all space deployment requirements.

Although ULA is not in a position to provide the full range of capabilities needed to support the end to end ISS resupply and cargo return service, it is a "Merchant Supplier" and is able to provide launch services directly to NASA or to other entities in support of NASA's ISS mission.

ULA SUPPORTS COMMERCIAL ISS CARGO TRANSPORTATION NEEDS

The United States aerospace and launch industrial base has the capability to supply the International Space Station (ISS) following the retirement of the Space Shuttle in 2010. The transition of the ISS Cargo resupply services to the commercial sector is extremely beneficial for the U.S. space industry as it includes all the activities associated with ISS cargo missions including manifesting, packaging, integrating onto a Transfer Vehicle and launch operations. This will provide high technology, good paying jobs to US workers, further U.S. space innovation, and launch vehicle production and assembly.

Therefore, ULA supports requirements for U.S. produced launch vehicles that are launched from U.S. launch sites to be incorporated into the COTS Phase 2 competitive RFP. The use of domestic launch for ISS transportation services should be in accordance with current U.S. Space Transportation Policy and NASA ELV Policy Directives. This will serve to sustain and maintain the U.S. launch industrial base and enable further economics of scale and cost savings for not only launch vehicle Prime contractors, but also for critical suppliers of the launch and aerospace industry.

ULA offers wide range of proven capabilities

- Proven, technically qualified, low risk launch solutions
- Established vendor offering schedule and manifest flexibility
- NASA certified Atlas and Delta launch vehicles
- 100% mission success for NASA launch services
- Flexible payload accommodations for launch service customers
- Extensive experience with a broad range of commercial and government contract arrangements
- Classified as a U.S. Commercial launch provider
- Compatible with existing and planned transfer vehicles
- ULA member companies have significant ISS expertise

	In Development	Delta II	Delta IV Medium (4,0)	Atlas 401	Delta IV Medium + (5,4)	Atlas 551	Atlas 552	Delta IV Heavy	Atlas V Heavy	In Development
ISS	1,000 - 4,000 kg	3,900 kg	8,400 kg	8,400 kg	12,800 kg	16,100 kg	18,600 kg	21,500 kg	21,700 kg	40,000 - 140,000 kg
Sun Synchronous	1,000 - 3,000 kg	3,000 kg	6,700 kg	6,700 kg	10,300 kg	13,700 kg	14,700 kg	19,100 kg	N/A	35,000 - 130,000 kg
GTO	500 - 2,000 kg	1,700 kg	4,300 kg	4,900 kg	7,000 kg	8,700 kg	N/A	12,900 kg	13,000 kg	15,000 - 60,000 kg
GEO	N/A	N/A	1,100 kg	N/A	2,700 kg	3,900 kg	N/A	6,100 kg	6,300 kg	7,000 - 31,000 kg

Figure 2: ULA Launch Vehicles offer a broad range of capabilities to meet NASA mission needs

The Commercial Space Launch Act provides the framework for NASA to procure commercial launch services. While honoring the basic agreements to the ISS partners to supply the already agreed-upon launches of ATV and HTV, further reliance on foreign launch providers is not needed. While a domestic capability for ISS Cargo end-to-end services does not currently exist, existing domestic launch capability does exist that can successfully integrate and deliver any ISS Transfer Vehicle (domestic or foreign supplied) to perform the full range of ISS Cargo missions. ULA stands ready to offer three launch vehicles families (Delta II, Delta IV and Atlas V) that are not only available, but that have achieved NASA flight certification to perform this critical mission.

ULA RECOMMENDS SOLUTIONS FOR FUTURE SPACE TRANSPORTATION NEEDS

- A Defined Business Case for Investment with Preservation of Competition

There are significant economies of scale to be achieved through larger economic order quantities. ULA therefore suggests that the procurement approach for NASA future launch requirements should balance the need to preserve and protect competition with the aggregation of firm requirements so competitors are able to substantiate a solid business plan and deliver an affordably priced service. At a minimum, NASA should consider combining annual launch procurements for science and ISS support missions into a single buy for each provider while reserving a limited set of missions for potential future competition to protect for the scenario that new launch vehicle suppliers emerge. The subset of missions can be assigned as Contract options and ordered in the case that no new suppliers become certified. Economies of scale are dramatically increased as these buys are extended over multiple years. This approach will demonstrate a commitment to the commercial transportation market by anchoring the business case required by commercial investors. More economic buy quantities will provide stability to the supplier base necessary to more efficiently spread fixed costs. The results will benefit the government, the service provider as well as the entire supply base.

- Launch as a Independent Variable Enables NASA to Optimize ISS Services and Operations

A domestic ISS Cargo solution should be sized to optimize the cargo supply missions required for most efficient ISS operations and to minimize life cycle costs of ISS resupply missions. ULA's wide range of launch vehicle capability allows NASA the flexibility to design and develop the optimally sized transfer vehicles for pressurized and unpressurized cargo in order to minimize interference to the microgravity environment while achieving lower cost/kg economies with fewer launches on larger launch vehicles. The modular capability of Atlas V and Delta IV can enable launch being treated as an independent variable in order to make the most intelligent decision on sizing the transfer vehicle. This enables NASA to remove the Launch Vehicle from the risk equation for NASA missions.

- The Right Requirements to Achieve Affordability

From a Launch Vehicle perspective, the affordability of ISS Supply Missions will be determined by the requirements specified in the RFP. Firm requirements for launch services should be established for one or two transfer vehicles with standardized interfaces that can be integrated and launched on a recurring basis. This can be accomplished using Class Analysis whereby flight software and guidance parameters can be developed for Classes of cargo packaging with pre-validated ranges for total mass and center of gravity offsets from the launch vehicle interface. Robust vehicle capability, high reliability, high launch availability, standardized interfaces and standardized integration processes for a recurring launch scenario will significantly reduce the recurring cost and therefore the lifecycle cost of ISS launch activities. Atlas V and Delta IV launch vehicles were designed using this philosophy for robustness and reliability.

- Commercial Requirements Lead to Commercial Practices and Contracting

Atlas and Delta have contracted for commercial launch services with a wide variety of customers around the world, including the U.S. Government. The current NASA Launch Services Contract is a FAR Part 12 commercial contract with many provisions that supply commercial value to NASA. ULA supplies launch services to commercial customers through direct contracts for launch and also through delivery on orbit services, whereby the customer procures an end-to-end solution of which launch is part. For ISS Missions, ULA is able to support NASA through either:

1) packaging the launch service within a commercial end-to-end service for ISS Operations (e.g., delivery in orbit or DIO), or

2) a direct launch service contract to NASA like NLS (e.g., direct launch service).

In either case, the resulting launch service contract can be written and administered to provide commercial benefits of cost, flexibility, and payment. The requirements that flow to ULA will determine the commercial nature of the launch service. As noted, the affordability of the launch service will be significantly influenced by the number of firm launches, the standardization of the interfaces and integration requirements, and the terms and conditions that effect profitability of the business case. Separating out the launch procurement allows NASA to use their proven processes for contracting and mission assurance while maintaining the flexibility to use different transfer vehicles as they become available.

Separating the procurement also best allows new entrants. By acquiring these assets separately, NASA can prepare and accommodate new entrants of both transfer vehicle and launch services. It will also give NASA more direct control in monitoring new entrants, certifying vehicles as they meet NASA requirements and on-ramping the newly qualified suppliers onto the contract. For a delivery in orbit type solution, the launch service contract will not be with NASA, so the terms of the contract between the Launch Vehicle provider and the services provider will be independent of NASA and will most likely be proprietary in nature between the two companies.

There are other significant benefits to NASA from separating Launch services from Transfer Vehicles. A separate procurement provides NASA with the maximum manifest and integration flexibility between launch vehicles and transfer vehicles to optimize ISS operations. NASA could select the most advantageous launch vehicle and transfer vehicle combination to meet specific ISS Cargo needs, thus offering more flexibility to meet unique or limiting requirements. Furthermore, this provides the opportunity to maintain NASA expertise in end-to-end integration of ISS Cargo acquisition and delivery services and maintains those critical skills in the Shuttle to Orion transition gap.

- Tailored Performance and Competitive Costs

The flexibility inherent in the Atlas and Delta families of launch vehicles ensure compatibility with the majority of existing and proposed transfer vehicles including: Progress, Soyuz, ATV, HTV, ARCTUS, DreamChaser™, Dragon, and others, Figure 3. Depending on transfer vehicle capability, NASA can tailor the delivered payload through the addition of SRB's or RL10's. The combination of a NASA defined transfer vehicle and ULA's launch services can provide ISS cargo services at very competitive prices, Figure 4.

		IOC	Atlas V		Delta IV	
			LV	Payload	LV	Payload
Progress	GoR	flying	401	1.5	MLV+(4,0)	1.5
ATV	ESA	2007	551/542	5	D-HLV	5
HTV	JAXA	2009	551/542	6	D-HLV	6
Dragon	SpaceX	2010	401	2.5	MLV+(4,0)	
ARCTUS	SPACEHAB	2010	401*	4	MLV+(5,2)*	4
Dream Chaser	SpaceDev	2010	432	1.6	n/a	
Progress	CSI	2010	401*	4	MLV+(4,2)*	4

* Larger LV varients can significantly increase performance
(Payload provided in mT)

Figure 3: The pairing of ULA launch vehicles and transfer vehicles provides NASA with maximum mission flexibility to accommodate ISS Cargo needs.

