SMALLER, BETTER, FASTER -- NASA'S ULTRALITE EXPENDABLE LAUNCH VEHICLE SERVICES (UELVS)

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Abstract

The signing of the Ultralite Expendable Launch Vehicle Services (UELVS) contract on December 23, 1994, marked the end of a fast-track, six-month procurement process and the beginning of a new "smaller-better-faster" operational paradigm within NASA's Mixed Fleet Program. Managed by the Goddard Space Flight Center's (GSFC) Orbital Launch Services Project (OLS), UELVS reflects a departure from the established Medium and Small Expendable Launch Vehicle Services (MELVS and SELVS) in both management philosophy and level of NASA technical oversight. The intent of this paper is to discuss the foundation and implementation of this paradigm and future plans for UELVS.

Introduction

With the introduction of the Ultralite Expendable Launch Vehicle Service (UELVS), NASA has now filled the "Ultralite" payload section of NASA's Mixed Fleet Program. Covering a payload mass/orbit range of 91 kg/960 km sunsynch to 227 kg/185 km 38° inclination, with an associated 18-to-24 month kickoff to launch schedule, UELVS reflects a "smaller-better-faster" concept for launch vehicle services.

Managed by the Goddard Space Flight Center's Orbital Launch Services Project, UELVS reflects a departure from the established Medium and Small Expendable Launch Vehicle Services, MELVS and SELVS, respectively, and an overall desire to reduce launch vehicle costs and time to launch. UELVS' "Smaller, Better, Faster" operational paradigm is structured to provide a "win-win" situation for all involved:

- UELVS' 18-to-24 month kickoff-to-launch period allows the graduate students involved in UELVS' primary payload—provided by the Universities Space Research Association's (USRA) Student Explorer Demonstration Initiative (STEDI)—to see the "fruits of their labors" prior to graduation.

- Combining an established launch vehicle—the Pegasus® XL—with well-defined electrical and mechanical payload interfaces, limited non-standard services, and reduced NASA oversight has allowed for the adoption of a "Smaller and Better" NASA and Orbital Sciences Corporation (OSC) management approach and a $6M price tag for a standard launch service for the primary payload.

- Excess launch vehicle payload volume/performance capability is available for OSC or NASA-manifested secondary payloads. Secondary payloads will have pre-defined electrical and mechanical interfaces with the launch vehicle.

This paper details the technical and programmatic aspects of UELVS including guidelines for primary and secondary payloads on the Pegasus® XL vehicle. The paper also describes how the UELVS team is proceeding to its scheduled launches of the SNOE (Student Nitric Oxide Explorer) and TERRIERS (Tomographic Experiment using Radiative Recombinative Ionospheric Extreme ultraviolet and Radio Sources) payloads in March and April of 1997, respectively.

Background

UELVS has its embryonic origin in the vision of Dr. Paul Coleman of the Universities Space Research Association. In late 1989, Dr. Coleman initiated an effort within USRA to identify excess U.S. Government expendable rocket assets that could be refurbished to provide low-cost access to space for university researchers. On July 31, 1992, following almost two years of intense discussions involving personnel from NASA, the U.S. Air Force, the U.S. Naval Research Laboratory, and the U.S. House of Representatives, Dr. Coleman met with Mr. Dan Goldin, NASA Administrator, to discuss the concept of a small missions complement and the status of USRA's effort to use excess Spartan rocket assets. Following this meeting, USRA gained support from Marshall Space Flight Center and Sandia National Laboratories to help quantify the key points associated with the use of Spartan assets. On May 20, 1993, USRA held a follow-up briefing with Mr. Goldin and senior NASA management that included representatives from DoD, the U.S. Air Force, and the university community. At this meeting, Mr. Goldin challenged USRA to demonstrate the launch of three polar-orbiting spacecraft in a three-year period commencing in government fiscal year 1994. NASA promised $24 million in funding to support these missions with a requirement that the program could not overrun this allocation. This effort was given the title of Student Explorer Demonstration Initiative (STEDI).

