JOHN F. KENNEDY SPACE CENTER

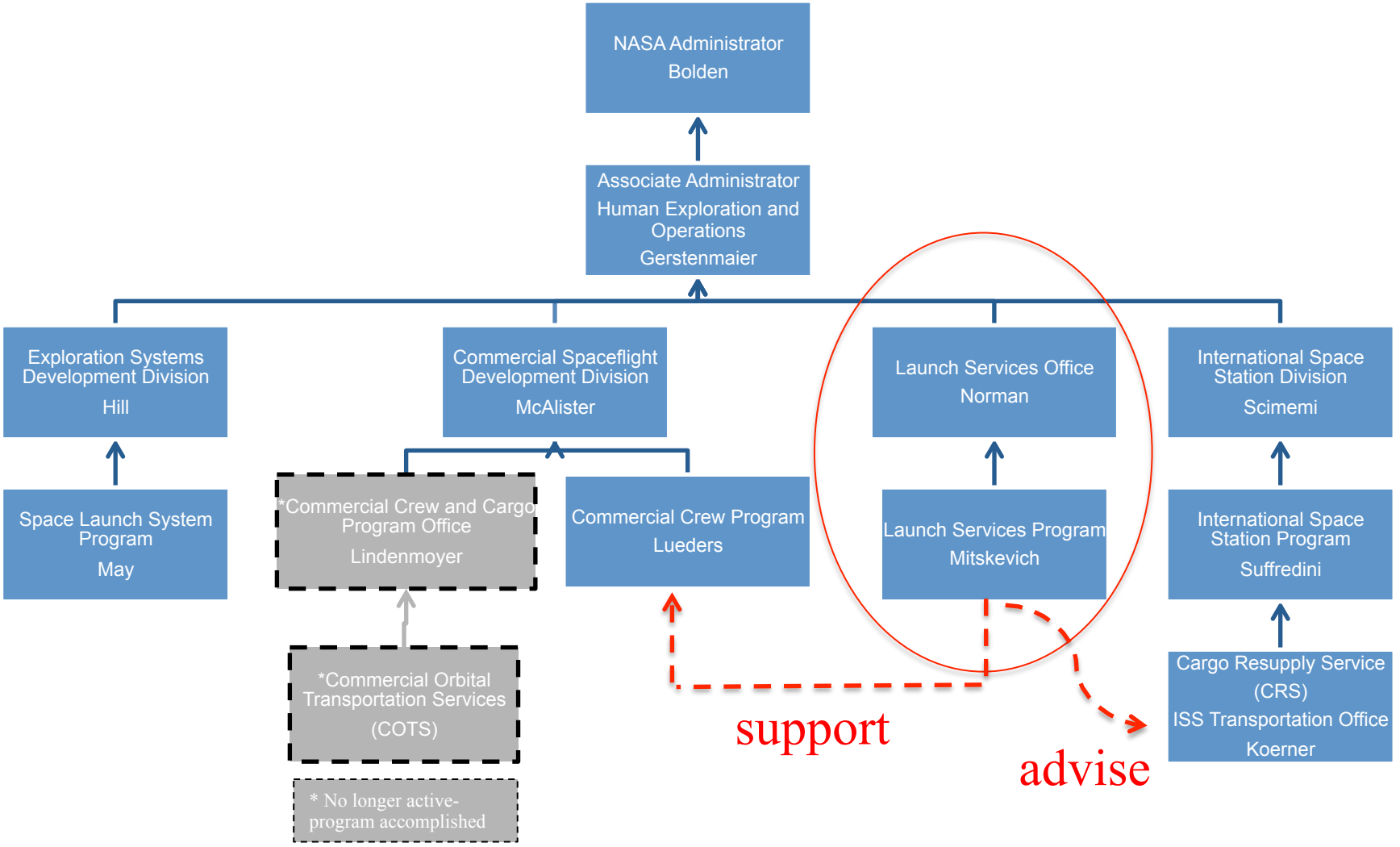
LAUNCH SERVICES PROGRAM

# NASA
# LAUNCH SERVICES OVERVIEW
# TO
# NASA ADVISORY COUNCIL

**July 27, 2015**

**Darren Bedell**
**Jim Norman**

Purpose: Provide an overview of the NASA's Launch Services Program and the relation to Commercial Resupply Services efforts and the Commercial Crew Program




