JOHN F. KENNEDY SPACE CENTER

LAUNCH SERVICES PROGRAM

NASA
LAUNCH SERVICES PROGRAM

HELIOPHYSICS SMALL EXPLORERS 2016 ANNOUNCEMENT OF OPPORTUNITY

CONCEPT STUDY REPORT KICKOFF

AUGUST 25, 2017

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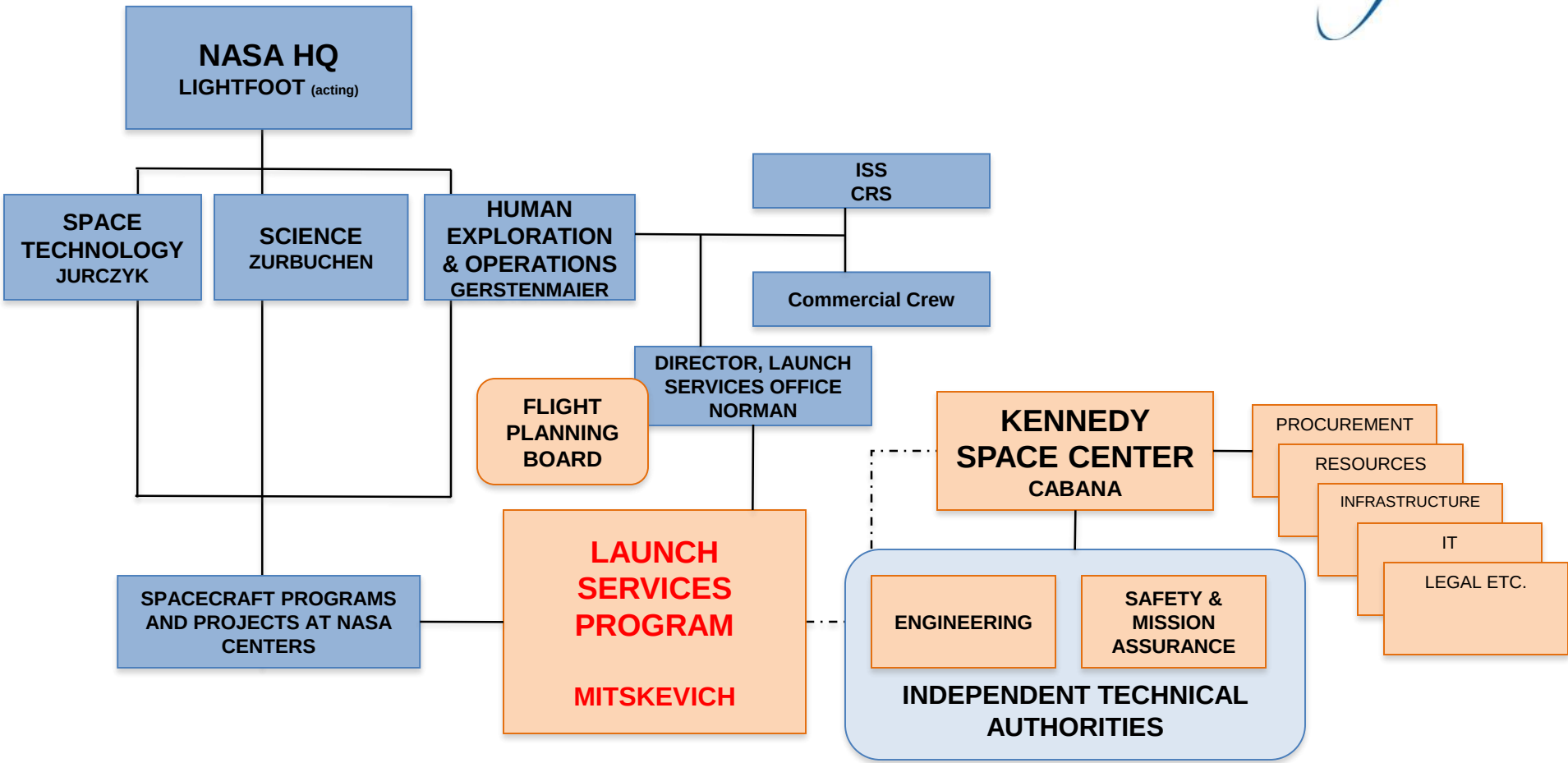
Flight Projects Office

Launch Services Program Relationships (NASA/HEOMD/KSC)