With the promise of $24 million in funding, USRA proceeded to formulate a working definition of a "smaller-missions" complement. On December 18, 1993, USRA released a preliminary Announcement of Opportunity (AO) for the STEDI missions to over 1,000 university researchers, industry representatives, and government scientists and managers. Serving as a continual undercurrent to the AO was Dr. Coleman's working definition of a "smaller-missions" complement[1]:

- Total cost per mission of $4 to $8 million
- Twenty-five launches per year

[1] Universities Space Research Association letter, dated 6/2/93, Dr. Paul Coleman

- Launch vehicle and launch costs between $1 and $2 million.
- More than 300 pounds to low earth orbit (500-km altitude, low-inclination) or equivalent
- Start up to lift off in six months
- Ability to ship and shoot in thirty days, if needed

While the preliminary AO baselined the use of excess Minuteman II assets as the projected expendable launch vehicle, NASA's Launch Vehicles Office initiated an internal study in January 1994 to assess the cost effectiveness of using these assets[2]. Based on information received from the U.S. Air Force, it was determined that the cost of using Minuteman II assets was not significantly lower than commercially available launch services, given the uncertainty of non-recurring costs. Coupled with the proposed U.S. Government policy regarding expendable launch vehicles[3], this determination led to a NASA decision in April 1994 to pursue a commercial procurement of launch services for STEDI to be called Ultralite. The Ultralite expendable launch vehicle baseline required the capability to place a 300 pound payload into a 300 nmi. circular polar orbit.

NASA's decision to proceed with an Ultralite launch service was paralleled by USRA's May 12, 1994, release of a formal AO for the STEDI missions. At NASA's direction, this AO was modified in June 1994 to require a minimum payload fairing length of 36 inches, rather than the original 70 inches, to enable broader competition[4]. Efforts accelerated in August of 1994 with USRA's receipt of sixty-six STEDI proposals and NASA's issuance of the Request For Proposal (RFP) for UELVS in the Commerce Business Daily. Consistent with the "smaller-better-faster" philosophy, the RFP emphasized NASA's requirement to maximize value and stated that price, payload volume and performance would be primary selection factors[5].

Sixty-six proposals in-hand, USRA proceeded with the rather daunting task of selecting six of the proposals for Phase I, Mission Definition studies. After multiple meetings of a body of very experienced evaluators, winners were announced on September 23, 1994[6]. At this point, the four-month Phase I clock began for the winners. Adding to these accomplishments in September, NASA received formal proposals in response to the Ultralite RFP and initiated its internal review/ selection process at the Goddard Space Flight Center.

On November 15, 1994, NASA announced that Orbital Sciences Corporation (OSC) had been

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[2]NASA letter, dated 3/4/94, C. Gunn (NASA code SV) to Col. Charles P. Pugsley, SAF/AQQS

[3]National Space Transportation Policy, 8/5/94

[4]NASA letter, dated 6/8/94, W. Huntress (Associate Administrator for Space Science) to Dr. Paul Coleman (USRA)

[5]ibid.

[6]USRA, Center For Advanced Space Studies, Division of Educational Programs, Press Release, dated 9/23/94

selected by NASA "...to negotiate a firm fixed price contract to provide launch services to deploy Ultralite-class payloads into their required orbits."[7] While the government procurement was not yet complete, the finish line was in sight. Implementing "lessons learned" from previous firm-fixed-price launch services contracts and staying true to the "smaller-better-faster" intent of Ultralite, the contract with OSC was signed on December 23, 1994.

With the launch vehicle defined, USRA's STEDI review panel and the six Phase I winners now had a "given" for the launch vehicle environment and electrical/ mechanical interfaces where there was previously a "might be". Armed with this information and a wealth of personal experience, the STEDI review panel began its whirlwind down select activity in February 1995. Meeting with each of the six finalists over a two week period, the panel digested the accumulated information and made its decision. Two Phase II selections—Student Nitric Oxide Explorer (SNOE) and Tomographic Experiment using Radiative Recombinative Ionospheric Extreme ultraviolet and Radio Sources (TERRIERS) missions—were announced on February 25, 1995[8].

