NASA
Launch Services Program

Explorer AO Proposal Conference
November 23, 2010

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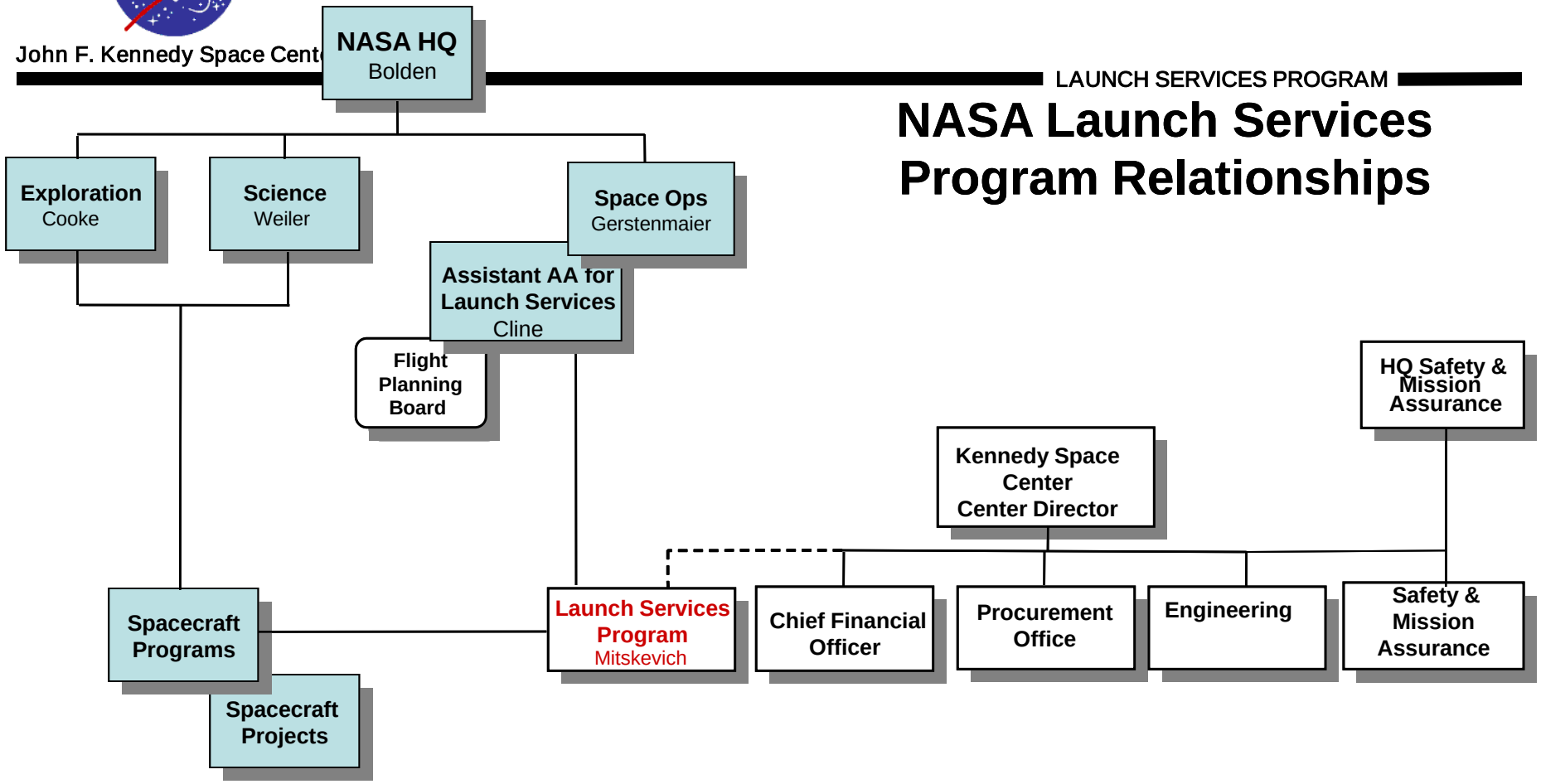
NASA Launch Services Program Relationships



Interfaces to other NASA Centers

- GRC Technical Support
- SSC Propulsion Support
- GSFC Spacecraft Projects
- MSFC Technical Support
- JPL Spacecraft Projects
- ARC Spacecraft Projects

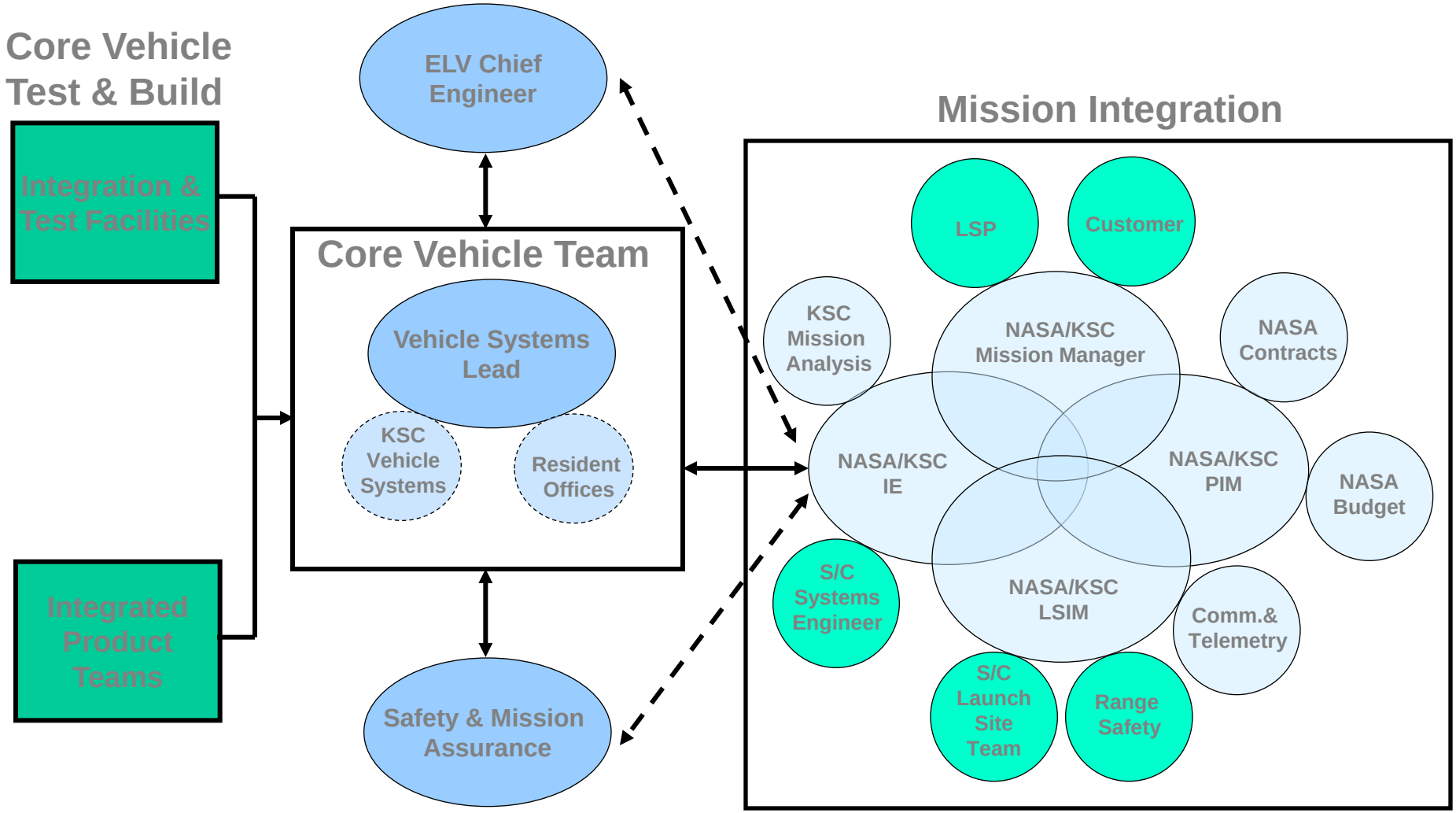
Launch Services Program

The Launch Services Program provides management of the launch service, technical oversight of the launch vehicle production/test, coordinates and approves mission-specific integration activities, provides mission unique launch vehicle hardware/software development, provides payload-processing accommodations, and manages the launch campaign/countdown.