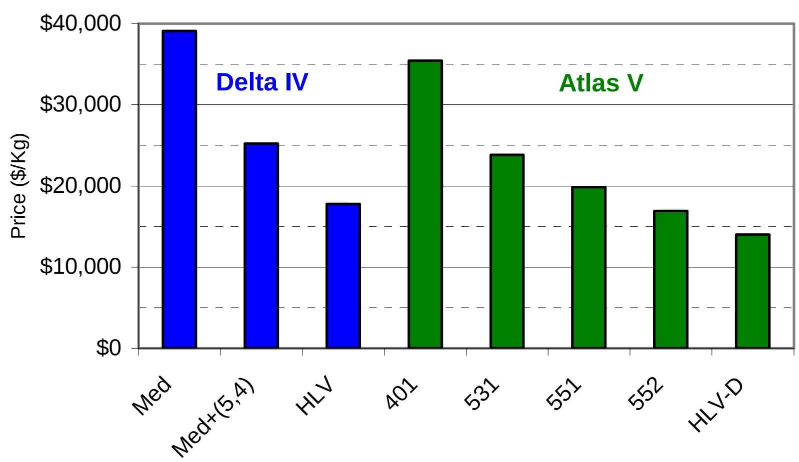


Figure 4: ULAs family of launch vehicles offer cost competitive options for delivering cargo to ISS (Assumptions: LV: NLS pricing; TV: 3.2 mT fueled, $80m)

SUMMARY

ULA is pleased to provide NASA with an overview of our capabilities, and to offer suggestions on future Space Transportation Services Acquisition strategies that might be utilized. We feel that NASA will realize significant benefits to a multi-year procurement of launch services that establishes a firm business case for companies to invest in this market, in addition to preserving competition for new entrants. In addition, procuring launch services separately from transfer vehicles, with NASA performing the end-to-end integration, provides the best value, reliability, flexibility, insight and control of these critical missions to the expertise inherent within NASA. This will also provide an opportunity to maintain critical integration skills during the Shuttle to Orion transition gap. Finally, NASA has developed a rigorous process for launch service risk reduction that has resulted in 100% mission success across all payload classes. The rigorous systems engineering process involves NASA experts in launch vehicle integration activities and provides the highest level of insight and lowest risk.

ULA is pleased to offer solutions to NASA that will support the ISS Commercial Space Transportation services and other space launch requirements. ULA is open and willing to discuss with NASA details to any of this recommendations and alternative solutions that will ensure mission success for ISS Cargo resupply and future commercial space transportation needs.

1. ISS REQUIREMENTS

1.1 Cargo Delivery and Return / Disposal Capability

As NASA considers how it will procure ISS Cargo services, ULA would like to point out the benefits of procuring launch services separate from in-space capabilities, as it has done for nearly a decade under the NASA Launch Services (NLS) contract. NLS has been a tremendously successful approach to supporting high priority missions. Its provisions for launch vehicle certification and technical insight of a menu of mission unique services would seem readily applicable to launching ISS cargo. ULA's wide range of launch capabilities supports most space launch requirements with its low risk, flight proven fleet of launch vehicles, ULA is able to provide NASA with greater confidence of mission success than a new, unproven launch vehicle. Additionally, by procuring launch separately, NASA can benefit from the fixed infrastructure cost coverage being provided by the USAF for the EELV launch systems and may realize additional savings through procurement of launch services through a multiyear block buy – something which ISS cargo services, with its relatively predictable annual upmass requirement, would seem to be especially well suited.

The Atlas V and Delta IV launch systems, developed to meet a wide range of Evolved Expendable Launch System (EELV) requirements, are inherently robust and flexible launch systems capable of meeting NASA's ISS Cargo launch needs. As a merchant launch service provider, it is not possible to state exactly which launch vehicle would be most appropriate for launching 2000 to 3000 kg to ISS since that will depend on transfer vehicle mass and its corresponding packing efficiency. However, the wide range of Atlas V and Delta IV launch vehicles provides NASA and its ISS cargo providers with a wide range of reliable and proven domestic launch systems to meet ISS cargo upmass requirements. NASA's lead times for ordering various EELV launch services to support ISS cargo would be similar to those currently in the NLS contracts for Atlas V and Delta IV plus any special integration time required to support the cargo carrier.

In addition, we can offer is the option of Launch-on-Request (LOR) for ISS Cargo missions. Upon request, ULA could launch a critical mission in as little as 120 days. ULA is uniquely capable to respond to an LOR requirement. For example, the Atlas Common Core Booster™ (CCB™) design that enables interchangeability of the booster for various launch vehicle configurations. Projected launch rates at CCAFS and VAFB also support call-up schedules with minimal or no impact to the ER and WR manifest. In addition ULA is also uniquely qualified to support LOR requirements due to our past experience and the integration capabilities that we are able to offer to the government. Our plan for execution calls for the early completion of non-perishable, leading-edge integration, requirements identification, and long-lead mission unique hardware procurement and fabrication that must be accomplished to support the schedule. Having completed these long-lead items, the remaining integration and launch operations can be accomplished on a schedule that protects for the potential LOR notification.

1.2 Rendezvous, Proximity Operations and On Orbit Attached Operations

ULA's Atlas and Delta rockets can accurately deliver payloads to just about any location required by the customer. With the demonstrated ability of our upper stages to provide 1, 2 or 3 burns with short or long coast periods, the Atlas and Delta vehicles have delivered payloads to LEO, MEO, sun synchronous, GTO, GSO, various Earth escape velocities and any orbit in between. This flexibility allows NASA and the transfer vehicle supplier to customize the launch to the transfer vehicle requirements. For example, ULA can deliver a Transfer Vehicle to a sub-orbital trajectory, allowing its on-board propulsion to complete the ascent circularization followed by ISS phasing and rendezvous. Alternatively, ULA's upper stages, with their demonstrated mission design flexibility and proven unparallel injection accuracy, Figure 5, can directly deliver transfer vehicles to just outside of the ISS visiting vehicle stay out zone. Such direct delivery can significantly reduce the requirements levied on the transfer vehicle while simultaneously reducing time from launch to ISS rendezvous.

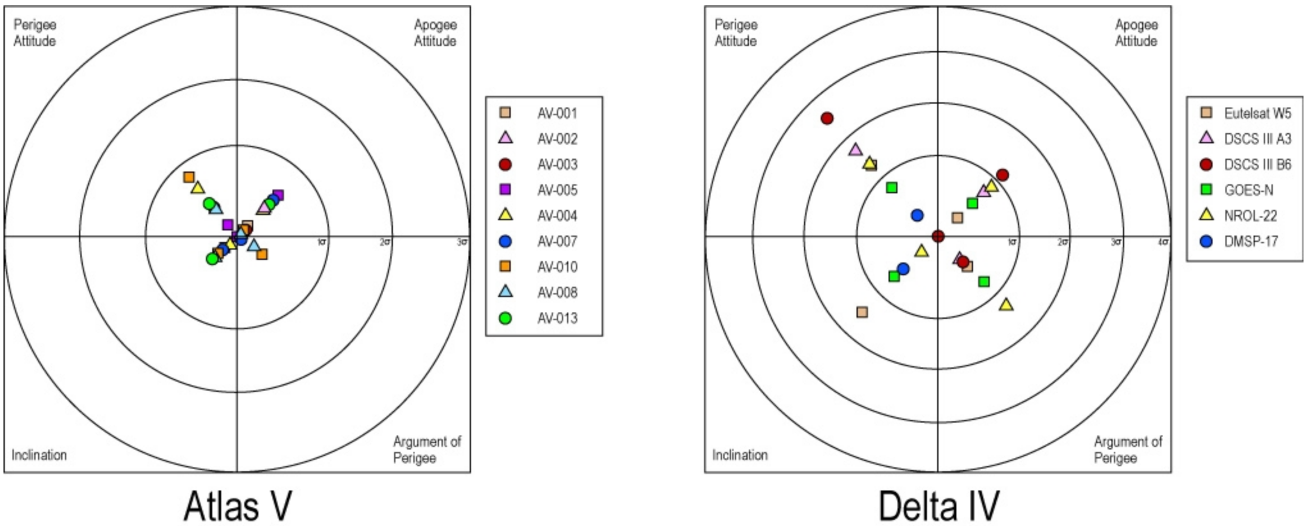


Figure 5: Atlas V and Delta IV flight demonstrated injection accuracies

Such flexibility is enabled by the advanced avionics, flight software and mission design capabilities developed over decades of support to NASA and other customers. For example, the current Atlas guidance system implements a robust suite of capabilities geared toward achieving a wide variety of mission profiles. The fleet wide incorporation of Block 2 avionics, first flown on NASA's Pluto New Horizons Mission, introduced a fault tolerant processor & sensor suite allowing a nominal mission to be achieved in the presence of a failed sensor or processor channel. With improved Block 2 processor throughput, the Atlas V guidance software was upgraded to implement Generalized Guidance, a new capability which allows the vehicle to steer in any direction to achieve up to 5 orbit parameters for any Centaur burn. If a customer doesn't require 5 orbit constraints, the steering is able to be optimized to maximize launch vehicle performance. Generalized Guidance can also be used to compute the time of future Centaur burns to minimize injection errors or maximize launch vehicle performance. All previous Atlas guidance capabilities have been maintained including steering around land masses during ascent flight, in-flight retargeting of the transfer orbit inclination based on measured booster performance, polynomial RAAN targeting, and hyperbolic trajectory targeting. Many of these capabilities can be combined to provide significant launch window duration while minimizing the imparted velocity requirements for a Transfer Vehicle performing an ISS re-supply mission. This combination, as an example, can be used to maximize the likelihood of launching by providing a longer window, while minimizing the extra analysis effort necessary for the current earth-relative ascent trajectory designs. All of these capabilities are flight proven with demonstrated accuracies well within mission requirements.