NASA Space Launch Chain of Command

# Launch Services Program Overview

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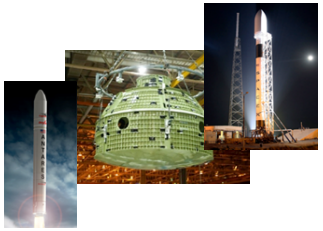
## Commercial Acquisition Expertise

Commercial Space Act of 1998 (est. 1984)
National Space Policy 2010
National Space Transportation Policy 2013

NLS

Insight & Approval

One-Off Solar Probe Plus (SPP)



Advisory Services

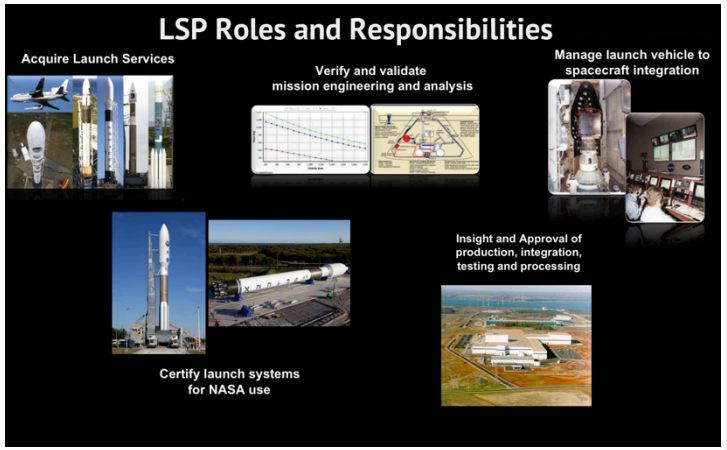
## Formalized Government Collaboration

Memorandum of Understanding – March 2011
Government ELV Executive Board, GEEB (Quarterly)
USAF-NASA-NRO Summit

## Program Management, Analysis, Engineering, Integration, & Launch Operations

**Experience:** technical, stable civilian workforce, 259 civil servants &180 contractors, 15+ years average in launch

**Consistency:** 79 full missions + advisory




**On Orbit**
- Technical Assessment
- Launch Mgmt. w/ "GO" for Launch
- 97+% Mission Success rate

**On Time**
- Mission Management
- Risk Management

**On Cost**
- Success in Fixed Price Contract Mgmt.

# LSP's Current and Future Fleet

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## Certified*

### Vehicles On Contract

Pegasus XL

Minotaur- C
Formerly Taurus XL

Atlas V
**

Delta II

Falcon 9 v1.1

### Launch Sites


## Not Yet Certified*

Antares
**

Athena Ic

Athena IIc

Delta IV Heavy

Delta IV

### Emerging Vehicles

Falcon Heavy
and
Falcon 9 Full Thrust

Antares 230
Athena IIS
Blue Origin
Firefly Alpha
GOLauncher2
RL Electron
Stratolauncher
Super Strypi
ULA NGLS
VG LauncherOne

**Governed by NASA Policy Directive (NPD) 8610.7, Launch Services Risk Mitigation Policy for NASA-Owned or NASA-Sponsored Payloads.*

***NASA is not prohibited from acquiring launch services that use Russian Engines*

# LSP Business Operating Success Strategies

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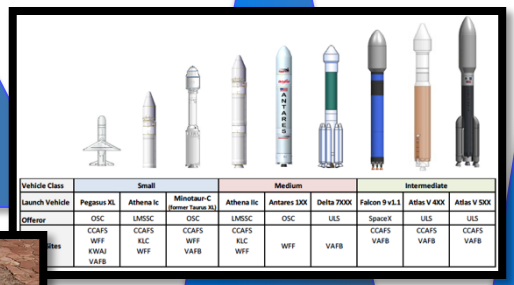
## Mission Life Cycle