LSP Functional Structure

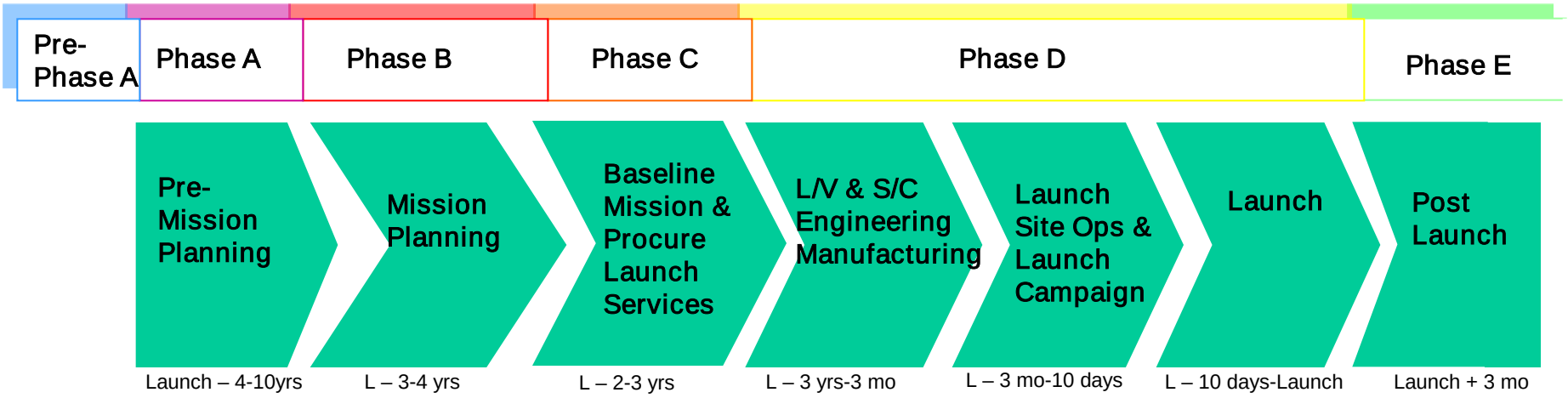
- **LSP procures/provides a Launch Service**
  - **Its more than the basic launch vehicle**
  - **We don't buy a tail number**
  - **This is a commercial FFP procurement with additional insight and oversight**
- **To enable this, LSP has two functional sides**
  - **Mission integration**
    - » **Mission Integration team 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**
    - » **Big stick – no-go for launch**
- **Interface with Safety and Mission Assurance**
  - **Safety**
  - **Quality**

Technical Information flow into the MIT



Ground Rules

- Any acquisition of a non-contributed 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 (NLS) contract.
- The LSP will competitively select a launch service provider for these missions based on customer requirements and NASA Flight Planning Board (FPB) approval.



Spacecraft reviews shown in red.

Available Vehicles

- Assumption of a specific launch vehicle configuration as part of this AO proposal will not guarantee that the proposed LV configuration will be selected for award of a launch service competitive procurement
  - Firm technical rationale for sole source justification is required in the proposal, and NASA would have to obtain appropriate approvals.
- The Agency policy, NPD 8610.7, “Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Mission” has been modified so newer launch service providers are eligible earlier to compete for any of NASA’s missions.

Available Vehicles - Continued

- NLS II has provided additional LV to be considered
- Most likely candidate vehicles for Explorers AO that are available on the NLS II contract are
  - Option A: Taurus-XL, Falcon 1e, Athena II
  - Option B: Pegasus-XL, Falcon 1, Athena I
  - Other vehicles have the option to bid if they choose
- Bidders must remain compatible with vehicles that provide their performance requirements
- LSP uses the NLS II contract and not the launch vehicle providers users guides when determining LV configurations and performance.

Launch Service Budget

- With the exception of the options noted in the next chart, the launch services cost will be held by the Explorer Program.
- The launch service includes:
  - The launch vehicle, engineering, analysis, and minimum performance standards and services provided by the contract.
  - Launch Site Processing
  - Range Support
  - Down Range Telemetry support (launch vehicle only)
  - Standard Mission Uniques – these are items typically necessary to customize the basic vehicle hardware to meet spacecraft driven requirements. Already budgeted for are items like Pre-ATP studies such as coupled loads and/or trajectories analysis, a GN2 or pure air purge prior to T-0 and 10,000 Class integration environment.
  - Budget does not include launch delays.

Option Costs

Non-standard services and options that proposers must account for:

Additional Options:	Launch Date NLT	Total ($M)
Mission Unique Adapter	12/16	1.0
Payload Isolation System*	12/16	1.5
Supplemental Propulsion**	12/16	proposer provided
Additional Options	**Launch Date NLT**	**Total ($M)**
Mission Unique Adapter	12/17	1.04
Payload Isolation System*	12/17	1.56
Supplemental Propulsion**	12/17	proposer provided
Additional Options	**Launch Date NLT**	**Total ($M)**
Mission Unique Adapter	12/18	1.08
Payload Isolation System*	12/18	1.63
Supplemental Propulsion**	12/17	proposer provided

* Bidders may choose to provide their own isolation system.
** Due to the multiple launch vehicle configurations within this launch vehicle class, supplemental propulsion systems must be defined and provided by the proposer to meet mission requirements. The system proposed and the spacecraft shall remain within the fairing envelopes provided.

Performance by Launch Site
Option A

Range	Assumed Inclination - Degrees	Altitude Range km	Max Performance kg
Cape Canaveral Air Force Station, CCAFS	28.5 ° - 51.6 °	200 - 2000	1585
Vandenberg Air Force Base, VAFB	60 ° - 90 ° , SunSynch	200 - 2000	1390
Wallops Flight Facility, WFF	45 °	200 - 2000	1435
Kodiak Launch Complex, KLC	70 ° - 90 ° , SunSynch	200 - 2000	1640
Reagan Test Site, RTS	0 ° - 90 ° , SunSynch	200 - 2000	855

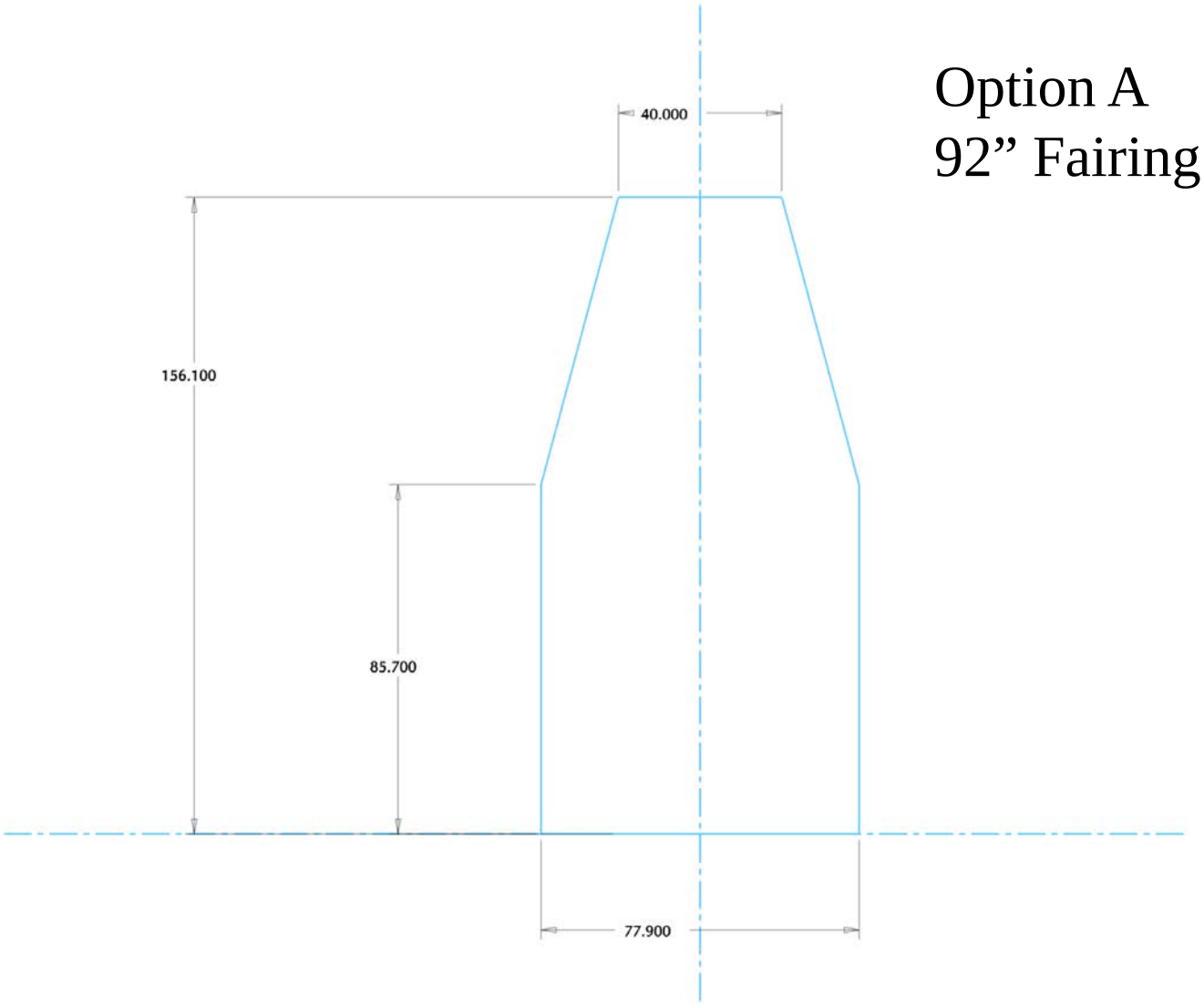
- This performance does not include the effects of orbital debris compliance, which must be evaluated on a mission-specific basis. This could result in a significant performance impact for missions in which launch vehicle hardware remains in Earth orbit.
- Guidance reserves account for 3-sigma flight performance.
- Performance is for baseline 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.
- Listed performance is for separated spacecraft mass.

