

EARTH'S BRIDGE TO SPACE

LSP

LAUNCH

SERVICES

PROGRAM

MISSION STATEMENT

Leadership and expertise
in providing on-time,
on-orbit and on-cost
launch services.

Agenda

General LSP
information

LSP CCE Spacecraft
support for
Contamination
Control and
Planetary Protection



OFFICE OF DIVERSITY AND EQUAL OPPORTUNITY

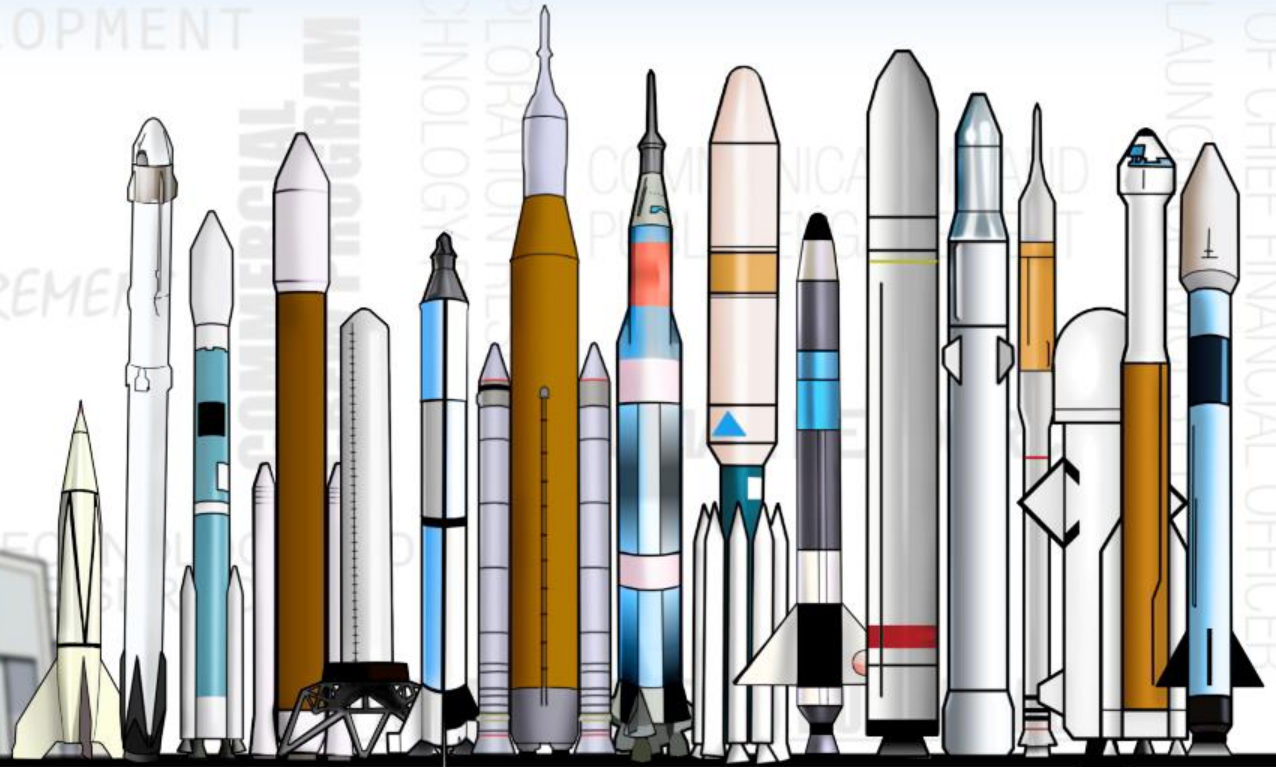
MISSION ASSURANCE

CENTER FOR PLANNING AND DEVELOPMENT

TECHNOLOGY AND EXPLORATION

OFFICE OF QUALITY CONTROL

LAUNCH OPERATIONS OFFICER
OFFICE CHIEF FINANCIAL OFFICER



KSC IS GO TOGETHER

Launch Services Program - Earth's Bridge to Space

Procure and Manage Launch Services and Payload Processing Facilities for NASA and NOAA

