NASA-Provided Launch Services Ground Rules/Policy

This document provides additional information for NASA-provided launch services. This launch service will be provided by NASA will be procured and managed by the NASA/Launch Services Program (LSP) using government contracts.

Under this AO, the Proposer may not arrange alternative access to space.

Under the provisions of the NASA Launch Services II (NLS II) contract, the launch service includes the Launch Vehicle (LV) and associated standard services, non-standard services (mission-unique options), all engineering and analysis, and minimum performance standards. LSP also provides technical management of the launch service, technical insight into the LV production/test, coordinates and approves mission-specific integration activities, provides mission unique LV hardware/software development, provides payload-processing accommodations, and manages the launch campaign/countdown.

At the appropriate time following mission selection, LSP will competitively select a launch service provider and award a launch service for the mission based on customer requirements. The launch service is awarded to the Contractor that provides the best value in launch services to meet the Government's requirements based on technical capability/risk, reasonableness of proposed price, and past performance. Accordingly, assumption of a specific launch vehicle configuration as part of the AO proposal will not guarantee that the proposed LV configuration will be selected unless there is firm technical rationale for sole source. Any such rationale should be clearly identified and explained in the proposal.

All NASA-procured launch services will be consistent with NASA Policy Directive (NPD) 8610.7D, NASA Launch Services Risk Mitigation Policy. Launch services acquired by NASA will be managed in accordance with NPD 8610.23C, Launch Vehicle Technical Oversight Policy, and NPD 8610.24C, Launch Services Program (LSP) Pre-Launch Readiness Reviews. These NPDs can be accessed through the AO library.

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Launch Vehicle Information/Configuration/Performance

Three scenarios are depicted in this summary, which must be addressed in the proposal (see Requirement 96 in the AO). Any areas that are not compatible with the launch vehicle scenario's capabilities and characteristics must be addressed in the proposal along with any impacts needed to meet these areas (see Requirement 96 in the AO).

Launch Service Costs

The Astrophysics Explorers Program within the Science Mission Directorate will hold the launch service costs. Standard services provided in the launch service costs to be covered by the Astrophysics Explorer Program are:

- the launch vehicle, engineering, analysis, and minimum performance standards and services provided by the NLS II contract in place at the time of LV selection;
- mission integration;
- launch site payload processing;
- range safety support;
- down range telemetry support (launch vehicle only);
- 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 (see attachment 2 within this document);

The Baseline launch service for this AO is based upon a medium/intermediate-class vehicle.

The Astrophysics launch service budget set aside for MIDEX 2021 does not include funding for PI/payload-caused launch delays.

Evaluation Criteria

Attachment 3 shows a preliminary Risk Assessment checklist that will be used as a guide for the launch service evaluators during the proposal evaluation phase. This checklist should provide an indication of the types of information that are expected to be in the proposals. If the proposal does not provide sufficient information, the launch vehicle section of the proposal may not be evaluated for full content and may be listed as a finding.

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NASA Launch Services Program Point of Contact (POC) for Additional Information

Additional information including performance quotes for other orbits/destinations, mission integration inquiries, standard services, and non-standard/mission unique services costs may be obtained from the point of contact below. Other questions must be directed as indicated in the Section 6.1.5 of the AO.

Shaun Daly
Mission Manager
NASA Launch Services Program
Code VA-C
Kennedy Space Center, FL 32899
Phone: 321-867-8400
Email: shaun.daly@nasa.gov

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Attachment 1
LV Launch Services Characteristics/Capabilities

Performance Information /Capabilities:

The performance listed for each representative orbit contains the equivalent maximum mass allowed under the standard launch service for the purposes of this AO. Note that other inclinations/altitudes/orbit energies are also available. In some scenarios, an increase in performance may be available, please contact LSP for feasibility.

Table 1 lists some reference orbits/destinations for Scenario 1, with expanded curves provided in Figures 1 and 2. Table 2 lists some reference orbits/destinations for Scenario 2, with expanded curves provided in Figures 3 and 4. Table 3 lists some reference orbits/destinations for Scenario 3, with expanded curves provided in Figures 5 and 6.

Scenario 1:

Reference Orbit		Performance (kg)	Volume
LEO	700 km, Sun-Synch	3385	PLF Scenario 1 (re: Fig. 7)
L2	C_3 = -0.5 km^2/s^2	1695	PLF Scenario 1
Lunar	C_3 = -1.8 km^2/s^2	1750	PLF Scenario 1

Table 1: Scenario 1 Performance Capability at Reference Orbits

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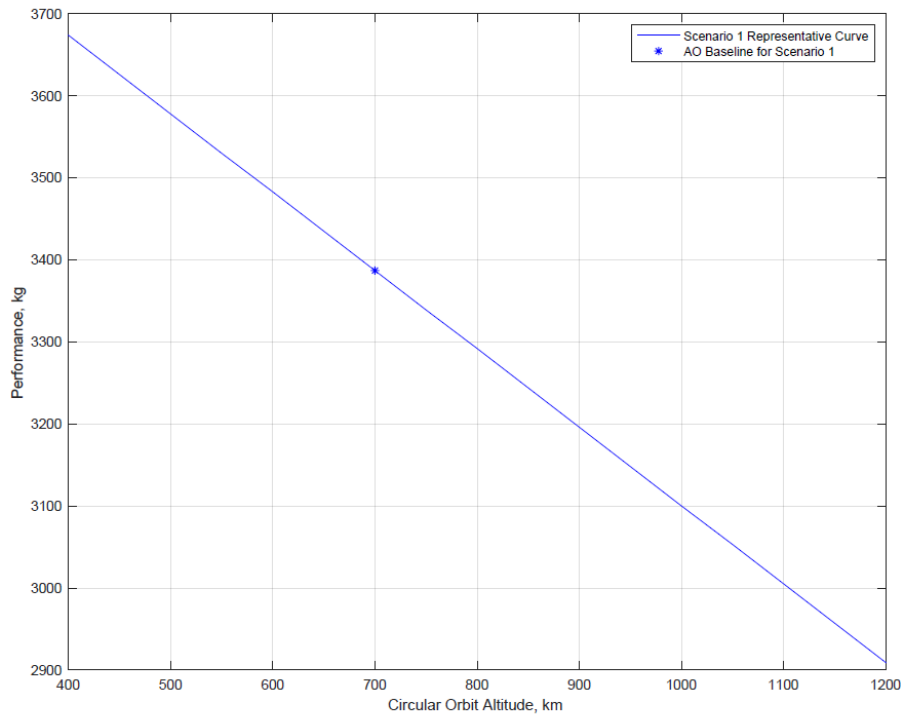

Figure 1: Scenario 1 Representative Performance Capability at Sun-Synchronous Inclination