1.3 Launch and On Orbit Support Services

ULA's Atlas and Delta launch systems are fully operational and provide NASA with mutual backup to space via reliable U.S. based launch systems and experienced launch teams. Using Atlas and Delta launch systems provides NASA the flexibility of independent launch systems that can launch virtually any proposed transfer vehicle, any combination of cargo types and quantity, with immediate capability to utilize either launch system as appropriate.

ULA's launch services concept of operations is naturally divided into three phases: analysis to define the mission requirements; ground operations; and flight operations. In each phase ULA relies on processes, facilities, equipment and personnel with decades of experience on similar missions thereby reducing or eliminating the critical verification and certification requirements that will be necessary to qualify any proposed new launch systems or launch providers.

Mission Requirements Analysis, including pre-mission planning and preparation operations, begins with a range of activities performed concurrently, including launch vehicle production; spacecraft manifesting, mission requirements definition, and analytical integration of the spacecraft and cargo with the launch vehicle.

Ground Operations commence with the delivery of the transfer vehicle to CCAFS. The spacecraft is delivered to an existing integration facility (candidates include Astrotech and the NASA KSC Space Station Processing Facility [SSPF]), where spacecraft integration and final assembly, cargo loading, checkout, and final verification is performed by the transfer vehicle contractor. After loading propellant into the re-supply spacecraft, the fully prepared spacecraft is then transferred to ULA for integration with the Payload Adapter Fitting (PAF) and final encapsulation in the Payload Fairing (PLF).

In parallel to the spacecraft processing, the launch vehicle (Atlas or Delta) is delivered to the launch vehicle integration facility at CCAFS, where the first and second stages are integrated and checked out. The launch vehicle is transported to the appropriate ULA CCAFS Space Launch Complex (LC-41 for Atlas and LC-37B for Delta), where it is erected and prepared for launch. The encapsulated PAF-spacecraft-fairing assembly is transported to the launch pad and integrated with the vertically erected launch vehicle. All launch site processing uses experienced ULA personnel and existing ULA and KSC facilities and procedures.

Flight Operations, the third and final ground operations phase, utilizes the mature capabilities of the Atlas V and Delta IV control centers for successful spacecraft deployment in the LEO ISS transfer orbit (nominally 300 km circular at 51 deg inclination), where the spacecraft is phased for subsequent ISS rendezvous. Additional performance is available for alternate orbits for maximized cargo capability.

Launch Vehicle—Transfer Vehicle Compatibility

ULA has been working closely with existing and planned ISS Cargo transfer vehicle developers to assess feasibility of the designs with our family of launch vehicles. Internally funded compatibility assessments have been completed for the two most mature transfer vehicles, the European Automated Transfer Vehicle (ATV) and Japan's H-II Transfer Vehicle (HTV). . ULA has also been working closely with the SpaceDev DreamChaser™, SPACEHAB ARCTUS, and Constellation Services International (CSI) LEO Express℠ design teams to assess the compatibility of their transfer vehicle designs with Atlas and Delta. ULA evaluated the ATV, HTV, DreamChaser™, ARCTUS, and LEO Express℠ technical requirements against the Atlas and Delta launch system and infrastructure capabilities. These compatibility assessments are either completed or are in work, and no significant issues have been discovered. A highlight of the compatibility assessments is provided below.

Delta IV Launch Vehicle—Automated Transfer Vehicle Compatibility

Initiated by The Boeing Company and completed by ULA, the Delta IV Launch Services Team and its civil space alliance team member Arianespace, allocated a significant investment of technical and financial resources to establish compatibility between the ATV and Delta IV. The Delta team worked closely with Arianespace to verify physical and operational compatibility and identify and mitigate technical issues between Delta IV and the ATV.

The compatibility studies were performed using a tailored Delta Mission Integration process, effectively performed through the first cycle of mission integration analysis. Using this process, the Delta team evaluated the structural, environmental, ground processing, and interface compatibility between the Delta IV Heavy launch vehicle, Delta IV processing facilities, and the ATV spacecraft. Existing Delta IV launch and processing facilities, including transportation systems, were determined to be fully compatible with the ATV for mission integration, launch processing, and launch events.

To date, the team has completed initial launch vehicle to transfer vehicle integration, processing facility, operational, and programmatic compatibility assessments. Payload adapter designs were developed and assessments of payload fairing integration completed. Flight environment analyses for the ATV, including coupled loads analysis, were performed, to determine the structural behavior of the integrated systems during flight. The integrated vehicles were analyzed at the maximum payload mass configuration with the most stressing clocking condition with respect to the transfer vehicle and launch vehicle coordinate systems. Thermal conditions were also analyzed, electromagnetic compatibility assessments completed, and electrical interfaces defined and analyzed. In addition, mission trajectory analysis and flight sequence of events were created, along with orbital injection dispersion predictions.

All technical issues identified in the ATV to Delta IV compatibility study were deemed to be low risk and well within the expected and usual bounds of preliminary payload integration efforts. As a result of these analyses, no technical issues were uncovered that would prevent launching the ATV on the Delta IV Heavy. Begun in 2004, the ATV/DIV compatibility assessment is now complete.

Atlas V Launch Vehicle— Automated Transfer Vehicle Transfer Vehicle Compatibility

The Atlas Mission Integration team worked closely with EADS Space to understand the interface requirements and establish the compatibility analysis baseline between the ATV and Atlas V. The Atlas V 552 is required for an ATV launch and is nearly identical to that flown on the New Horizons mission. The differences are the addition of a second Centaur engine and a 3-meter payload fairing extension. The Atlas V 552 is capable of placing 18,840 kg into the 260 km circular, 51.6 degree inclination phasing orbit required by ATV. This capability enables a full ATV cargo load. The Atlas team designed a low risk solution for a truss adapter, payload separation ring, the ground support equipment and unique work platforms, and developed detailed system structural and modal testing. The compatibility analyses are completed, and there were no significant technical issues identified between Atlas V and the ATV.

Atlas V Launch Vehicle—H-II Transfer Vehicle Compatibility

Atlas worked closely with Japan Manned Space Systems Corporation (JAMSS) and JAXA to verify physical and operational compatibility of the HTV and Atlas, as well as to identify and mitigate any technical issues between the launch and the transfer vehicles.

The Atlas V 542 configuration has been baselined for launching the HTV to ISS orbit. This configuration is capable of lifting a fully loaded, 16,500 kg HTV into its injection orbit with ample performance margin (>500 kg). The Atlas Program completed the conceptual design for an HTV-unique truss adapter that provides the mechanical interface to the HTV payload attach fitting. The medium length 5.4m diameter payload fairing is also employed for the HTV but in this case requires local outer mold line modifications to accommodate HTV violations of the fairing static payload envelope in the vicinity of HTV's attitude control thrusters and grapple fixture. These payload fairing modifications have been assessed by the Atlas payload fairing supplier and can be readily incorporated as a HTV- unique payload fairing kit. Atlas-HTV coupled loads analysis verified the PLF dynamic envelope and loads compatibility between the two vehicles. A concept of operations was devised for the Atlas-HTV to cover transportation of the HTV to the US at CCAFS, HTV processing at payload processing facilities on or near CCAFS, cargo processing and loading into the HTV, integrated transfer vehicle and launch vehicle ground operations, and launch and on-orbit operations. The HTV to Atlas compatibility analyses are complete, and fully demonstrated the viability of Atlas as the launch system of choice for the HTV.

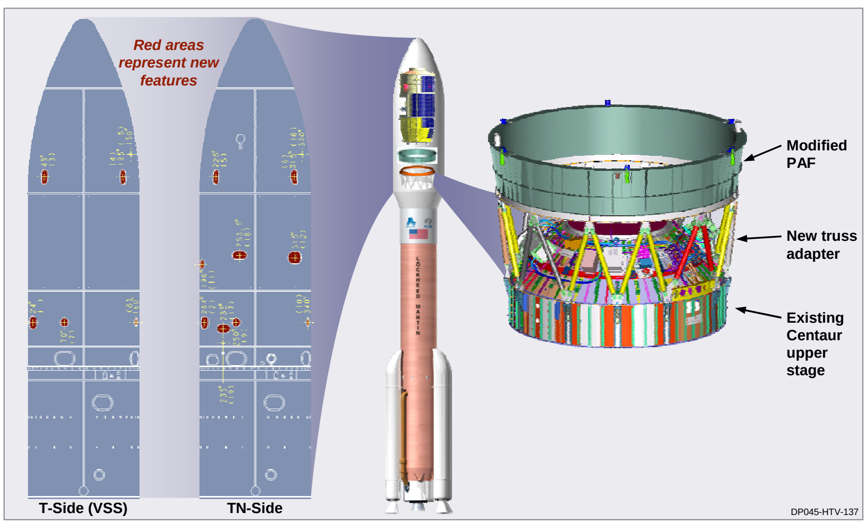


Figure 6: ULA's proven Atlas payload integration capabilities provide NASA a low risk HTV integration effort.