With the launch vehicle and missions defined and approximately $12M allocated for each mission,[9] the evolution of Dr. Coleman's embryonic 1989 vision into the entity that is the Ultralite Launch Services was complete. The "smaller-better-faster" UELVS/ STEDI operational paradigm was born into the NASA Mixed Fleet world.

Making "Smaller-Better-Faster" Work

It has long been said that an organization will resist change until the pain of resisting is greater than the pain associated with the change. In the case of the Ultralite launch service, the budget guideline established by Mr. Goldin made change mandatory. The only question was how to minimize the pain and ensure mission success. The following four prong approach to pain mitigation has been adopted and implemented:

1. Form a small, multi-talented NASA team and promote an entrepreneurial management approach;

2. Establish strong lines of communication among NASA, spacecraft and launch vehicle personnel;

3. Reduce the level of NASA technical oversight over the

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[7]NASA News Press Release, dated 11/15/94, 4:00 p.m., EST, RELEASE C94-ii

[8]USRA, Center For Advanced Space Studies, Press Release, dated 2/15/95

[9]Approximately $4.3M for each spacecraft (design/fabrication/on-orbit activities) and approximately $7.7M per mission for launch services (includes $ for NASA management/technical oversight of OSC, mission-specific modifications requested by the spacecraft and launch delay contingency)

launch vehicle consistent with the resources at risk and,

4. Establish well-defined spacecraft-to-launch vehicle interfaces, standard launch services, and non-standard launch services.

The following sections describe specifics of each of these prongs and accomplishments to date in making "smaller-better-faster" work.

Small, entrepreneurial NASA team

With less than $300,000 allocated per mission for OLS Project's programmatic/technical support, Ultralite has, from the start, required a significant departure in management philosophy from the established Medium and Small Expendable Vehicle Services (MELVS and SELVS). The OLS Project's Ultralite team (Figure 1) has embraced the following operational imperatives:

1. "Open-book" understanding of the Ultralite budget — while the team does not have financial books in the sense that a small commercial company does, each member of the team does understand what the established manpower level is (2.4 Full Time Equivalent (FTE) civil servants, 1.2 FTE contractor) to support both missions and how much funding is available for mission specific non-standard services ($750,000 per mission[10]). The

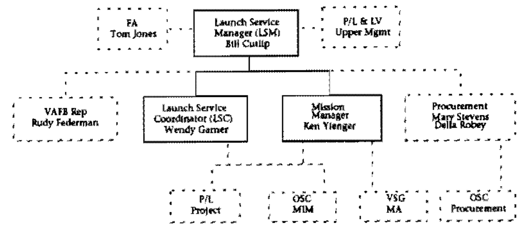

Figure 1. The OLS Project's Ultralite Team

team receives a monthly manpower report that lists all civil servant charges against the job order numbers established for the SNOE and TERRIERS missions.

2. Entrepreneurial/ bootstrapping spirit — as Figure 1 shows, the team consists of three core people: the Launch Service Manager (LSM), the Mission Manager (MM), and the Launch Service Coordinator (LSC). What the figure doesn't show, however, is the entrepreneurial, bootstrapping spirit behind the team. Each team member understands that the STEDI, and thus the UELVS, program is a pilot to demonstrate that "smaller-better-faster" can work. As such, "it's not my job" is not an accepted comment. Each team member, in addition to treating his/her part of the overall effort as if it were their own "company", is expected to understand the efforts of the other team members. Based on their "open-book" understanding of the budget, each person knows exactly what he/she has to work with. A recent example of this entrepeneurship is the Mission Manager's initiative to investigate alternate launch

[10]It should be noted that, at this time, the SNOE and TERRIERS missions do not require any non-standard services. In theory, this makes the allocated money available for future missions.

vehicle structures for possible NASA secondary payloads. This effort was made within his manpower ceiling and was facilitated by the bootstrapping aspect of the team.

