RD-180 Availability Risk Mitigation Study Summary

Outline

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- Summary

Charter

- **A quick reaction review to focus on issues, risks, costs and options for dealing with the current situation. As such the scope of the review is to examine form, fit and function replacement options for the Atlas RD-180 engine and options for continued assured access to space for National Security Space (NSS) payloads**
  - **Examine scenarios regarding availability of Russian-built RD-180 engines and support for launch needs for NSS missions. Scenarios should range from limited duration to long term interruptions**
  - **Develop long-term mitigation options to meet launch requirements for NSS missions**
    - **Include costs, industrial base issues, technical risk, mission assurance impacts, competition effects, and other factors pertinent to providing an affordable and sustainable launch capability for NSS missions**
    - **Identify potential impacts to NASA and other Atlas V users**
  - **Leverage data and information from existing Evolved Expendable Launch Vehicle (EELV) and RD-180 studies, and, where necessary seek out new data, information and recommendations from the Air Force, NASA, industry and other parties**
  - **Provide a recommendation for a way-ahead**

Team Members – Board Members

Name	Organization	Role
Maj Gen (ret) H. J. “Mitch” Mitchell	Aerospace	Chair
Dr Michael Griffin (former NASA Administrator)	CEO, Schafer Corp	Deputy Chair
Gen (ret) Thomas Moorman (former HQ AFSPC/CC)	Aerospace Consultant	Senior Advisor
Col Eric Krystkowiak	OUSD AT&L/SSI	Board Member
Jim Norman	HQ NASA/HEOMD	Board Member
Col Pat Youngson	NRO	Board Member
Col (sel) Rob Bongiovi	Air Force	Board Member
Curt Khol	OSD/CAPE	Board Member

Background

National Space Transportation Policy*
(Two Distinct Launch Agents)

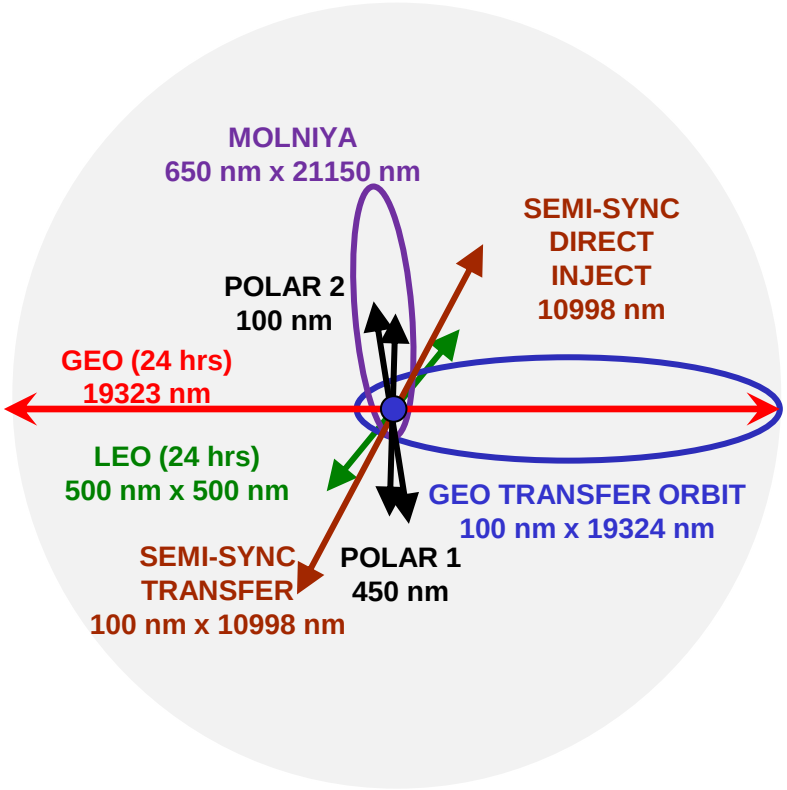
- **"Secretary of Defense, as the launch agent for national security space missions, shall:**
  - **Ensure, to the maximum extent possible, the availability of at least two US space transportation vehicle families capable of reliably launching national security payloads"**
- **"Administrator, NASA, as the launch agent for civil space missions, shall:**
  - **Develop, in support of US space exploration goals, the transportation-related capabilities necessary to support human and robotic exploration to multiple destinations beyond low-Earth orbit, including an asteroid and Mars"**
- **"Secretary of Defense and Administrator, NASA, shall:**
  - **Assure access to space for USG departments and agencies taking into account risk management, affordability, competition among providers, and measures for enhancing transparency regarding USG space transportation needs**
  - **Rely on US-manufactured capabilities and services, and ensure the ability to develop, operate, and enhance space-transportation capabilities, infrastructure, and support**
  - **Work with each other and other departments and agencies, and with the private sector, as appropriate, to pursue research and development activities regarding alternative launch capabilities to improve responsiveness, resiliency, and cost effectiveness for future space launch alternatives"**