Delta IV Launch Vehicle—H-II Transfer Vehicle Compatibility

Initiated by The Boeing Company and completed by ULA, the Delta IV Launch Services Team and its civil space alliance team member, Mitsubishi Heavy Industries (MHI), allocated a significant investment of technical and financial resources to establish compatibility between the H-II Transfer Vehicle (HTV) and the Delta IV. The Delta team worked closely with MHI to verify physical and operational compatibility and identify and mitigate technical issues between Delta IV and the HTV.

The compatibility studies were performed using a tailored Delta Mission Integration process, effectively performed through the first cycle of mission integration analysis. Using this process, the Delta team evaluated the structural, environmental, ground processing, and interface compatibility between the Delta IV Heavy launch vehicle, Delta IV processing facilities, and the and HTV spacecraft. Existing Delta IV launch and processing facilities, including transportation systems, were determined to be fully compatible with the HTV for mission integration, launch processing, and launch events.

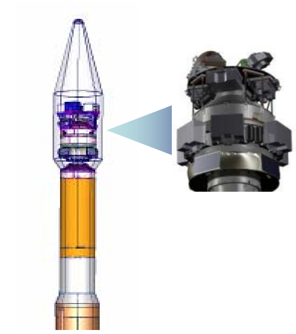
To date, the ULA and MHI team has completed initial launch vehicle to transfer vehicle integration, processing facility, operational, and programmatic compatibility assessments. Payload adapter designs were developed and assessments of payload fairing integration completed. Flight environment analyses for the HTV, including coupled loads analysis, were performed to determine the structural behavior of the integrated systems during flight. The integrated vehicles were analyzed at the maximum payload mass configuration with the most stressing clocking condition with respect to the transfer vehicle and launch vehicle coordinate systems. Thermal conditions were also analyzed, electromagnetic compatibility assessments completed, and electrical interfaces defined and analyzed. In addition, mission trajectory analysis and flight sequence of events were created, along with orbital injection dispersion predictions.

All technical issues identified in the HTV to Delta IV compatibility study were deemed to be low risk and well within the expected and usual bounds of preliminary payload integration efforts. As a result of these analyses, no technical issues were uncovered that would prevent launching the HTV on the Delta IV Heavy. Begun in 2004, the HTV/Delta IV compatibility assessment is now complete.

Atlas Launch Vehicle—SpaceDev DreamChaser™ Compatibility

ULA is working closely with SpaceDev to investigate the compatibility of flying the DreamChaser™ on an Atlas. As a lifting body, the DreamChaser™ provides unique challenges to integrate on an existing launch vehicle, including loads, controllability, and performance, in addition to the human-rating considerations. Our initial studies have leveraged the considerable experience gained during NASA's Orbital Space Plane (OSP) Program that baselined EELVs for launch of numerous OSP configurations, including similar lifting body concepts. This provided an excellent baseline from which we conducted numerous Trade Studies focused on risk reduction and design integration to meet an ILC of 2011. The initial studies have indicated that the risks associated with integrating the DreamChaser™ on an Atlas are manageable and can be accomplished.

Atlas Launch Vehicle—SPACEHAB ARCTUS Transfer Vehicle Compatibility



ULA has reviewed SPACEHAB's ARCTUS concept and determined that it is compatible with both the Atlas V and Delta IV launch vehicle families. Composed of two Centaur Forward Adapters, ARCTUS is designed to meet the EELV interface and environmental requirements. The light weight nature of ARCTUS enables over 5 mT of delivered performance on an Atlas 401, and more on larger Atlas or Delta variants. ARCTUS will mate with either ULA LV using a standard C-29 payload adapter. ULA has developed advanced algorithms enabling the precise time of arrival at desired delivery point that will allow our launch vehicles to deliver ARCTUS to just outside of the ISS visiting vehicle stay out zone. This capability will reduce the total time to arrival, while reducing the transfer vehicle propulsion requirements. Ongoing work is further investigating the extremes of payload masses and Cg's that ULA LV / ARCTUS can offer without vehicle modifications.

Atlas Launch Vehicle—CSI Compatibility LEO Express℠ Compatibility

We have performed preliminary analysis of the LEO Express℠ concept and have determined that our launch vehicles are easily compatible with the cargo canisters proposed by CSI. The flexibility in net cargo delivered matches well with the broad range of ULA launch vehicle performance capabilities. The launch vehicle upper stage changes required to accommodate longer duration missions include minor propulsion and avionics system changes to support extended mission times and Progress rendezvous is well understood and within our experience base. As such, there are no significant technical issues associated with this concept.

2. Future Payload to Orbit Requirements

The Delta and Atlas families have a long and successful history of launching NASA payloads to a wide variety of orbits. Delta II has 100% mission success in launching 38 NASA payloads going back 15 years, from low earth orbits to inter-planetary missions. In all, Delta has completed 132 launches over the past 47 years for NASA. Atlas history launching NASA payloads goes back even further, to 1959, and includes over 100 launches. Most recently, Atlas/Centaur has sustained a string of 81 consecutive successful launches, of which 12 were for NASA. Delta and Atlas have supported narrow, time-dependent and critical science mission launch windows for payloads going to Mars, Pluto, and the asteroid belt, to name a few just in recent years.

All ULA launch systems will be fully Category 3 certified by NASA by the last quarter of FY2010, in time for meeting ISS cargo requirements, making them the most reliable, lowest risk solution for NASA's mission-critical science payloads. ULA expects to have completed 40 Atlas/Centaur launches, 14 Delta IV Medium-class, and five xx Delta IV Heavy class missions by that date, providing complete confidence in the ULA family of launch vehicle's performance and reliability for these important cargo missions. The knowledge and insight NASA gains from regular and extensive cooperation in using Delta and Atlas further reduces NASA's risk in using ULA launch systems.

As evidenced by our mutual history, ULA launch systems have a solid track record of supporting changing NASA requirements across a wide range of payload and orbit requirements. Examples of ULA's demonstrated success with NASA include the 2004 successful launch of the Mars Exploration Rover Spirit on the first Delta II-Heavy –

which was developed specifically for NASA – and the 2006 launch of the New Horizons mission on an Atlas V with a Delta-II derived solid rocket motor third stage. NASA will also benefit as new improvements come along for the EELV fleet, such as the upgraded RS-68A engine. Scheduled to fly on a Delta IV Heavy in 2011, this single improvement will increase the capability of ULA's most capable vehicle from 21,500 kg to over 27,000 kg to ISS, a 25% improvement.

ULA's Delta II family can carry payloads in the 1600 – 3000-kg range to sun-synchronous orbit. ULA currently has two west-coast capable Delta II's in inventory. An additional six Delta II Heavies are also available which could be modified to support the sun-synchronous mission. ULA is considering the option to continue Delta II beyond the existing vehicles. We would be pleased to further elaborate on the Delta II future options for a cost effective restructured program. Beyond 2010, ULA is considering several other options for supporting Delta II-class missions as well. First, NASA could choose to launch either an Atlas 401 or a Delta IV-Medium. While both vehicles have substantial performance margins over Delta II, the cost effectiveness of these EELV vehicles, with their fixed infrastructure costs covered by the US Air Force EELV program, may make this the most cost effective option. The additional launch vehicle performance could also be used by NASA to either launch a larger, more capable spacecraft or to potentially manifest two or more payloads.

Second, if NASA wishes to keep payload capabilities within the Delta II range while taking advantage of the US Air Force EELV infrastructure cost coverage, a hybrid Atlas-Delta II could be developed using an Atlas V Common Core Booster and a Delta II second stage, payload fairing and, if needed, the Star-48 third stage. This approach, while requiring some non-recurring investment, would enable NASA to have a Delta II class capability for the indefinite future while sharing the EELV-paid, fixed infrastructure with Atlas V.

Finally, ULA is pleased to offer NASA a variety of multi-payload concepts which can provide Delta II-class capabilities (and beyond) at a reduced cost per kg for a given mission than a dedicated launch, and potentially enable NASA an opportunity to share a launch among two or more of its own science missions, or with another US Government entity, further reducing mission costs. Having regular, recurring ISS-cargo missions, for example, provides an excellent and unique opportunity for dependable multi-payload missions where small to medium-class spacecraft can obtain very affordable launch. Multi-payload concepts provide reduced cost per kg for a given mission compared to dedicated launched and also provide an opportunity to leverage multi-launch buys, which further reduce mission costs.