- Primary Missions
- Advisory Missions
- CubeSat rides to Space

U.S. Launch Vehicles Expertise

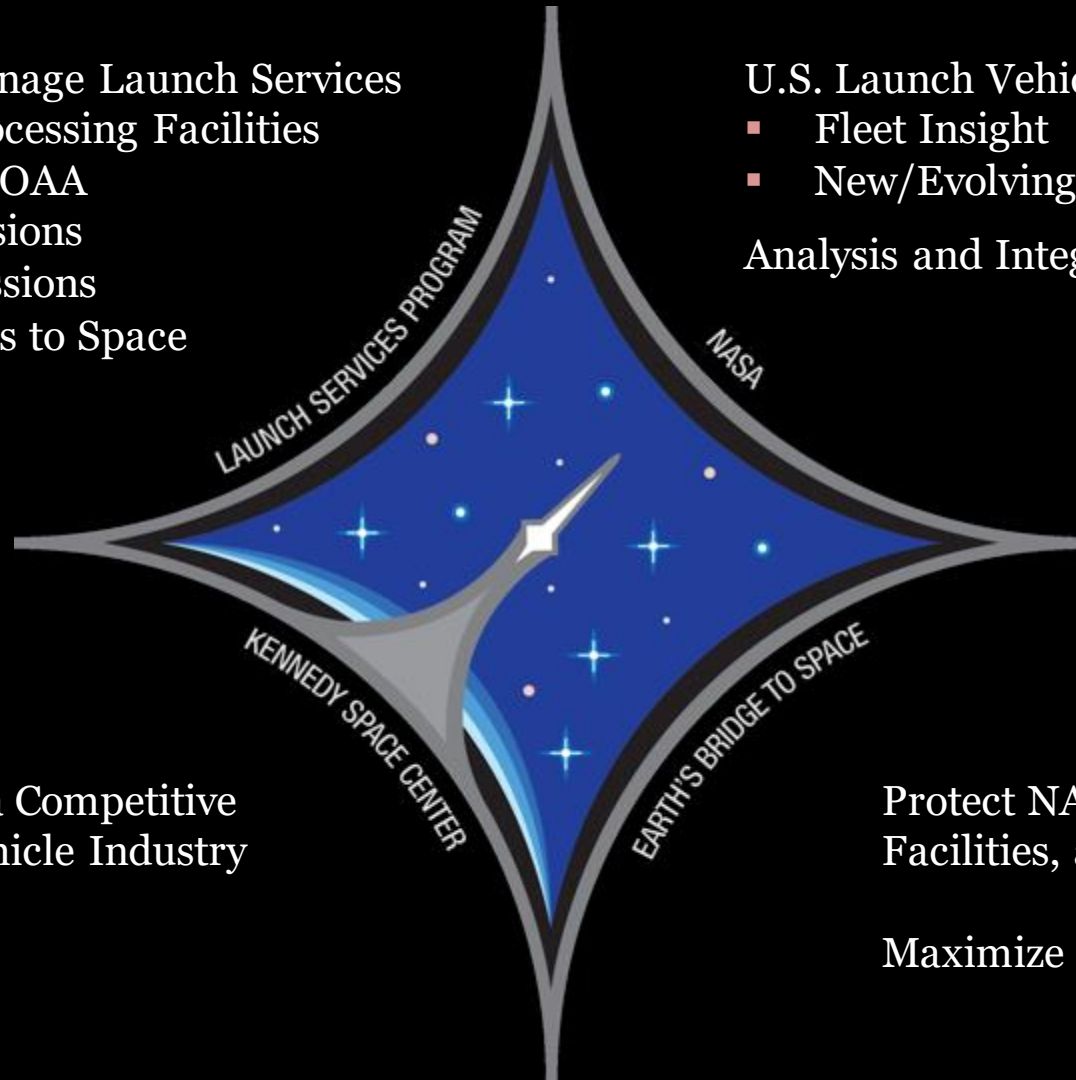
- Fleet Insight
- New/Evolving Rockets

Analysis and Integration Expertise

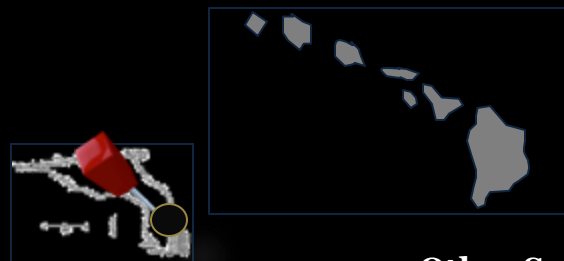
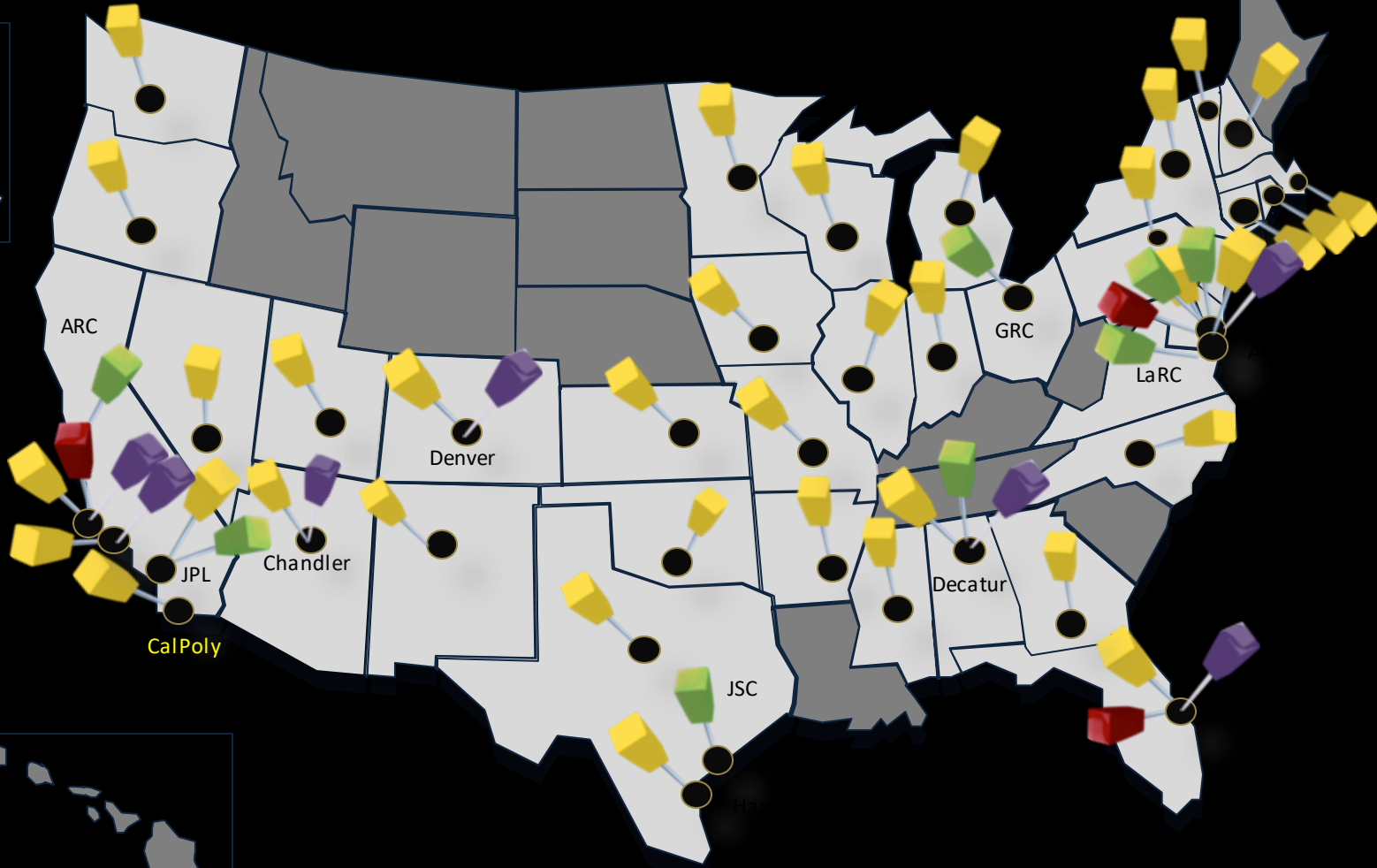
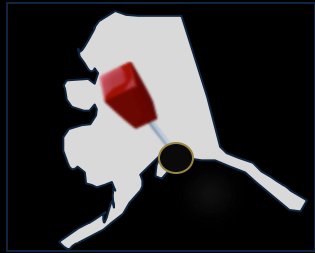
Help Maintain a Competitive U.S. Launch Vehicle Industry







Protect NASA Personnel, Facilities, and Hardware

Maximize Mission Success



Launch Services Program Locations



-  **Other Supplier Locations:**
Germany, Japan, Sweden,
Ukraine, Russia, & Switzerland
-  **Other Customer Locations:**
France & Argentina
-  **Launch Sites**
-  **Supplier Locations**
-  **Customer Locations**
-  **Resident Office Locations**