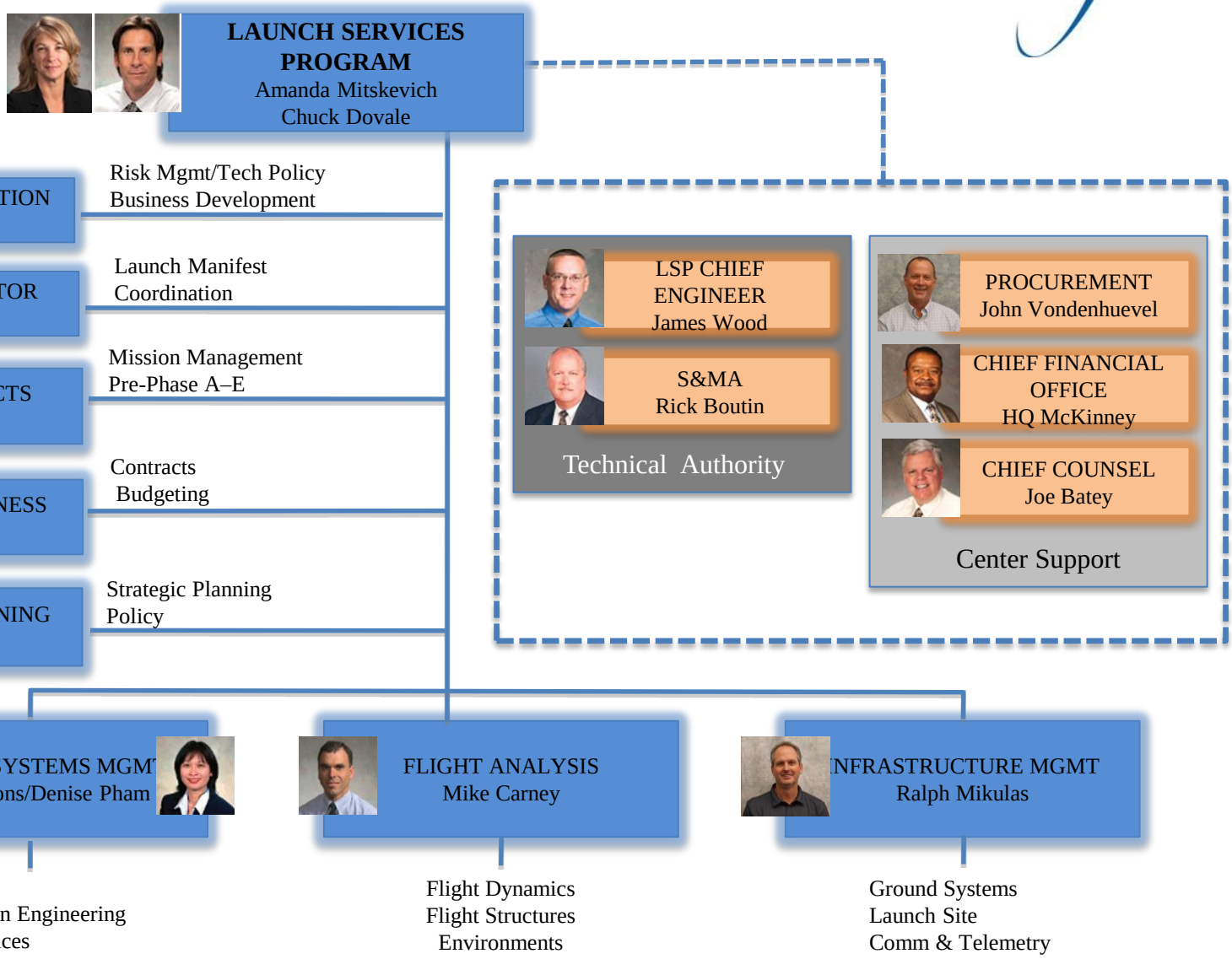
Interfaces to other NASA Centers

- SSC PROPULSION SUPPORT
- MSFC, GRC TECHNICAL SUPPORT

Support Contractor Interface

- ELVIS (AI Solutions) SUPPORT CONTRACTOR

LSP Organizational Structure



Launch Services Program

The Launch Services Program (LSP) provides:

- **Procurement and management of the launch service**
- **Technical insight/approval of the launch vehicle (LV) production/test**
  - **Mission Management and engineering support**
  - **Oversight (approval) of mission unique launch vehicle hardware/software development**
- **Launch campaign/countdown management – formal readiness reviews**
- **Risk management for launch service**
- **Payload-processing accommodations**
- **Downrange telemetry assets for launch vehicle data**

Launch Services Program

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LAUNCH SERVICES PROGRAM

NASA Strategic Plan 2014

Strategic Goal 3:
Serve the American public and accomplish our Mission by effectively managing our people, technical capabilities, and infrastructure.

Objective 3.2:
Ensure the availability and continued advancement of strategic, technical, and programmatic capabilities to sustain NASA's Mission

Key Strategy:
Provide access to space

Lead Office: **HEOMD**
Contributing Program: **LSP**

Key Strategy "Provide access to space" citation:

"…certify and procure domestic commercial space transportation services for the launch of robotic science, communication, weather, and other civil sector missions"

"…provide robust, reliable, commercial and cost-effective launch services"

"…assured access to space through a competitive 'mixed Fleet' approach utilizing the breadth of U.S. industry's capabilities"

