



National Aeronautics and Space Administration
John F. Kennedy Space Center, Florida

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Launch Services Program

Launch Services Program (LSP) Advisory Services Plan

EXECUTIVE SUMMARY:

This Advisory Services Plan defines the functions, operating structure, and policies of the LSP with regards to defining and executing advisory services or consulting for government or commercial entities.

APPROVAL: //Original signed by//
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Process Reference List				
Document Number		Document Title		
NPD 8610.7		Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions		
NPD 8610.23		Launch Vehicle Technical Oversight Policy		
NPD 8610.24		Launch Services Program Pre-Launch Readiness Reviews		
LSP-P-321.01		Engineering Review Process (ERP)		
LSP-P-353.01		Launch Services Program Risk Management Process		
Revision History				
Revision		Description		Date
Basic		Document baseline		7/29/10
Basic-1		Admin change to correct typo called out in internal audit: one reference to NPD 8610.23 showed "NPR 8610.23" on page 3, section 2		5/26/11
Launch Services Program Records Retention				
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1 Introduction

NASA's Launch Services Program (LSP) is expanding its services by offering advisory services role in order to expand its customer base and assist these customers in maximizing their mission success by using NASA LSP's unique expertise. While LSP believes that providing full launch services to customers is the best way of supporting them, it recognizes that in some cases, for programmatic reasons, full LSP provided launch services are not always going to meet every customer's needs. Therefore, LSP will offer these advisory services to traditional customers in these cases. A major focus of this effort will be for LSP to provide launch vehicle engineering, safety and mission assurance, and mission management expertise to customers; e.g., Jet Propulsion Laboratory (JPL), Goddard Space Flight Center (GSFC), and Johns Hopkins University Applied Physics Laboratory (APL), who are conducting a launch by means other than LSP's contracting mechanisms. Other types of services will include providing technical assistance to the developers of new launch systems and providing technical or management expertise to new non-traditional customers, such as the US Air Force (USAF).

2 Scope

The LSP defines "Advisory Services" as any service provided to traditional or non-traditional customers where the support is less than the end-to-end launch service provided by the LSP under an LSP-managed launch services contract; i.e. NASA's Launch Services (NLS) contract. This would include providing consulting on launch services where LSP will likely not be provided with sufficient technical data for equivalent depth of penetration in order to perform its typical insight and oversight per [NPD 8610.23](#) and launch management readiness reviews per [NPD 8610.24](#). Since advisory mission launch services are not managed by LSP under the NLS contract, LSP will not be responsible for launch vehicle mission success. If the customer requests LSP to perform an [NPD 8610.23](#)-level of effort, then LSP would work to establish a full launch service on the LSP NASA Launch Services (NLS).

3 Overview

LSP Advisory Services is a consulting service to government and commercial organizations, providing mission management, overall systems engineering and/or specific discipline expertise; e.g. mission assurance, flight design, systems safety, etc., as requested.

There are currently four general categories of advisory services that LSP is or is planning to be engaged in. Additionally, LSP may be able to provide a custom service from the full menu of LSP expertise and capabilities.

1. SMART (Supplemental Mission Advisory and Risk Team) – This service will be offered to NASA spacecraft projects that for unusual programmatic reasons (e.g. co-operative missions, unique risk posture, unique opportunity) contract their launch service through a contract mechanism different than LSP's NASA Launch

