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National Security Space Launch at a Crossroads

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Summary

The United States is in the midst of making significant changes in how best to pursue an acquisition strategy that would ensure continued access to space for national security missions. The current strategy for the EELV (Evolved Expendable Launch Vehicle) program dates from the 1990s and has since been revised a few times. The program has been dogged by perennial concerns over cost and competition. Those same concerns are a major impetus for change today.

The EELV program stands at a crossroads today. Factors that prompted the initial EELV effort in 1994 are once again manifest—significant increases in launch costs, procurement concerns, and concerns about competition. In addition, a long-standing undercurrent of concern over U.S. reliance on a Russian rocket engine (RD-180) for critical national security space launches on one of the primary EELV rockets was exacerbated by the Russian backlash over U.S. sanctions against Russian actions in Ukraine. Moreover, significant overall EELV program cost increases and unresolved questions over individual launch costs, along with legal challenges to the Air Force EELV program by SpaceX, have contributed to Congress recently taking legislative action that has significantly affected the EELV program. Efforts by the Obama Administration and the Air Force to work with Congress on changing the EELV strategy have been deemed insufficient by those in Congress eager to proceed more quickly and definitively.

The Air Force and the Department of Defense (DOD) have argued for a slower, more measured transition to replace the RD-180. Although some in Congress have pressed for a more flexible transition to replace the RD-180 and possibly allow for development of a new launch vehicle, others in Congress have sought legislation that would move the transition process forward more quickly with a focus on developing an alternative U.S. rocket engine. This debate over how best to proceed with NSS launch has been a leading legislative priority in the defense bills over the past few years and is likely to continue to be so throughout the coming year.

Transitioning away from the RD-180 to a domestic U.S. alternative would likely involve technical, program, and schedule risk. A combination of factors over the next several years, as a worst-case scenario, could leave the United States in a situation where some of its national security space payloads would not have a certified launcher available. Even with a smooth, on-schedule transition away from the RD-180 to an alternative engine or launch vehicle, the performance and reliability record achieved with the RD-180 to date would not likely be replicated until well beyond 2030 because the RD-180 has had 68 consecutive successful civil, commercial, and NSS launches since 2000.

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Introduction

The EELV (Evolved Expendable Launch Vehicle) program stands at a crossroads today. Factors that prompted the initial EELV effort in 1994 are once again manifest—significant increases in launch costs, procurement concerns, and concerns about competition. In addition, a long-standing undercurrent of concern over U.S. reliance on a Russian rocket engine (RD-180) for critical national security space launches on one of the primary EELV rockets was exacerbated by the Russian backlash over U.S. sanctions against Russian actions in Ukraine. Moreover, significant overall EELV program cost increases and unresolved questions over individual launch costs, along with legal challenges to the Air Force EELV program by SpaceX, have contributed to Congress recently taking legislative action that has significantly affected the EELV program. Efforts by the Obama Administration and the Air Force to work with Congress on changing the EELV strategy have been deemed insufficient by those in Congress eager to proceed more quickly and definitively.

The EELV program was initiated by the Air Force in 1994 after years of concerns within the service and space launch community over increasing cost and decreasing confidence in the continued reliability of national access to space. EELV was developed to provide the United States affordable, reliable, and assured access to space with two families of space launch vehicles. Overall the program succeeded in providing critical space lift capability to support Department of Defense (DOD) and intelligence community missions, together known as National Security Space (NSS) missions.

The EELV program eventually evolved modestly in response to changing circumstances, and the Air Force approved the current EELV acquisition strategy in November 2011, further revising it in 2013. That strategy was designed to (1) sustain two major independent rocket-powered launch families to reduce the chance of launch interruptions and to ensure reliable access to space; (2) license and stockpile the Russian-made RD-180 heavy-lift rocket engine, a critical component of the Atlas V; (3) pursue a block-buy commitment to a number of launches through the end of this decade to reduce launch costs; and (4) increase competition to reduce overall launch costs. The Air Force and others view the overall EELV acquisition strategy as having successfully reduced launch costs while demonstrating highly reliable access to space for DOD and the intelligence community. But others in Congress and elsewhere have argued that the program remains far too costly and not nearly as competitive as it should be.