**** November 21, 2013***

EELV Requirements

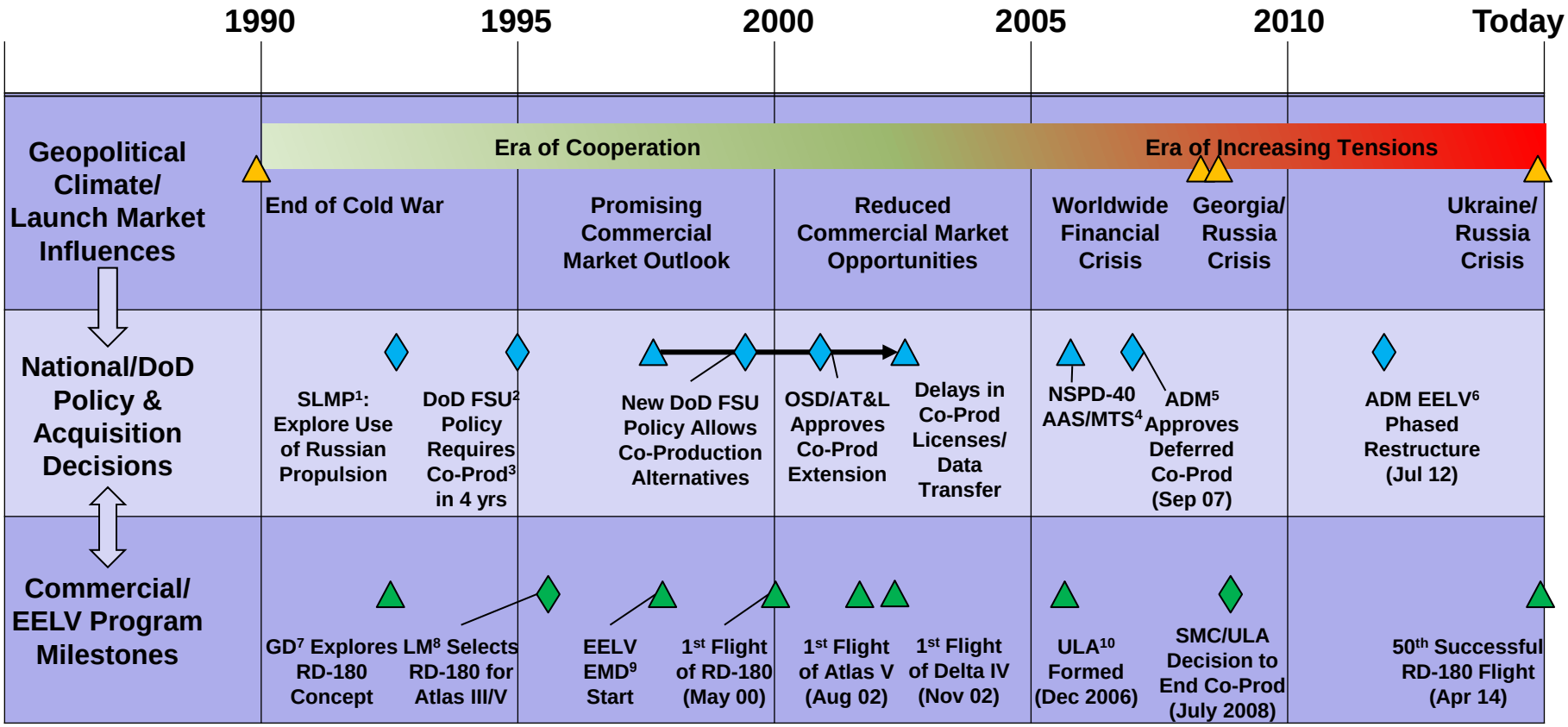
- **EELV program Key Performance Parameter (KPPs)**