Multi-payload Carrier Options

While the Delta and Atlas launch systems have demonstrated their ability to provide 100% mission success for schedule-critical NASA missions, ULA launch systems are also capable of providing lower cost opportunities for payloads with some scheduling flexibility. With payload mass capabilities ranging above 20 tons, ULA can provide transportation cost reductions by carrying two or more payloads on a single launch. ULA has a variety of multi-payload carriers available to support payloads sized from small-sats up to intermediate-class spacecraft. Schedule protection against significant delays can be provided through an option for a dedicated launch backup solution.

For pico-sats, small-sats, micro-sats, and up to Small-class payloads, ULA offers numerous flexible carrier options. ESPA, Type-C Carrier (TCC), the integrated payload carrier (IPC), secondary attach mounting (SAM), and the secondary payload carrier (SPC), to name a few, provide a wide range of capabilities (See Figure 7). The TCC utilizes standard mounting brackets to the Atlas Type-C payload adapter to accommodate micro payloads such as P-Pods and is under development for flight in 2008. The EELV secondary payload attachment (ESPA) was flight proven on STP-1 in 2007 and is available on either Atlas or Delta for carrying up to six secondaries each weighing up to 200 kg. The IPC, which includes an ESPA as one potential element, can support large secondary payloads will be flight proven in 2008 on NASA's Lunar Reconnaissance Orbiter (LRO) mission. The IPC will accommodate the LCROSS secondary mission weighing in at approximately 1,000 kg. The external payload carrier (XPC) is similar to the scientific passenger POD and Orbital Vehicle 1 missions flown by Atlas in the 1960's (a total of 124 sub-orbital experiments were performed during the 1960's providing critical input for bio science, astrophysics and spacecraft subsystem development). The Atlas secondary payload carrier (SPC) is a flexible and modular approach to secondary payload manifesting. It can be flown on either 4-m or 5-m PLF configurations (400 or 500 series vehicles). It is designed to carry one to four secondary payloads up to 60 kg each, and is under development of a launch in 2009. Delta II has an extensive history of accommodating secondary payloads, typically up to two pay-loads of 70 kg can be readily handled in the guidance section. Secondary payloads, especially larger ones, can also be accommodated in our dual-manifest payload hardware, see below.

For Small- and Medium-class payloads, ULA's dual spacecraft system (DSS) allows a dual manifest of two small- to medium-class spacecraft to be carried and launched at the same time on either Atlas V or Delta IV (Figure 8). The DSS consists of two modified flight-proven Centaur Forward Adapters mated back-to-back in a clamshell-type arrangement. This arrangement utilizes existing payload fairing explosive bolts to hold together and separate the DSS halves. The Centaur forward adapter has successfully flown more than 100 missions atop Centaur, and the PLF/Boattail explosive bolts have a remarkable flight record on both Atlas and Titan/Centaur Programs.

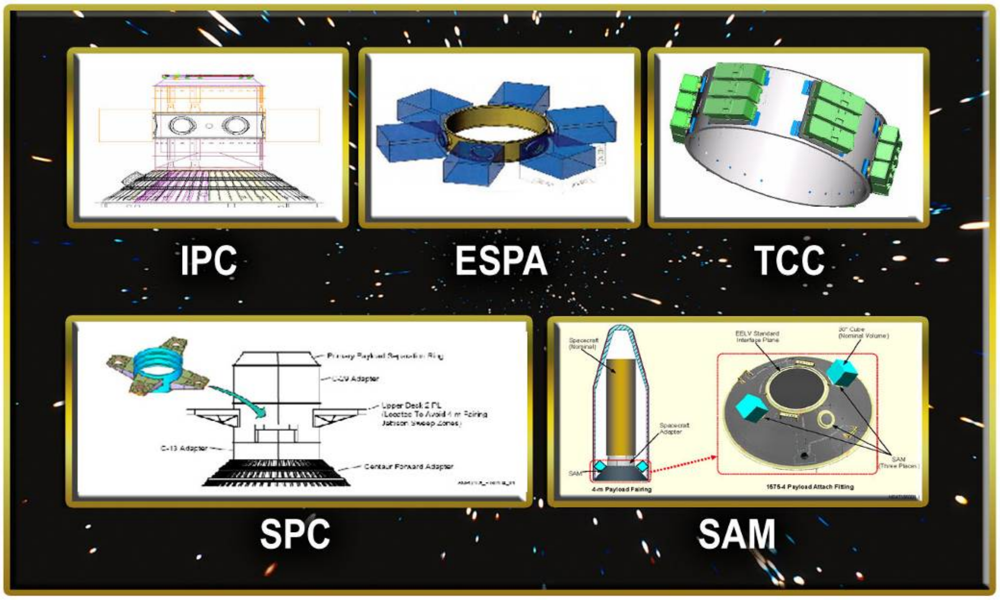


Figure 7: ULA has numerous secondary payload mounting solutions

For heavier or larger payloads, ULA's dual payload carrier (DPC) on a Delta IV-H or Atlas 551 provides the ability to launch two larger payloads (Figure 8). This dual-manifest system provides flexible spacecraft packaging on either Atlas or Delta system using common hardware.

The reduced cost on a $/kg basis of launching multiple payloads on a single launch vehicle provides an excellent opportunity for payloads and mission planners to save mission costs and leverage multi-launch acquisitions.

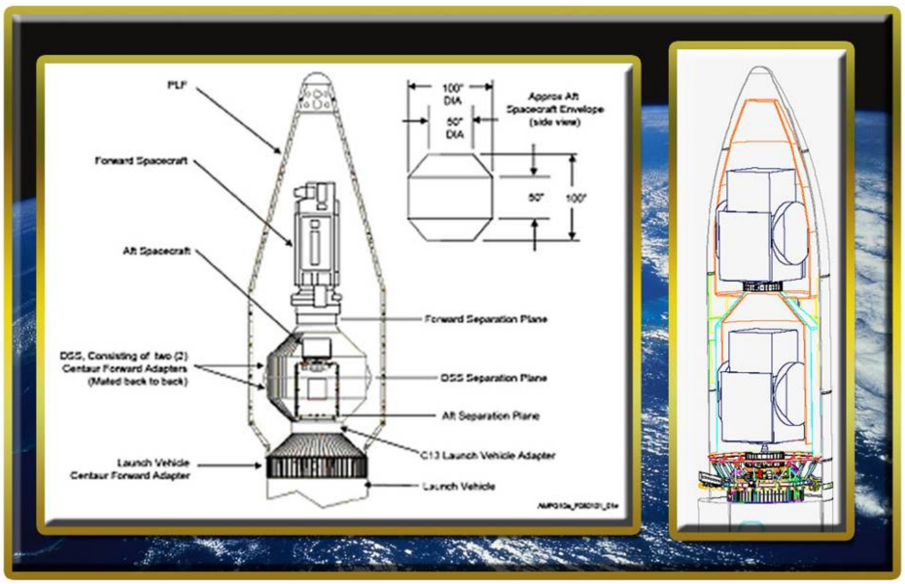


Figure 8: The DSS and DPC provide lower $/kg launch options than single-launch scenarios

3. Specific NASA-Requested Information

3.1 Company Information

a. Company Name, point of contact, phone number, e-mail address

United Launch Alliance, LLC
9100 East Mineral Circle
Centennial, Colorado 80112

Mr. Michael Gass, President and CEO
(720) 922-7110
michael.c.gass@ulalaunch.com

Dr. George Sowers, Business Development and Advanced Programs Vice President
(303) 269-5431
george.f.sowers@ulalaunch.com

Mr. Kevin Finnel, Contracts and Pricing Director
(303) 269-5812
kevin.r.finnel@ulalaunch.com

b. Major development activities underway related to this transportation service.

Under the auspices of the Evolved Expendable Launch Vehicle (EELV) program, United Launch Alliance developed the Atlas V and Delta IV launch systems to deliver the highest capability, reliability, and operability for medium, intermediate, and heavy class missions. Through heritage evolution that leverages unequalled record of successful launches, Atlas V and Delta IV provide the highest level of mission success to ISS Cargo. Atlas V and Delta IV deliver on-orbit mission success with the best match of vehicle capabilities to mission requirements; the best designs, development, mission integration, and launch operations capabilities; and the best systems engineering discipline and practices. This year both launch systems celebrated their 50 year anniversary in the launch services industry!

Atlas and Delta have entered into a significant new era of providing mutual backup to space for our nation's most critical satellite programs. We have completed development, launched our first ten missions with 100% mission success. These accomplishments have been achieved by collaborating and coordinating with our commercial, NASA, and DoD customers.