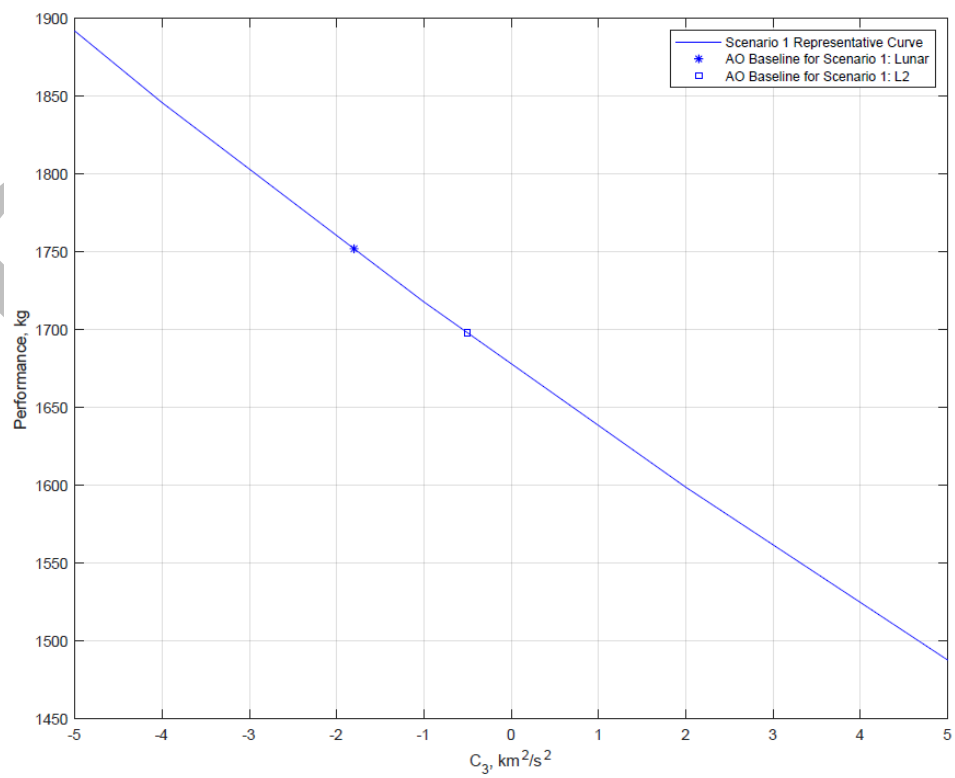

Figure 2: Scenario 1 Representative Performance Capability to High Energy Orbits

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Scenario 2:

Reference Orbit		Performance (kg)	Volume
LEO	700 km, Sun-Synch	5620	PLF Scenario 2 (re: Fig. 8)
L2	C_3 = -0.5 km^2/s^2	1810	PLF Scenario 2
Lunar	C_3 = -1.8 km^2/s^2	1925	PLF Scenario 2

Table 2: Scenario 2 Performance Capability at Reference Orbit

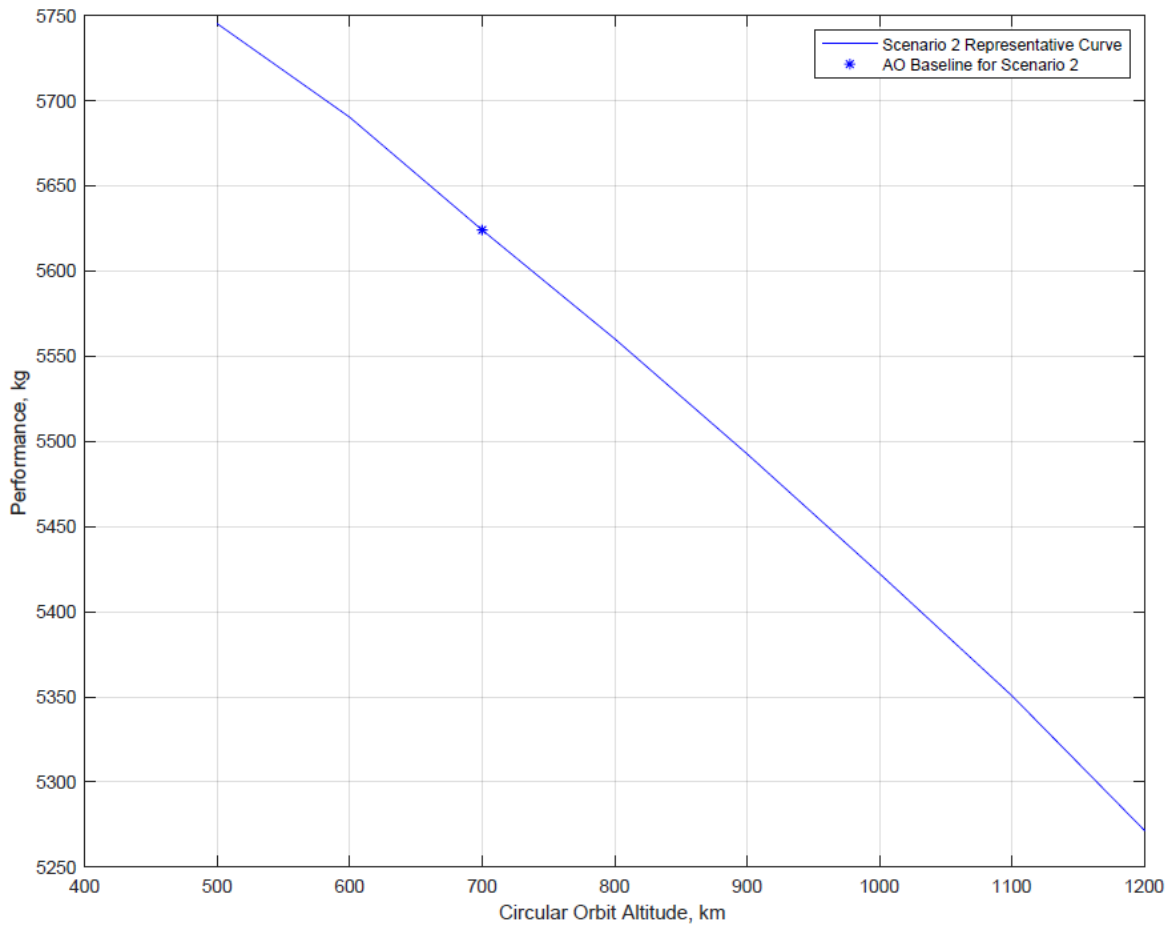

Figure 3: Scenario 2 Representative Performance Capability at Sun-Synchronous Inclination