The EELV program currently consists of two families of launch vehicles, Atlas V and Delta IV (both provided by United Launch Alliance [ULA] of Denver, CO), with 14 different configurations to accommodate the launch of all NSS (and other spacecraft types) to a variety of orbits.¹ EELV NSS launches have supported the Air Force, Navy, and National Reconnaissance Office (NRO). More specifically, the Atlas V has launched commercial, civil, and NSS satellites into orbit, including commercial and military communications satellites; lunar and other planetary orbiters and probes; earth observation, military research, and weather satellites; missile warning and NRO reconnaissance satellites; a tracking and data relay satellite; and the X-37B space plane (a military orbital test vehicle). The Delta IV has launched commercial and military communications and weather satellites, and missile warning and NRO satellites.

¹ Nine Atlas V variants have flown: Atlas V 400 series (401, 411, 421, and 431) and Atlas V 500 series (501, 521, 531, 541, and 551). Five Delta IV variants have flown: the Delta IV Medium, three variants of the Delta IV Medium-Plus, and the Delta IV Heavy.

The Atlas V and Delta IV launch vehicles are produced by ULA, which was formed in 2006 as a joint venture of The Boeing Company (of Chicago, IL) and Lockheed Martin (of Bethesda, MD). In addition to the launch vehicles themselves, the EELV system consists of an extensive array of support capabilities and infrastructure to permit safe operations of U.S. launch ranges.² ULA operates five space launch complexes, two at Cape Canaveral Air Force Station, FL (Space Launch Complex-37 and Space Launch Complex-41), and three at Vandenberg Air Force Base, CA (Space Launch Complex-2, Space Launch Complex-3F, and Space Launch Complex-6). A large number of key suppliers for the Atlas V and the Delta IV are spread throughout the country, while some are located overseas. The EELV program is managed by the Launch and Range Systems Directorate of the Space and Missile Systems Center (Air Force Space Command), Los Angeles Air Force Base (El Segundo, CA).

SpaceX (of Hawthorne, CA), the primary new entrant in the NSS launch community, is now certified to provide some NSS space launches. SpaceX plans to develop more capable launch capability in the Falcon Heavy to compete for some, if not all, of the largest national security space launch missions.

Evolution of the EELV Program

1990s-2011

By the early 1990s, the U.S. space industrial base supported the production of a number of launch vehicles (i.e., Titan II, Delta II, Atlas I/II/IIAS, and Titan IV) and their associated infrastructure. Although launch costs were increasing and operational and procurement deficiencies were noted by many decisionmakers, no clear consensus formed over how best to proceed. Congress took the initiative in the National Defense Authorization Act for Fiscal Year 1994 (NDAA; P.L. 103-160, §213) by directing DOD to develop a Space Launch Modernization Plan (SLMP) that would “establish and clearly define priorities, goals, and milestones regarding modernization of space launch capabilities for the Department of Defense or, if appropriate, for the Government as a whole.”

The recommendations of the SLMP led DOD to implement the EELV program as the preferred alternative. The primary objective of the EELV program was to reduce costs by 25%. The program also sought to ensure 98% launch vehicle design reliability, and to standardize EELV system launch pads and the interface between satellites and their launch vehicles. Congress supported these recommendations through the FY1995 NDAA (P.L. 103-337, §211), directing DOD to develop an integrated space launch vehicle strategy to replace or consolidate the then-current fleet of medium and heavy launch vehicles and to devise a plan to develop new or upgraded expendable launch vehicles. Congress recommended spending \$30 million for a

² The EELV system includes launch capability, a standard payload interface, support systems, mission integration (includes mission unique requirements), flight instrumentation and range interfaces, special studies (alternative upper- and lower-stage rocket propulsion subsystems, mission feasibility analysis, secondary payloads, dual manifesting, dual integration, special flight instrumentation, loads analysis, etc.), post-flight data evaluation and analysis, mission assurance, infrastructure, critical component engineering, Government Mission Director support, system/process and reliability improvements, training, and other technical support. The system also includes launch site operations activities, activities in support of assured access, systems integration and tests, and other related support activities. See Department of Defense, *Selected Acquisition Report (SAR), Evolved Expendable Launch Vehicle (EELV)*, Defense Acquisition Management Information Retrieval (DAMR), RCS: DD-A&T(Q&A)823-176, Washington, DC, May 21, 2013, http://www.dod.mil/pubs/foi/logistics_material_readiness/acq_bud_fin/SARs/2012-sars/13-F-0884_SARs_as_of_Dec_2012/Air_Force/EELV_December_2012_SAR.pdf.

competitive reusable rocket technology program and \$60 million for expendable launch vehicle development and acquisition.