Another aspect of the Ultralite team that is not indicated by Figure 1 is the fact that the three core people also manage the OLS Project's Titan II expendable launch service that supports NOAA's TIROS weather satellite program. The sine wave nature of launch service programmatic/ technical support (peak being the actual launch operations) means the team's work load fluctuates between the two services even though the allocated manpower budget stays constant. The bootstrapping aspect of the team is facilitated by this management arrangement. Through careful planning, the team has been able to optimize the return on budgeted manpower by applying civil servant support from other Directorates within GSFC while the core team members were otherwise occupied on Titan II-related efforts. This situation also applies to programmatic/ engineering tools already in place in support of the Titan II effort. Where applicable, they are also utilized for Ultralite efforts. It is a given that the team fully utilizes all aspects of the OLS Project's existing infrastructure to the maximum extent possible. In cases where hardware or software required for an Ultralite task does not currently exist within the OLS Project, a search encompassing GSFC surplus assets and other GSFC projects is made before a new procurement is initiated. To date, only one Ultralite-specific procurement has been necessary—a piece of management software purchased in order to comply with licensing requirements.

Communication

As many small commercial companies have demonstrated, just adopting an entrepreneurial, bootstrapping approach does not ensure success. Without well defined means of communication that are fully utilized, failure will come—it's just a matter of when. The OLS/OSC/Spacecraft projects' Ultralite team (Figure 2) has put a premium on establishing and maintaining good lines of communication. This effort takes multiple forms. As shown in Table 1, there are defined Orientation, Mission Integration Working Group (MIWG) and Launch Operations Working Group (LOWG) meetings. In an effort to mitigate the effect of limited travel budgets and optimize the face-to-face contact between NASA, OSC, and spacecraft engineers/managers, the MIWGs alternate between

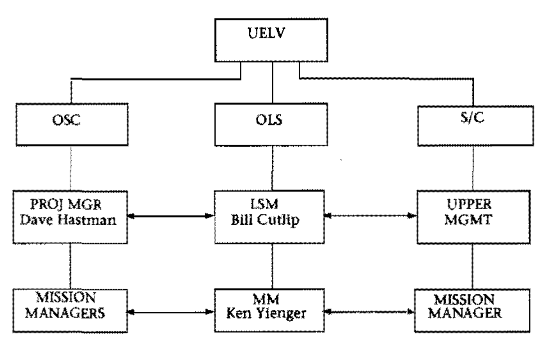

Figure 2. The OLS / OSC / Spacecraft Project's Ultralite Team

Table 1. Summary of Working Group Meetings

Approx Date	Type	Purpose	Meeting Location
L-24M	Orient. Briefing	UELV Kick-Off Meeting Identifying Responsibilities	OSC
L-21M	MIWG #1	- P/L Questionnaire - Outline ICD - Prelim. Mass Properties - Draft ARAR	P/L Provider
L-18M (After P/L PDR)	MIWG #2	- Preliminary Drawings - Updated Mass Properties - Prel ME/EE Interfaces - Environments	OSC
L-12M (After P/L CDR)	MIWG #3	- Final Drawings - Updated Mass Properties - Definitize Interfaces - Environments	P/L Provider
L-8M	LOWG #1	Range Coordination Working Groups: Discuss Detailed Operational Concerns & Plans as Stated in the Operations Directive. Topics Include: Launch Ops, Countdown Manual, P/L Support, Mission Peculiar Support Req'ts	VAFB
L-6M	MIWG #4	- Finalize ME/EE Interfaces - Final Mass Properties - Final ARAR - Review Launch Site Procedures	OSC
L-4M	LOWG #2	P/L Procedure Review: Review and Comment on P/L IntegrationProcedures	VAFB
L-30d	MRR	Prelaunch Assessment of Integrated LV/Payload/ Facility Readiness	OSC
L-3d	FRR	Summary Status of LV & All Supporting Elements is Presented to NASA	NASA/ GSFC
L-1d	LRR	Final Assessment of Readiness Prior to Activation of Range Resources on Day of Launch	VAFB