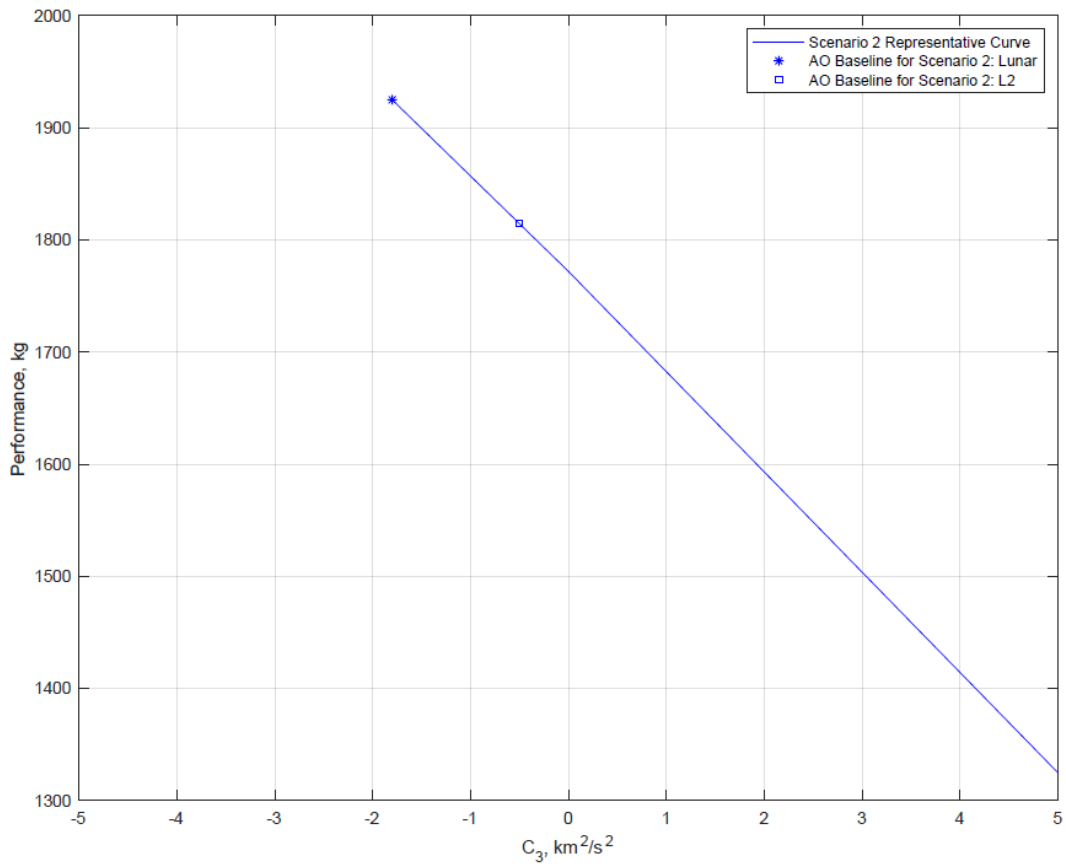

Figure 4: Scenario 2 Representative Performance Capability to High Energy Orbits

Performance Ground Rules (valid for all scenarios):

- The 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. Depending on LV design, this could result in a significant performance impact to ensure full compliance with orbital debris policy.
- Guidance reserves have been allocated to account for 3-sigma flight performance.
- Performance is for a Baseline LV configuration; non-standard, mission-unique hardware will require additional assessment.
- Assumes a 47-inch (1194 mm) separation system.
- Mass of entire separation system is book-kept on the launch vehicle side.

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Payload Envelopes:

There are 2 different scenarios for payload fairing volumes allowed under the standard launch service for the purposes of this AO.

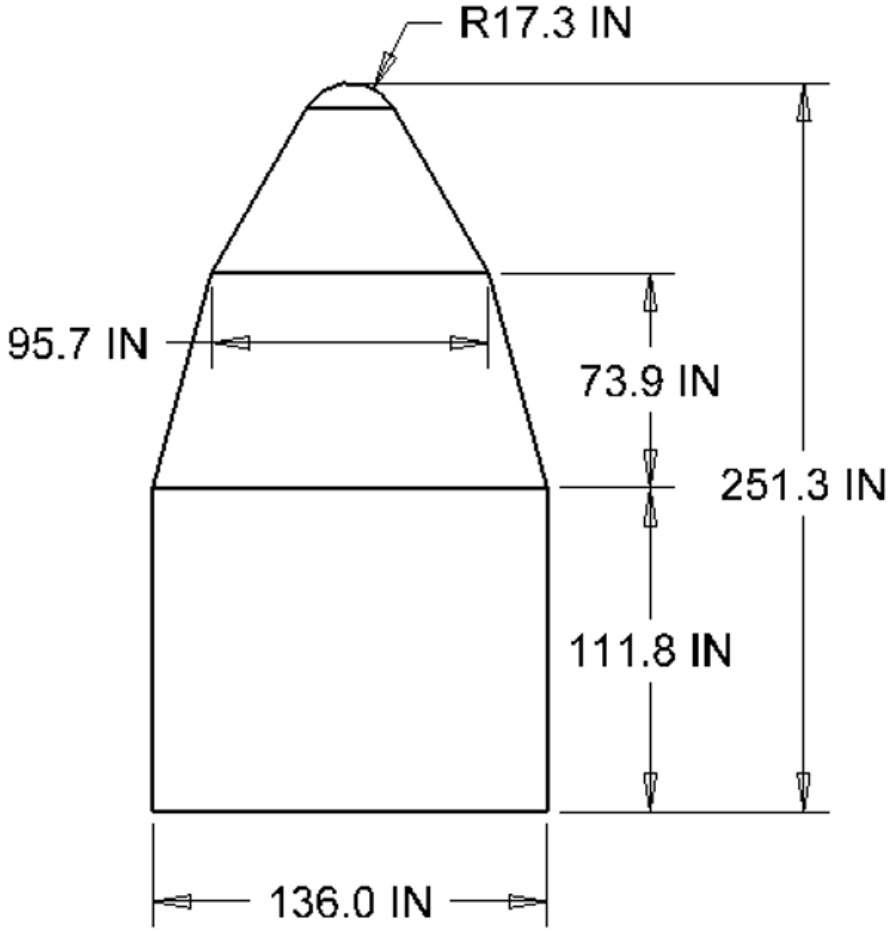

Figure 7: Scenario 1 PLF Static Envelope (inches)