Seek to understand all viable US LV's for potential future use

Vehicles On Contract to LSP



Pegasus XL



Minotaur- C
Formerly Taurus XL



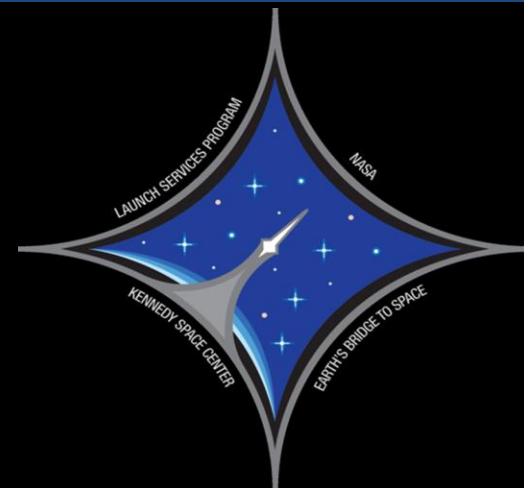
Atlas V



Delta II



Delta IV
Heavy



Certified*

Not Yet Certified*



RL
Electron

VG
LauncherOne



Antares



Falcon 9 FT



Delta IV



Falcon Heavy

Emerging Vehicles

Blue Origin
(New Glen)
Stratolauncher
ULA (Vulcan)
Super Strypi

*Launch certification is meant to understand and possibly mitigate risks; not to ensure every last item and process is reviewed on every launch vehicle. Governed by NASA Policy Directive (NPD) 8610.7, Launch Services Risk Mitigation Policy for NASA-Owned or NASA-Sponsored Payloads.

Where We Launch



Wallops

Kwajalein

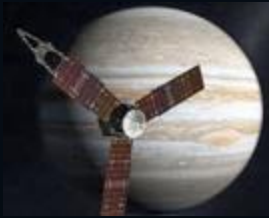
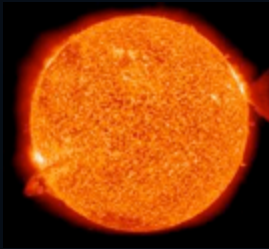
Cape Canaveral

Vandenberg

Kodiak

High Level LSP Mission Support

End to End Mission Support
(Pre-Mission Planning to
Post Launch Support)