The original EELV acquisition strategy, initiated in 1994, called for a competitive down-select³ to a single launch provider and development of a system that could handle the entire NSS launch manifest. In 1995, the Air Force selected four launch providers for the initial competition: Lockheed Martin, Boeing, McDonnell Douglas, and Alliant Techsystems. After the first round of competition, the Air Force selected Lockheed Martin and McDonnell Douglas to continue forward. When Boeing acquired McDonnell Douglas in 1997, Boeing took over the contract to develop an EELV. Soon thereafter, however, the Air Force revised the EELV acquisition strategy, concluding that there was now a sufficient space launch market to sustain two EELV providers and not just one.

Throughout the acquisition process, DOD maintained that competition between Lockheed Martin and Boeing was essential. At the time, GAO reported that there would be sufficient growth in the commercial launch business to sustain both companies, a premise that, in turn, would lead to lower launch prices for the government.⁴ But “the robust commercial market upon which DOD based its acquisition strategy of maintaining two launch companies [throughout the life-cycle of the program] never materialized, and estimated prices for future contracts, along with total program costs, increased.”⁵

Retaining two launch providers, however, did provide DOD with some confidence in its ability to maintain “assured access to space.” But this confidence soon collapsed when the United States suffered five space launch failures in less than a year in the late 1990s. These failures included the loss of three national security satellites in 1998-1999, at a cost of over \$3 billion. One, a critical national security communications satellite (MILSTAR—Military Strategic and Tactical Relay), was lost on a failed Titan IV launch in 1999. That satellite capability was not replaced until 2010 with an AEHF (Advanced Extremely High Frequency) satellite, which experienced substantial acquisition challenges and frequent changes in both design and requirements.⁶ The other two losses were an NRO reconnaissance satellite and a DSP (Defense Support Program) satellite. In addition to the cost, schedule, and operational impacts of these lost missions, including a classified national security loss in coverage with MILSTAR, these failures significantly influenced the transition to EELV launches and how the EELV program was later executed.

President Clinton directed a review of these failures and sought recommendations for any necessary changes. The subsequent Broad Area Review (BAR) essentially concluded that the U.S. government should no longer rely on commercial launch suppliers alone to provide confidence and reliability in the EELV program. Instead, the BAR recommended more contractor and government oversight through increasing the number of independent reviews, pursuing performance guarantees from the launch providers, and greater government involvement in the

³ This refers to the competitive process that DOD mandates for the procurement of major systems and subsystems to choose the final source (or sources) that will eventually deliver the production system from an initial supplier base of two or more competing firms.

⁴ U.S. Government Accountability Office, *Evolved Expendable Launch Vehicle: Introducing Competition into NSS Launch Acquisition, Testimony before the Committee on Appropriations, U.S. Senate, Subcommittee on Defense*, GAS-14-259T, March 5, 2014, p. 2.

⁵ *Ibid.*

⁶ U.S. Government Accountability Office, *Defense Acquisitions: Space System Acquisition Risks and Keys to Addressing Them*. Letter to Hon. Jeff Sessions and the Hon. Bill Nelson, June 1, 2006, p. 5, <http://www.gao.gov/assets/100/94232.pdf>.

mission assurance process.⁷ Although these additional oversight activities eventually proved to significantly increase EELV costs,⁸ they also eventually led to significant improvements in launch successes.

The early 2000s saw considerable turmoil within the Air Force space community and among the EELV launch service providers due to competition in the shrinking space launch industrial base, cost increases, and the growing need for reliable access to space. During this time, the poor business prospects in the space launch market drove Lockheed and Boeing to consider leaving the market altogether. Therefore, to protect its objective of assured access to space, the U.S. government began to shoulder much of the EELV program's fixed costs.