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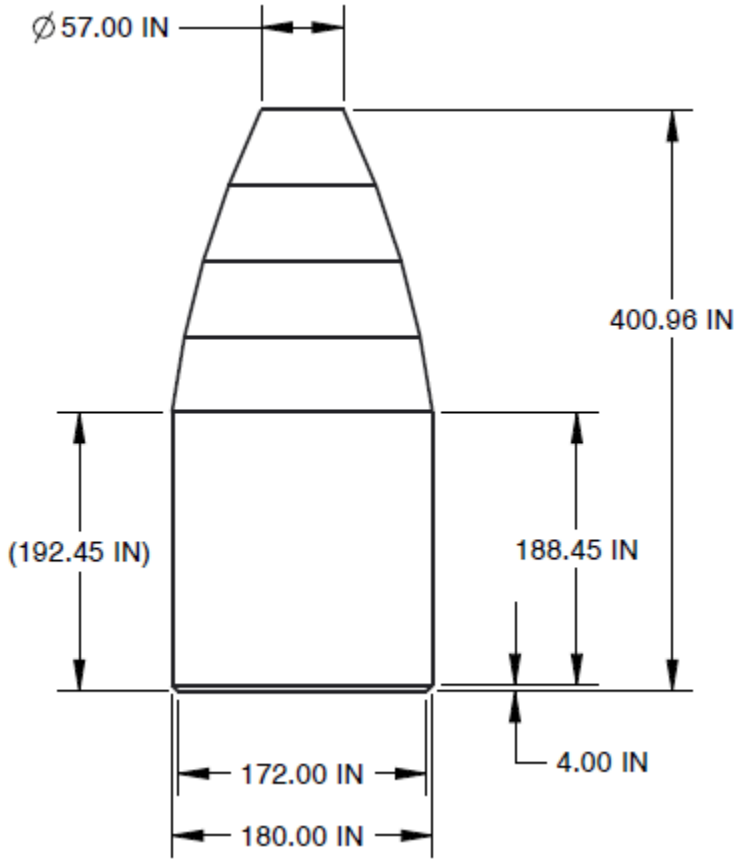

Figure 8: Scenario 2 PLF Static Envelope (inches)

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Launch Vehicle Enveloping Environments:

In the Environments data below, a mass of 1500 kg was used.

Equivalent Sine Environment:

Scenario 1: *Covers LEO missions with spacecraft mass < 3385 kg and L2 missions < 1695 kg*

Scenario 1 Envelope			
Frequency (Hz)	Axial	Frequency (Hz)	Lateral
5	0.5	5	0.18
10	0.5	10	0.3
12	0.8	20	0.3
16	0.8	30	0.18
18	0.5	50	0.18
30	0.3	65	0.1
100	0.3	100	0.1

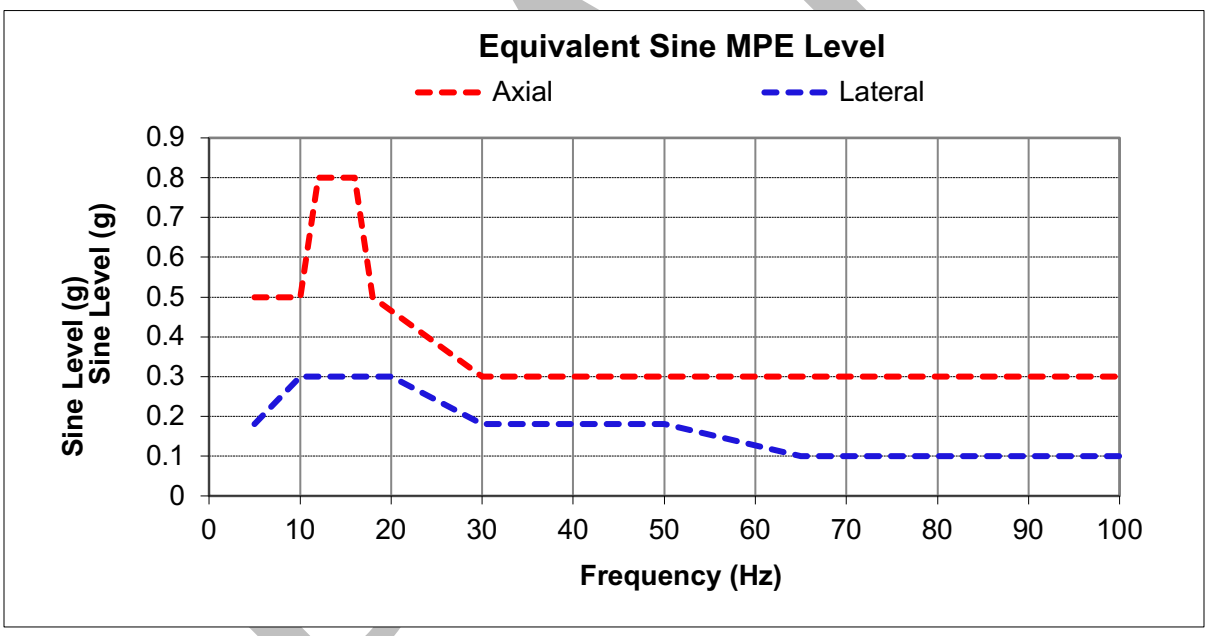

Figure 10: Scenario 1 Enveloping Equivalent Sine – Flight Level

Scenario 2:

Load Factors cover L2 and Lunar missions with mass < 1800 kg and Low Earth Orbit missions with mass > 1800 kg.

Envelope			
Frequency (Hz)	**Axial**	**Frequency (Hz)**	**Lateral**
5	0.6	5	0.5
20	0.8	80	0.5
35	0.8	80	0.55
35	0.6	85	0.55
75	0.6	85	0.6
75	0.7	100	0.6
78	0.7		
80	0.75		
80	0.9		
100	0.9		