LSP Strategic Goals 2014

Goal 1: Maximize Mission Success

Goal 2: Assure Long-Term Launch Services

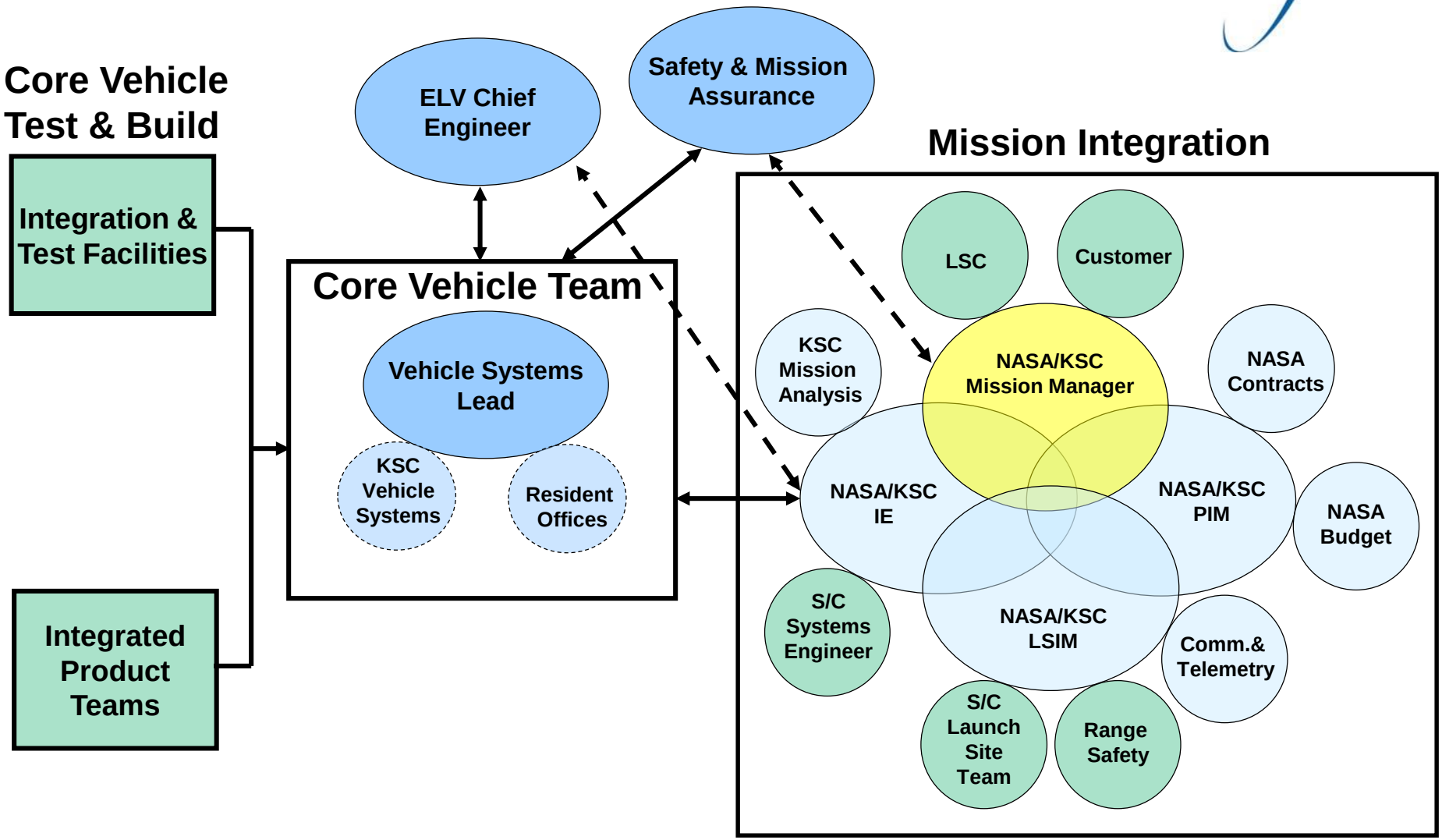
Goal 3: Promote Evolution of a U.S. Commercial Space Launch Market

Goal 4: Continually Enhance LSP's Core Capabilities

LSP Functional Structure

- LSP procures/provides a Launch Service
  - Its more than the basic launch vehicle
  - We don't buy a tail number
  - This is a commercial FFP procurement with additional insight and oversight
- To enable this, LSP has two functional sides
  - Mission integration
    - » Mission Integration Team (MIT) assigned to each mission
    - » Manages mission specific procurement, integration, and analysis
    - » Includes launch site integration and processing
  - Fleet management
    - » Personnel assigned to each contracted rocket
    - » Includes resident offices within the production facilities of all active providers
    - » We watch the production and performance of entire fleet – we certify the manufacture's production line, not just a particular unit (tail number)
    - » We have a say in any change/upgrade/anomaly
- LSP maintains the final go or no-go for launch
- Interface with Safety and Mission Assurance
  - Safety
  - Quality

Technical Information flow into the MIT



Options available for this AO

- **Several options are available to proposers for this Heliophysics SMEX AO**
  - **NASA provided launch services may be proposed at a charge of $50 million in FY 2017 dollars against the PI-Managed Mission Cost (provided under NLS II Contract)**
    - » **Unencumbered 25% reserve against launch costs are not required for NASA provided launch services**
  - **Alternative access to space (including contributed launch services), must be arranged by the proposer and funded within the PI-Managed Mission Cost, may also be proposed**
    - » **A charge to the PI-MMC of $2.0 million will be levied for the NASA launch vehicle monitoring functions and advisory services**
    - » **The proposal must describe the arrangement between the PI and the non-NASA launch service provider to enable the PI's insight for launch services, consistent with NASA Procedural Documents (NPD) 8610.7 and 8610.23.**

NASA Provided Launch Services

- The NASA Launch Services (NLS) II Contract is LSP's primary method to acquire all classes of commercial launch services for spacecraft (SC) customers
- Provides NASA with domestic launch services that are safe, successful, reliable, and affordable
- Provides services for both NASA-Owned and NASA-Sponsored payloads through multiple Indefinite Delivery Indefinite Quantity (IDIQ) Launch Service Task Order (LSTO) contracts with negotiated Not To Exceed (NTE) Prices
- Provides services on a Firm-Fixed-Price (FFP) basis
  - Incorporates best commercial practices to the maximum extent practical
  - Includes Standard and Non-Standard services
  - Mission unique modifications
  - Special studies
- Allows LSP to turn on a Task Assignment or Non-Standard Service at any time for analyses