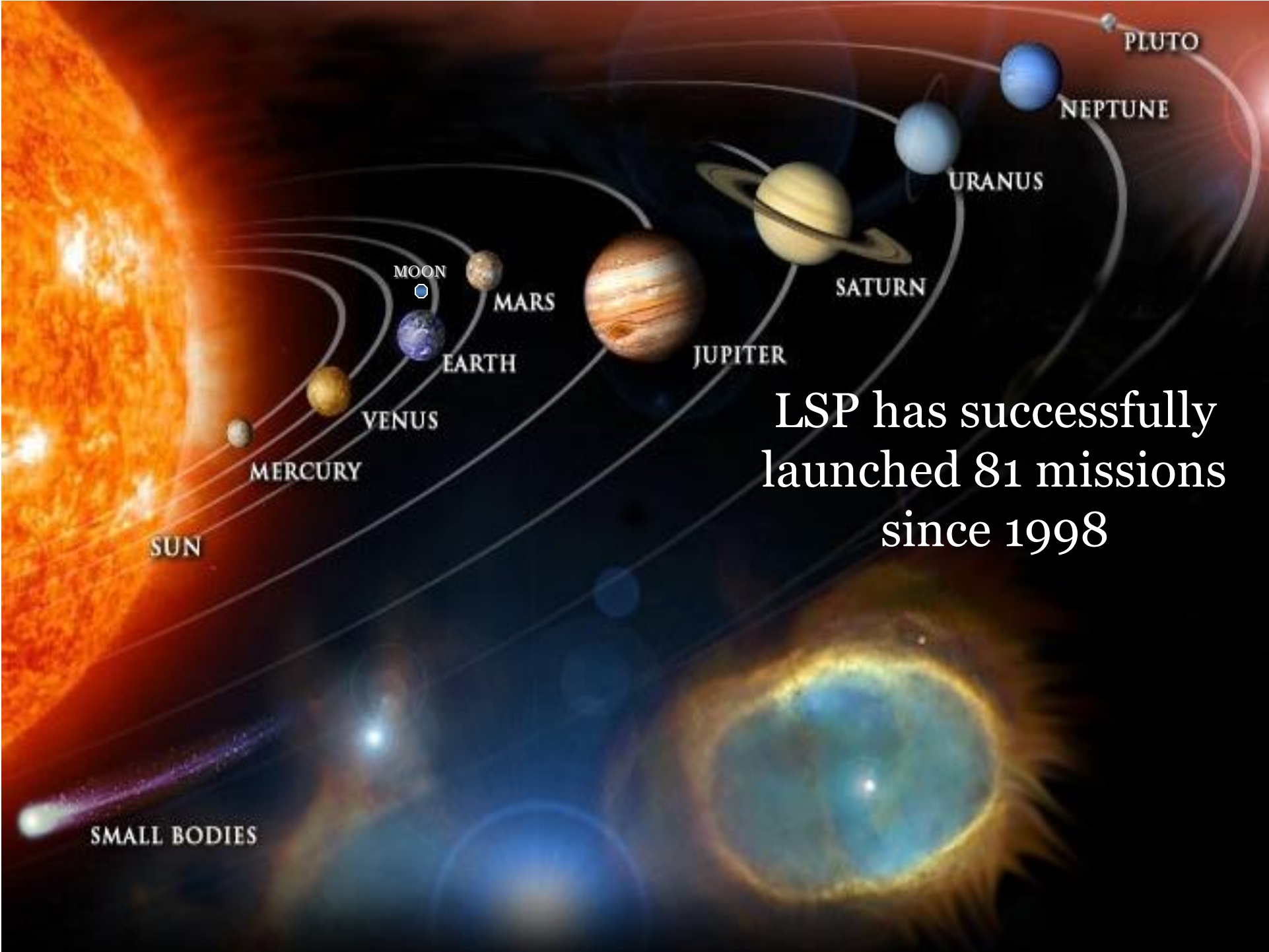


Advisory Services
(Tailored mission services
based on customer needs)



Small Payloads (CubeSat and
P-Pod missions)





LSP has successfully
launched 81 missions
since 1998

SMALL BODIES

2017 - 2021 Missions



JPSS-1
2017



ICON
2017



TDRS-M
2017



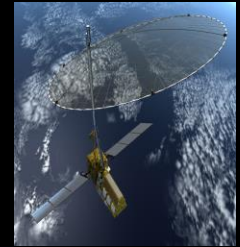
GRACE-FO
(Advisory)
2017



TESS
2018



InSight
2018



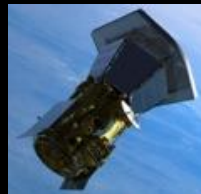
NI-SAR



ICESat-2
2018



GOES-S
2018



Solar Probe Plus
2018



Solar Orbiter
2019



JWST
(Advisory)
2019



GOES-T
2019



MARS-2020
2020



SWOT
2021



Sentinal 6A
2020



IXPE
2020



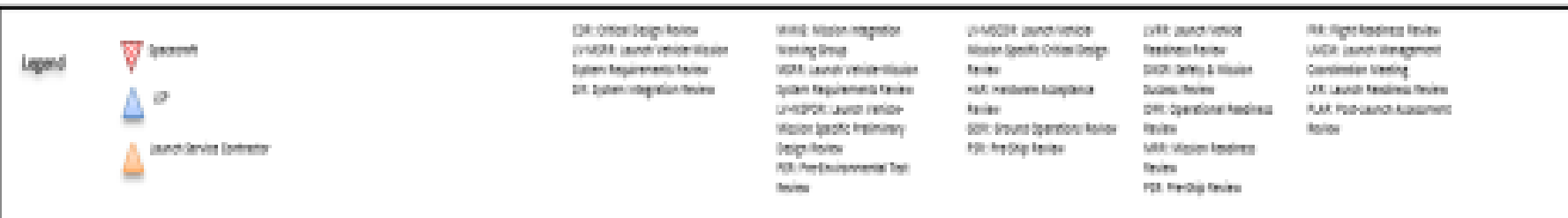
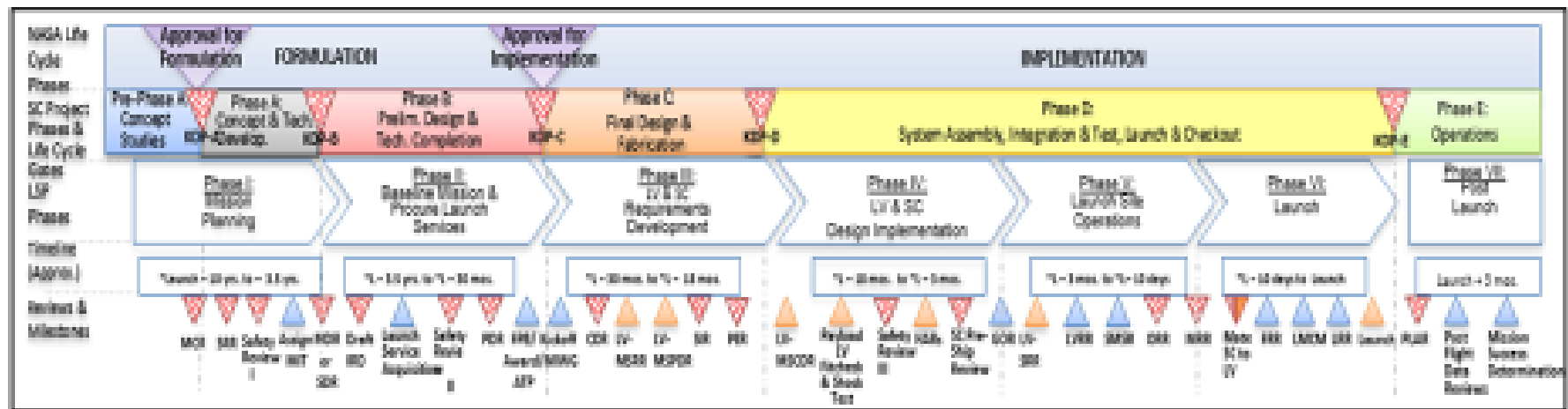
Landsat 9
2021