Performance by Launch Site
Option B

Range	Assumed Inclination - Degrees	Altitude Range km	Max Performance kg
Cape Canaveral Air Force Station, CCAFS	28.5 ° - 51.6 °	200 - 2000	700
Vandenberg Air Force Base, VAFB	60 ° - 90 ° , SunSynch	200 - 2000	375
Wallops Flight Facility, WFF	45 °	200 - 2000	425
Kodiak Launch Complex, KLC	70 ° - 90 ° , SunSynch	200 - 2000	535
Reagan Test Site, RTS	0 ° - 90 ° , SunSynch	200 - 2000	465

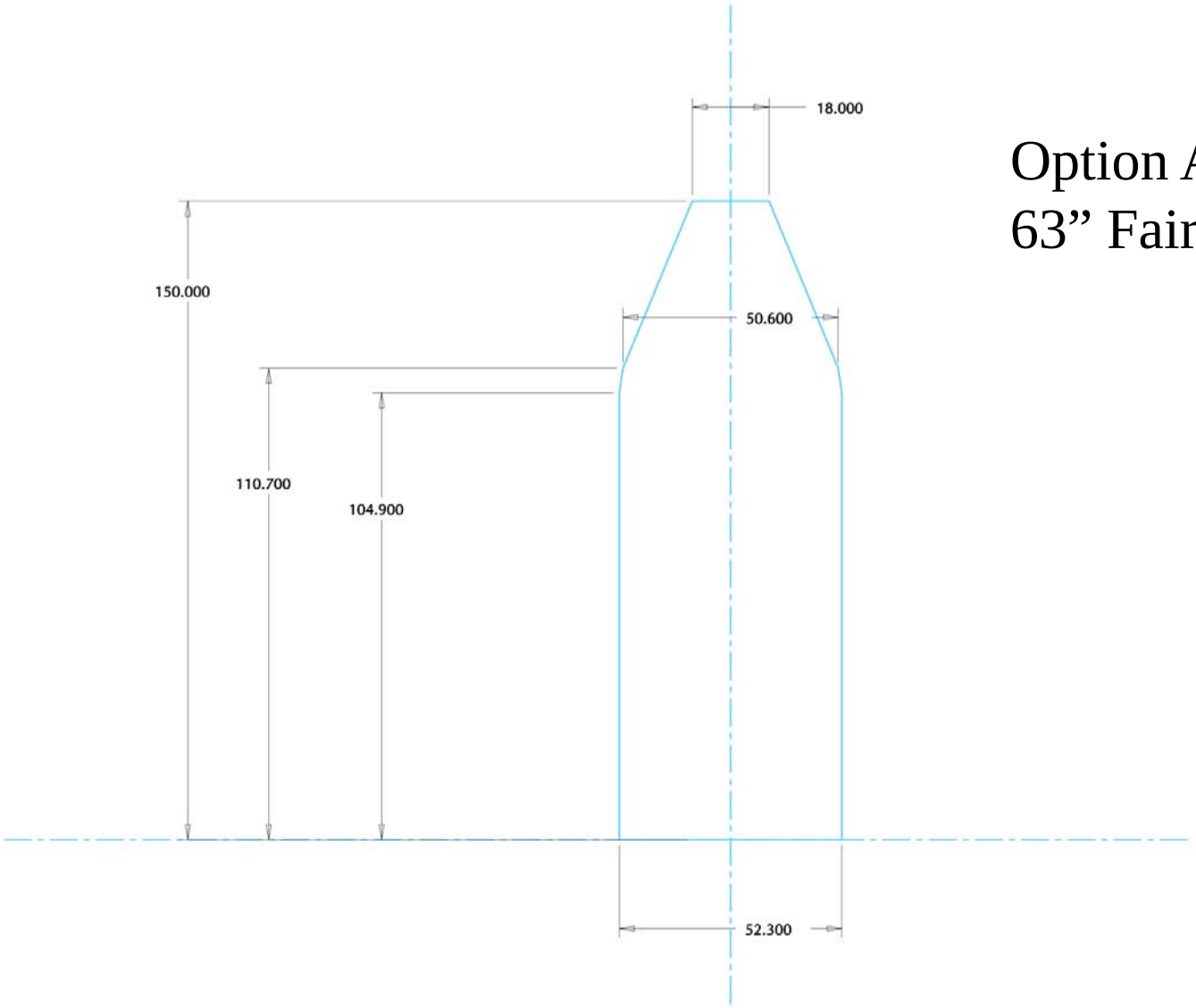
- This performance does not include the effects of orbital debris compliance, which must be evaluated on a mission-specific basis. This could result in a significant performance impact for missions in which launch vehicle hardware remains in Earth orbit.
- Guidance reserves account for 3-sigma flight performance.
- Performance is for baseline 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.
- Listed performance is for separated spacecraft mass.