NLS II Contracts Overview

- **Launch Services Risk Mitigation Policy for NASA-owned and/or NASA-sponsored Payloads/Missions can be found under NPD 8610.7. Document can be found at http://nodis3.gsfc.nasa.gov/**
  - **Risk Category 1: Low complexity and/or low cost payloads-Classified as Class D payloads pursuant to NPR 8705.4**
  - **Risk Category 2: Moderate complexity and/or moderate cost payloads-Classified as Class C payloads and, in some cases, Class B payloads, pursuant to NPR 8705.4**
  - **Risk Category 3: Complex and/or high cost payloads-Classified as Class A payloads and, in some cases, Class B payloads, pursuant to NPR 8705.4**
- **NLS II Launch Service Costs**
  - **Acquisition process begins at approximately L-36 months**
  - **Authority to Proceed (ATP) concurrent with Task Order Award at approximately L-30 months**
  - **$50M from the PI-Managed Mission Cost is allocated to the Explorer Program to pay all standard and *some* Mission Unique launch service costs**
  - **Costs not covered by the Explorer Program include**
    - » **Payload-caused Launch delay costs**
    - » ***Some* mission unique services such as a custom payload adapters, auxiliary propulsion, extreme cleanliness/contamination sensitivities, or costs due to a requirement for a unique launch site may require additional funding (SEE Attachment 2 of SMEX 2016 LSP Info Summary, Rev D)**

NLS II Contracts Overview – Cont'd

- **Each Provider has their own unique Launch Delay Table**
  - **Delay terms are identical for both parties (Contractor/NASA)**
  - **No-fault Launch delays**
    - » **Includes: range constraints, floods, acts of God, strikes and other conditions**
    - » **No adjustment made to mission price**
    - » **No limit on number of days**
- **For the remaining delay cases grace days are based on sliding scale for both Contractor and NASA delays**
  - **150 days of grace at ATP through L-24**
  - **Sliding down to 7 days of grace at L-10 days**

Launch Service Budget

- **Under a NASA provided Launch Service a standard launch service includes:**
  - **Procurement and management (including risk management) of the launch service, technical insight/approval of the launch vehicle production/test and mission unique launch vehicle hardware/software development**
  - **Launch campaign/countdown management – formal readiness reviews**
  - **The launch vehicle, engineering, analysis, and minimum performance standards and services provided by the contract**
  - **Mission integration**
  - **Launch site payload processing facility and support, logistics, hazardous support**
  - **Range support and services, contractor engineering support, base support contracts**
  - **Down Range Telemetry support (launch vehicle only)**

Launch Service Budget (cont.)

- **Under a NASA provided Launch Service a standard launch service includes:**
  - **Nominal allocation for non-standard/mission unique launch vehicle modifications/services – items typically necessary to customize the basic vehicle hardware to meet spacecraft driven requirements. Items included for this AO are Pre-ATP studies such as coupled loads and/or trajectories analysis, payload isolation system, T-0 purge, and ISO 14644-1 Class 7 integration environment.**
  - **Payload fairing with approximately 2 access doors with thermal and/or acoustic blankets**
  - **Standard payload adapter and LV-provided payload separation system**
  - **Standard test payload adapter availability**
  - **Spacecraft spin/de-spin capability for separation (if required)**
  - **Single-Spacecraft vehicle analyses (trajectory, controls, environments, flight software, etc)**
  - **Collision/contamination avoidance maneuver (CCAM) capability if needed**
  - **Electrical interface connectors (approximately 3 sets)**
  - **Potential additional funding needed to support selectees requiring launch from sites other than the LV base launch complex**
- **Budget does not include launch delays**

Launch Service Budget (cont.)

- **The following non-standard/mission unique launch services are examples of items NOT covered under the LSP budget and cost must be included in the PI-Managed Mission Cost:**
  - **Nuclear launch services utilizing a RHU/MMRTG**
  - **Enhanced contamination control, planetary protection, operational clean enclosures**
  - **Cameras on the LV to capture spacecraft separation etc**
  - **Extended mission integration periods (in excess of 33 months)**
  - **LV mods/analyses for non-separating interface with multiple SC deployments (separation, trajectory, controls, flight software, etc)**
  - **Deployable spacecraft telemetry tracking asset**
  - **Supplemental LV propulsion**
  - **Mission Unique payload adapter**
  - **LV hardware modifications required to accommodate unique payload configuration**

Examples of Non-Standard Services/ Mission Unique Costs

Additional Options	Launch Date NLT	Total ($M)
Mission Unique Adapter	12/2022	0.5
Multiple Spacecraft Deployment Launch Vehicle Analyses	12/2022	0.75
Deployable Spacecraft telemetry tracking asset (ocean vs airborne vs ground)*	12/2022	1.4 – 4.0*
Supplemental Propulsion**	12/2022	Contact LSP POC