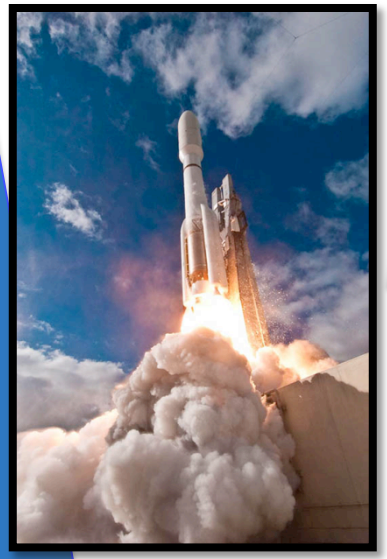
PRE-MISSION PLANNING → MISSION PLANNING → BASELINE MISSION & PROCURE LAUNCH SERVICES → L/V & S/C ENGINEERING MANUFACTURING → LAUNCH SITE OPS & LAUNCH CAMPAIGN → LAUNCH → POST LAUNCH

L-10yrs to L-4yrs



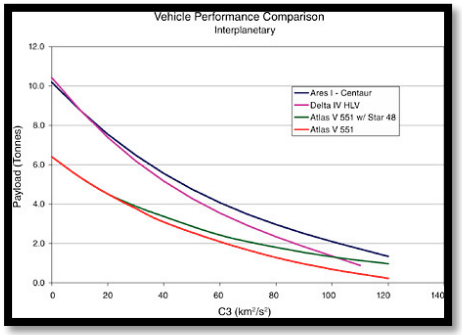
| Vehicle Class | Small | | | Medium | | | Intermediate | | |
|---|---|---|---|---|---|---|---|---|---|
| Launch Vehicle | Pegasus XL | Athena Ic | Minotaur-C (former Taurus XL) | Athena IIc | Antares 1XX | Delta 7XXX | Falcon 9 v1.1 | Atlas V 4XX | Atlas V 5XX |
| Offeror | OSC | LMSSC | OSC | LMSSC | OSC | ULS | SpaceX | ULS | ULS |
| Sites | CCAFS WFF KWAJ VAFB | CCAFS KLC WFF | CCAFS WFF VAFB | CCAFS KLC WFF | WFF | VAFB | CCAFS VAFB | CCAFS VAFB | CCAFS VAFB |

L-3yrs



L+3 mo

L-3 mo to L-10 days




L-30 mo to L-3 mo

Launch Vehicle Certification Evaluation Complete (L-6mo)

# LSP Acquisition Strategy

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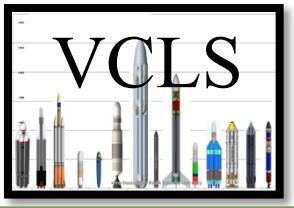
NLS


Federal Acquisition Regulation (FAR)

VCLS



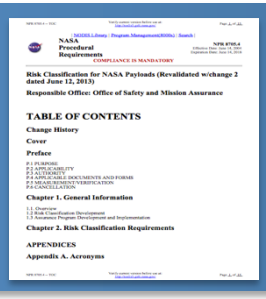
***Low Risk Tolerant Approach***

NASA Launch Services (NLS) II Contract

Firm Fixed Price Commercial Launch Services (Best Value)

Optimal Government Insight/Oversight

On-ramp provision enables new entrants




NPR 8705.4
Risk Classification for NASA Payloads

Office of Safety and Mission Assurance

***Tailored Approach***

Stand Alone Contracting Strategies (e.g. Solar Probe Plus)

Based on Customer Need

***High Risk Tolerant Approach***

Venture Class Launch Services (VCLS)

Firm Fixed Price Commercial Launch Services

Minimal Government Insight

FAA Licensed Approach

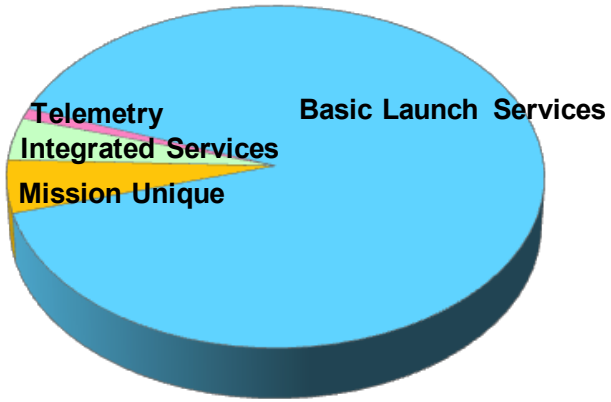
# Components of Launch Service Budget



Fixed-Price Contracts for Commercial Launch Services
- Basic Launch Service
- Mission Uniques
- Commercial Payload Processing Facility