OSC's Dulles, Virginia, site and the spacecraft project sites. The LOWG meetings must occur at Vandenberg Air Force Base, California, (VAFB) to facilitate the support of Western Range personnel (civilian and Air Force) and to allow spacecraft personnel to see the facilities that they will operate within during spacecraft-to-launch vehicle integration operations and actual launch operations. In keeping with the "smaller-better-faster" principle behind Ultralite, the number of LOWG meetings is limited to two—not the normal four held for a typical Small Explorer payload launched under SELVS and scheduled during the overall flow of launch-related activities to optimize their productivity.

Unique to the Ultralite communication effort has been a concerted effort to have the OLS and OSC team members intimately involved in the spacecraft projects' design activities to ensure spacecraft-to-launch vehicle compatibility and to provide for the transferal of knowledge gained from prior NASA and commercial experiences. The main mechanism for this has been the OLS and OSC team members' involvement in the SNOE and TERRIERS Critical Design Reviews (CDRs).

Wrapped around the scheduled CDRs, MIWG meetings, and LOWG meetings is a network of almost daily communication. All members of the Ultralite team are tied together via e-mail over the Internet, fax machines, voice mail, and phone—with free video conferencing over the Internet still in the works. To date, this communication network has been used to (1) conduct telecons on technical issues and review mission status on a monthly basis, (2) transmit draft Interface Control Documents (ICDs) and mechanical drawings (both electronic format and hard copies), and (3) relay spacecraft and launch vehicle status information on an as-necessary basis.

The OLS Project core team has taken communication another step forward by locating the three core members within thirty feet of each other in the OLS Project's facility (the LSM and MM share an office, with the LSC just down the corridor) and by employing portable computers equipped with telecommunication packages. As studies have shown, close proximity promotes contact[11]. To date, the OLS team has proven this to be true. In addition to daily conversations, the team meets on a weekly basis to review action items, the team's activity calendar, and the integrated spacecraft/launch vehicle schedule.

Mobile computing has proven invaluable to date, allowing each person to have his/her "office" with them regardless of where they are. For example, this paper was written, in part, on a train, in the office, at home, and in hotel rooms in Colorado and New Jersey, with draft versions transmitted to reviewers via e-mail and fax. From a purely technical standpoint, the team's Mission Manager has equipped his portable to support thermal and structural analyses while he is in the field, with thermal work having already been performed. Productivity continues when team members leave the office!

The last important piece of communication is documentation. In keeping with the "smaller-better-faster" intent of Ultralite, documentation has been pared down to those items that have the maximum return on the time invested. The Ultralite contract has only twenty-eight items on its Contract Documentation Requirements List (CDRL)—only eleven requiring NASA approval (Table 2), while the SELVS contract has fifty-nine items—twenty-four requiring NASA approval. The "maximum return" items on Ultralite include the spacecraft-to-launch vehicle interface control document (ICD), integrated spacecraft/launch vehicle coupled loads and thermal analyses, integrated mission constraints document, and the final mission analysis. The documentation required of each spacecraft project (Table 3) is identified during that spacecraft project's orientation briefing and becomes a part of the integrated spacecraft/launch vehicle schedule.