JPSS-2
2021

Considerations for Launch Service Selection

Business Operating Success Strategies (BOSS)



Considerations for Launch Service Selection

LSP selects Launch services on a best value basis

- Strive to maximize competition
- Requires US launch vehicle from US company
- Balance price, past performance and technical based as defined in RFP

Payload and Launch Vehicle Risk Classification

Vehicle Performance Characteristics

Vehicle Environments

- Structural Loading
- Thermal Heating
- Vibration
- Shock
- RF Emission
- Contamination

Budgetary Constraints

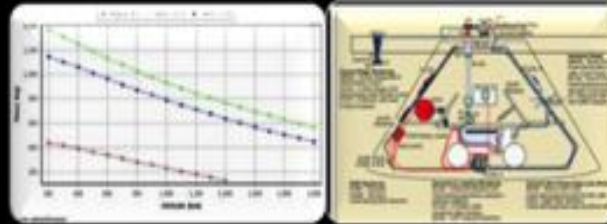


LSP Roles and Responsibilities

Acquire Launch Services



Verify and validate mission engineering and analysis



Manage launch vehicle to spacecraft integration



Insight and Approval of production, integration, testing and processing



Certify launch systems for NASA use

LSP CCE/PPE/M&P goal



LSP CCE/PPE/M&P goal:

To ensure flawless launch site mission requirements and processing, cost savings and risk reduction by productive use of resources.

LSP Contamination Control



STANDARD

LV hardware cleanliness is 2 part. IEST-STD-CC-1246E level 750A and 1.0% obscuration maximum particulate

150 angstroms

PLF ECS air cleanliness ISO 146441 Class 6.7

Cleanroom air cleanliness ISO 146441 Class 8

We need to know if you are Helium sensitive or Silicone sensitive

NON-STANDARD

LV hardware cleanliness is 2 part. IEST-STD-CC-1246E level 500A and .05% obscuration maximum particulate

100 angstroms

Cleanroom air cleanliness ISO 146441 Class 7

NVR and PFOF inside the PLF

GN2 Grade B, C and UHP

Hydrocarbon requirements

LSP Contamination Control



Launch Vehicle First flight

Material verification

Ensuring that the materials used meet the NASA material requirements for offgassing and outgassing

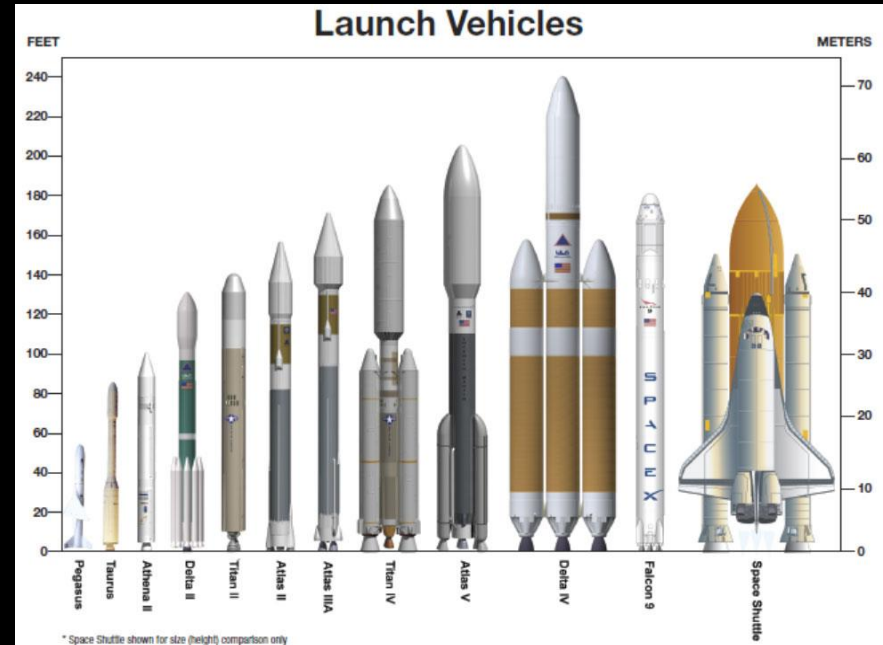
Cleanliness verification

Ensuring that the hardware can meet the cleanliness of standard and non standard launch vehicle IEST-STD-CC1246 cleanliness