*Cost depends on locations of spacecraft separations and type of asset required

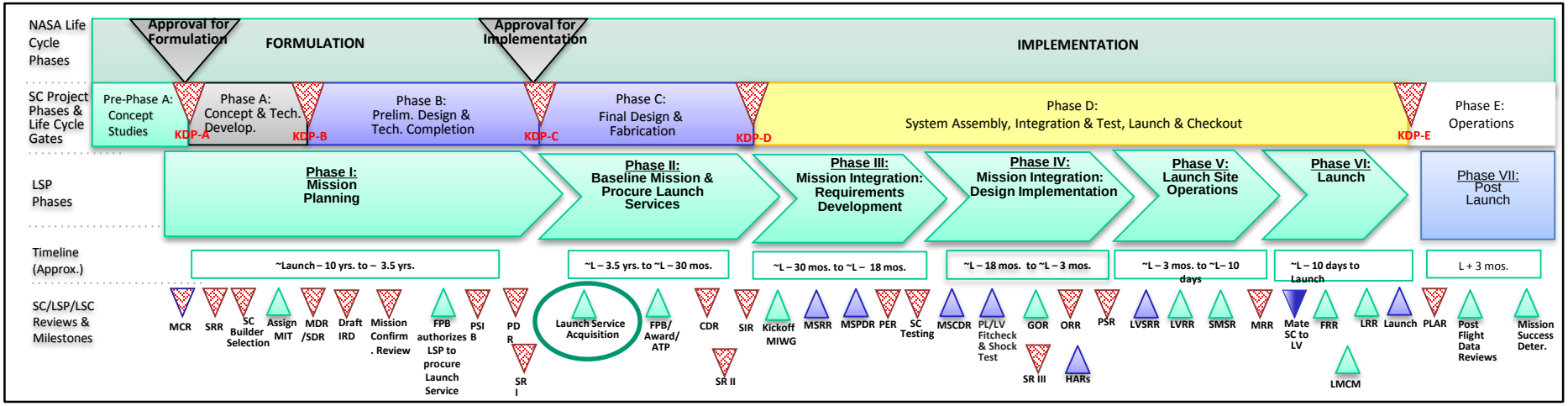
**Due to the multiple launch vehicle configurations within the launch vehicle class, supplemental propulsion systems must be defined and described by the proposer to meet mission requirements. The system proposed and the spacecraft shall remain within the fairing envelopes provided.

Contact LSP POC for cost for your specific configuration

Launch Vehicle Acquisition

- **The acquisition of a NASA-provided domestic expendable launch vehicle proposed for this AO will be procured and managed by the NASA/Launch Services Program (LSP) via the NASA Launch Services II (NLS II) contract.**

- **The LSP will competitively select a launch service provider for these missions based on customer requirements and NASA Flight Planning Board (FPB) approval.**

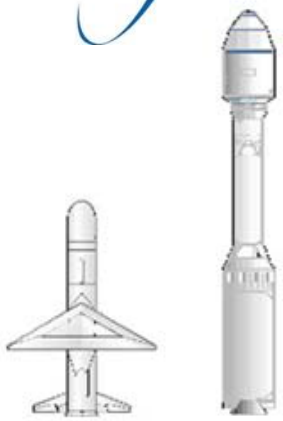


Printed documents may be out of date; please validate with the LSP Flight Projects Office (FPO) prior to use.

Spacecraft reviews shown in red.

Available Vehicles under NLS II

- **Most likely candidate vehicles for this SMEX AO that are available on the NLS II contract are**
  - **Pegasus XL**
  - **Minotaur-C**
- **Assumption of a specific launch vehicle configuration as part of the AO proposal will <u>not</u> guarantee that the proposed LV configuration will be selected**
- **Proposers are advised to plan for compatibility with all small class vehicles that are expected to be available through spacecraft Preliminary Design Review.**
  - **Payload design should accommodate the limiting/enveloping launch characteristics and capabilities included in "ELV Launch Services Information" document**



Vehicle Class	Small	
Launch Vehicle	Pegasus XL	Minotaur-C
Offeror	OSC	OSC
Perf@ 600 km Sun Synch	200 kg	800 kg
Certification Category	Cat 3	Cat 2
Launch Sites	CCAFS WFF KWAJ VAFB	CCAFS WFF VAFB

http://elvperf.ksc.nasa.gov/Pages/Default.aspx/

For mission specific information, utilize the LSP performance website and/or conatct the LSP POC.

Alternative Access to Space

NASA Supplemental Mission Advisory and Risk Team Tenets

- **SMART (Supplemental Mission Advisory and Risk Team) services integrate LSP Program, Engineering, and SMA positions as advice to our customer/partner**
  - **Offering advisory services, but not inserting ourselves without customer request**
  - **Overall Advisory Plan Exists, but LSP will document each advisory service separately to define what LSP will do, responsibilities, and resources required**
- **LSP utilizes existing insight and risk management processes to provide evaluations of mutually agreeable items**
  - **Subject to constraints and data provided by the partner/customer**
  - **Reporting of risks by LSP shall be coordinated with the customer project and will include a range of mitigation options and offer a coherent go-forward plan**
- **The responsibility for overall mission success of the Mission rests with the Spacecraft Project and SMD**
  - **LSP will not take overall mission assurance responsibility when in an advisory role because mission assurance is a complex combination of the full complement of LSP services**

- **A Memorandum of Understanding (MOU) will be created between LSP and the Project defining the roles and responsibilities associated with a SMART with NASA SMD agreement and Agency Stakeholder knowledge**

For additional information on SMART visit the AO Program Library:

Launch Services Program (LSP) Advisory Services Plan

- https://explorers.larc.nasa.gov/HPSMEX/SMEX/programlibrary.html

Alternative Access to Space (cont)