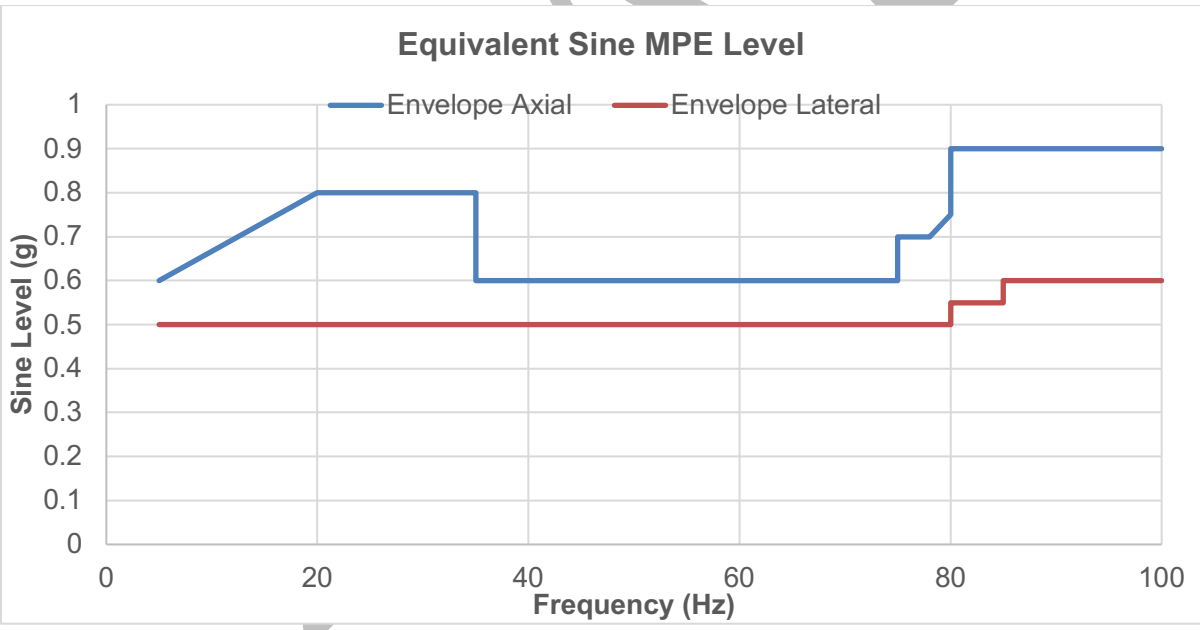

Figure 11: Scenario 2 Enveloping Equivalent Sine – Flight Level

CG Loads Factors:

Scenario 1:

Envelope	
Lateral (g's)	Axial (g's) *
-1.5	6.5
1.5	6.5
1.5	-1
-1.5	-1
-1.5	6.5

* positive sign in axial load factor denotes compression

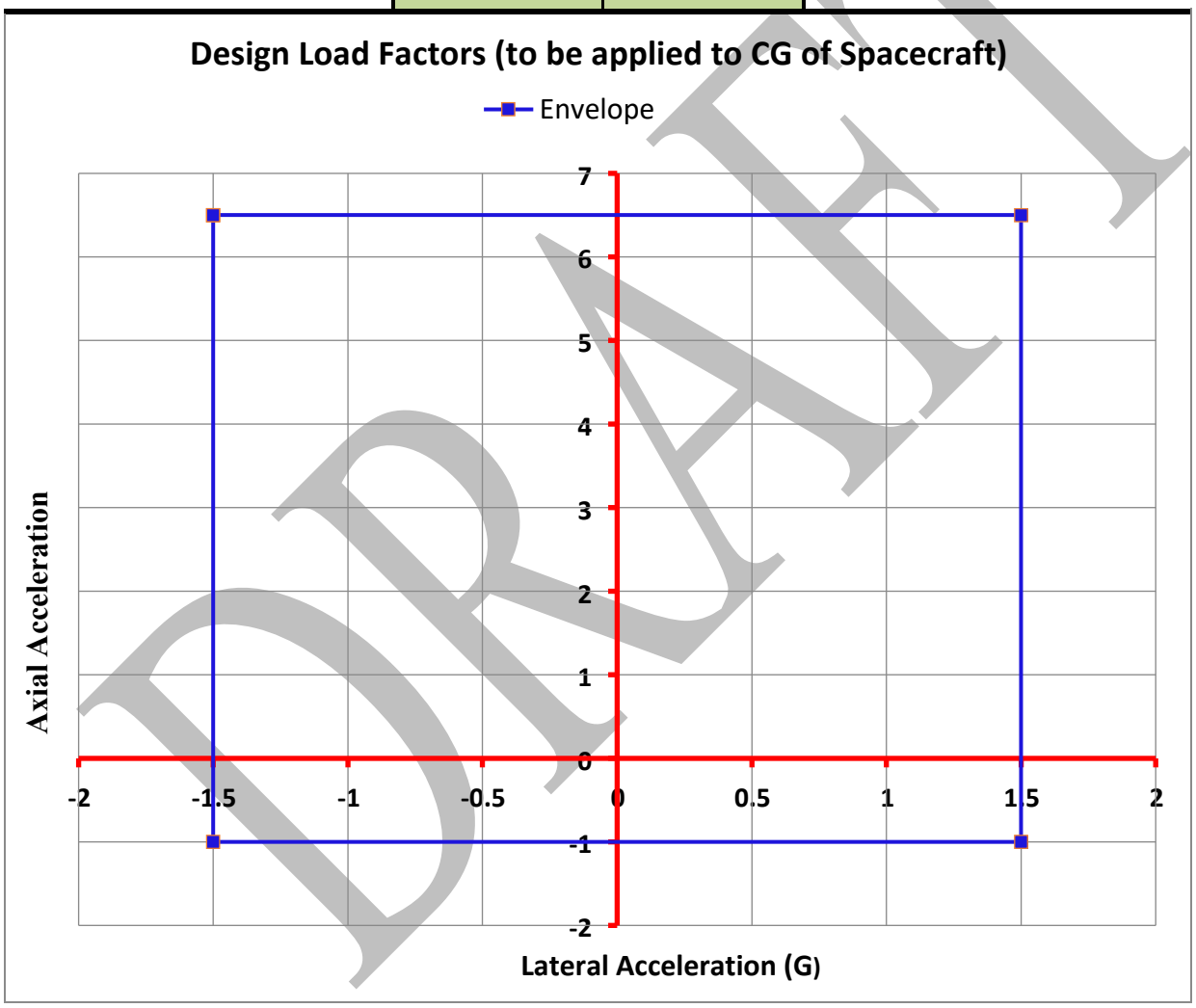

Figure 12: Scenario 1 Enveloping Design Load Factors (to be applied to CG of Spacecraft)

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Scenario 2: *Load Factors cover L2 and Lunar missions with mass < 1800 kg and Low Earth Orbit missions with mass > 1800 kg*

Envelope	
Lateral (g's)	**Axial (g's) ***
1	6
1	4
1.5	4
1.5	3.7
2	3.5
2	-1.5
0.6	-1.5
0.6	-2
-0.6	-2
-0.6	-1.5
-2	-1.5
-2	3.5
-1.5	3.7
-1.5	4
-1	4
-1	6
1	6

