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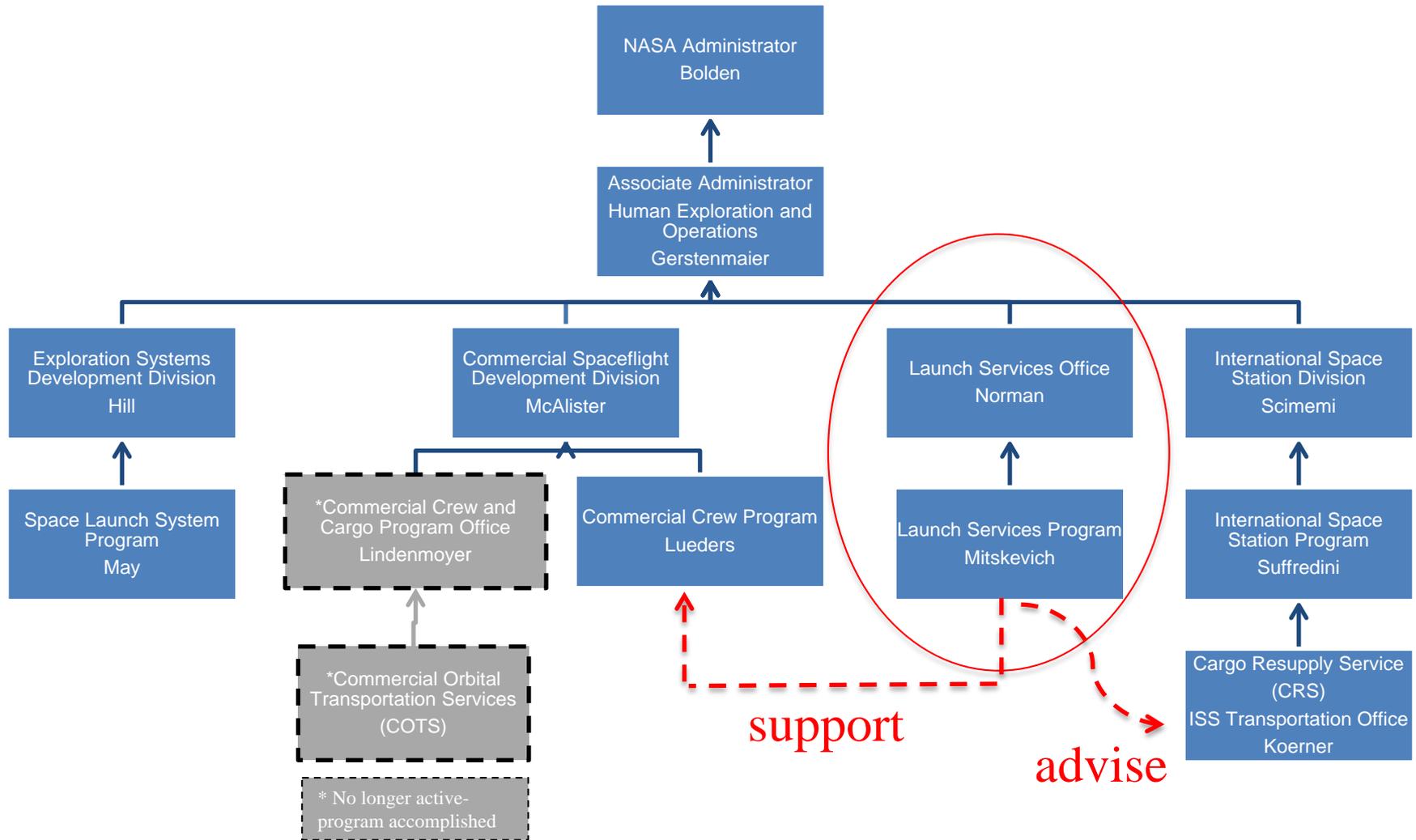


# **NASA LAUNCH SERVICES OVERVIEW TO NASA ADVISORY COUNCIL**

**July 27, 2015**

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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**



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# Launch Services Program Overview



## Commercial Acquisition Expertise

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



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

### 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

### 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.

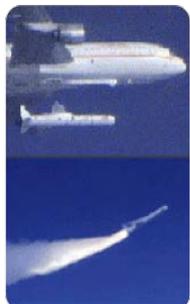


# LSP's Current and Future Fleet



## Vehicles On Contract

Certified\*



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



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# LSP Business Operating Success Strategies



## Mission Life Cycle



L-10yrs to L-4yrs

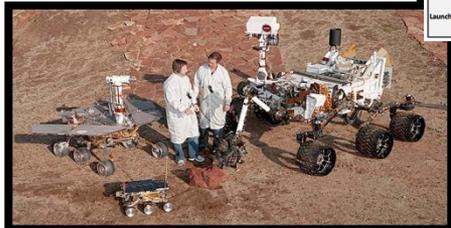
Vehicle Class	Small			Medium			Intermediate		
Launch Vehicle	Pegasus XL	Athena LC	Minotaur-C (former Orion 3)	Athena LC	Antares 100	Delta 7000	Falcon 9 v1.1	Atlas V 400	Atlas V 500
Officer	OSG	EMSSC	OSG	EMSSC	OSG	US	SpaceX	US	US
Launch Sites	CCAFS WFF KWAJ VAFB	CCAFS KLC WFF	CCAFS WFF VAFB	CCAFS KLC WFF	WFF	VAFB	CCAFS VAFB	CCAFS VAFB	CCAFS VAFB