NLS

Insight & Approval




95%+ of Cost is via Fixed Price Contracting

Price remains constant regardless of the cost of production (contractor assumes risk)
- Sets budget early at fixed level
- Total cost for launch vehicle understood @ Award
- Provider incentivized by schedule & success

# NASA Space Launch Technical Oversight

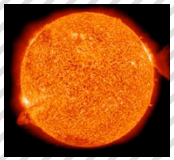
**NASA'S ACCOUNTABILITY FOR MISSION SUCCESS**

LEVEL OF GOVERNMENT TECHNICAL OVERSIGHT

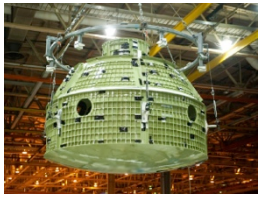
LEVEL OF OVERSIGHT COMMERCIAL PROVIDER MUST ASSUME

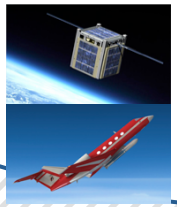












**Government Owned**

Shuttle
Station
SLS

**End-to-End Services**

**LSP Commercially Procured Services**
Science (Earth, Helio, Astro, Planetary)
Communication & Navigation
Technology Demonstration

**Advisory Services**

**Foreign Cooperative**
JWST
GPM
GRACE-FO

**Enabling Exploration Systems**
CRS
EFT-1

**Strategic**

**Enabling Commercial Markets**
PPODs
NEXT
VCLS

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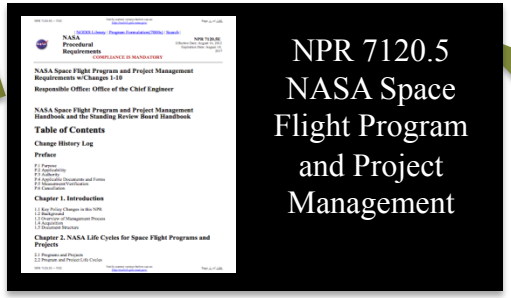
# LSP Requirement Flowdown

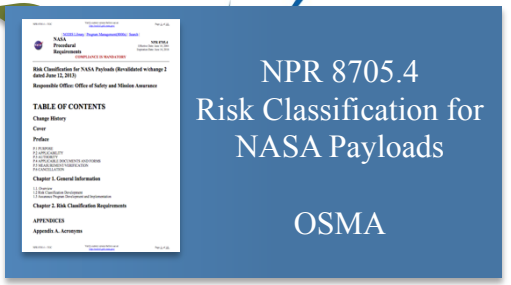
LAUNCH SERVICES PROGRAM





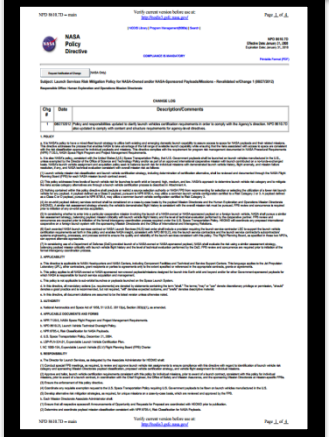


NPR 7120.5
NASA Space Flight Program and Project Management



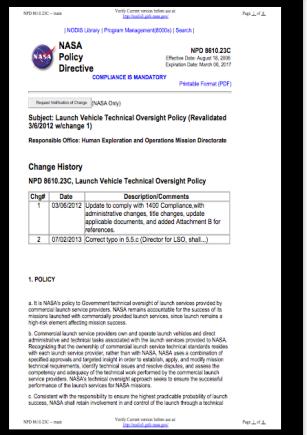
NPR 8705.4
Risk Classification for NASA Payloads