- Services (NLS) contract. It may also be provided to non-traditional customers as well. The Launch Services Program at KSC, in an advisory capacity to a Project or customer, is available to provide technical evaluation, recommendations and risk assessments without taking responsibility for launch vehicle mission success. Example: GOES-O/P, LADEE, JWST
- As with all NASA missions, LSP has a primary role for the agency to evaluate options for LSP provided launch services. In these cases where the Agency is seeking an atypical launch service, the LSP will aid the Spacecraft Project in evaluating those services as well. This is part of the advance planning pre-mission authorization to proceed (ATP) efforts of the LSP.
 - Basic tasks have typically included: attendance at reviews/meetings, review of analysis and documentation, completed trade study evaluation, evaluation of Project-identified risks, and Test-Like-You-Fly (TLYF) assessments.
 - Optional tasks include: Mission integration advice, safety documentation review, launch site processing assessments, anomaly assessment/resolution, launch campaign advice and support, launch day attendance (depending on the launch site)
2. Design and Development – This service entails providing consultation to existing and/or emerging launch service providers in order to assist them in the development of their launch systems that are not currently on the NLS contract. Typically this would be through Space Act Agreements (e.g. Orbital for Taurus II and ATK for the Space Launch Vehicle (SLV) A and B family). Another example is LSP participation in the Minotaur IV+ development as part of the Integrated Product Team (IPT) for the first mission and the Commercial Orbital Transportation Services (COTS) advisory team. Potential activities are shown below
- Design review attendance
 - Test Like You Fly Assessments – This type of task would entail a thorough review of the customer’s testing strategies, plans, and/or test data to assess if the qualification or acceptance testing performed to show flightworthiness adequately reflects the manner in which the environments will be encountered or the functions performed.
 - Elements of a Launch Vehicle Certification –This type of task would be to the requirements set forth in [NPD 8610.7](#). Typically a certification is a major effort and isn’t done for launch systems unless that launch system has been chosen to launch a NASA payload.
 - Launch System Design Assessments that are mutually agreeable to the service provider and LSP
3. Independent Verification and Validation (IV&V) - Typically handled through the Flight Analysis Division, this work involves LSP analysts developing independent models and simulations to assess the validity of the customer’s analysis. This could be a stand-alone advisory service or it could be part of any of the other 3 types of advisory services. LSP has performed this type of work for several previous missions and vehicle certifications, and the same approach can be applied here to satisfy an advisory requirement.

4. Independent Review Teams (IRT) – NASA or Government projects may require technical personnel to assist them on IRTs for launch activities or launch vehicle related hardware. LSP can offer to include a member on such an IRT, or in unique cases could form an IRT for a specific topic. Typically, participation in an IRT would be limited to one individual with access to supporting expertise within the LSP. Specific topic IRTs would typically be for spacecraft using common systems with launch vehicles. Examples: HAS/HyBoLT IRT, Pluto New Horizons Star 48 Upper Stage Review.

4 Roles and Responsibilities

The LSP Program Manager authorizes the Advisory Services efforts and will approve all advisory agreements through the Program Requirements Control Board (PRCB).

The LSP Systems Integration Manager (SIM) will be the focal point for all new business, strategic planning, and policy coordination. This will be in conjunction or coordination with the LSP Program Manager.

A Mission Manager of LSP will provide mission management advice, if required, and typically be the principal interface with the spacecraft customer project for the SMART advisory services being performed by the LSP. Responsibilities include defining level of Advisory Service via a Memorandum of Agreement (MOA) in coordination with the SIM, management of schedule and budget, and LSP team activities as required for the advisory service. If the advisory service does not involve a spacecraft customer, or the effort is relatively small and confined to technical items, the interface would come from the Fleet and Systems Management Division.

The Safety & Mission Assurance (SMA) Launch Services Division Chief or designee will provide advice on SMA capabilities that can be provided to the advisory customer and designate which SMA resources will be provided to support the advisory services. An SMA point-of-contact (POC) will be assigned by the SMA Launch Services Division Chief to be the principal interface with the advisory services team. Responsibilities include defining level of Advisory Service via a MOA, management of Schedule, Budget and SMA activities as required by and commensurate with the advisory service. The SMA POC will interface with the SIM, Mission Manager, and Vehicle Systems Engineer (VSE) as required.