Planetary Protection verification

Is the material capable of meeting the planetary protection requirements

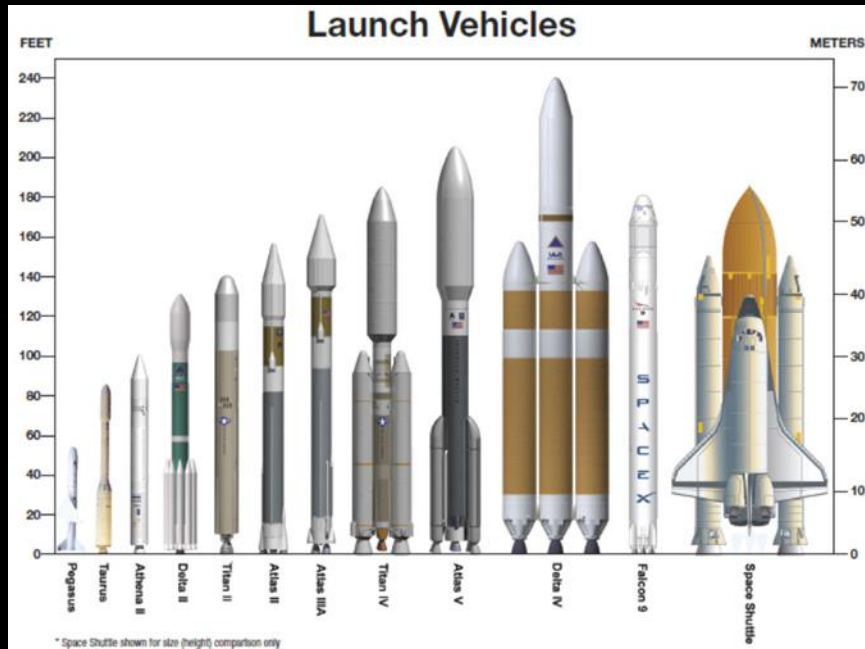
We have supported one organic contamination mission and future certification will include the polyamide materials limitations



LSP Contamination Control



Prior to picking a LV



Assist the NASA integration Engineer and Mission Manager

Reviewing mission contamination and planetary protection requirements in the IRD

IRD - Interface Requirements Document spacecraft built

LSIRD - Launch Service Integration Requirement Document
Down size of the IRD

NASA will then go into a "black-out" for the Launch Services Technical Order (LSTO) for selection of the launch service provider.

Start communication with the mission lead CCE is to start our support

LSP Contamination Control

Requirements and documents



- **Building requirements:**
 - Launch Service Integration Requirement Document (LSIRD)
 - Launch Site Support Plan (LSSP)
 - Launch Site Contamination Control Plan due at L-7m (LSCCP)
 - Launch Site Planetary Protection Plan due at L-7m (LSPPP)
 - Various launch vehicle requirement memo's/plans
 - Interface Control Document (ICD)
 - Technical review of TA's/SOW's

- **Reviewing documents**
 - LV Drawings
 - SC Purge Plan
 - Non-conformance documentation
 - LV CCP's
 - PPF CCP's
 - LV Documentation – Cleaning, sampling analysis, and quality stamps
 - LV MU & generic contamination analysis

LSP Contamination Control

Support the CCEWG meetings @ L-2/4 Years



Support launch site questions

Learn about the mission

Discuss facility updates

Discuss launch vehicle updates

Identify possible mission unique items that are not documented

Establish key requirements to avoid last minute task orders

- GN2 purge cleanliness

- Clean enclosures

- mission unique hardware cleanliness

- Silicone cleanliness

- Purge filters

LSP Contamination Control

Launch vehicle



Support first flight item review

GN2 certification/hardware cleanliness

Provide LV documentation

Review ECS data daily

Review mission specific documentation

- Task Assignments

- Statement Of Work

- Clean tent designs

- Material reviews



Flight hardware inspections/environmental samples

- Payload Fairing

- Payload adapter

- Payload attach fitting

- Isolation system

- Pre-blanket install

- Post-blanket install

- MLI blankets

- Spacecraft can

- Isolation diaphragm

- Contingency inspections

- post-cleaning when applicable

LSP Contamination Control



PPF - Payload Processing Facility



- Support facility readiness walkdowns
- Address facility contamination issues
- Hardware arrival support
- Recommendations on protocols
- HVAC and purge support
- Facility modification support
- SC arrival
- Media Day support
- Verify GN₂ certifications
- Daily data review
- Laminar Flow Enclosure (LFE) certification
- Materials involvement
 - Work with M&P and safety to ensure approved materials are used during operations (i.e. bagging material, tape, caulk, etc.)