Static Envelopes
Option A



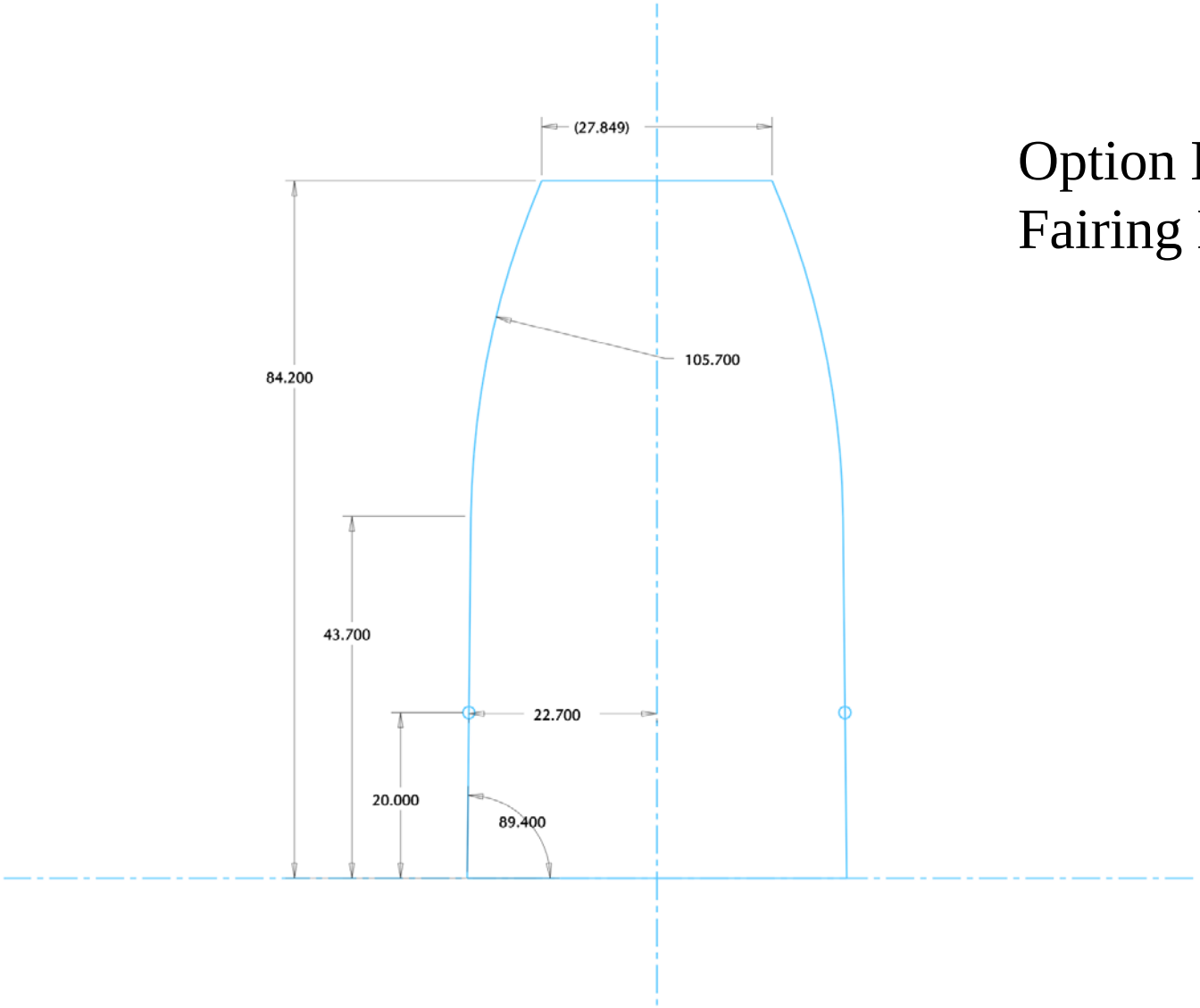
Option A
92” Fairing Envelope

Static Envelopes
Option A



Option A
63” Fairing Envelope

Static Envelopes
Option B



Option B
Fairing Envelope

Summary

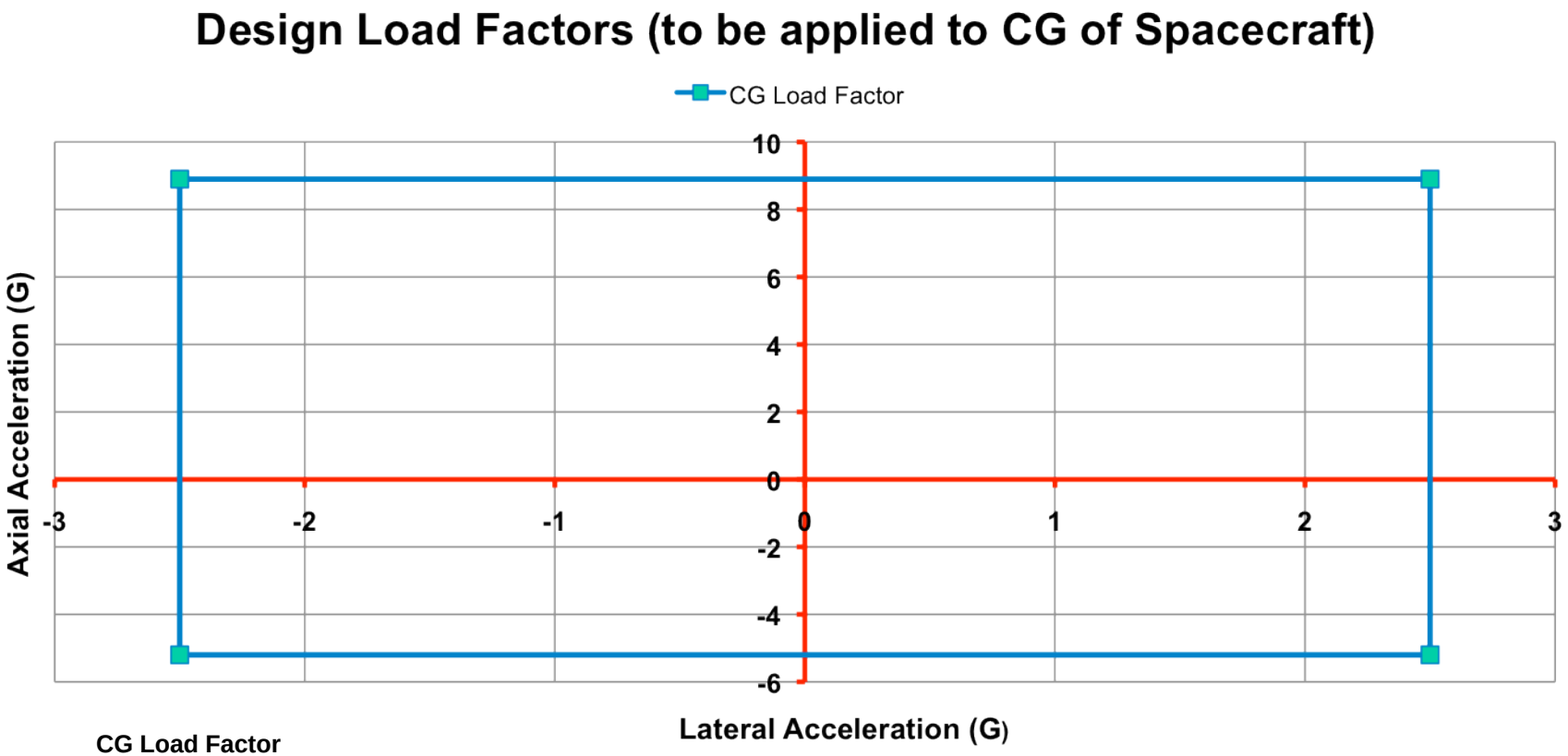
- It is the Launch Service Program's goal to ensure the highest practicable probability of mission success while managing the launch service technical capabilities, budget and schedule.
- Questions must be officially submitted to HQ-Explorers@mail.nasa.gov; LSP will gladly respond as quickly as possible.

Back Up

Environments

- Attached are the combined environment of EX AO for the two options of launch vehicles. The two options are:
  - Option A: Taurus-XL, Falcon 1e, Athena II
  - Option B: Pegasus-XL, Falcon 1, Athena I
- Whenever possible, one enveloping environment is provided. If the resulting envelope is unrealistically conservative, then the bounding vehicle environments (listed as Vehicle A, Vehicle B, …..).
- Please note the following regarding environments:
  - The NLS II contract does not include the shock environment for Athena I and Athena II for a 38” sep system. These are not defined anywhere yet so no shock data for Athena.
  - All Athena (I and II) and Falcon (1 and 1e) numbers are subject to updates with flight data coming for both vehicles.
- All question regarding environment should be directed to the Launch Services Program.

CG Load Factor

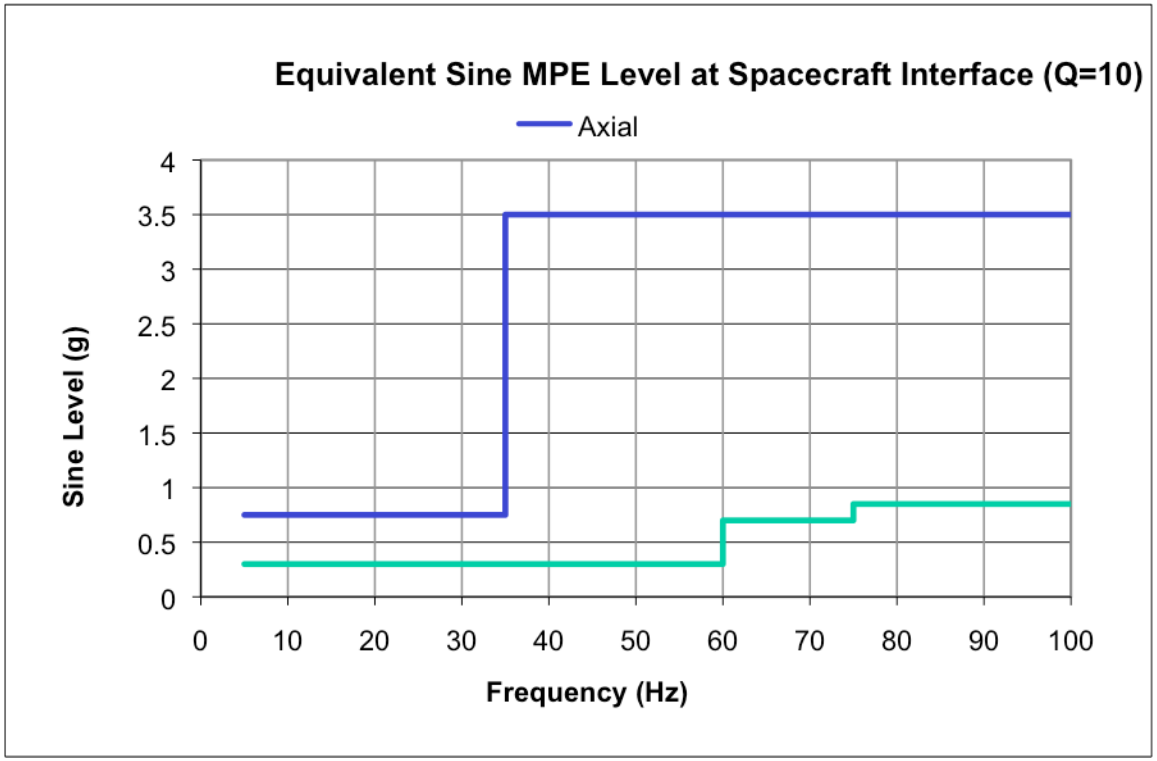


CG Load Factor	
Lateral (g's)	**Axial (g's) ***
-2.5	8.9
2.5	8.9
2.5	-5.2
-2.5	-5.2
-2.5	8.9