A Vehicle Systems Engineer (VSE) from the Fleet Systems Integration Branch will typically be the principal interface with launch service providers for Design and Development advisory services being performed by the LSP. Responsibilities include generation of an unfunded Space Act Agreement in coordination with the SIM, management of the technical activities performed, and a systems engineering function. The SIM will generally be the Chief Engineer for Engineering Review Sheets (ERSs) used in design and development advisory services.

For both the SMART and Design and Development services, the Fleet and Systems Management Division, the SIM, and Flight Projects Office will determine the proper

technical team structure based upon the customer's requirements and type of advisory service requested.

Stand alone IV&V activities will typically be administered and executed by the Flight Analysis Division, who will designate a lead and conduct appropriate coordination from the Fleet Systems Integration Division.

The approach for LSP participation in IRTs will be determined by the SIM in coordination with the LSP Program Manager.

Other LSP KSC Engineering and/or KSC SMA support will be used as necessary to ensure adequate review of documentation and products while abiding by the LSP governance model. The support will be supplied from resources already dedicated to LSP unless the customer is providing funds, the agreement is sufficiently large and of a long enough duration to warrant augmenting the staff. LSP will use its standard practices regarding risk management ([LSP-P-353.01](#)) and the Engineering Review Process ([LSP-P-321.01](#)).

5 Implementation

An advisory team may consist of a mission manager (MM) and/or an Integration Engineer (IE), but that is dependent upon the requirements of the service. Other disciplines may be included depending on the scope of the task and the level of effort as well. If there is a Mission Manager, the MM will be the primary point-of-contact (POC). Additional program-level personnel may also be involved.

SMART: LSP provides consultation services to the responsible NASA Center's Spacecraft Project Office or non-traditional customers. These services can apply to launch vehicles currently used by NASA/LSP (Atlas 5, Delta IV, Delta II, Pegasus, and Taurus XL, Falcon 1, and Falcon 9) when flown under a Federal Aviation Administration (FAA) license. These services may also apply to launch vehicles that do not fall under the purview of the LSP, such as the USAF's Minotaur family or foreign providers. For launches that are not FAA licensed, there is typically a responsible launch vehicle organization that already provides the governmental systems engineering that the LSP provides for the launch vehicles used by NASA missions. However, NASA Spacecraft Projects or HQ Directorates may request to have the LSP as a consultant to advise the projects on launch vehicle matters.

This advisory team may consist of a MM, IE, and/or a Vehicle Systems Engineer (VSE). Typically there would be only one of the 3 functions due to the limited nature of most advisory services. Other disciplines will be utilized to meet the customer's technical requirements and LSP fleet insight requirements. Tasks for the SMART will be mutually agreeable between the customer and the LSP. The LSP team may attend launch vehicle reviews and integration and test operations as defined by the customer project. If requested, on launch day the LSP will provide an on-console technical team to monitor launch vehicle telemetry and provide recommendations as needed to the designated customer project counterpart. However, the LSP will not give a "go" for launch under any advisory service. The LSP will assist the customer project office in its determination of flightworthiness for those items identified to be assessed by LSP.

The LSP intends to utilize current insight and risk management processes to provide evaluations of the data and activities within the constraints and data provided.

One of the key processes of insight management is the Engineering Review Process (ERP), [LSP-P-321.01](#). The ERP and the Engineering Review Board Information System (ERBIS) will be used to describe, resolve and disposition technical items assigned by the Project. Each LSP participant in a review is required to write an assessment of his or her area of expertise. This assessment is to be included in the ERS, and contain highlights of strengths and concerns identified by the participant. In addition it will include areas where LSP could potentially provide additional help, and any additional documents (analyses, drawings, specifications) desired for review. In general, Engineering Review Boards will not be conducted unless specifically requested by the Project and mutually agreed upon by the LSP Chief Engineer. It is anticipated that significant data would be required by the LSP to make this level of evaluation.