OSMA



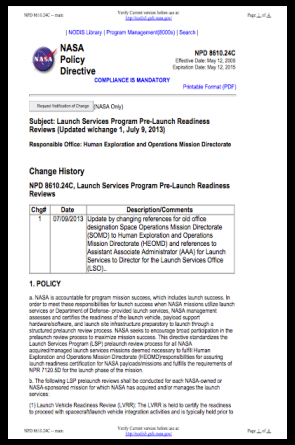
NPD 8610.7

Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions



NPD 8610.23

Launch Vehicle Technical Oversight Policy



NPD 8610.7

Launch Services Program Pre-Launch Readiness Reviews

# LSP Mission Assurance

## Oversight & Mission Integration

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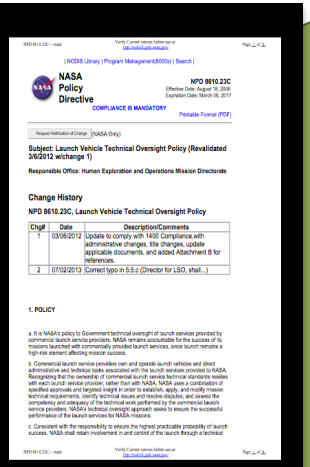

NASA Policy Directive

NPD 8610.23C

Effective Date: August 15, 2008
Expiration Date: March 06, 2017

COMPLIANCE IS MANDATORY

Printable Format (PDF)

Subject: Launch Vehicle Technical Oversight Policy (Revalidated 3/6/2012 w/change 1)

Responsible Office: Human Exploration and Operations Mission Directorate

Change History

NPD 8610.23C, Launch Vehicle Technical Oversight Policy

| Chg# | Date | Description/Comments |
|---|---|---|
| 1 | 03/06/2012 | Update to comply with 1400 Compliance,with administrative changes, title changes, update applicable documents, and added Attachment B for references. |
| 2 | 07/02/2013 | Correct typo in 5.5.c (Director for LSO, shall...) |

1. POLICY

a. It is NASA's policy to Government technical oversight of launch services provided by commercial launch service providers. NASA remains accountable for the success of its missions launched with commercially provided launch services, since launch remains a high-risk element affecting mission success.

b. Commercial launch service providers own and operate launch vehicles and direct administrative and technical tasks associated with the launch services provided to NASA. Recognizing that the ownership of commercial launch service technical standards resides with each launch service provider, rather than with NASA, NASA uses a combination of specified approvals and targeted insight in order to establish, apply, and modify mission technical requirements, identify technical issues and resolve disputes, and assess the competency and adequacy of the technical work performed by the commercial launch service providers. NASA's technical oversight approach seeks to ensure the successful performance of the launch services for NASA missions.

c. Consistent with the responsibility to ensure the highest practicable probability of launch success, NASA shall retain involvement in and control of the launch through a technical

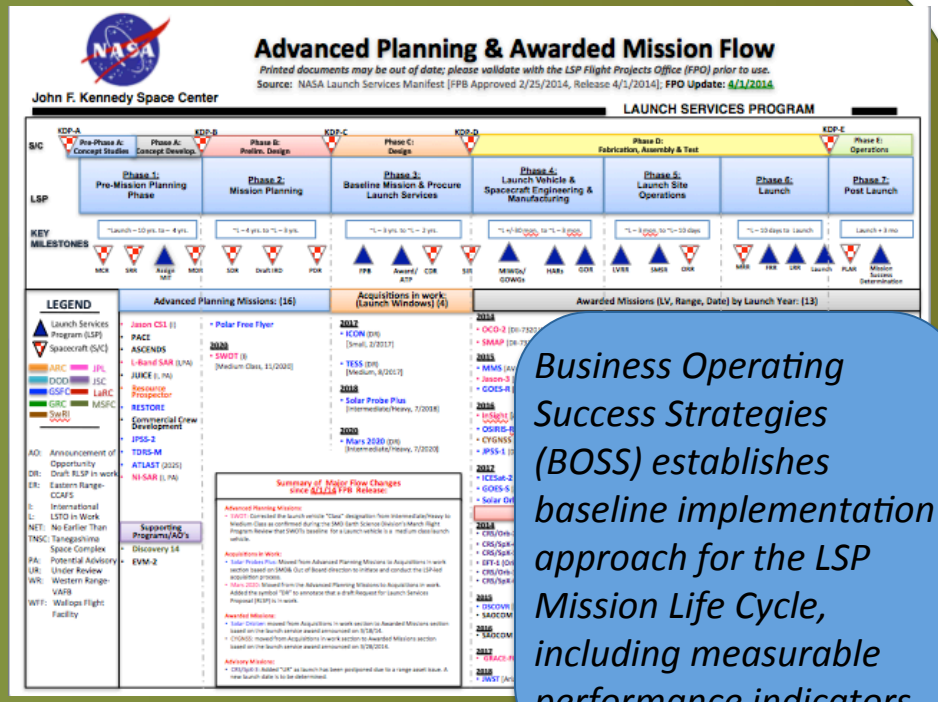
NPD 8610.23

Launch Vehicle Technical Oversight Policy (Since 1990)