Key Performance Parameter (KPP)	Requirement
Mass-to-Orbit	• Meet mass requirements for 8 reference orbits
Vehicle Design Reliability	• Vehicle design reliability of 0.98 at 50% confidence level
Standard Launch Pads	• Shall be able to launch all configurations of EELV intended to be launched from that site
Standard Payload Interfaces	• Shall have a standard interface for each vehicle class in the EELV family



RD-180 History: How Did We Get Here?

Use of RD-180 Rooted in Atlas Commercial Development and US Policy Decisions



[1]Space Launch Modernization Plan (1994)
[2]Former Soviet Union
[3]US Co-Production of RD-180 Engine
[4]National Space Policy Directive-40 Assured-Access-to-Space/Maintain Two Systems
[5]Acquisition Decision Memorandum
[6]Evolved Expendable Launch Vehicle
[7]General Dynamics (Later Became Lockheed Martin)
[8]Lockheed Martin
[9]Engineering and Manufacturing Demonstration
[10]United Launch Alliance

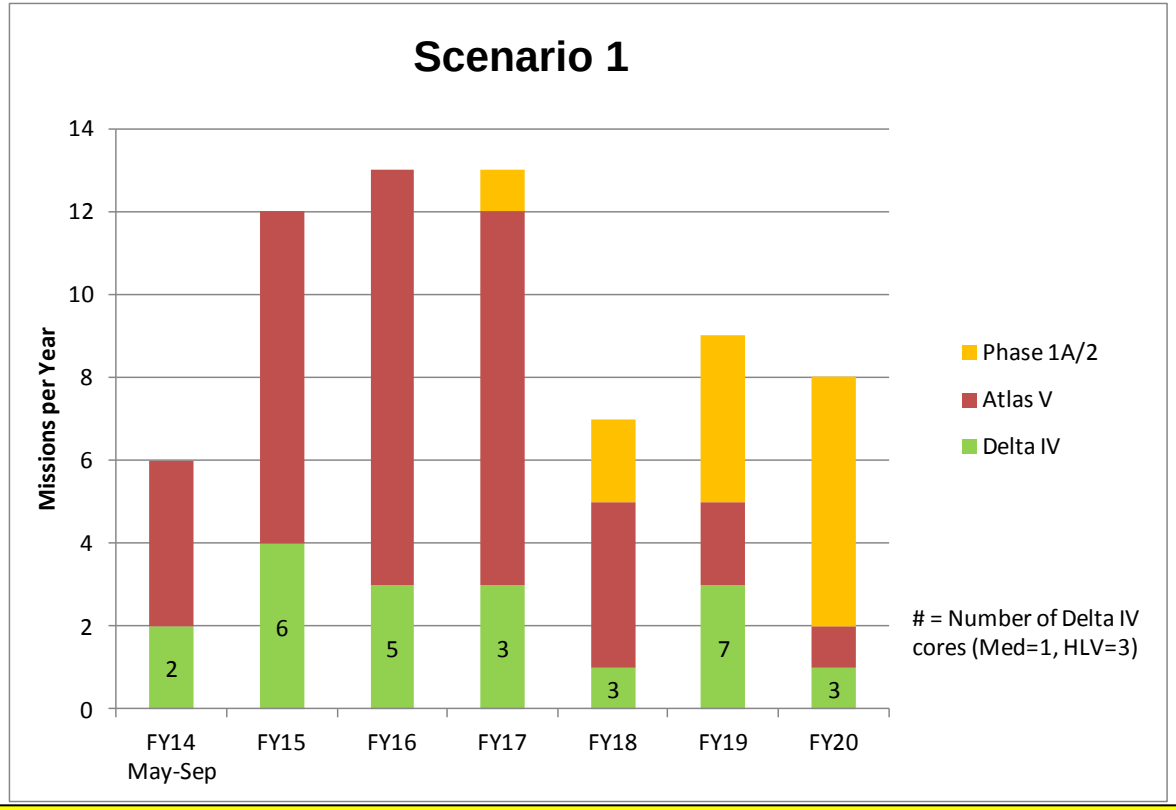
Current Status

EELV Acquisition Strategy

- DAE approved multi-phased approach (Nov 12; reiterated Feb 13) that:
  - Obtains near-term savings by stabilizing industrial base
  - Creates new entrant opportunities
  - Encourages competition
- Phase 1 (FY 13-19)—Sole source award to ULA
  - Procurement of up to 36 cores over five years (FY 13-17)
  - Seven years of Launch Capability (FY 13-19)
- Phase 1a (FY 15-17)—Certification and competition
  - Award of up to 14 cores over three years (FY 15-17) through a competitive award if a New Entrant becomes certified
  - RFP in work for first of the seven planned competitive acquisitions
- Phase 2 (FY 18-22) and Phase 3 (FY 23-30)—Competition among certified providers
  - Award of any/all requirements to any certified provider
  - Phase 2 acquisition strategy in work

Current Manifest

- **Observations:**
  - **Atlas V > 56% of EELV manifest for FY14 – FY20**
  - **Delta IV core production paces Delta IV launch rate**
  - **Major perturbations require interagency discussions**



Delta IV requires 1 booster core for Mediums and Intermediates and 3 cores for HLV