Table 2. CDRL Items Requiring NASA Approval

Item No.	Title	Approval Decision Required Within (Calendar Days)
4	Coupled Dynam. Loads Analysis	15
5	I/F Control Document (ICD)	15
6	UELV/P/L Int .Thermal Analysis	30
12	Final Mission Analysis	15
14	P/L Integrated Test Procedure	15
16	Molecular & Particulate Contamination Analysis	15
18	Mission Success Criteria	15
22	Mission Failure/Anom. Report	30
26	Integ Mission Constraints Doc.	15
27	P/L Envelope Clearance Analysis	15
28	Dual P/L Compatability Assess.	15

Table 3. Documentation Provided by the S/C Contractor

Due Weeks	Action Required
ATP+2	P/L Questionnaire Response
L-72	P/L Mathematical Model for Dynamic Analysis
L-72	P/L Environmental Test Documents
L-72	Preliminary P/L Configuration Drawings
L-44	Final P/L Configuration Drawings
L-42	Launch Intervals
L-36	P/L Safety Approval Package
L-20	P/L Launch Site Test Plan
L-15	P/L Launch Site Test Procedures
L-20	P/L Mass Properties Document
L+2	Postlaunch Orbit Confirmation Data
L+8	Mission Success Determination (TBD by NASA)

[11] Professor Thomas Allen of MIT. Probability of communicating at least once a week >25% once distance is 5m or less (~8% when distance ~10m)

In addition to the contractually identified documentation, every member of the overall Ultralite team has an individual copy of the Ultralite User's Guide which details all services available to the spacecraft project(s). This guide is kept current by OSC throughout the duration of the Ultralite contract. Finally, to make sure no spacecraft concerns regarding the total Ultralite service inadvertently fall through the cracks, the OLS Project team sends out questionnaires to the spacecraft projects following the mission kick-off orientation briefing and every six months thereafter. The six-month questionnaires are generated by the OLS Project's Mission Analysis and Integration group with the results reviewed by OLS Project upper management.

Technical Oversight

Based on the "limited resources at risk", a decision was made by NASA's Associate Administrator for Space Science[12] that the language contained in the Ultralite contract regarding NASA technical oversight of the Ultralite launch service provided by OSC was to be applied in lieu of NASA Management Instruction (NMI) 8610.23. To help quantify the concept of "limited resources at risk", the following "apples-to-oranges" comparison between UELVS spacecraft and SELVS[13] spacecraft is provided:

UELVS
- SNOE and TERRIERS
  - ~$4.2M per mission for spacecraft fabrication and one year of on-orbit operations

SELVS
- TOMS-EP
  - ~$68M for spacecraft fabrication and one year of on-orbit operations ($9M actually budgeted for 3 years on-orbit)
- FAST
  - ~$43M for spacecraft fabrication and one year of on-orbit operations ($15M actually budgeted for 2 years on-orbit)

In an attempt to ensure that there would be no misinterpretation of the intent of this decision regarding scaling back NASA's oversight role, the OLS Ultralite team generated a GSFC internal oversight policy that was distributed to all parties within GSFC who might be involved with UELVS in the future[14]. Because the Ultralite team is committed to mission success, this scaling back of mandatory NASA oversight has been balanced by a "smaller-better-faster" approach to NASA oversight—it goes by the simple name of "teamwork". Working cooperatively with OSC, the OLS team will actively participate in OSC's internal readiness review process, which has been

[12] NASA letter, S/Associate Administrator for Space Science to GSFC Attn: 280/Chief, Program Procurement Division, dated 7/27/94

[13] Personal communication with Mr. Philip Sabelhaus, TOMS-EP PM, and Mr. Tim Gehringer, FAST PM

[14] NASA letter, 470/UELVS Launch Services Manager to Distribution, dated 5/26/95

documented as part of the GSFC internal oversight policy[15]. The OLS team has implemented, with OSC, a mission-specific launch vehicle hardware tracking system that provides for a monthly summary of the status of all launch vehicle hardware designated for Ultralite missions. In conjunction with these efforts, the OLS Ultralite team once again applies bootstrapping techniques. In this case, it is gaining launch vehicle insight from SELVS (which complies with the requirements of NMI 8610.23), which also utilizes OSC's Pegasus® XL launch vehicle.