To further protect the United States' ability to deliver NSS satellites into orbit, the George W. Bush Administration conducted a number of internal reviews that culminated in the 2004 National Security Policy Directive (NSPD)-40. This directive established the requirement for "assured access to space" and obliged DOD to fund the annual fixed launch costs for both Lockheed and Boeing until such time as DOD could certify that assured access to space could be maintained without two launch providers.⁹

DOD thus revised its EELV acquisition strategy because of the collapse of the commercial launch market and the ongoing erosion of the space industrial base, both of which threatened DOD's requirement to maintain assured access to space.¹⁰ GAO wrote that "in acknowledging the government's role as the primary EELV customer, the new strategy maintained assured access to space by funding two product lines of launch vehicles."

In 2006, The Boeing Company and Lockheed Martin announced plans to consolidate their launch operations into a joint venture—ULA. The companies argued that by combining their resources, infrastructure, expertise, and capabilities, they could assure access to space at lower cost. DOD believed that having two launch families (Atlas V and Delta IV) under one entity (i.e., ULA) provided significant benefits that outweighed the loss of competition. As a result, "unparalleled EELV mission success" ensued,¹¹ and the tradeoff over increased costs and reduced competition outside ULA was largely deemed acceptable.

The EELV Program Today

Since 2006, the Air Force has procured EELV launches from ULA on a sole-source basis. The EELV program has focused primarily on mission success—not cost control. GAO reported, however, that by 2010 "DOD officials predicted EELV program costs would increase at an unsustainable rate" due to possible instabilities in the launch industrial base and the inefficient buying practice of purchasing one launch vehicle at a time.¹²

⁷ Maj Gen Ellen M. Pawlikowski, USAF, "Mission Assurance—A Key Part of Space Vehicle Launch Mission Success," *High Frontier (Air Force Space Command)*, May 2008, p. 7., <http://www.nro.gov/news/articles/2008/2008-05.pdf>.

⁸ Stewart Money, *Competition and EELV: Challenges and Opportunities in New Launch Vehicle Acquisition, Pt. 1*, Future In-Space Operations Presentation, May 9, 2012, p. 16.

⁹ The White House, *U.S. Space Transportation Policy*, NSPD-40, Washington, DC, January 6, 2005, <http://fas.org/irp/offdocs/nspd/nspd-40.pdf>.

¹⁰ U.S. Government Accountability Office, *Evolved Expendable Launch Vehicle: Introducing Competition into National Security Space Acquisitions*, GAO-14-259T, March 5, 2014, <http://www.gao.gov/products/GAO-14-259T>.

¹¹ Ibid.

¹² Ibid.

In response, DOD recognized the need to again reorganize the way it acquired launch services. Additional studies and internal reviews evaluated alternatives to the EELV business model, which in turn led to a new EELV acquisition strategy adopted in November 2011.¹³ The new acquisition strategy advocated a steady launch vehicle production rate. This production rate was designed to provide economic benefits to the government through larger buys, or block-buys, of launch vehicles, providing a predictable production schedule to stabilize the space launch industrial base. The new EELV acquisition strategy also announced the government's intent to renew competition in the program.

In addition to revising its acquisition strategy, DOD undertook significant efforts to obtain greater insight into ULA program costs in advance of contract negotiations. In May 2011, DOD solicited a Request for Information to prospective launch providers. In March 2012, DOD issued a sole-source solicitation for the block-buy to ULA, and in April 2012, the EELV program incurred a critical Nunn-McCurdy cost breach.¹⁴

In December 2013, DOD followed through on its new EELV strategy, signing a contract modification with ULA committing the government to buy 35 launch vehicle booster cores over a five-year period, along with the associated infrastructure capability to launch them. DOD viewed this contract modification as a significant effort on its part to negotiate better launch prices through improved knowledge of ULA contractor costs. DOD officials expected the new contract to realize significant savings, primarily through stable unit pricing for all launch vehicles. However, some in Congress, and some analysts outside government, strongly disputed the DOD estimates of cost savings.

DOD then announced it would open up to 14 additional NSS launches to broader competition.¹⁵ However, in the FY2015 budget request, the Air Force announced that the number of EELV launches open to broader competition through FY2017 would be reduced from 14 to 7.¹⁶ Some Members of Congress, and officials with SpaceX, raised questions about how many launches would ultimately be openly competed.

Perhaps resulting from turmoil associated with the Nunn-McCurdy cost breach, as well as the perceived instabilities mentioned above, the EELV acquisition strategy proceeded to a three-phased approach:

¹³ Ibid.