- **For this AO, given, the high-risk tolerance of the mission (Launch Vehicle Risk Category 1 per NPD 8610.7D), it is expected that PI's will tailor their management approach of the launch service to be consistent with the principles of NPD 8610.7 and NPD 8610.23.**
  - **NPD 8610.23 Launch Vehicle Technical Oversight Policy describes NASA's policy for technical oversight of commercial launch services. Technical oversight is a combination of focused approvals and technical insight of the launch service provider.**
    - **Under this policy, specific areas requiring government approval are focused on the interface with the spacecraft including any mission unique hardware and services. Other elements of the launch service are open to government insight.**
    - **Refer to the policy for complete details of items in which traditionally the government has insight and approval.**

- **The proposal must describe the arrangement between the PI and the non-NASA launch service provider.**
  - **Describe the PI's approach for managing the commercial launch service to ensure safe delivery of the spacecraft to orbit within committed cost and schedule.**
  - **Identify elements of the launch service that the PI will have approval of and insight of.**
  - **Describe the approach that the PI will utilize to ensure the adequacy of the technical work performed by the launch provider and make flight worthiness determinations.**
  - **Provide a full cost estimate for the launch service, to include mission unique costs, payload processing facility costs, delay penalties, spacecraft fueling costs, etc.**
  - **Indicate the type of launch vehicle payment schedule (Are all funds due up front or are payments made over the integration period?)**

- **Rideshare launch service options involves several complex issues.**
  - **For PI's that are proposing a rideshare access to space it is in the proposer's best interest to clearly support the maturity of their plan.**
  - **Proposal must describe the arrangement between the PI and the entity providing the rideshare to include specific launch opportunity and launch service costs including mission unique requirements.**
  - **Proposal must demonstrate clear understanding of the specific risk inherent in rideshares and must discuss their approach for mitigating these risks. Examples of such risks are: schedule control over launch date, PI's control over their mission unique orbit, de-manifesting risk if spacecraft is unable to meet integration schedule and/or requirements, launch delay penalties, etc.**
  - **Proposal shall identify elements of the launch service for which the PI will have approval and insight.**
  - **Describe the approach that the PI will utilize to ensure the adequacy of the technical work performed by the launch provider and make flight worthiness determinations.**

Available Launch Site Info

Representative Launch Site Inclinations

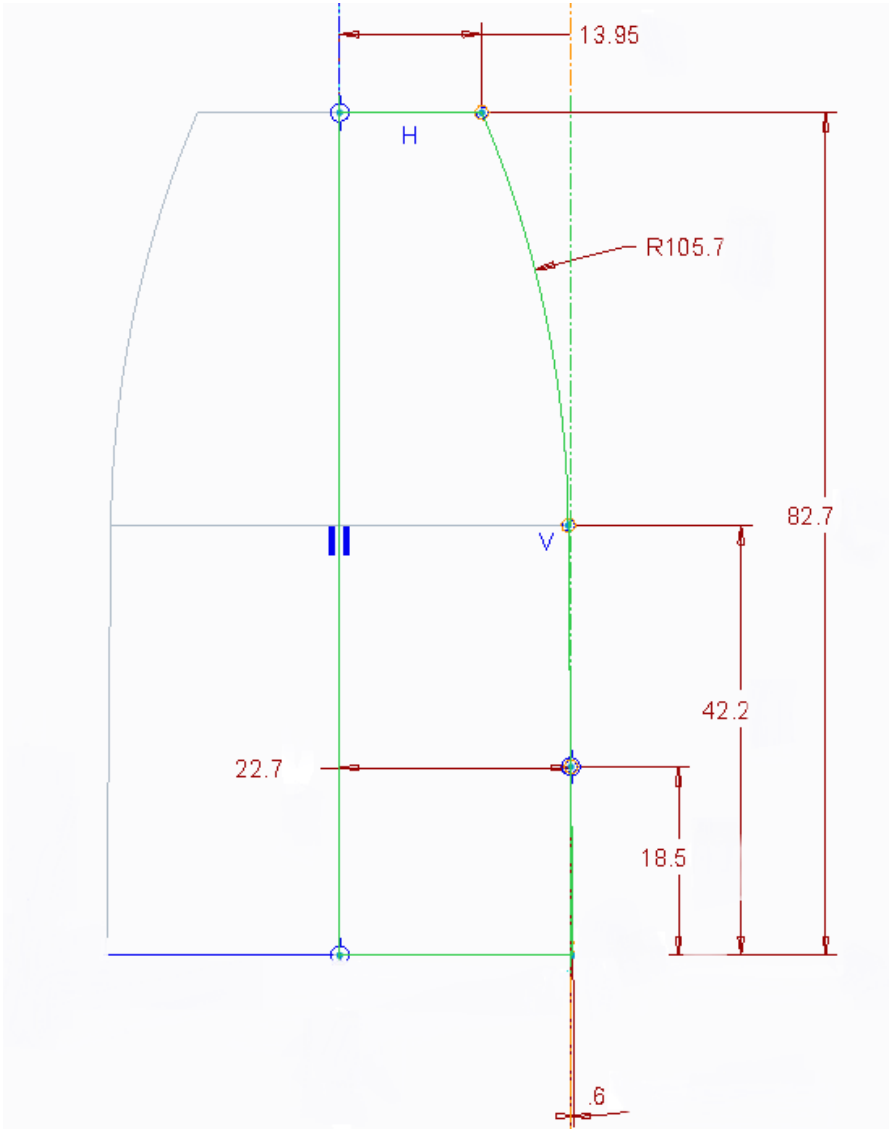
Launch Site	Assumed Inclinations
CCAFS	28.5° - 51.6°
RTS	0° - 20°, ~60°
VAFB	70° - 90° Sun-synch
WFF	38° - 51.6°

Performance Information:

Above table lists the typical inclinations for the launch sites available on NLS-II.
Any deviation from these inclinations will have an impact on available performance.
For mission specific information, utilize the LSP performance website and/or the LSP point of contact listed in this document.
The LSP performance website may provide multiple vehicle solutions for a practical orbit, however not all vehicles are to be considered in this AO due to cost constraints.