Well defined interfaces and standard/non-standard services

Does the spacecraft really understand the launch vehicle environment it will travel to orbit in and the electrical/mechanical interfaces it will mate with? This is a question that historically is always asked but usually not early enough in the spacecraft's design/fabrication process to head off costly launch vehicle and/or spacecraft modifications later on. For "smaller-better-faster" to work, this is a critical question that must be asked early on and continually throughout the spacecraft's design and fabrication phases. Starting with the initial discussions with OSC to finalize the UELVS contract language, a concerted effort has been made to ensure that all members of the Ultralite team have the same understanding of the standard and non-standard services offered and the related launch vehicle environments and interfaces. In a change from previous launch services contract negotiations, the GSFC negotiation team in several instances actually included language submitted in OSC's UELVS proposal addressing launch vehicle environments and interfaces in the final version of the contract—once it had been agreed that the GSFC team's interpretation of the wording matched OSC's. An example of the flip side of this was where OSC had proposed a mechanical interface that was not yet flight proven as part of the UELVS standard services. The GSFC team deleted it from the final version of the contract, with the provision that OSC would be able to resubmit it for inclusion once the interface had flight heritage and NASA had approved the design via an OSC-funded CDR presented to NASA. In short, all spacecraft interfaces had to have flight heritage and all launch vehicle environments had to be consistent with recorded operational data from prior Pegasus® missions before the UELVS contract was signed.

As shown in Table 4, the standard services offered to spacecraft projects under UELVS are subdivided under Electrical/ Telemetry, Mechanical, and Launch Operations headings. This is the menu that comes with the firm-fixed $6M launch service price tag[16]. This menu is backed by the Ultralite User's Guide, which is the product of a joint OLS/OSC effort to produce a document that

[15]ibid.

[16]$6M if ordered prior to 1/1/96, with inflation-based, pre-priced ordering periods extending through 12/31/99—e.g.,. $7.11M if ordered between 1/1/99 and 12/31/99

Table 4. Standard Services

Electrical/ Telemetry	LV environmental monitoring
	5 twisted shielded pairs of pass-through wires during captive carry
	4 discrete (opto-isolated) lines for post-drop P/L commands
	Payload-to-separation system harness
	Maximum 5 Kbps of P/L download data interleaved with Pegasus telemetry
	Maximum 4 discrete telemetry signals
Mechanical	Class 100,000 Cleanroom Operations
	Maximum 2 mission-specific payload fairing access doors
	Continuous A/C service from fairing closure until Pegasus release
	Dry GN_2 purge using grade B quality nitrogen
	Separation Sytsems: choice of 38", 23" or 17" diameter with associated attach hardware
	46" diameter dynamic envelope, up to 70" long (P/L fairing - cylinder transitions to an ogive)
Launch Operations	Coordination with Western Range
	P/L integration at Vandenberg AFB, CA
	Meetings per mission: - 4 Mission Int Working Group (MIWGs) - 2 Launch Ops Working Grp (LOWGs) - 1 Mission Readiness Review (MRR) - Technical Interface Meetings (TIMs), as required

provides maximum benefit to the Ultralite team's potential customers. Figures 3 through 6 have been taken directly from the most current version of the User's Guide and reflect a general overview of the detail included in the document.

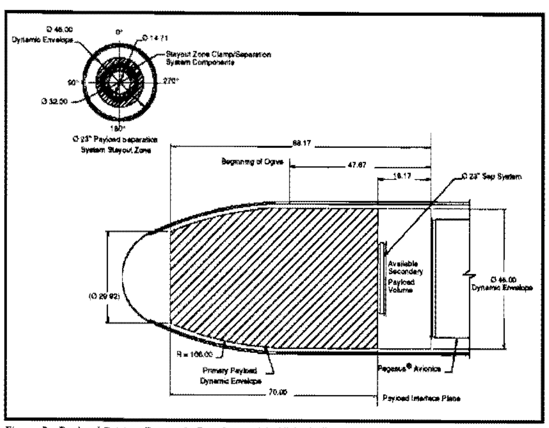

Figure 3. Payload Fairing Dynamic Envelope with 23 Inch Diameter Payload Interface