* positive sign in axial load factor denotes compression

Environments Option A

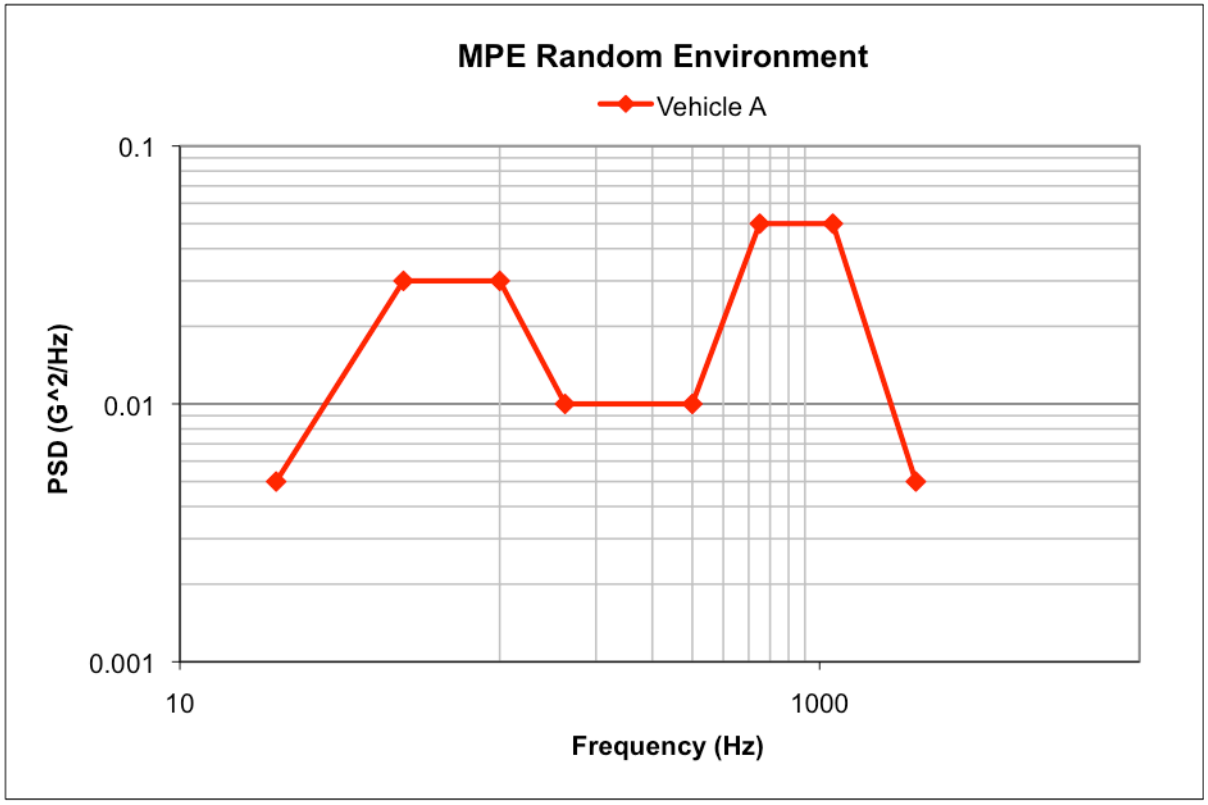
Sine



Equivalent Sine MPE Level at Spacecraft Interface (Q=10)

Frequency (Hz)	Axial	Frequency (Hz)	Lateral
5	0.75	5	0.3
35	0.75	60	0.3
35	3.5	60	0.7
100	3.5	75	0.7
		75	0.85
		100	0.85

Random Vibration



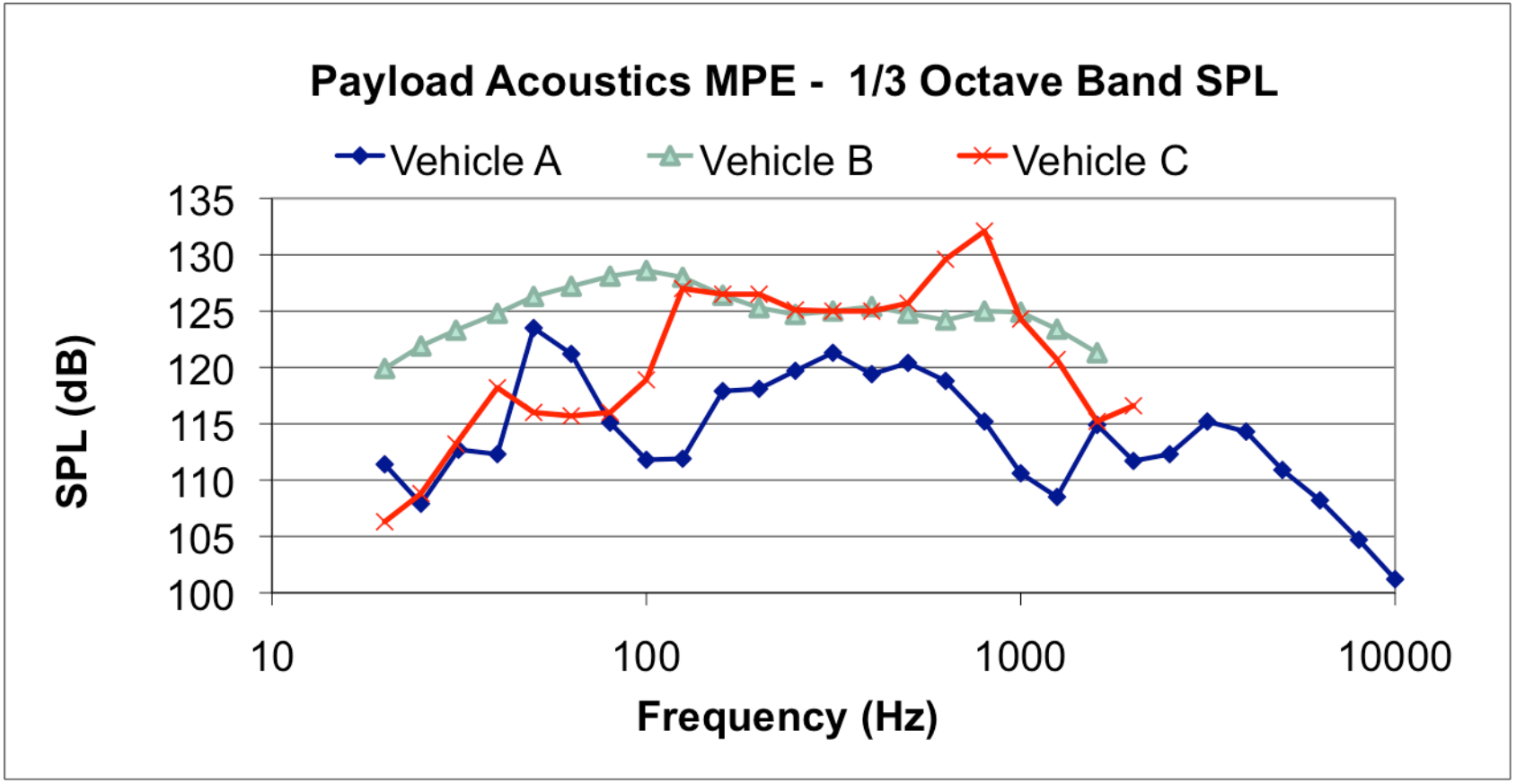
Random MPE Levels at Spacecraft Interface

Vehicle A	
Frequency (Hz)	**PSD (G^2/Hz)**
20	0.005
50	0.03
100	0.03
160	0.01
400	0.01
650	0.05
1100	0.05
2000	0.005