Current manifest is best value; changes will cost $$$

Key Findings/Recommendations

Key Findings/Recommendations

- **Finding #1 - Impacts of an RD-180 loss are significant, and near term (FY14 – FY17) options to mitigate them are limited**

Discussion

- **Atlas - Without additional RD-180 engines national launch baseline manifest not supportable beyond Mar 2016**
  - **38 Atlas missions on manifest - only 16 RD-180s in stockpile**
  - **If RD-180 can no longer be flown: ~$2.5 - $5B cost + commercial impacts**
  - **Worst case – 22 May launch is the last RD-180 flown: ~$5B impact**
    - **31 missions delayed, avg of 3.5 years delay and 8 additional HLVs**
  - **Fly the RD-180s in the stockpile, no replenishment: ~$2.5B impact**
    - **9 missions delayed, avg of 2 years delay and 0 additional HLVs**
  - **Allocation of existing RD-180s would require national-level prioritization (issues for DoD, IC, NASA, NOAA and commercial)**
  - **US produced RD-180 does not improve the current situation**
- **Delta - Cannot ramp up Delta production fast enough to avoid payload delays**
- **New Entrants – Only 1 NE projected to be certified to launch NSS payloads by FY17**
  - **Current schedule for certification (1QFY15) is aggressive**

Neither Delta nor New Entrants can fully replace Atlas thru FY17

Key Findings/Recommendations

- **Recommendations to mitigate Finding #1**
  - **Atlas**
    - Accelerate current RD-180 engine buy to preserve Phase 1 schedule and facilitate Phase 1a/2 competition
    - Do not initiate US production of RD-180 ("co-production")
      - Doable but does not improve the current situation
  - **Delta**
    - Complete dual integration for Atlas-only payloads
    - Create and maintain a stockpile of long lead items, engines and solids
  - **New Entrants**
    - Complete leading edge integration studies
    - Accelerate payload integration analysis
    - Validate vertical integration design and accelerate capability at Falcon NSS launch sites
  - **Other**
    - Increase technology investment (~$141M) for LOx/HC risk reduction