Reporting of risks by LSP shall be coordinated with the Project or Customer. In the event of an LSP finding of residual technical risk, the LSP will strive to develop and evaluate the range of mitigation options and offer a coherent go-forward plan. For issues or findings identified by the LSP, which the Project is resolving to make their flight worthiness determination, the LSP will participate by bringing its recommendation to the requested forum in the requested format. The LSP reserves the right to maintain the Intellectual Property, tools and products utilized to provide recommendations. MOAs which document SMART agreements with NASA organizations will include a statement that the LSP SMART findings will be briefed at the appropriate readiness review to ensure visibility to the mission stakeholders; i.e., Science Mission Directorate (SMD), Office of Chief Engineer (OCE), Office of Safety and Mission Assurance (OSMA).

The LSP can advise (i.e. review and comment) on mission management functions in the following areas (Project to select any/all/or none of the below)

- Mission budget development
- Mission Requirement Document development
- Interface Control Document (ICD) development
- Mission Requirement Verification
- Payload Safety documentation

The LSP can advise on launch campaign management and launch day operations in the following areas

- Readiness review process
- Launch management structure
- Launch day requirements definition & categorization
- Status checks and Go/No-Go Calls
- Communications protocol
- Polling structure
- Recycle requirements
- Mission Dress Rehearsal process
- Payload Processing requirements development and/or implementation

The LSP can advise on Safety and Mission Assurance items in the following areas:

- Mission Assurance issues and risk assessments
- Safety Documentation

- Ground Processing/Operation Safety
- Range Safety Compliance (launch site dependent)
- Quality and Quality Systems-related matters
 - o Launch site surveillance
 - o Production site surveillance
 - o Procedure review
 - o Nonconformance review
 - o Mission Success Review (MSR)/Hardware Acceptance Review (HAR)/Pedigree review support
 - o Vehicle Subsystem Turnover Review (VSTR) support
 - o Audit support
 - o Limited Life Item Tracking
 - o Government-Industry Data Exchange Program (GIDEP) Tracking
 - o Mishap preparedness and contingency planning

On launch day the LSP can (Project to select any/all/or none of the below):

- Provide a Senior Systems Engineer to advise the Project manager.
- Provide Systems Engineer(s) to interface with the launch team as requested by the Project Launch Vehicle Liaison.
- The launch team will be technical and will not contain any launch management functions or a classical "NASA Advisory Team."
- Provide observations on launch vehicle telemetry, if made available by the customer, to the designated counterpart. Recommendations will be provided as requested by the customer.

The LSP will evaluate the risks and issues identified by the launch agent and provided to the spacecraft customer. The depth of LSP evaluation will be at the discretion of the Project based on the level of risk, or significance of the issue in question subject to the resources available from the LSP to support the advisory agreement. The evaluation will be subject to the data provided by the Launch Service Contractor (LSC) under the (LSP/Customer) agreement to launch the mission and will be consistent with data normally provided to a Project or customer. In addition mutually agreeable Launch Vehicle related tasks, may be requested of the LSP by the Project. LSP will provide cost and schedule estimates for any assigned task beyond the scope of the risk/issue evaluation

Design and Development: The LSP may provide technical assistance to screened companies developing new launch vehicles. The screening is to prevent the over extension of LSP resources on products that have little or no chance to enhance NASA's future ability to provide access to space for its science and exploration missions. If a company requests LSP's assistance and meets the following criteria, the LSP may offer an unfunded Space Act agreement to provide assistance to a predetermined development milestone (e.g. Preliminary Design Review (PDR), Critical Design Review (CDR), specific element test), if the LSP determines it is in the best interests of LSP and NASA to do so.

- 1) U.S. launch vehicle from a U.S. company, with existing funding thru the predetermined development milestone.
- 2) Systems Requirements Review Level of maturity with a credible schedule (based on vehicle concept, partnerships in place, company experience, test schedule etc.) for achieving a first launch attempt within 4 years.