* positive sign in axial load factor denotes compression

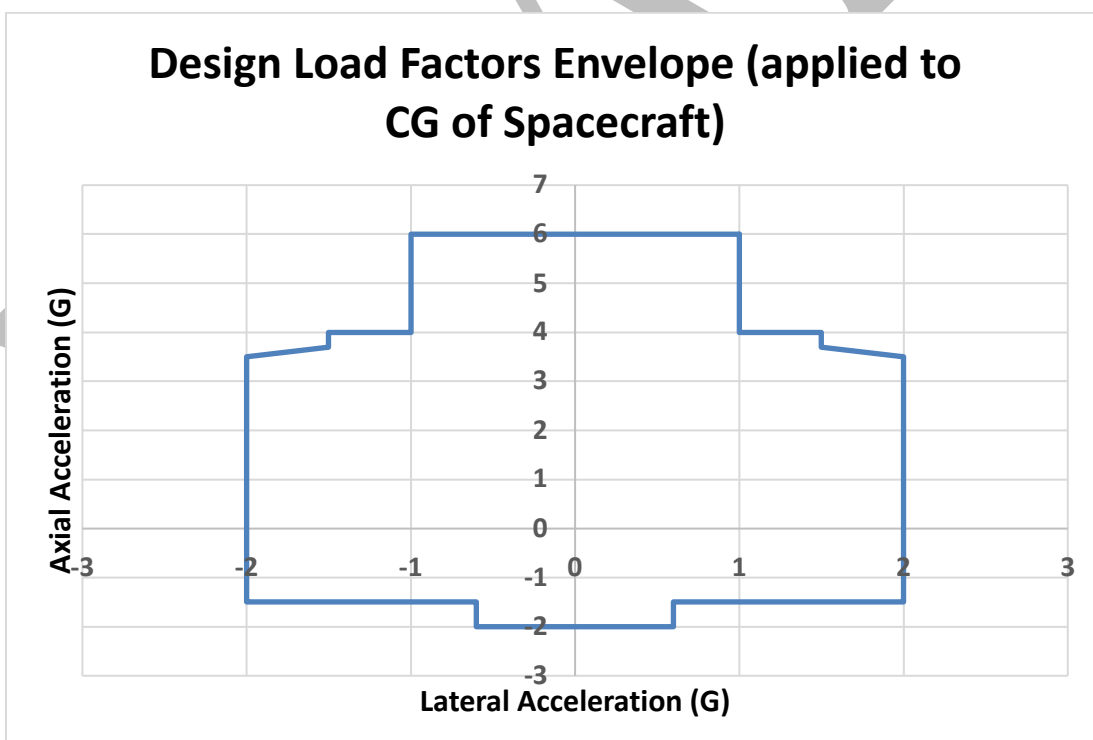

Figure 13: Scenario 2 Enveloping Design Load Factors (to be applied to CG of Spacecraft)

Acoustic Environment:

Scenario 1:

Envelope	
Frequency (Hz)	SPL (dB)
20	122.3
25	123.8
31.5	125.5
40	127.1
50	128.5
63	129.7
80	130.7
100	131.4
125	131.7
160	131.6
200	131.3
250	128.9
315	127.7
400	126.6
500	124.8
630	128.4
800	128.6
1000	126.9
1250	123.1
1600	117.5
2000	116.2
2500	113.6
3150	113.1
4000	112.5
5000	111.8
6300	111
8000	110
10000	109.1

Overall SPL (dB) = 141.5

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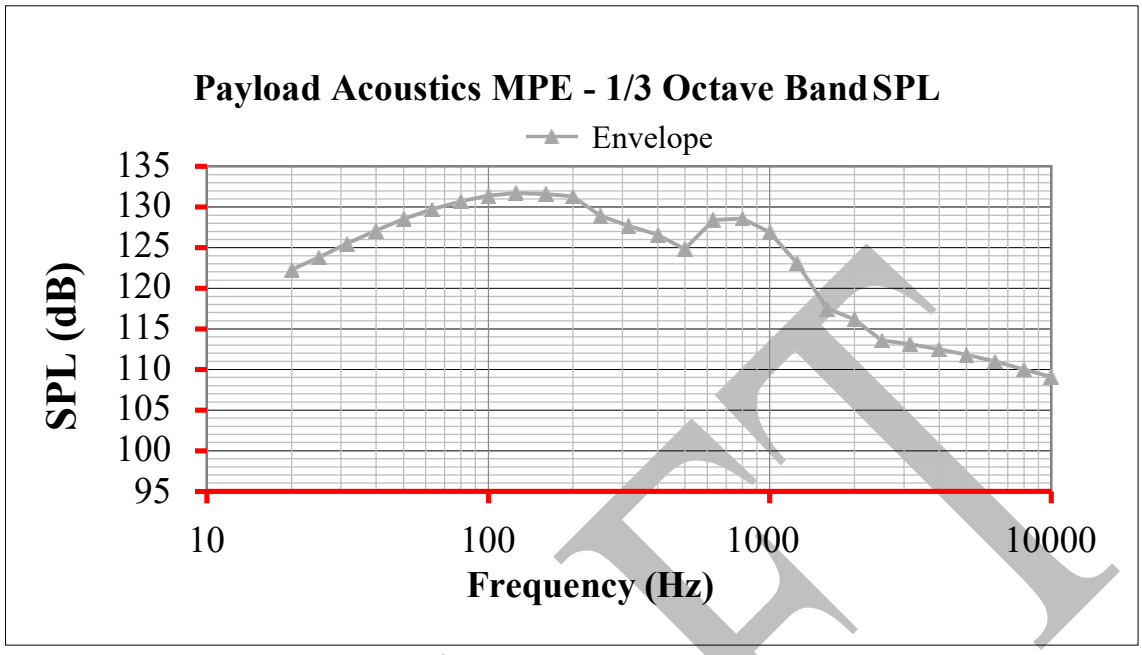

Figure 14: Scenario 1 Enveloping Payload Acoustics MPE – 1/3 Octave Band SPL

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Acoustic Environment:

Scenario 2:

Frequency (Hz)	SPL (dB)
31.5	123.0
40	124.8
50	126.2
63	127.5
80	128.3
100	128.8
125	129.0
160	128.7
200	127.5
250	126.0
315	124.6
400	123.3
500	121.9
630	120.5
800	119.1
1000	117.8
1250	116.4
1600	115.0
2000	113.6
2500	112.3
3150	110.9
4000	109.5
5000	108.1
6300	106.8
8000	105.4
10000	104.0