Overall Grms 7.10

Environments
Option A

Acoustics



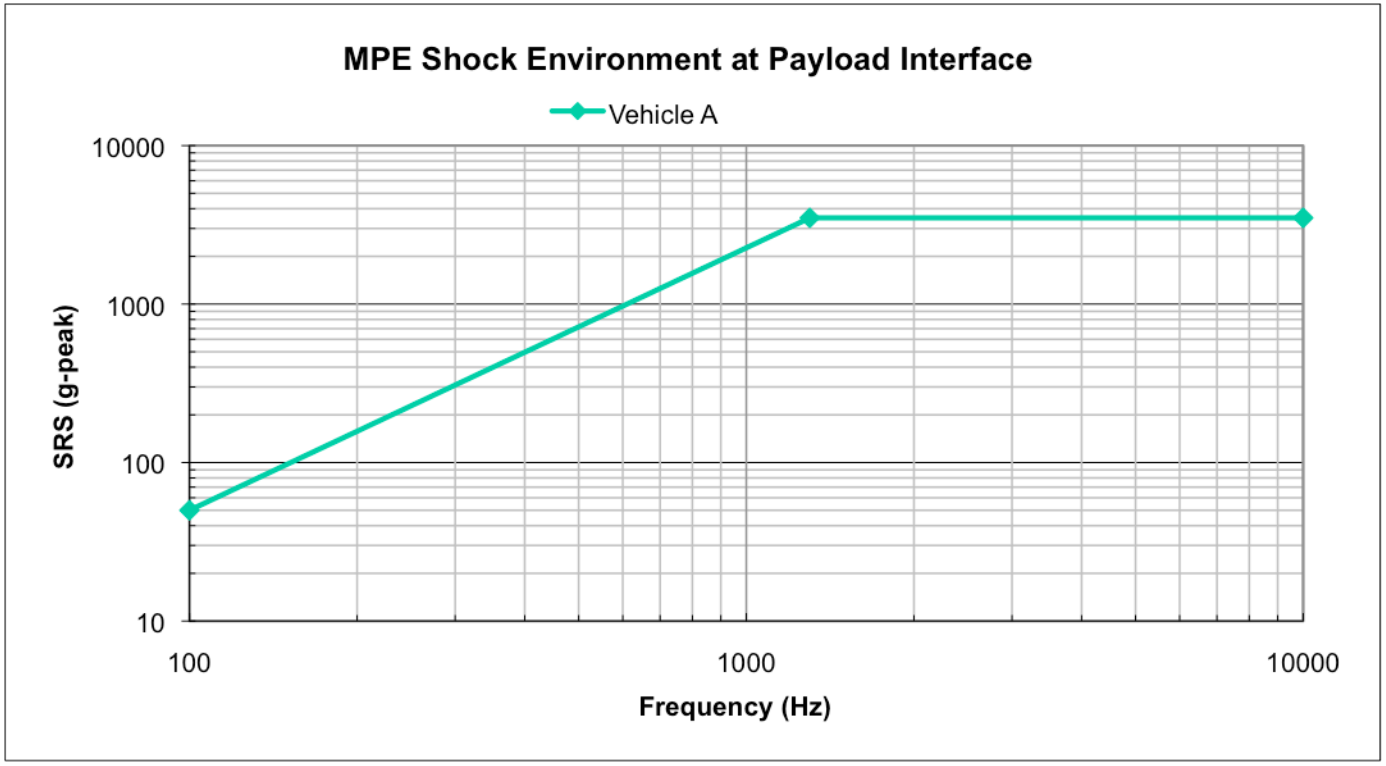
Acoustics

Acoustics MPE Level (1/3 Octave Band SPL)

Vehicle A			Vehicle B			Vehicle C		
Frequency (Hz)	SPL (dB)	to compute OASPL	Frequency (Hz)	SPL (dB)	to compute OASPL	Frequency (Hz)	SPL (dB)	to compute OASPL
12.5								
15.75								
20	111.4	1.38038E+11	20	119.9	9.77237E+11	20	106.3	42657951880
25	107.9	61659500186	25	121.9	1.54882E+12	25	108.8	75857757503
31.5	112.7	1.86209E+11	31	123.3	2.13796E+12	31	113.2	2.0893E+11
40	112.3	1.69824E+11	40	124.8	3.01995E+12	40	118.2	6.60693E+11
50	123.5	2.23872E+12	50	126.3	4.2658E+12	50	116	3.98107E+11
63	121.2	1.31826E+12	63	127.2	5.24807E+12	63	115.7	3.71535E+11
80	115.1	3.23594E+11	80	128.1	6.45654E+12	80	116	3.98107E+11
100	111.8	1.51356E+11	100	128.6	7.24436E+12	100	118.9	7.76247E+11
125	111.9	1.54882E+11	125	128	6.30957E+12	125	127	5.01187E+12
160	117.9	6.16595E+11	160	126.4	4.36516E+12	160	126.5	4.46684E+12
200	118.1	6.45654E+11	200	125.3	3.38844E+12	200	126.5	4.46684E+12
250	119.7	9.33254E+11	250	124.7	2.95121E+12	250	125.1	3.23594E+12
315	121.3	1.34896E+12	315	125	3.16228E+12	315	125	3.16228E+12
400	119.4	8.70964E+11	400	125.4	3.46737E+12	400	125	3.16228E+12
500	120.4	1.09648E+12	500	124.8	3.01995E+12	500	125.7	3.71535E+12
630	118.8	7.58578E+11	630	124.2	2.63027E+12	630	129.6	9.12011E+12
800	115.2	3.31131E+11	800	125	3.16228E+12	800	132.1	1.62181E+13
1000	110.6	1.14815E+11	1000	124.9	3.0903E+12	1000	124.3	2.69153E+12
1250	108.5	70794578438	1250	123.4	2.18776E+12	1250	120.7	1.1749E+12
1600	114.9	3.0903E+11	1600	121.3	1.34896E+12	1600	115.2	3.31131E+11
2000	111.7	1.47911E+11	2000			2000	116.6	4.57088E+11
2500	112.3	1.69824E+11	2500			2500		
3150	115.2	3.31131E+11	3150			3150		
4000	114.3	2.69153E+11	4000			4000		
5000	110.9	1.23027E+11	5000			5000		
6300	108.2	66069344801	6300			6300		
8000	104.7	29512092267	8000			8000		
10000	101.2	13182567386	10000			10000		
		131.1356259			138.4498812			137.7920953