ULA has established itself in both government and commercial markets as the launcher of choice. ULA has supported NASA with a history of mission successes including Deep Impact, Mars Reconnaissance Orbiter, Pluto New Horizons, CALIPSO/Cloudsat, GOES II, Themis and Phoenix missions. NASA selected ULA products to launch both the Mars Science Laboratory and the Lunar and the Lunar Reconnaissance Orbiter/Lunar Crater Observation and Sensing Satellite. Civil and commercial missions have provided significant benefits to Atlas and Delta as follows:

- Higher system reliability through production learning & operational tempo for the launch crews
- Launch vehicle system & flight environment characterization from vehicle flight instrumentation
- Verification of performance, allowing release of design margin that is now available to Atlas and Delta
- Retired program risks with operational flights of Atlas V and Delta IV configurations prior to U.S. Government 1st flight
- Retained skills from heritage programs during ramp up of Atlas V and Delta IV
- Continuous industrial base support to subcontractors & multiple tiered suppliers
- Achieved NASA category 3 certification for Atlas V and Delta IV
- Fostered competition in civil market breeding program efficiency and continuous improvement

ULA has a continuous improvement program, as well as customer-funded product improvement programs, which provide NASA improved product reliability, performance, and lower cost. One example is the RS-68A, which will provide increased Delta IV Heavy capability through a customer-funded engine improvement program to be completed in time for a 2011 flight. The RS-68A program will provide increased thrust and specific impulse while simultaneously improving engine reliability, yielding a significant performance gain (25% to ISS). ULA is also working closely with the customer to define how the RS-68A engine will be extended and implemented through the rest of the Delta IV fleet after being proven on the Heavy.

For Atlas, Block 2 avionics upgrades and SRB Block 2 enhancements were first flown in 2006 on NASA's Pluto-New Horizons mission. This fleet change provides increased mission reliability for all future customers. Currently, Atlas-

Centaur's RL-10A4-2 engine is undergoing an extensive enhancement program, including cooling manifold and gear-train improvements, with qualification expected by EOY 2007. Following this, a new series of improvements to the RL-10 is in customer discussions to incorporate improved idler bearings, eliminate single-point valve failure modes, and enhancements enabling a more common RL-10 configuration between Atlas and Delta, increasing reliability, lower cost, and provider a wider operating range for NASA.

ULA has a unique opportunity to combine the best of both Atlas and Delta heritage. As an example, we have begun work on a conceptual common upper stage, called the advanced cryogenic evolved stage (ACES), which utilizes the knowledge and hardware of both launch system teams to provide a lower cost, higher reliability, longer duration, higher performing stage which can be used by both launch systems. ULA is actively maturing key technologies that will enhance ACES. Circumferential Friction Stir Welding (CFSW) enables solid state tank manufacture with improved mechanical properties and near zero defects is assumed for ACES. On-going development intends to introduce CFSW for Atlas booster production in Decatur providing experience prior to the introduction of ACES. Explosive bonding promises to enable solid state transition from aluminum to stainless steel replacing numerous bolted joints on the existing launch vehicles with inherent reduction in weight and hermetic, leak tight joints.

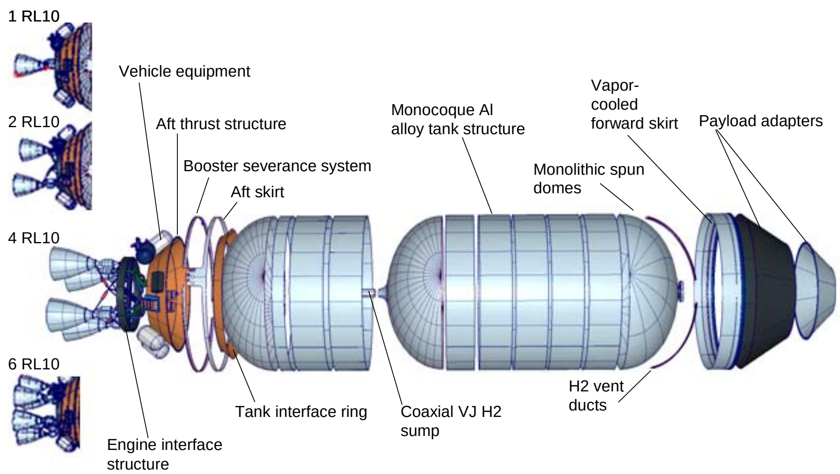


Figure 9: Advanced Common Evolved Stage (ACES) Combines The Best of Centaur and Delta Heritage to Provide Enhanced Customer Support.

In addition to examining a new common stage, ULA is actively expanding the capabilities of our existing upper stages. One example of this is the ongoing research and development into extending the on-orbit duration the Delta and Atlas second stages are capable of actively supporting from mere hours currently to mission durations exceeding months, with minimal performance impact. The technologies required to support this improvement exist and are low-risk, and ULA is examining opportunities for on-orbit flight demonstrations of these technologies in the near future. These same technologies are also applicable for improving the performance of the existing vehicle's for common missions like GEO.

Other development activities are also underway. As mentioned earlier, we are actively assessing options to address the medium market including dual payload carriers and EELV "light" versions. We are also pursuing human rating our existing vehicles in support of several commercial programs. This capability is potentially useful to NASA for crew transport to the ISS. Finally, we have developed future evolution plans and technology roadmaps for both the Atlas and Delta families to increase performance and dramatically lower cost per kilogram to orbit. Details of any of these activities are available to NASA upon request.

c. Provide sufficient information to determine if your company qualifies as a United States commercial provider of space transportation services as defined in Public Law 105-303, Commercial Space Act of 1998, meets the U.S. National Space Transportation Policy of 2004, and the Iran-Syria Non Proliferation Act.

ULA is fully compliant with NASA eligibility requirements and applicable federal laws, regulations, and polices.

ULA qualifies as a United States commercial provider of space transportation services as defined under Public Law 105-303, Commercial Launch Act of 1998, which states that a 'United States commercial provider' is more than 50 percent owned by United States nationals. Both the Delta IV and Atlas V launch vehicles have greater than 50% U.S. content. The United States Government is required to use launch systems with more than 50% domestic content under the Commercial Space Launch Act. ULA already provides compliant commercial launch services to NASA under the Boeing Launch Services and Lockheed Martin Commercial Launch Services NASA Launch Services contracts.

Using Atlas V or Delta IV for NASA Space Transportation requirements meets guidelines to purchase commercially to the maximum extent possible. Utilizing ULA product lines is consistent with the Government requirement to not compete with commercially available capabilities while leveraging the commercial investments made during the development of these two vehicle lines, Atlas V and Delta IV specifically.

ULA meets the requirements of the current U.S. Space Transportation Policy, dated January 6, 2004, through the two Evolved Expendable Launch Vehicle (EELV) product lines, Atlas V and Delta IV that ensure the nation's capability for mutual backup to and use of space for U.S. national, homeland security, civil, scientific, and commercial purposes. NASA's use of EELVs contributes to a healthy industrial and technology base required for a viable domestic space transportation capability that is critical to assuring access to space for critical national security and civil purposes.

With its wide range of space launch capabilities, ULA is capable of providing NASA with human space flight related space transportation services that are fully compliant with the Iran/Syria Nonproliferation Amendment Act of 2005. ULA provides this capability to NASA as a qualified U.S. commercial launch provider which can meet the agency's near-term and long-term space transportation requirements, including support to the ISS.

3.2 ISS Cargo / Re-supply Transportation Services Capability

ULA has a substantial launch vehicle production capability at its state of the art launch vehicle production facility in Decatur, Alabama. This capacity should be more than sufficient to meet both anticipated national security space launch requirements as well as NASA's in the future.

Currently, Delta IV takes up about 50% of the Decatur manufacturing facility's capacity, and will not need a larger footprint even if the rate were to go to 20 boosters per year. Decatur is currently staffed and tooled to build 7 Delta IV boosters annually in a 1-shift operation, 14 in a 2-shift operation. Increasing this to 20 boosters a year would only require a minimal capital influx for tooling modifications. Decatur is also staffed and tooled to build 5 Delta IV upper stages in a 1-shift operation, 10 in a 2 shift operation. Getting to 15 requires a minimal capital influx for tooling modifications.


ULA Decatur Alabama Production Facility

Atlas V is expected to use ~25% of Decatur's capacity for a 12 per year capability. ULA plans to maintain the capacity for 12 boosters plus 12 upper stages annually in Decatur.

Although Delta II is not an ISS Cargo launch candidate in the 2000 to 3000kg to orbit range, space limitations are not expected to be an issue in Decatur with the probable ramp-down of Delta II. Even now, Decatur currently can build 12 Delta II vehicles per year (12 boosters plus 12 upper stages) in only ~25% of the facility's capacity.

Operational launch site infrastructures at Cape Canaveral Air Force Station (CCAFS) includes Launch Complex 37 for Delta IV and Launch Complex 41 for Atlas V, both of which would be used to support ISS Cargo Delivery mission requirements. These existing, flight-proven complexes are each capable of launching up to 10-12 times per year, providing maximum manifest and schedule assurance for ISS Cargo needs.

The cargo and payload processing requirements for the purposes of ISS support missions are compatible with the numerous payload processing facilities available at CCAFS for the pre-launch servicing, propellant loading and integration with payload accommodations. Depending on customer requirements, ISS support missions could be processed at the existing Shuttle-related facilities at NASA Kennedy Space Center (KSC) or at commercial facilities such as Astrotech Space Operations (ASO) at the SPACEHAB Payload Processing Facility (SPPF).

The logistics cargo missions are also compatible with processing at ASO, located in Titusville, Florida. ASO is capable of processing spacecraft and has facilities capable of integrating 5-m-PLF encapsulations. The processing and integration timeline for ATV, HTV or other transfer vehicles is similar to processing flows provided in the Delta IV and Atlas V payload planner's guide.