Overall SPL (dB) = 138.1

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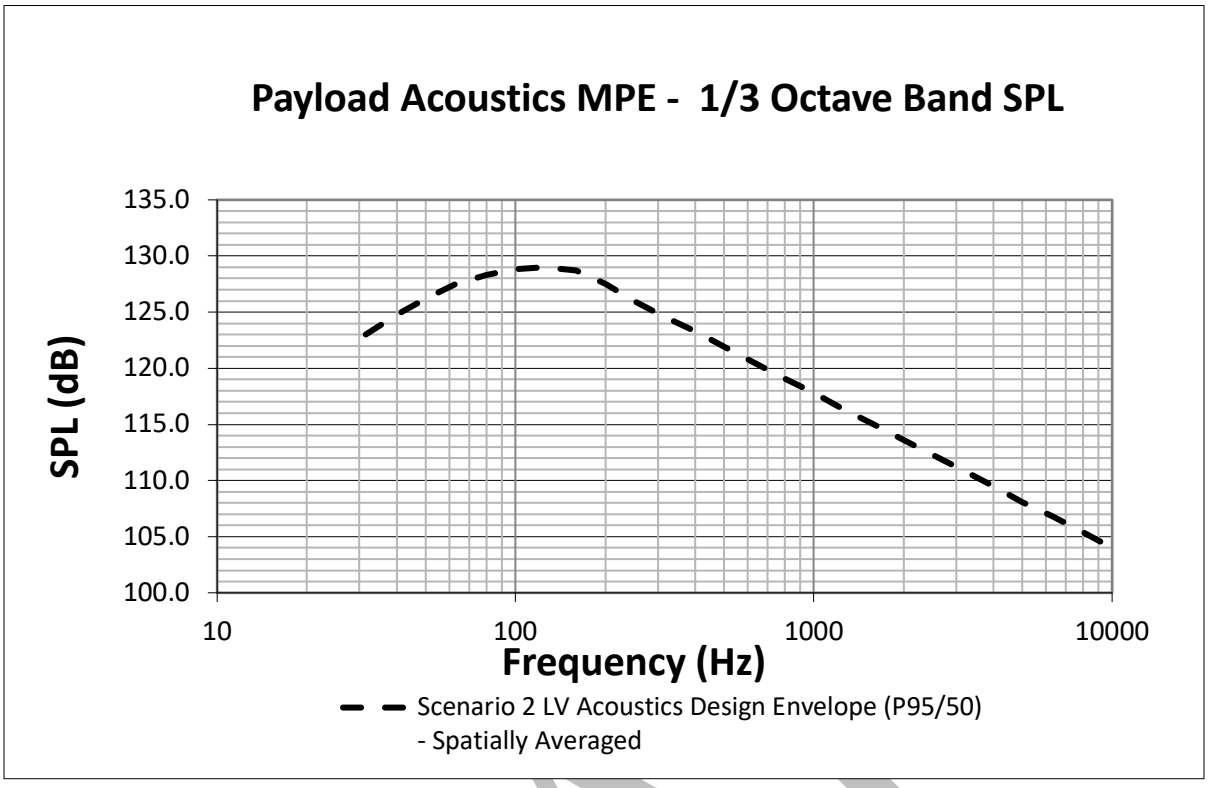

Figure 15: Scenario 2 Enveloping Payload Acoustics MPE – 1/3 Octave Band SPL

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Shock Environment:

Hz	SRS (g-peak)
100	100
625	2000
10000	2000

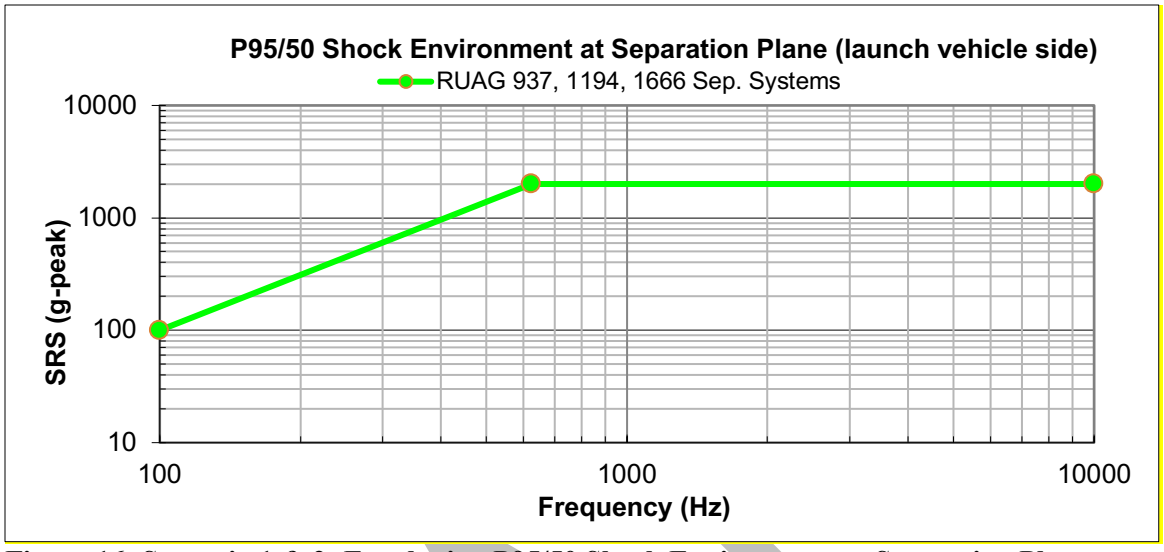

Figure 16: Scenario 1 & 2- Enveloping P95/50 Shock Environment at Separation Plane (LV side)

Note: The provided shock curve is based on LSP experience with separation shock test data of past missions.

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Random Vibe Environment:

Frequency	Max Envelope
20	0.0044
100	0.0044
300	0.01
700	0.01
800	0.03
925	0.03
2000	0.00644
GRMS	**5.13**