Near-term actions required to mitigate potential loss of RD-180s

Key Findings/Recommendations

- **Finding #2 – There are decision points that will provide indicators on the viability of the RD-180**

Discussion (2 of 2)

- **Far Term**
  - **End User agreement for transfer of RD AMROSS to Aerojet-Rocketdyne – not yet submitted – est 1 year from submission**
  - **Overall Technical Assistance Agreement expires FY17–USG action required**
  - **Requirement for a new Manufacturing Licensing Agreement (co-production)**
  - **License for FY 15 engine deliveries - not yet submitted to GoR**

- **Recommendations to mitigate Finding #2**
  - **Responsible and affected agencies of the US Government should track these decisions**
  - **Respond based on actions taken at decision points**

Regardless of RD-180 viability, US needs to develop a domestic engine

Key Findings/Recommendations

- **Finding #3 – Current Phase 1a/2 EELV acquisition strategy is impacted by RD-180 availability**

Discussion

- **Uncertainty of RD-180 situation puts Atlas into question for competition**
- **If only RD-180s in country available, Delta would likely not be a competitor for Phase 1a or 2**
  - **Manifest shift of 22 missions from Atlas to Delta requires ramp-up in Delta production**
  - **Backlog for Delta not eliminated until FY19**

- **Recommendation to mitigate Finding #3**
  - **If no RD-180s beyond those in country, need to reassess Phase 1a/2 competition and acquisition strategies**

Disruption of RD-180 engine supply limits competitive options

Key Findings/Recommendations

- **Finding #4 – Key milestones/decision points for current EELV acquisition strategy will come to a head in FY22 (Phase 3)**

Discussion

- **Acquisition Strategy Phase 3 (FY23 - 30) - Competition among certified providers**
  - **Market dominated by USG requirements**
  - **Commercial launch demand projections are minor/flat beyond 2013**
  - **Additional certified New Entrants unlikely**
  - **Current POR unlikely to be viable**
- **There is a Heavy Lift requirement forecast beyond FY30**
  - **Delta IV HLV – for NSS missions, the only option until FY21**
  - **SpaceX HLV – projected certification in FY18**
- **A new LOx/HC engine could be available by FY22**
- **A new launch vehicle could be certified by FY23 and replace the Delta IV as a more effective marginal cost solution to Heavy Lift**

Reliance on commercial market will not meet DoD/IC needs

Key Findings/Recommendations

- **Recommendations to mitigate Finding #4**
  - **Issue an ADM directing the development of a new LOx/HC engines -- provides options for EELV Phase 3**
    - **Based on Sep 2007 EELV ADM**
    - **Should include a next generation launch vehicle**
    - **Direct full funding in FY16 POM for new program**
  - **Create a joint AF/NASA Program Office to manage**
    - **Investment in a LOx/HC engine risk reduction phase ($141M)**
    - **Provide FSD options for engines and new launch vehicles in support of Phase 3 EELV acquisition strategy**
  - **Incorporate new engines and launch vehicle development as alternatives in the Phase 3 acquisition strategy**
    - **Consider private-public partnership arrangements with sufficient Government funding to attract private investment**
    - **Additional New Entrants unlikely without government investment**
  - **Minimize dependence on foreign components in US launch vehicles while maintaining competitive environment**

DoD is lead time away from the next generation launch architecture

Summary

Summary

- Impacts of an RD-180 loss are significant and near term (FY14 – FY17) options to mitigate them are limited
- There are near term decision points that will provide indicators on the viability of the RD-180
- If no RD-180s beyond those in country, need to reassess Phase 1a/2 competition and acquisition strategies
- Issue an ADM directing the development of a new LOx/HC engine -- provides options for EELV Phase 3
  - Should include a next generation launch vehicle
  - Direct full funding in FY16 POM for new program
- Create a joint AF/NASA Program Office to manage risk reductions and FSD for a new LOx/HC engine

Actions must be taken in FY14 to mitigate current risk and preserve future options