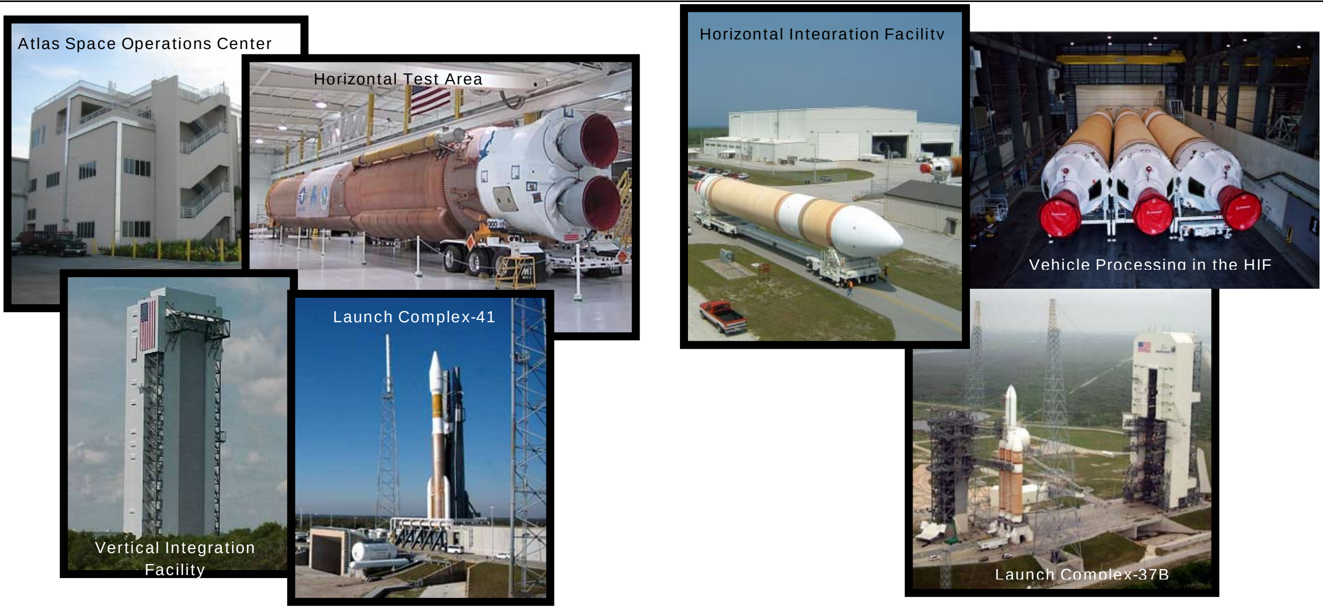


Figure 10: Atlas and Delta Processing and Launch Complexes at Cape Canaveral Air Force Station

For late cargo access, much will depend on the configuration of the cargo transfer vehicle and its ability to accommodate late access. Typically, for a fully encapsulated payload on Delta IV, access ends 10 days prior to launch although much later access could be possible with proper cargo carrier design since the Mobile Service Tower, which could enable access, rolls back from the launch vehicle only 8 hours before launch. Similarly, access to a fully encapsulated payload for Atlas V ends at approximately 3 days prior to launch, although later access after the vehicle arrives at the launch pad may be accommodated once specific requirements are defined.

3.3 Safety, Programmatic and Technical Risk

a. Describe the safety, programmatic, and technical risks you consider to be the drivers from a program execution perspective and any mitigating actions that may be appropriate for NASA to consider in its planning.

Understanding and mitigating risks are critical to the continuation of successful launch services for NASA's science, cargo, and other missions. Successful launch service providers have well-established procedures in place to identify and manage risks. These continually improving procedures result from decades of operational experience in partnership with the U.S. Government. Current NASA launch service contracts incorporate terms to address these risks based on this same experience. Specific areas of safety, programmatic, and technical risk that should be addressed in NASA planning are discussed below.

<u>Safety</u>

Safety considerations should include provision of safe work environments for contractor and government personnel, safety of people and hardware during prelaunch operations, and safety of people and hardware during launch operations and flight. Current NASA methods provide an excellent solution for ensuring safety in these areas.

Risks related to safe working environments are adequately addressed by current general regulations (not specific to NASA contracts), by incorporation of Safety and Health requirements in NASA contracts (e.g. NFS 1852.223-70, Safety and Health), and by NASA's requirement for contractors to submit Safety and Health Plans for NASA review prior to award of major contracts.

Safety during prelaunch operations is adequately ensured by provisions in current NASA launch service contracts, and by other government requirements applicable to launches from U.S. Ranges. Important provisions include NASA insight into contractor technical activities, detailed NASA review of procedures for integrated (pay-load and launch vehicle) operations, development of a Missile System Prelaunch Safety Package or equivalent for Range approval, and compliance with NASA and Air Force safety documents (e.g. KNPR 8715.3, EWR 127-1). Tailoring of requirements in these documents should continue. Tailoring, with government concurrence, allows contractors to meet the intent of the requirements in the most economical manner with no increase in risk.

Rigorous provisions are in place, and should be maintained, to enhance safety during launch operations and flight. In addition to the elements discussed above, further safety assurance is provided by experienced NASA personnel participating on the integrated launch support team during final processing and countdown. Oversight is also provided by Air Force Range Safety during countdown to provide independent safety assurance for resource (facility) protection, and to provide final safety monitoring during flight to orbit.

Programmatic

Programmatic risks related to launch services include cost, schedule, and program viability. The first two items can be mitigated through contract terms. Program viability (the risk of a launch service provider being unavailable to launch when required) can be mitigated by requiring potential providers to meet minimum requirements prior to award of a launch contract (stable financing, demonstrated technical capabilities, successful flight experience).

Cost risk mitigation can best be addressed through the use of quantity buys. The benefits to NASA are known costs for a defined period of time, and lower costs resulting from the quantity buy approach. Benefits to industry include a stable business base and lower costs for launch service providers and for the sub-contractor community. History shows that trying to lock in long term costs without commitments on the buying side doesn't work. Knowing that some level of demand for launch services will exist, NASA should leverage the power of its demand for the benefit of the U.S. Government and for industry.

Technical

Technical risk can be mitigated by ensuring that contractors meet rigorous standards for quality, reliability, and demonstrated capability. Contractors should also support NASA insight through open access to technical information and with in-line participation of NASA personnel in day-to-day contractor technical activities. The requirements currently implemented in NASA launch services contracts address these items, and have been effective in mitigating technical risk.

Current contractor requirements related to quality include ASO 9100 certification and submittal of a Quality Management Plan for NASA review. Launch service reliability and demonstrated capability is addressed primarily by NASA's risk mitigation policy (NPD 8610.7), and associated requirements for launch vehicle certification. Since implementation of 8610.7 and certification, NASA has achieved a 100% success rate for expendable vehicle launches.

The insight achieved by NASA through in-line participation in a contractor's technical activities is invaluable. The detailed knowledge resulting from this level of insight, combined with complementary NASA and con-tractor technical review processes, allows NASA to add greater value to the program. Current contract requirements for insight, resident offices, and well-defined and rigorous technical review processes within NASA are key elements that should be retained. Experience shows that it is possible for NASA to implement these requirements with minimal impact to contractor standard operations, given that the contractor processes are already robust and proven.

b. Provide suggestions for accommodating launch date flexibility (i.e., late determination of launch date, changes in launch date, etc.) and specific cargo manifest changes while minimizing cost impacts.

Launch service contracts should include a clearly defined process for determining and changing launch dates, and should balance the need to know when a launch will occur (for planning purposes) with the need to be flexible (to accommodate the inevitable launch date changes that occur for almost all non-planetary missions).

For cargo and other missions that do not have a specific launch date driven by a planetary window, we recommend adopting a launch period approach. Each party would initially agree to a 90 day launch period at the time of launch service ATP, followed by selection of a 30 day slot approximately 1 year prior to launch, followed by selection of a specific date approximately 6 months prior to launch. Technical integration activities would support the first day of the period or slot to maintain flexibility. Launch service contractors should also clearly define their manifesting policies and procedures for resolving launch date conflicts. Cost impacts can be better predicted in advance and minimized with clearly defined procedures that provide flexibility like those outlined here.

Costs can also be controlled through NASA's use of quantity buys. NASA could reserve multiple launch periods on a contractors manifest, and both parties could agree in advance on the level of flexibility NASA requires with regard to changing mission requirements. Similar scenarios have been addressed with other government customers, and a variety of options exist to maintain NASA's flexibility until very close to a mission's launch date.

c. Provide feedback on the application of, or elements within, the following NASA policy directives - NPD 8610.7, Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions and NPD 8610.23, Launch Vehicle Technical Oversight Policy (http://nodis3.gsfc.nasa.gov). What is NASA doing, as a result of these policies, that could be changed or eliminated without increasing launch risk? What items are driving service cost without adding significant benefit? Discuss risks and benefits to NASA and the supplier for any of your proposed changes in these oversight/insight policies.