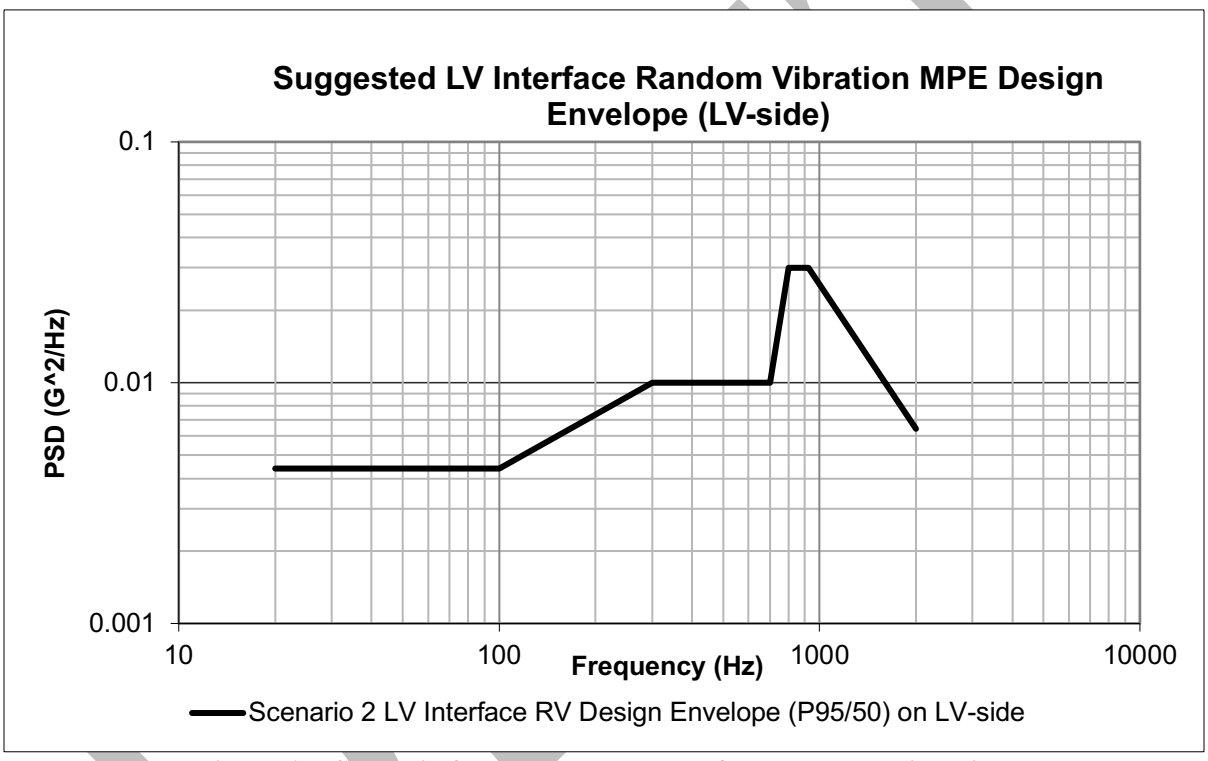

Figure 17: Scenario 2 only- Payload Interface Random Vibration Max Envelope

NASA-LSP Standard Launch Services

This list provides an overview of the standard and mission-specific services that the spacecraft customer receives with the NASA-LSP **Baseline** launch service for this AO. If additional services are required but not listed herein, or for any questions, please contact the NASA LSP POC listed in this document.

Integrated Services:

- Range support and services
- Payload processing facility and support
- Contractor Engineering support
- Base Support contractors and logistics
- Hazardous support

Launch Vehicle:

- Launch vehicle that meets customer's performance needs
- Payload Fairing with approximately 2 access doors in standard locations, with thermal and/or acoustic blankets
- Standard LV-provided Payload Separation System
- Standard Payload Adapter
- Standard Test Payload adapter availability
- Spacecraft Spin/De-spin capability for separation (if required)
- Single-Spacecraft Collision/Contamination Avoidance Maneuver (CCAM) capability if needed
- Electrical interface connectors (approximately 3 sets)
- Mission-Unique Reviews (approximately 3)
- Readiness Reviews (approximately 4)
- Risk Management
- Launch Vehicle insight and approval per NPD 8610.23
- Mission integration management & engineering support
- Launch campaign management
- Down range telemetry assets for LV data

Baseline Mission-Unique Services

- Mission-Unique payload isolation system
- T-0 Grade B GN2 or pure air Purge
- ISO 14644-1 Class 7 (Class 10K) integration environment
- Pre-ATP studies such as coupled loads and/or trajectories analysis

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- Although use of low-level radioactive sources (i.e., with an A2 mission multiple less than 10, as defined in NPR 8715.3, Chapter 6 and Appendix D) is a non-standard service, there is no charge to the PI-Managed Mission Cost, as any charges are minimal (such as radiological storage during payload processing). Note that costs associated with environmental review and launch approval are separate from these activities (reference AO Section 5.2.4).

The following list provides a few examples of non-standard/mission-unique services that are not included in this AO's NASA-provided launch service, and whose cost would need to be included as part of the Principle Investigator-Managed Mission Cost. Contact the LSP POC for further information on these and other non-standard/mission-unique services.

- Custom payload adapters
- Auxiliary Propulsion for target orbit achievement
- Deployable telemetry tracking assets for multiple spacecraft missions
- LV mods/analyses for non-separating interface with multiple SC deployments

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Attachment 3

Rev A

Risk Assessment/Evaluation Form
Launch Services Program

Proposal Name: _____

Proposal #: _____

Evaluator POC: _____

Phone: _____

Email: _____

Launch Service Risk Evaluation:

Overall Assessment: - Given the ground rules in the AO, is the proposed launch vehicle (LV)), standard services, mission-unique services, performance class, costs and concept feasible for this application? (☐Yes or ☐No)

Areas of risk: _____

LV Performance: Area of risk/concern? (☐Yes or ☐No)

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): _____ : _____

Orbit requirements: Apogee: _____ km Perigee: _____ km Inclination:_____deg.

High Energy requirements: C_3: _____ km^2/sec^2 DLA: _____deg RLA: _____deg

Proposed LV Performance: _____

CBE Mass (including reserves) Dry Mass: _____ kg Wet Mass: _____ kg
NTE 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/risks:

_____

_____

_____

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LV Integration: Area of risk/concern? (☐Yes or ☐No)

Does the proposer have experience in LV integration? (☐Yes or ☐No)

LV to Spacecraft Interface: Area of risk/concern? (☐Yes or ☐No)

Proposed Payload Fairing (PLF) _____

Spacecraft (S/C) Dimensions: Radial:_____ m Height _____ m

Any intrusions outside of the AO Baseline PLF usable **STATIC** volume? (☐Yes or ☐No)

Are there any special access requirements post-fairing encapsulation? (☐Yes or ☐No)

If so, list risks:_____

Mechanical Interface:

Standard Adapter: _____ Custom Adaptor: _____

Electrical Interface: Are there unique electrical interfaces proposed? (☐Yes or ☐No)

Standard _____ Pin(s) Connector(s): (☐Yes or ☐No)

Mission-Unique or Non-Standard 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)

Contamination Control Requirements: PLF: (☐Yes or ☐No) LV adapter: (☐Yes or ☐No)

Cleanliness Level:_____ other: _____

List of Mission-Unique or Non-Standard Services proposed that are not part of the AO Baseline launch service offered:

_____

_____

Unique Facility Requirements: (☐Yes or ☐)

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/risks:

_____

_____

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Launch Service Budget Assessment Summary: Area of risk/concern? (☐Yes or ☐No)

Are the additional Mission-Unique or Non-standard Services, not included in the AO Baseline service, covered by mission flex funding allocated by LSP? (☐Yes or ☐No)

If not, list risks:_____

Has additional funding been identified in the PI-Managed Mission Cost (PI-MMC)? (☐Yes or ☐No)

If not, list risks:_____

Spacecraft Summary Schedule: Area of risk/concern? (☐Yes or ☐No)

Launch Service Integration time 30+/-3 months? (☐Yes or ☐No)

SC Environmental Test program end date L-_____mo

Delivery of verified SC loads model delivery to LSP at L-10 months or earlier? (☐Yes or ☐No)

SC Ship date L-_____mo

SC to LV integrated operations L-_____days

Describe risk of missing the proposed launch date due to spacecraft schedule (environmental testing, launch processing, LV integration):_____

Missions with Radiological material Area of risk/concern? (☐Yes or ☐No)

List the Radiological Sources: _____

Are facilities, not already approved for use, required to store/process the Rad Sources? (☐Yes or ☐No)

Are any LV modifications not included in the AO Baseline service required for additional safety or Launch approval? (☐Yes or ☐No)

Other identified cost, technical, schedule risks?: Area of risk? (☐Yes or ☐No)

List Risks:
_____
_____
_____

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