Please communicate with the LSP point of contact listed in this document for additional info.

Static Payload Fairing Envelope



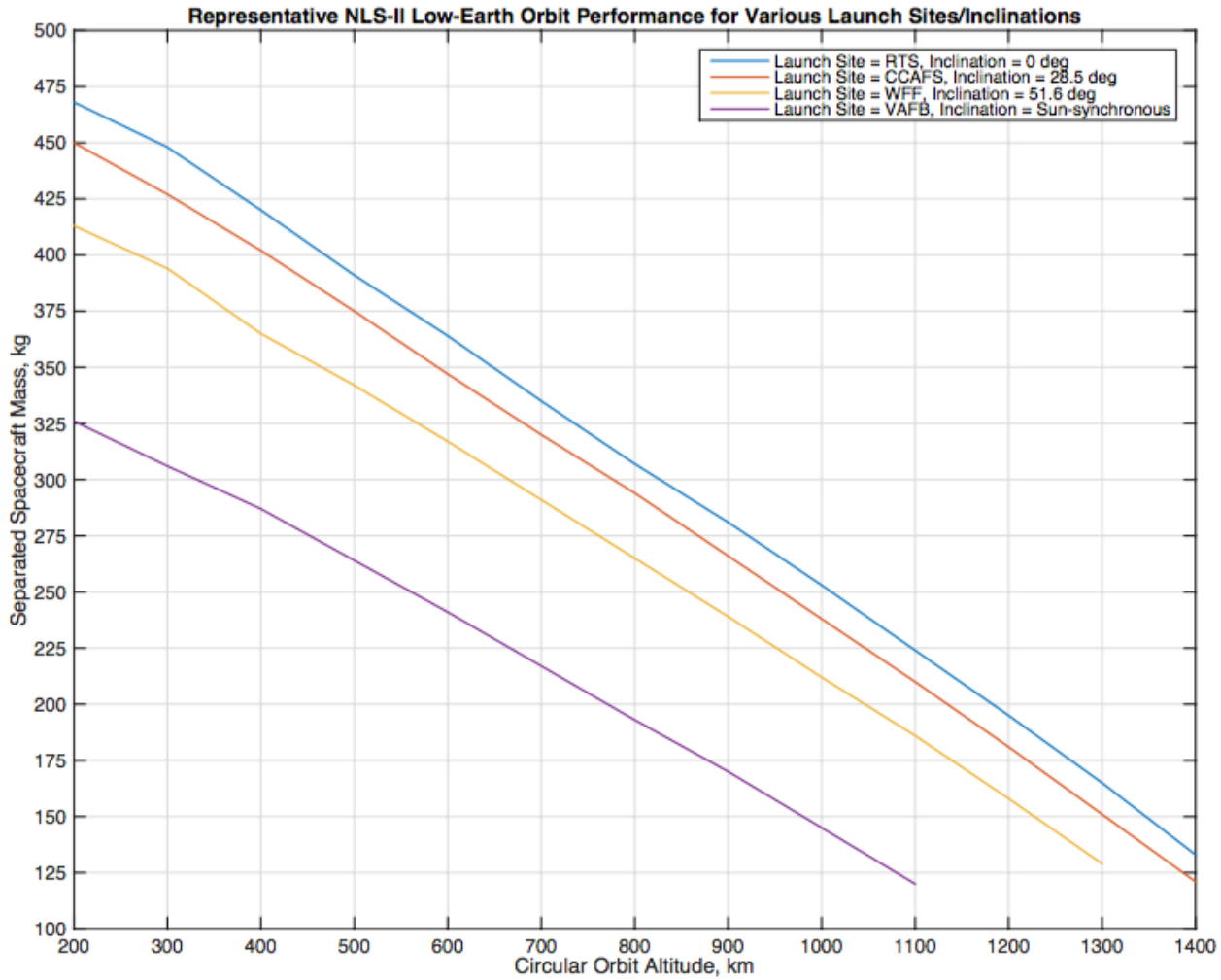
Encompassing Case

* Proposals should include sufficient S/C dimensions to validate fit within this PLF static envelope, including any close approaches.

* Figure has been reduced by 1.5" to account for a typical payload isolation system. If the provider is providing their own isolation system, 1.5 inches may be added to overall height shown.

* In the case of a Pegasus XL, inclusion of the HAPS reduces available fairing envelope. Contact LSP POC for details.

Enveloping Mass Performance



Limiting Orbit Performance Curves

Performance Ground Rules:

- This LV performance available on NLS-II generally does not include impacts associated with orbital debris compliance; this must be evaluated on a mission-specific basis.
- Guidance reserves have been allocated to account for **3-sigma flight performance.**
- Performance is for baseline LV configuration; non-standard, mission-unique hardware will require additional assessment.
- 38-inch (0.96-meter) separation system.
- Mass of entire separation system is book-kept on the launch vehicle side.

Figure depicts **representative nominal** performance to various **circular** orbits.
Vehicle injection dispersion capabilities will determine the accuracy of targeting these orbits.