Environments
Option A

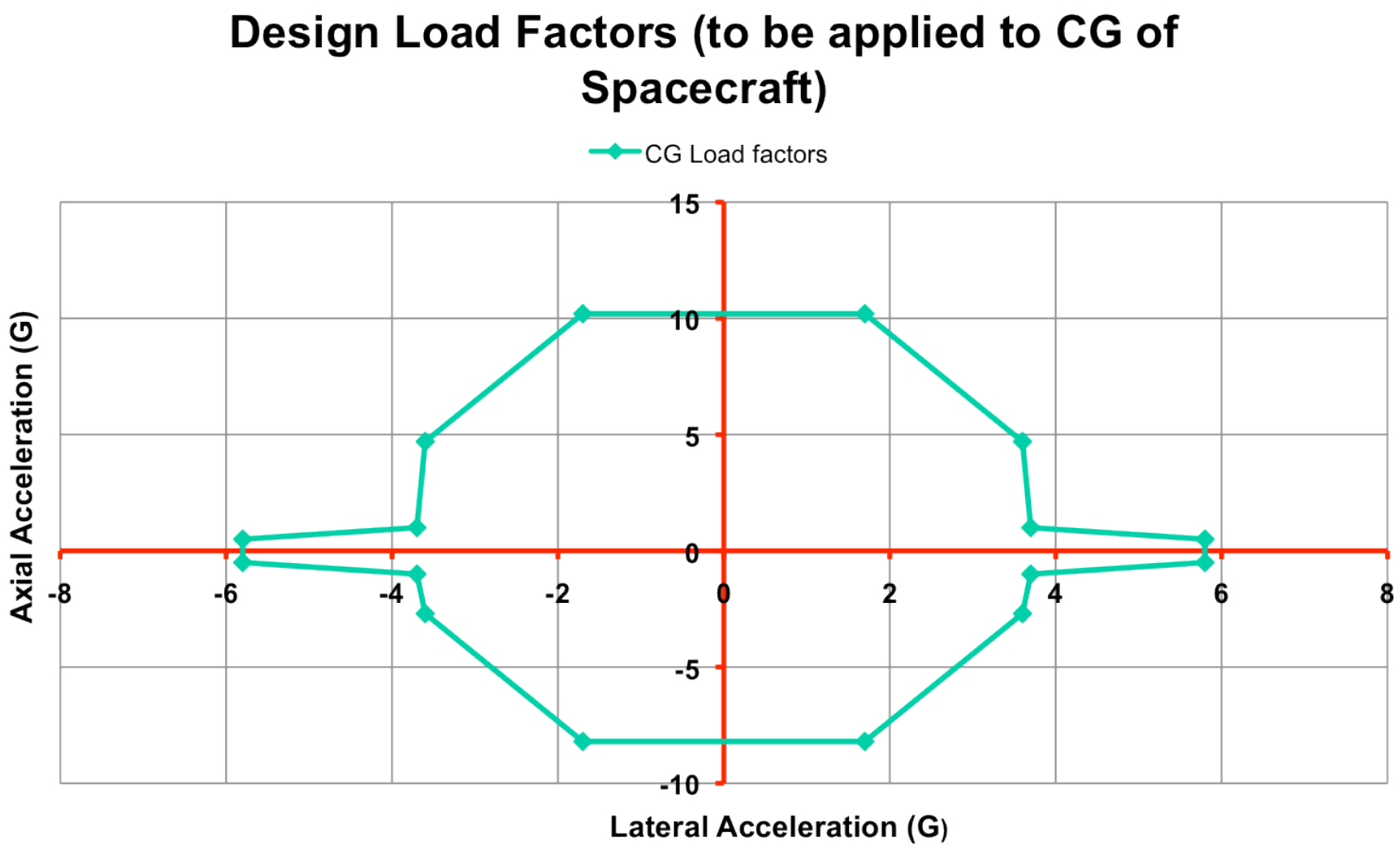
Shock



Shock MPE Levels at Spacecraft Interface

Vehicle A	
Hz	**SRS (g-peak)**
100	50
1300	3500
10000	3500

CG Load Factor



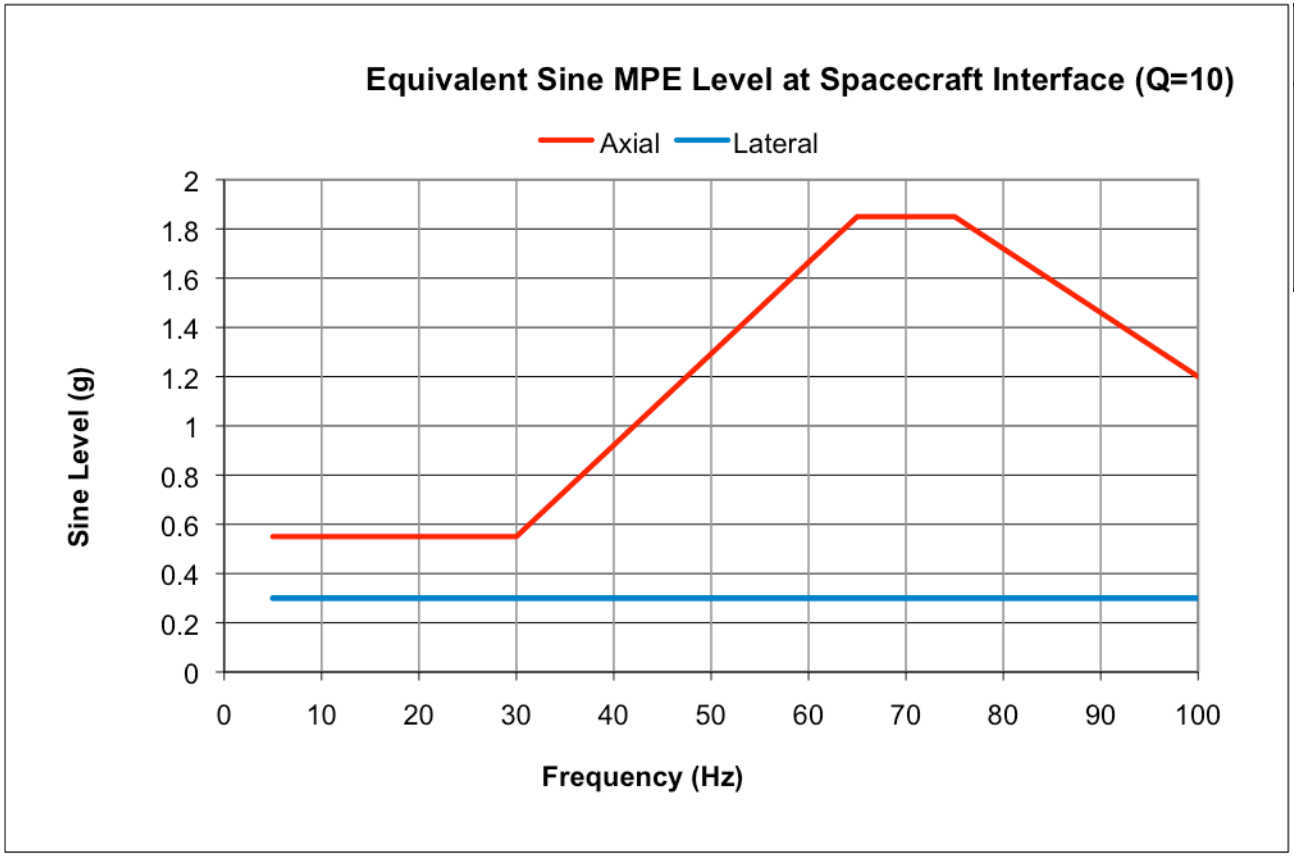
CG Load factors

Lateral (g's)	Axial (g's) *
1.7	10.2
3.6	4.7
3.7	1
5.8	0.5
5.8	-0.5
3.7	-1
3.6	-2.7
1.7	-8.2
-1.7	-8.2
-3.6	-2.7
-3.7	-1
-5.8	-0.5
-5.8	0.5
-3.7	1
-3.6	4.7
-1.7	10.2
1.7	10.2

* positive sign in axial load factor denotes compression

Environments
Option B

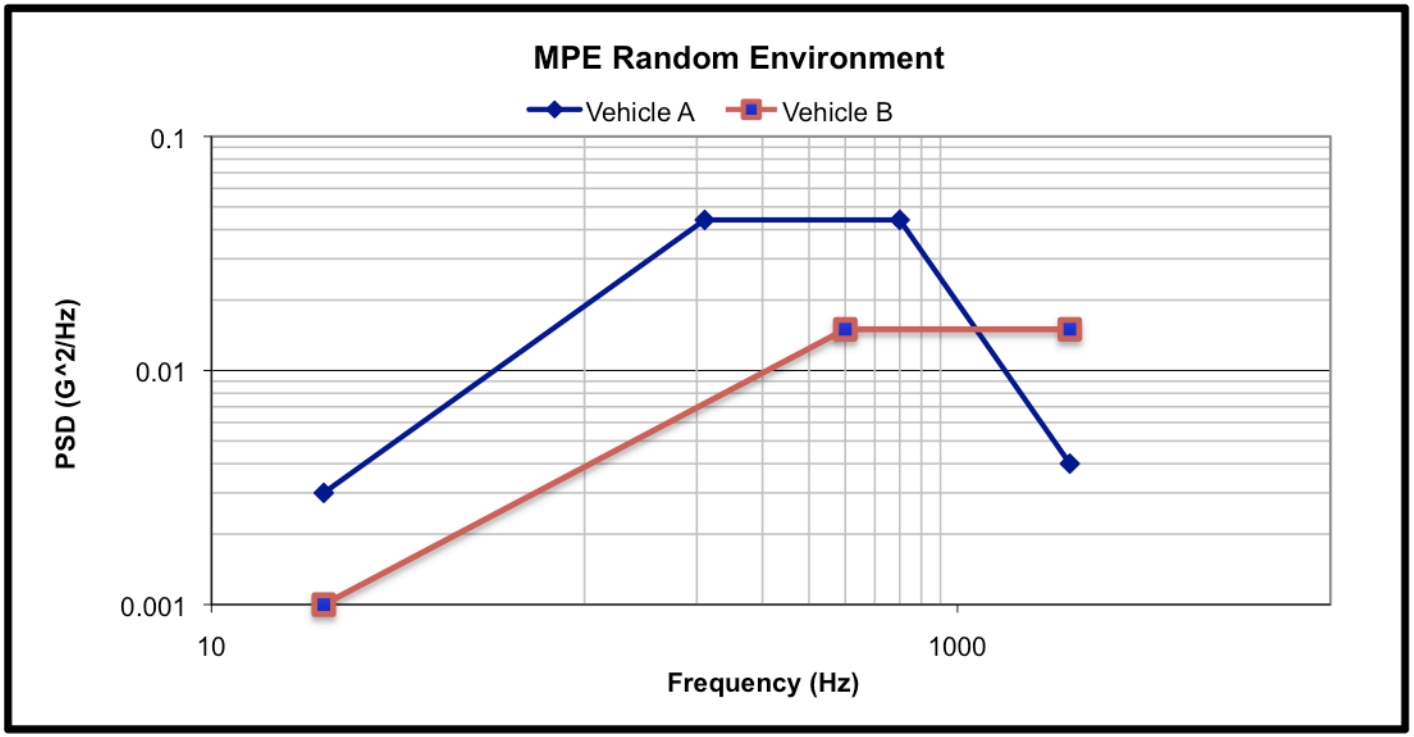
Sine



Equivalent Sine MPE Level at Spacecraft Interface (Q=10)

Frequency (Hz)	Axial	Lateral
5	0.55	0.3
30	0.55	0.3
65	1.85	0.3
75	1.85	0.3
100	1.2	0.3