*Establishes NASA's role for commercially-provided launch services to ensure the highest practicable probability of launch success*

*Combines focused approvals & technical insight*

*Engineering Review Process guides formal multi-discipline engineering evaluations and provides technical recommendations*




*Business Operating Success Strategies (BOSS) establishes baseline implementation approach for the LSP Mission Life Cycle, including measurable performance indicators*

S&MA & OCE

Technical Authorities

| Integration Engineer | Vehicle System Engineer | | |
|---|---|---|---|
| Launch Vehicle Interface Environment Verification | Launch Vehicle Certification Fleet Systems Integration | | |
| **Mission Analysis** | **Mechanical Engineers** | **Electrical Engineers** | **Resident Offices** |
| Flight Design<br>Modeling<br>Controls<br>Software<br>Loads<br>Environments<br>Stress<br>EMC<br>Thermal<br>NLA | Liquid Propulsion<br>Solid Propulsion<br>Ordnance<br>Pneumatics<br>Hydraulics<br>Mechanical Systems<br>S/C Mechanical I/F<br>Contamination<br>Materials<br>MGSE | Avionics<br>Flight Controls<br>Power Systems<br>TM Systems<br>Instrumentation<br>S/C Electrical I/F<br>EGSE | VAFB, CA<br>Hawthorne, CA<br>Decatur, AL<br>Chandler, AZ<br>Denver, CO<br><br>(Engineering Design Center and Production Insight) |

*Flight Planning Board (FPB) aggregates mission requirements, assigns missions to launch vehicles, and approves any mission-specific tailoring*

*Advisory Services provide tailored support for non-traditional missions*

# Certification Requirement

## Flowdown and Implementation

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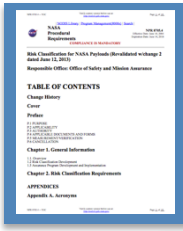

NPR 8705.4
Risk Classification for NASA Payloads

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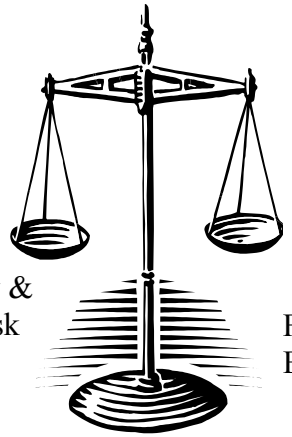
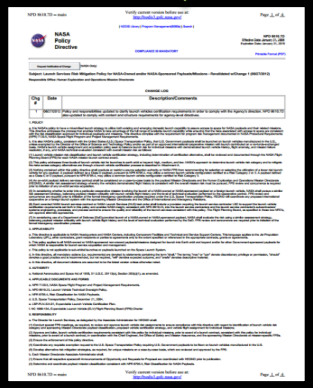


Design/Qual Evaluation

Process Assessment

Availability & Mission Risk

Flight Experience

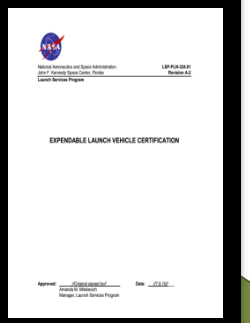


NPD 8610.7

Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions

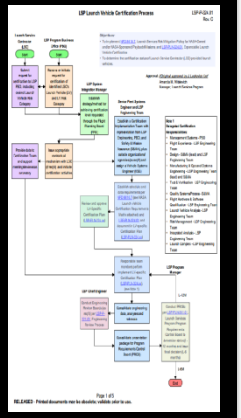
(Since 1999)

Certification Strategy adopted by USAF and NRO via "Coordinated Strategy"



LSP-PLN-324.01

Expendable LV Certification



LSP-PLN-324.01

Expendable LV Certification Process


Vehicle Specific Certification Plan

*"... balance launch risk for individual missions with launch vehicle demonstrated flight history and NASA technical penetration..."*