Summary

- **It is the Launch Service Program's goal to ensure the highest practicable probability of mission success while managing the launch service technical capabilities, budget and schedule.**

- **Questions must be officially submitted to:**

Aly Mendoza-Hill
Mission Manager
NASA Launch Services Program Code VA-C
Kennedy Space Center, FL 32899
Phone: 321-861-5914
Email: Alicia.Mendoza-Hill@nasa.gov

LSP is ready to respond to your mission specific questions.

Back Up

Evaluation

- **<u>Launch Service Technical Evaluation:</u>**
  - **Overall Assessment: - Given the ground rules in the AO, is the proposed launch vehicle (LV) concept feasible for this application? (Yes or No)**
  - **Comments:_____**
    _____
    _____
- **<u>LV Performance: Area of concern (Yes or No)</u>**
  - **Proposed LV configuration: _____**
  - **Proposed Launch Date: _____**
  - **Launch Period (MM/DD/YYYY to MM/DD/YYYY): _____/____/_____ to _____/____/_____**
  - **Launch Window (On any given day of the launch period Minutes:Seconds): _____ : _____ .**

Evaluation

- **LV Performance: Area of concern (cont)**
  - **Orbit requirements: Apogee: _____ km Perigee: _____ km Inclination: _____deg.**
  - **High Energy requirements: C^3: _____ km^2/sec^2 DLA: _____deg RLA: _____deg**
  - **Proposed LV Performance: _____**
  - **Mass (including reserves) Dry Mass: _____ kg Wet Mass: _____ kg**
  - **Dry Mass Margin: _____ kg _____ %**
  - **Wet Mass Margin _____ kg _____ %**
  - **Formulas:**
  - **Mass Margin kg = LV Performance – S/C Mass (including reserves)**
  - **Mass Margin % = [(Mass Margin kg) S/C Mass (including reserves)kg] X 100**
  - **LV Performance Comments/issues/concerns:**

Evaluation

- **Launch Service Cost Assessment: Area of concern (Yes or No)**
  - **Is there additional funding for any mission unique modifications/services? (Yes or No)**
- **LV Integration: Area of concern (Yes or No)**
  - **Does the proposer have experience in LV integration? (Yes or No)**
- **LV to Spacecraft Interface: Area of concern (Yes or No)**
  - **Proposed Payload Fairing (PLF) _____**
  - **Spacecraft (S/C) Dimensions: Radial:_____ m Height _____ m**
  - **Any intrusions outside of the PLF usable Static volume? (Yes or No)**
  - **Mechanical Interface:**
  - **Standard Adapter: _____ Custom Adaptor: _____**
  - **Electrical Interface:**
  - **Standard _____ Pin(s) Connector(s): (Yes or No)**

Evaluation

- **LV to Spacecraft Interface: Area of concern (Yes or No)**
- **Mission Unique requirements:**
  - **Instrument T-0 GN^2 Purge: (Yes or No)**
  - **T-0 S/C Battery Cooling: (Yes or No)**
  - **Planetary Protection Requirements: (Yes or No)**
  - **Multiple Spacecraft Deployment: (Yes or No)**
  - **Telemetry Requirement thru Launch: (Yes or No)**
  - **Contamination Control Requirements: PLF: (Yes or No) LV adapter: (Yes or No)**
  - **Cleanliness Level: _____ other: _____**
  - **Unique Facility Requirements: (Yes or No)**
    - » **Pad: _____**
    - » **S/C Processing Facility: _____**
  - **S/C Environmental Test Plans**
    - » **Environmental Test Plan/Flow described: (Yes or No)**
    - » **Test Levels provided: (Yes or No)**
    - » **Test Schedule provided: (Yes or No)**
    - » **Comments/issues/concerns: _____**

Evaluation

- **<u>Spacecraft Schedule: Area of concern (Yes or No)</u>**
  - **Adequate timing of: Launch Service Integration Start Time: (Yes or No)**
  - **S/C Environmental Test Program: (Yes or No)**
  - **Delivery of Verified S/C Model @ L-9 months: (Yes or No)**
  - **S/C ship date: (Yes or No)**
  - **S/C to LV integrated Operations: (Yes or No)**
- **<u>Missions with Radiological material Area of concern (Yes or No)</u>**
  - **List the Radiological Sources:**

    _____
  - **Are unique facilities required to store/process the Radiological Sources? (Yes or No)**
  - **Any LV modifications required for additional safety or Launch approval? (Yes or No)**

Evaluation

- **<u>Non-NASA Launch Services:</u> <u>Area of concern (Yes or No)</u>**
  - **Does proposal address the PI's approach to managing the commercial launch service: (Yes or No)**
  - **Is the proposal clear on the approach that the PI will utilize to ensure the adequacy of the technical work performed by the launch provider and to determine flight worthiness: (Yes or No)**
  - **Does the proposal identify elements of the launch service in which the PI has approval per NPD 8610.23: (Yes or No)**
  - **Does the proposal identify elements of the launch service in which the PI will have insight per NPD 8610.23: (Yes or No)**
  - **Does the proposal address PI's responsibility to obtain NASA Flight Planning Board approval prior to acquisition of the launch service: (Yes or No)**
  - **Does the cost estimate account for the full launch service including mission unique costs, payload processing facility costs, delay penalties, spacecraft fueling costs, and identified risks: (Yes or No)**
  - **Indicate the type of launch vehicle payment schedule. Are all funds due up front or are payments made over the integration period: (Yes or No)**