LSP Contamination Control

Meetings to support



- Mission Integration Working Group (MIWG)
- Ground Operation Working Group (GOWG)
- Ground Operation Review (GOR)
- Mission Specific Critical Design Reviews (MSCDR)
- Mission Specific Program Design Review (MSPDR)
- Launch Vehicle Readiness Review (LVRR)
- Launch Readiness Review (LRR)
- Technical Interchange Meetings (TIM's)
- Mission Integration Telecoms (MIT)
- LV integrated Readiness Review
- Vehicle Tag-ups
- Daily mission meetings during the launch campaign
- Ground Operation Telecoms (GOT)
- Test Readiness Reviews (TRR)
- LV Daily Coordination Meetings (DCM)
- Engineering Review Boards (ERB)
- Spacecraft Contamination Control Engineering Working Group (CCEWG)



*Other meetings as requested – Team building, after meeting functions and
LAUNCH PARTIES*

LSP Contamination Control



Other responsibilities

purge support activity

Hurricane plans

Assist with troubleshooting issues

Material evaluation

Organic Contamination

Control burns

Planetary Protection Engineering support



Tip of a needle →



All of the bacteria allowed on the InSight mission would fit on the tip of this needle

Surgeons protect patients from bacteria



PP protects spacecraft's from bacteria



Planetary Protection Engineering support



-
- Cat V**
- Missions involving a SC or component returning to Earth
 - Protects Earth from backwards contamination
 - Two subcategories
 - “Unrestricted Earth Return”- missions to bodies deemed to have no life forms
 - “Restricted Earth Return”- highest degree of concern, need for containment of all components throughout return phase
-
- Cat IV**
- Involves entry probes, landers and rovers to bodies of chemical interest.
 - Detailed documentation, bioassays to enumerate the burden, probability of contamination, inventory bulk and more procedures to minimize contaminates
 - Sterilization of spacecraft may be necessary
-
- Cat III**
- Target body is of chemical evolution or origin-of-life interest and there is significant chance of contamination
 - More documentation than Cat II, trajectory biasing, clean rooms must be used
-
- Cat II**
- Missions to bodies that hold significant interest in understanding origin of life but there is only a remote chance that contamination carried by SC could jeopardize future missions.
 - Simple documentation required to specify intended or potential impact targets and briefings will occur should an inadvertent impact occur
-
- Cat 1**
- Target body is of chemical evolution or origin-of-life interest and there is significant chance of contamination
 - More documentation than Cat II, trajectory biasing, clean rooms must be used
-

Planetary Protection Engineering support



LSP Planetary Protection at the Launch Site

Facilitate and assist with Planetary Pathfinders – New launch vehicles or facilities

Assist JPL PPE by developing the Launch Site Planetary Protection/Contamination Control Plan

Assist in developing the LV and facility PP Sampling Plan

Work with LV/SC/PPF personnel to develop schedules based on above PP plans

Work with PPE to develop planetary protection training

Support the PP team with taking/processing samples and counting colony



KSC Labs Testing and Analysis Capabilities for Spacecraft/Payload Processing Support

Materials Testing per NASA-STD-6001 and KSC/MMA-1985-79:

- Flammability
- Offgassing
- Hypergolic ignition/breakthrough
- Electrostatic Discharge (ESD)

Sampling and Identification of contaminants, residual or particulate:

- Tape lifts, filters, or wipes as appropriate for sample collection
- FTIR, SEM/EDS and other microscopy methods

Mechanical Testing:

- Hardness
- Tensile
- Metrology

Failure Analysis



To Learn More About LSP

YouTube Videos

Earth's Bridge to Space

ELaNa Educational Launch of
Nano Satellites

NASA's Mars Science
Laboratory (MSL) Final
Countdown to Launch

Mobile Apps

Rocket Science 101

Social Media

Twitter
@NASA-LSP

Facebook
www.facebook.com/NASALSP



<http://www.nasa.gov/centers/kennedy/launchingrockets/index.html>

To Learn More About VENCORE™



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Kennedy Space Center, FL
Jet Propulsion Laboratory, CA
NASA IV&V Facility, WV
USAF SMC, CA
Intelligence Community customer sites



RESPECT

ACCOUNTABILITY

DEDICATION

IMPROVEMENT

INTEGRITY