8610.7 and 8610.23 have proven to be effective methods for achieving high quality reliable launch services. Since the implementation of 8610.7, NASA has developed well-defined processes for ensuring reliability and mitigating mission risk, and has achieved a record of 100% success for expendable launches. 8610.23 provides NASA with detailed insight into all technical aspects of contractors' launch vehicle programs, and has proven to be an effective method for NASA to ensure that contractors maintain and consistently follow robust technical processes.

Two key practices allow NASA to obtain insight per 8610.23 and mitigate risk through the certification process developed in response to 8610.7. The first of these is in-line participation by experienced NASA personnel in the daily technical activity of a launch vehicle program (attending reviews, reviewing reports, witnessing tests, complementary review processes within NASA, etc.) The second is NASA's acceptance of standard contractor reports and other data products in support of insight, CDRL requirements, and certification requirements. Both of these result in NASA insight with minimal (but not zero) impact to contractor costs, and should be retained.

A recommended improvement to reduce cost with no increase in risk is to replace the current mission success reviews conducted for major launch vehicle components with in-line participation during standard data reviews already performed by the contractor. For contractors with established and proven review processes, this would eliminate redundancy and cost while still providing the same level of NASA insight.

d. Suggest ways NASA can incentivize a service supplier to provide safe, cost effective, and reliable services.

Launch service providers capable of meeting NASA's requirements are already incentivized to provide safe and reliable missions. The consequences of mission failures extend far beyond the directly-affected mission and contractors that have demonstrated the ability to fly reliably and consistently will continue to do whatever it takes to achieve mission success, regardless of any specific additional incentives.

Cost effective launch services can best be achieved through the use of quantity buys based on known NASA launch demand. Providing a multi-year multi-vehicle commitment allows for lower prices to NASA due to lower contractor costs. Quantity buys result in more favorable pricing to NASA, and provides greater stability for the industrial base.

3.4 Acquisition Terms and Conditions

Responders are invited to provide suggestions on what terms and conditions are beneficial for industry and NASA for this service.

a. Describe and provide rationale for the desired type of pricing in a fixed price service contract (e.g., fixed price by launch vehicle class, fixed price per mass or volume or other unit measure of payload capacity). Address any known or potential risks associated with your recommended arrangement and provide any appropriate mitigation techniques.

For fixed price launch service contracts, we recommend pricing by vehicle configuration for a set of standard configurations. This would result in a range of prices for a range of performance capabilities. NTE or ROM prices based on order year should be established for no more than one or two years at a time, and the time from order to launch should not exceed approximately two years under standard conditions. Prices could still be provided for firm missions (or blocks of missions) requiring longer integration periods on a case-by-case basis. Recent history has shown that establishing useful NTE prices more than one or two years in advance of potential orders either can not be done by contractors, or can only be done at great financial risk.

To meet NASA's ongoing and emerging space transportation requirements, ULA recommends first that the contract type be consistent with the government objectives to allow maximum operational flexibility, ensure mission assurance and support changing program priorities. To satisfy these NASA objectives, unique services not standard to a commercial launch service are required and need to be provided to the government – specifically, more detailed government insight and oversight than what is typical for commercial customers. NASA's visibility, unique missions and accountability to Congress and the White House argue against it being able to successfully contract commercially in ways typical in the private sector. To meet its responsibilities, NASA requires far greater insight and control over key aspects of a program. As an example, for ISS, some cargo missions will involve unique, one of a kind scientific or orbital replacement hardware that is both costly and not easy to replace. It is only logical that NASA would need a great deal of oversight in order to assure that high priority missions will be executed successfully. While this level of oversight is a valid customer need, it is incompatible with a commercial Delivery in Orbit (DIO) procurement approach – but well suited to commercial contracting with Fixed Price Level of Effort (FP LOE) Contract Line Item Numbers (CLINs).

Second, in order to minimize costs in this unique market, the best way to satisfy NASA's total space transportation requirements and its objectives is by procuring quantity buys (block buys) of launch services, potentially in coordination with the US Air Force's EELV program office to maximize cost savings while addressing any potential national space launch infrastructure limitations. Working together, the two government agencies can develop a plan to utilize both infrastructure and capabilities to maximize the utilization of these assets. Such an approach would benefit the nation's taxpayers and improve mission success.

b. Suggest terms and conditions to implement the incentive approaches described in your response to Section 3.

Launch service providers capable of meeting NASA's requirements are already incentivized to provide safe and reliable missions. The consequences of mission failures extend far beyond the directly-affected mission and contractors that have demonstrated the ability to fly reliably and consistently will continue to do whatever it takes to achieve mission success, regardless of any specific additional incentives.

Cost effective launch services can best be achieved through the use of quantity buys based on known NASA launch demand. Providing a multi-year multi-vehicle commitment allows for lower prices to NASA due to lower contractor costs. Quantity buys result in more favorable pricing to NASA, and provides greater stability for the industrial base.

c. Provide comments on unique ways mission success could be measured for ISS cargo missions. Note: Due to on orbit timeline constraints, specific cargo condition may not be immediately verified upon receipt on the ISS.

Current contract concepts for determining mission success for the launch service phase of the mission are straightforward and should be retained with only minor clarification. Essentially, the launch phase of the mission would be successful if the launch vehicle separates the cargo carrier into the proper orbit without violating any other ICD requirements. If ICD requirements (orbit parameters or others) are not met, the mission would be successful only if the cargo carrier could complete it's mission to some predetermined degree.

d. Provide recommendations regarding payment schedules, milestone events, and any related cash flow implications.

Current launch service contracts require payment milestones based on performing specific tasks defined in advance of ATP. This occasionally causes problems when it is determined during the integration period that certain tasks should be performed later than originally planned. NASA should adopt the calendar based milestone approach used by other government launch customers, which significantly reduces the paper-work and time associated with payments.

We recommend that NASA consider reducing the total number of payments and provide the bulk or all of the launch service payment at or shortly after ATP. The resulting cash flow benefit to the contractor would result in more favorable pricing to NASA, and both parties would experience significant reductions in the time required to process invoices and payments.

e. Provide recommendations for commercial service contract terms and conditions (e.g., IDIQ versus firm and/or optional requirements, termination for cause and convenience provisions, liability, insurance, warranties and intellectual property rights).

In concert with NASA's LSP organization, the NLS contracts are considered commercial service contracts with commercial terms and conditions. These contracts will work well for the ISS Cargo initiative, with some minor revisions, should the ISS Cargo procurement be let by NASA LSP. In addition, there would be considerable flexibility to the Government if the launch services are procured separately from the transfer vehicles. Using the existing NLS Contract will provide assured assess across all transfer vehicles as long as the launch vehicles are compatible with existing and planned transfer vehicles.

If NASA can ensure quantity buys under an IDIQ-type contract, all contractors could operate under commercial contracts with firm launch requirements. In addition, NTE pricing tables (for one- or two-year periods) for a variety of launch vehicle configurations could be supported. Combining the NTE pricing tables with standard and non-standard launch services while offering separately priced mission unique services works well for procuring other NASA missions and we think it would work well for ISS Cargo missions. We recommend that NASA consider procuring launch services in a multi-year / quantity buy manner so as to secure the best prices for the Government. We believe significant cost savings could be demonstrated if other NASA missions are also included in ISS Cargo quantity buys.

Should NASA prefer not to utilize the existing NLS contract, a stand-alone NLS-like contract having similar terms and conditions for insurance, warranties, and intellectual property rights, etc. is highly recommended. This type of contract can be let from any organization within NASA, whether it be NASA/HQ, ISS Program Office, ESMD, or LSP.

Wherever the contract is let, we highly recommend adherence to current mission success criteria and certified launch vehicles. NASA has benefited from the use of low risk, flight proven launch vehicles to support science missions. Therefore, we support the continuation of the rigorous NLS requirements-driven approach to mission success. Further, we fully support NASA insight and participation in launch vehicle mission integration processes and other technical activities. Insight is accomplished through in-line participation in ongoing technical activities, working group meetings, technical interchange meetings, non mission-specific functional discipline meetings (e.g., Loads TIMs, Flight Operations TIMs, etc.), and mission-specific flight readiness and mission success reviews.

Finally, to support NASA's emerging space transportation requirements, a revision to its policy with respect to contractor risk is required. The risks inherent in space do not change with the different branches of government. Consequently, the basic indemnification allowed for DOD contractors under Public Law 85-804 should apply to NASA's space transportation and launch service contractors as well. This is advisable since many potential NASA missions are higher risk than the DOD launch services. Missions using nuclear power introduce risks resulting from radioactive materials or nuclear systems into the launch service and spacecraft; no launch or products liability insurance is available to cover these types of risks. Thus contractors must be indemnified to have any reasonable financial protection. Legislation such as Public Law 85-804 was created in recognition of situations where significant uninsurable liabilities may be present; the law was specifically designed to prevent such issues from impeding procurement activity. NASA's emerging space transportation requirements should be achieved through partnership and cooperation with contractors rather than by levying financial damages in the event of failure. Space systems are inherently risky – especially for new developments. NASA's current Performance Based Payment for Mission Success Determination should be revised to eliminate its negative incentive on the contractor to re-allocate or refund 15% of the launch service price in the event of failure.