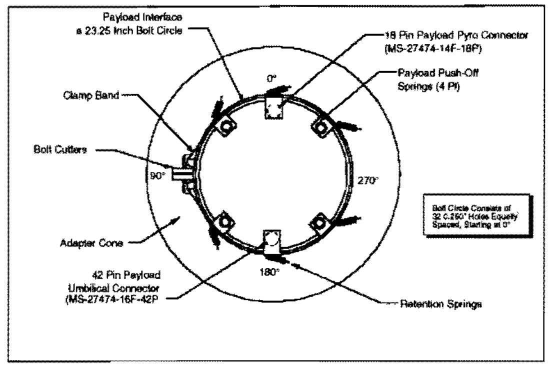

Figure 4. 23 Inch Separable Payload Interface - Forward View Looking Aft

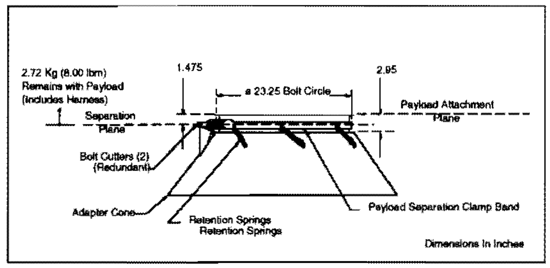

Figure 5. 23 Inch Separable Payload Interface - Side View

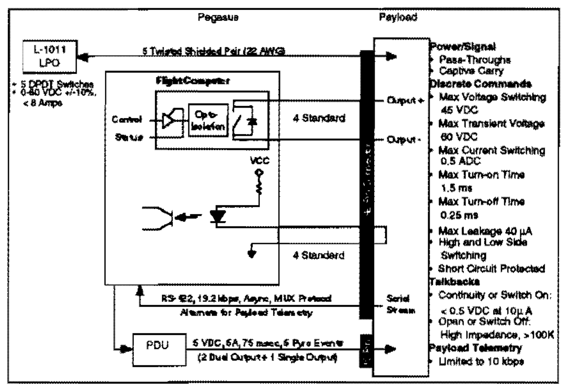

Figure 6. Pegasus Payload Electrical Interface

In yet another instance of the "smaller-better-faster" philosophy behind the Ultralite effort, the number of non-standard services offered (Table 5) is less than a third of those in place under the SELVS contract. This limitation precludes the spacecraft-driven escalation of launch services costs that have occurred in the past under the SELVS and MELVS efforts. This limited list of non-standard services is complemented by a pre-determined price list that eliminates the need for complicated

Table 5. Non-Standard Services

Class 10,000 Cleanroom Operations
Alternative range services at Wallops Flight Facility (WFF), VA (25° - 65° inclination)
Payload propellant loading
Hydrocarbon pre-filter replacement
Payload electrical interface testing at contractor site
Secondary Payload

consumer price index related calculations of the prices in the future—yet another contractual "first" for NASA firm-fixed-price launch services contracts.

In light of the growing interest within the NASA science community regarding Ultralite's secondary payload non-standard service, the OLS/OSC Ultralite team undertook an internal, cooperative effort that has resulted in a greatly enhanced contractual definition of this $4.5M service—subsequently inserted into the UELVS contract as a no-cost, administrative change. This enhanced definition of a service, and its related interfaces is a good example of the Ultralite team's continuing efforts to make "smaller-better-faster" work.

Summary

Faced with a direct challenge from the NASA Administrator, the Ultralite launch services team is well on its way towards proving that a "smaller-better-faster" operational paradigm will work for NASA firm-fixed-price launch service contracts. The UELVS implementation has coupled a group of highly motivated OLS/OSC/Spacecraft project personnel with management tenets taken from the entrepreneurial, small company, commercial community and well defined launch vehicle environments/interfaces. This union has set the stage for the birth of a new generation of restricted budget, maximum science return on investment spacecraft/launch vehicle efforts—currently set to occur with the launches of the SNOE and TERRIERS missions in early 1997.