- 3) For suppliers not on an LSP launch services contract, acceptable completion of an LSP 1 day systems evaluation consistent with those performed in 2006 for the Alternate Launch Providers (ALP) study.
- 4) Willingness to give NASA substantial insight into the launch vehicle development activities by providing items such as company documents (qualification plans, risks, analyses memos, environments definitions, etc) and/or access to major design reviews, testing, IPT meetings, and any regularly scheduled company status meetings.
- 5) Vehicle meets at least one of the small or medium class reference orbits determined in the Strategic Review of Medium Class Expendable Launch Vehicle (ELV) Options Study.
- 6) Vehicle from a supplier who has previous launch experience, or from a supplier of flown space hardware major components (e.g. engines, SRMs, stages, spacecraft, complete Launch Vehicle (LV) or spacecraft (S/C) avionics systems)

This assistance will normally include review and assessment of the data presented by the contractor through documentation, design reviews, and Technical Interchange Meetings (TIM). Each LSP participant in a review is required to write an assessment of the data presented in his or her area of expertise. This assessment will be included in an ERS, and contain highlights of strengths and concerns identified by the participant. In addition it will include areas where LSP could potentially provide additional help, and any additional documents (analyses, drawings, specifications) desired for review. LSP may develop models or other analytical tools to provide the support or an adequate response to the LV developer. The LV developer will provide adequate information to allow LSP to accomplish the requested task. The data generated from these tools will remain the property of NASA and will be considered the proprietary data of the contractor. LSP will be allowed to use all the data received and or generated for its own purposes, such as, launch vehicle certification if the contractor's launch vehicle becomes a supplier of launch services on the LSP's NLS contract. Once the new common core launch vehicle system is on-ramped onto the NLS contract, the LSP's formal design and development advisory service via the Space Act Agreement (SAA) will be terminated, because the SAA is no longer required. The insight provisions of NLS allow LSP to evaluate the specific launch vehicle design and development as part of the LSP's fleet insight.

This advisory team will typically consist of a small team of engineers led by a VSE. The composition of the team will vary depending on the stage of the development of the launch vehicle and the particular areas in which LV developer has requested assistance.

Once the advisory service has been established, launch supplier-requested advice or assessments of less than approximately 8 hours are automatically approved if LSP has or can find the information to conduct them. For specific assessment requests received that will take more than approximately 8 hours, the LSP will evaluate the request in the following manner:

- 1) List the tasks in which the program has an interest and has resources to perform.
- 2) List any direct benefit to LSP for applying this effort to future certification of a future fleet.

- 3) Provide an estimate of hours and completion date (with any key milestone dates) to accomplish each item listed in 1.
- 4) Develop a basic plan on using contractor or civil servants.
- 5) Evaluate LSP's ability to support the proposed tasks and capability to perform a similar level of effort for another ALP should other ALPs request LSP's assistance on similar development items.

The VSE in coordination with the SIM will then determine if LSP will comply with the request from the ALP and inform the provider on LSP's agreement to conduct the assessment. Assessments will be documented in an ERS.

IV&V: The LSP can perform an in-depth assessment of various LV analyses. Each discipline performing IV&V will define the best modeling approach and methodology to be used, as well as the model validation success criteria; this will be presented at an engineering review board.

- a) Responsibility: Flight Analysis Division
- b) Provided Data:
 - Qualification and acceptance documentation and supporting data for FCI and Subsystems
 - Integrated Test Plan (ITP) associated with the FCI and subsystem.
 - Documents / Reports used in the development of the SC and LV environments (acoustic, random, sine, shock) and hardware qualification
 - Flight data for all missions
 - Any additional data, models, packages, reports, Engineering Review Board (ERB), etc. to support the following NASA Assessment
- c) NASA Assessment(s): Primary goals and objectives may include the following:
 - Validate models which are not anchored in substantial flight data.
 - Verify system design is robust against model variations
 - Augment flight margin verification effort by verifying margins across several disciplines.

The analytical disciplines listed below, along with examples of specific tasks, illustrate the scope of potential IV&V that can be performed:

Flight Design:

- 1) Develop 3DOF Trajectory Model.
- 2) Validate model against performance reports and flight data.