L-3yrs



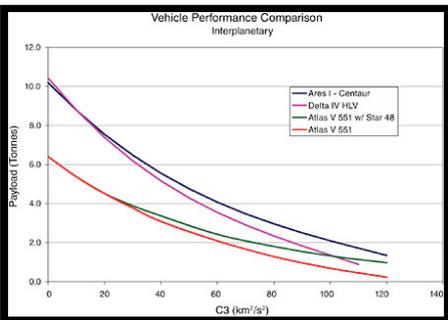
L+3 mo

L-3 mo to L-10 days



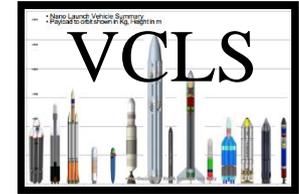
L-30 mo to L-3 mo

Launch Vehicle Certification Evaluation Complete (L-6mo)





# LSP Acquisition Strategy



**NPR 8705.4**  
**Risk Classification for NASA**  
**Payloads**  
**Office of Safety and Mission Assurance**

**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

**High Risk Tolerant Approach**

Venture Class Launch Services (VCLS)

Firm Fixed Price Commercial Launch Services

Minimal Government Insight

FAA Licensed Approach

**Tailored Approach**

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

Based on Customer Need



# Components of Launch Service Budget



Fixed-Price Contracts for Commercial Launch Services

- Basic Launch Service
- Mission Uniques
- Commercial Payload Processing Facility



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

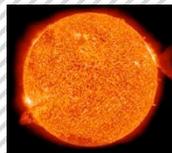


# NASA Space Launch Technical Oversight



## 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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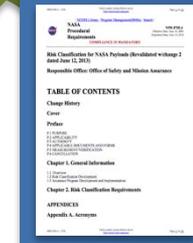
# LSP Requirement Flowdown



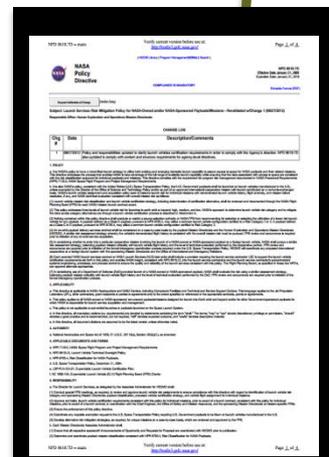
LAUNCH SERVICES PROGRAM



**NPR 7120.5  
NASA Space  
Flight Program  
and Project  
Management**



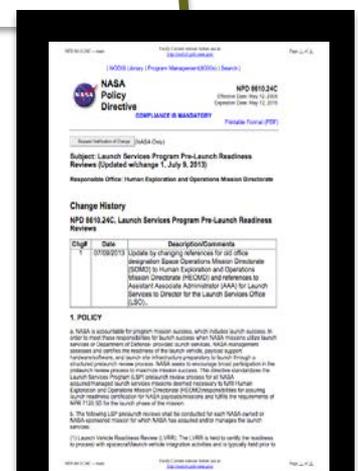
**NPR 8705.4  
Risk Classification for  
NASA Payloads  
  
OSMA**



**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**







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# Certification Requirement

## Flowdown and Implementation



LAUNCH SERVICES PROGRAM

**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

(Since 1999)

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



Availability & Mission Risk

Design/Qual Evaluation  
Process Assessment

Flight Experience



**LSP-PLN-324.01**

Expendable LV Certification

**LSP-PLN-324.01**

Expendable LV Certification Process

**Falcon 9 v1.1 Certification Plan**

Vehicle Specific Certification Plan

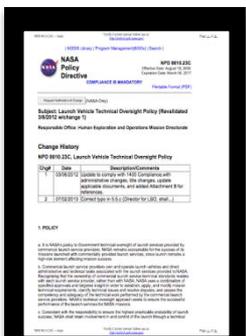
*"... balance launch risk for individual missions with launch vehicle demonstrated flight history and NASA technical penetration..."*

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



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# LSP Launch Readiness



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*





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



- 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





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# LSP Support to the Commercial Crew Program (CCP)



- 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
- 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*

**LSP Achievements**

**LSP Certification Strategy Adopted by USAF & NRO**

S/C Classification	Launch Vehicle Category	May Launch On
Class D per NPR 8763.4	Category 1, High Risk	New "common launch vehicle configuration" with no previous flight history Limited NASA technical review
Class C and in some cases class B per NPR 8763.4	Category 2, Medium Risk	A "common launch vehicle configuration" with limited flight history (one flight attempt) NASA LSP technical evaluation RSC notification that the "common launch vehicle configuration" met predicted vehicle and performance parameters (Flight Margin certification)
Class A and in some cases class B per NPR 8763.4	Category 3, Low Risk	A "common launch vehicle configuration" with a robust demonstrated successful flight history (fourteen consecutive, six, or three successful flights) Major NASA technical evaluation RSC notification that the "common launch vehicle configuration" met predicted vehicle and performance parameters (Flight Margin certification)

**Nuclear Launch Approval**

**Demonstrated Launch Vehicle Certifications**

**97+ % Success Rate (74/76)**

**NASA - LSP Managed ELV Launch History (1998 - 2014)**

**Learning Organization**

**Return to Flight**

**Advisory Support**