*Initial non-reoccurring risk assessment provides a strong foundation for launch vehicle oversight and individual mission CoFR*

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# LSP Launch Readiness

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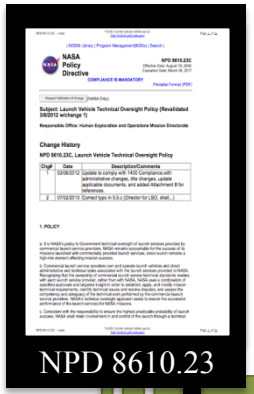
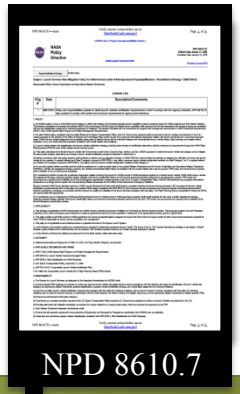
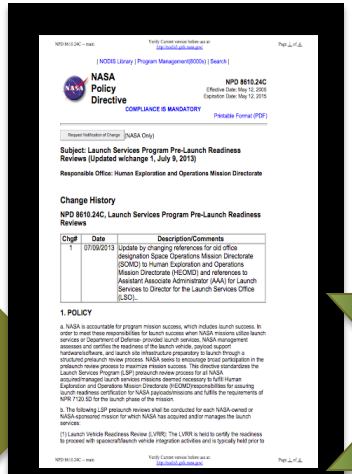


NPD 8610.23



NPD 8610.7



NPD 8610.24

Launch Services Program Pre-Launch Readiness Reviews

*Establishes milestones for LVRR, LRR, FRR, & Final Poll for Launch*

*Significant results of launch vehicle certification and oversight inform the launch readiness assessment process*

*Blended Commercial and Government CoFR*

ULA United Launch Alliance

Orbital ATK

SPACEX

# LSP Advisory Role for ISS Commercial Resupply Services (CRS)

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- In 2008 the Flight Planning Board approved key areas to provide the ISS with the best evaluation of the contractor's launch vehicle technical risk
  - Guiding principle was the commercial provider, not NASA, will be responsible for the launch success of the service
  - Engineering mainly focused on LV design and qualification
  - S&MA focused on build processes and insight into the specific vehicle as requested
  - The NASA Technical Authorities for CRS missions are at JSC
- Test Like You Fly Assessment (non-recurring)
  - Launch vehicle systems limited to propulsion, flight controls, and separation
  - LSP approach for identified systems equivalent to NPD 8610.7

- GN&C simulation and Flight Software Development Practices (non-recurring)
- Post Flight Data Review (recurring)
- Quality, Reliability, Systems Engineering and Risk Management (recurring)
- Technical findings and risks communicated regularly to ISS Program Office since LSP began NLS II technical oversight and certification for Falcon 9
  - LSP has not yet purchased an Antares vehicle so additional information is not available

# LSP Support to the Commercial Crew Program (CCP)

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- LSP has supported CCP Programmatic & Technical tasks related to launch services
  - Firm Fixed Price Contracting and certification process lessons learned
  - Participation in CCtCap SEB
  - Supporting CCP launch vehicle tasks for CCiCap milestone reviews and CPC deliverables

COMMERCIAL CREW PROGRAM

- LSP and CCP have defined LSP support for the certification phase of the Program
  - Certification for CCP is based on compliance to NASA human rating and key ISS Design Reference Mission requirements, not to NPD 8610.7
  - Maximizes LSP's expertise gained in management of the launch services for NASA's high value spacecraft
  - Recognizes that Human Spaceflight requirements drive differences in the typical LSP support model
  - Certification approaches have common requirements (e.g. Quality) and types of assessments (e.g. qualification/acceptance)
  - 8 task statements approved for LSP execution in support of CCP certification determination
    - Hardware/Software qualification and vehicle build assessments

# Summary

Global impact

Awareness of fleets across the world

Established commercial provider relationships

Leverage Government partnerships

Provide expertise for multiple customers (e.g. CRS and CCP) with common LV issues

Optimize Government oversight to balance risk & mission success

*LSP has established requirements which flow down to robust & demonstrated internal processes and experienced personnel*

*Experience with a variety of providers has shaped LSP to be flexible, allowing tailorable implementation for a wide variety of customers*