Controls:

- 1) Develop and validate high fidelity nonlinear time domain simulation to assess controllability and control system performance.
- 2) Develop and validate high fidelity linear frequency models to assess stability.

Guidance and Flight Software:

- 1) Develop and validate high fidelity time domain software model.

2) Model and verify injection accuracy.

NOTE: Classical IV&V of flight software (independent verification of flight code) will not be performed.

Thermal:

- 1) Develop integrated thermal analyses.
- 2) Develop thermodynamic analysis to validate propellant management and propellant conditioning.
- 3) Develop aeroheating model and validate against contractor data.
- 4) Develop venting analyses.

EMI/RF:

- 1) Develop RF Link Analysis

Loads:

- 1) Implement and validate generic CLA (with KSC code) using contractor models and forcing functions
- 2) Review contractor model validation
- 3) Review contractor dynamic event selection and associated forcing function development

Stress and Dynamic Environments:

IV&V is not typically performed

This team will consist of the specific analysts required to perform the task. For IV&V tasks associated with launch vehicle fleets that are not the responsibility of LSP; i.e., Shuttle, ARES I/V, no coordination with a VSE is required. For larger advisory efforts, the responsible VSE for that advisory service will coordinate the IV&V tasks with the appropriate managers and analysts. For tasks associated with current or proposed expendable launch vehicles; i.e. Atlas 5, Delta 4, Delta II, Taurus XL, Pegasus, Taurus II, Falcon 1, and Falcon 9, tasks of a purely analytical nature that involve multiple systems, coordination with the appropriate VSE will be required. If the task is large enough or complex enough to need a broader systems-level perspective, the task should be assigned to a VSE as the project lead.

IRT Support: No further detail on implementation of IRT support is needed other than what is in the overview and responsibilities section due to the ad hoc nature of this form of advisory service.

6 Resources

The LSP is authorized to use up to 6 Full Time Equivalent (FTE/WYE combined) annually to execute this activity for unfunded advisory services. This includes overall management of the advisory function by the SIM, general surveillance of emerging launch vehicle capabilities, initial ALP system engineering and schedule assessments, and coordination of advisory services with non-traditional customers, and Design and Development and IV&V advisory services. When performing any of these functions civil service personnel shall charge to ALP Strategic Planning/New Capability and

contractors shall charge to ALP. This is effectively an R&D budget for which the LSP will fund. While PRCB approval of agreements is required, approval of resource expenditure up to 6 FTE/WYE is authorized with release of this plan. If additional resources are required the SIM and/or project lead will get approval from the PRCB for the increased usage.

SMART services will generally have specific resource estimates and be assigned a unique time charge code. For NASA spacecraft, the LSP will pay for current government resources (budget permitting) and the customer organization will pay for the LSP's contractor Work Year Equivalent (WYE) costs, as is typical for standard LSP launch services. For SMART services requiring significant resource commitment from LSP, the advisory services management team, typically the SIM, Fleet and Systems Management Chief, Flight Projects Chief, and the Launch Services SMA Chief will recommend if a full reimbursable funding agreement is the best approach. For non-NASA government spacecraft; e.g. GOES, the LSP will seek full payment from the customer organization for both civil service and contractor costs, as is done in current reimbursable missions on the NLS contract. Depending on the strategic benefit of the agreement, the advisory services management team will make recommendations for a modified approach.

7 Agreements

Agreements for advisory services are required when services are more than a single event/activity with very short duration. These agreements may be through either a Memorandum (e.g. MOU, MOA) or an SAA for launch vehicle development assistance, or appropriate partner document. The SIM and the customer/partner management team will determine the specific agreement documentation. The SIM and designated project leads will be the primary LSP points-of-contact (POCs) for the development of these agreements. Level of approval authority for any agreements will be determined on a case-by-case basis depending on the advisory effort and the organizations involved.