Random Vibration

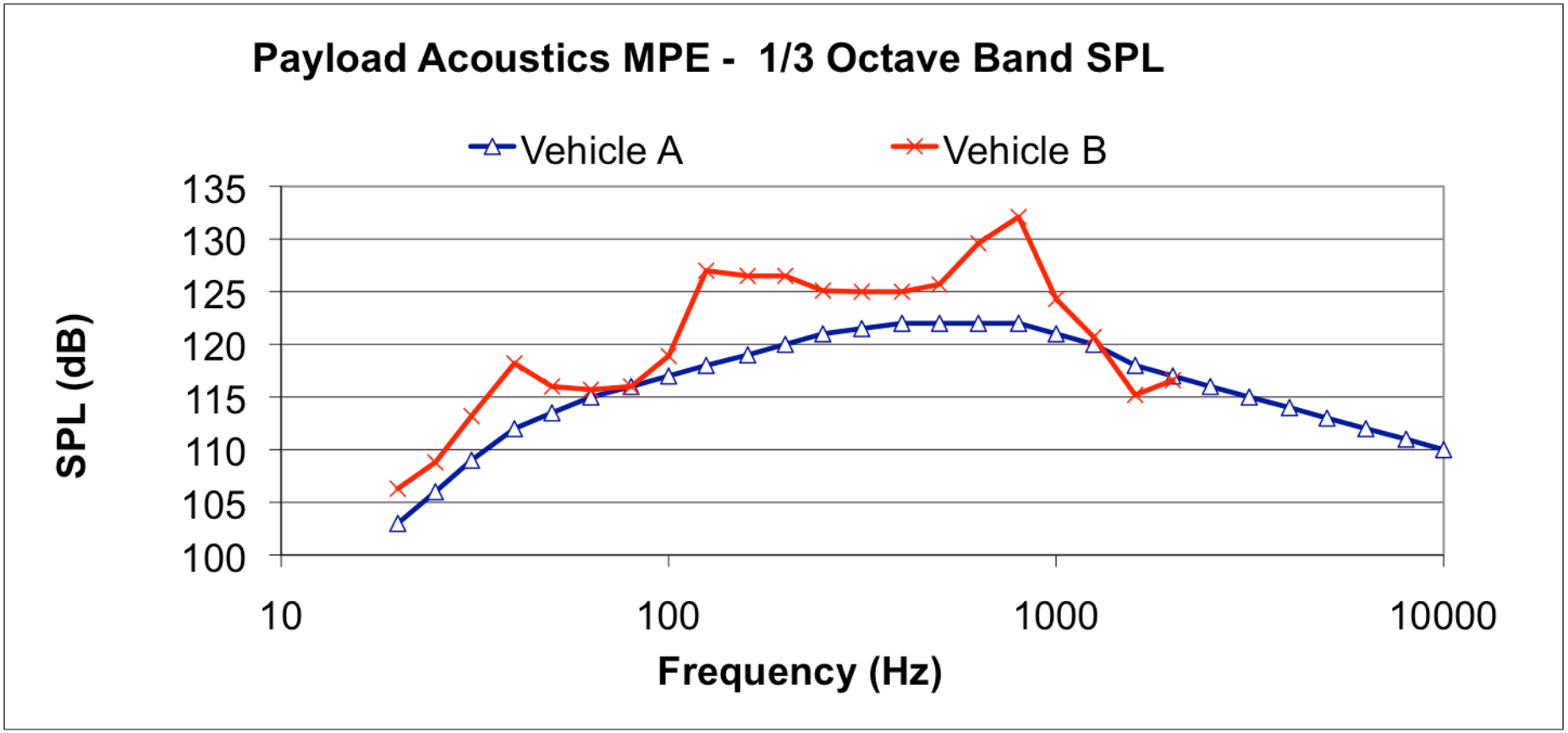


Vehicle A		Vehicle B	
Frequency (Hz)	PSD (G^2/Hz)	Frequency (Hz)	PSD (G^2/Hz)
20	0.003	20	0.001
210	0.044	500	0.015
700	0.044	2000	0.015
2000	0.004		
Overall Grms	6.50		5.15

Random MPE Levels at Spacecraft Interface

Environments
Option B

Acoustics



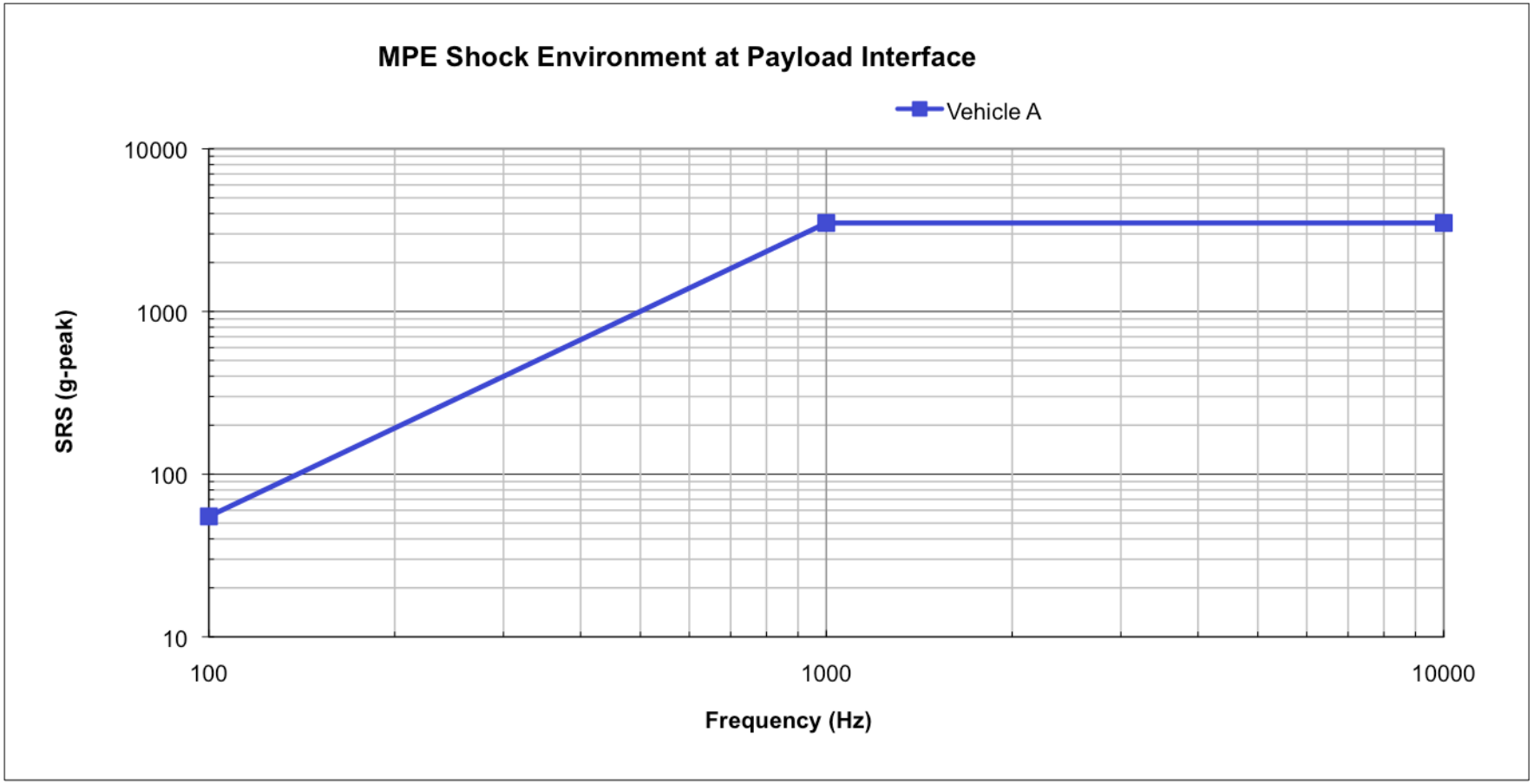
Acoustics

Acoustics MPE Level (1/3 Octave Band SPL)

Vehicle A			Vehicle B		
Frequency (Hz)	SPL (dB)	to compute OASPL	Frequency (Hz)	SPL (dB)	to compute OASPL
20	103	19952623150	20	106.3	42657951880
25	106	39810717055	25	108.8	75857757503
31	109	79432823472	31	113.2	2.0893E+11
40	112	1.58489E+11	40	118.2	6.60693E+11
50	113.5	2.23872E+11	50	116	3.98107E+11
63	115	3.16228E+11	63	115.7	3.71535E+11
80	116	3.98107E+11	80	116	3.98107E+11
100	117	5.01187E+11	100	118.9	7.76247E+11
125	118	6.30957E+11	125	127	5.01187E+12
160	119	7.94328E+11	160	126.5	4.46684E+12
200	120	1E+12	200	126.5	4.46684E+12
250	121	1.25893E+12	250	125.1	3.23594E+12
315	121.5	1.41254E+12	315	125	3.16228E+12
400	122	1.58489E+12	400	125	3.16228E+12
500	122	1.58489E+12	500	125.7	3.71535E+12
630	122	1.58489E+12	630	129.6	9.12011E+12
800	122	1.58489E+12	800	132.1	1.62181E+13
1000	121	1.25893E+12	1000	124.3	2.69153E+12
1250	120	1E+12	1250	120.7	1.1749E+12
1600	118	6.30957E+11	1600	115.2	3.31131E+11
2000	117	5.01187E+11	2000	116.6	4.57088E+11
2500	116	3.98107E+11	2500		
3150	115	3.16228E+11	3150		
4000	114	2.51189E+11	4000		
5000	113	1.99526E+11	5000		
6300	112	1.58489E+11	6300		
8000	111	1.25893E+11	8000		
10000	110	1E+11	10000		
		132.0583433			137.7920953

Environments
Option B

Shock



Shock MPE Levels at Spacecraft Interface

Vehicle A	
Hz	**SRS (g-peak)**
100	55
1000	3500
10000	3500

Evaluation

- **Launch Service Technical Evaluation:**
  - **Overall Assessment: - Given the ground rules in the AO, is the proposed launch vehicle (LV) concept feasible for this application? (Yes or No)**
  - **Comments:**_____
    _____
    _____
- **LV Performance: Area of 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):** _____ : _____ .

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)**
  - **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

- **Spacecraft Schedule: Area of concern (Yes or No)**
  - **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: (Yes or No)**
  - **S/C ship date: (Yes or No)**
  - **S/C to LV integrated Operations: (Yes or No)**
- **Missions with Radiological material Area of concern (Yes or No)**
  - **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)**