¹⁴ See CRS Report R41293, *The Nunn-McCurdy Act: Background, Analysis, and Issues for Congress*, by Moshe Schwartz and Charles V. O'Connor. The Nunn-McCurdy Act (10 U.S.C. §2433) requires DOD to report to Congress whenever a major defense acquisition program experiences cost overruns that exceed certain thresholds. The purpose of the act was to help control cost growth in major defense systems by holding the appropriate Pentagon officials and defense contractors publicly accountable and responsible for managing costs.

A program that experiences cost growth exceeding any of the established thresholds is said to have a Nunn-McCurdy breach. There are two types of breaches: significant breaches and critical breaches. A "significant" breach is when the Program Acquisition Unit Cost (the total cost of development, procurement, and construction divided by the number of units procured) or the Procurement Unit Cost (the total procurement cost divided by the number of units to be procured) increases 15% or more over the current baseline estimate or 30% or more over the original baseline estimate. A "critical" breach occurs when the program acquisition or the procurement unit cost increases 25% or more over the current baseline estimate or 50% or more over the original baseline estimate.

¹⁵ U.S. Government Accountability Office, *Evolved Expendable Launch Vehicle: Introducing Competition into National Security Space Acquisitions*, GAO-14-259T, March 5, 2014, <http://www.gao.gov/products/GAO-14-259T>.

¹⁶ The Air Force cited decreased demand for satellites, payload weight increases in some missions beyond new entrant capabilities, and the long-term commitment the Air Force has with ULA.

- Phase 1 (FY2013-FY2019) would consist of the sole-source block-buy awarded to ULA to procure up to 36 cores and to provide seven years of NSS launch infrastructure capability;
- Phase 1a (FY2015-FY2017) emerged as a modification to Phase 1 that would consist of opening up competition for NSS launches to new space launch entrants (such as SpaceX).¹⁷ The Air Force said it could award up to 14 cores to a new entrant over three years, if a new entrant became certified;
- Phase 2 (FY2018-FY2022) envisioned full competition among all launch service providers. The operational requirements, budget, and potential for competition are currently being worked on; and
- Phase 3 (FY2023-FY2030) envisioned full competition with the award of any or all required launch services to any certified provider.

The Air Force views its current strategy to fulfill the mandates to maintain assured access to space and to introduce competition into the launch market as successful and on track. To date, ULA's Delta IV and Atlas V launch vehicles have performed over 90 consecutive successful missions, and SpaceX has been certified as a new competitor for some NSS launches. Nevertheless, it views the third mandate to transition off the RD-180 in the near term as a notable challenge, due in part to the legislative restrictions placed on use of the RD-180 engine, which has a particular impact on use of the Atlas V launch vehicle.

Factors That Unsettle the EELV Acquisition Strategy

Several interrelated factors now create considerable uncertainty over the Air Force's ability to continue with its current three-phase EELV acquisition strategy. These include ongoing concerns over program and launch costs, U.S. national security vulnerability to a critical Russian component in the EELV program (the RD-180 main engine), legal challenges to the acquisition strategy, and legislation whose effects could change the EELV program.

Cost Growth in the EELV

In March 2012, the EELV program reported two critical Nunn-McCurdy unit cost breaches,¹⁸ which resulted in a reassessment of the program. The cost of the newly restructured program was estimated by GAO in March 2013 at \$69.6 billion.¹⁹ This amount represented an increase of \$34.6 billion, or about 100%, over the program's estimated cost of \$35 billion from a year earlier.²⁰ GAO identified several causes for this cost growth, including an extension of the

¹⁷ Lt. Gen. Pawlikowski (Commander, Space and Missile Systems Center, Air Force Space Command) said, "The whole reason for doing the certification of new entrants is seeking to see if we can leverage the commercial launch market. We're not doing this so we can have another vendor or two more vendors that are 100 percent reliant on national space missions. If we do that, we won't save any money." Aaron Mehta, "Despite Lawsuits, Disagreement, SpaceX and USAF Moving Forward," *Defense News*, June 28, 2014, online edition, <http://www.defensenews.com/article/20140628/DEFREG02/306280021/Despite-Lawsuits-Disagreements-SpaceX-USAF-Moving-Forward>.

¹⁸ See CRS Report R41293, *The Nunn-McCurdy Act: Background, Analysis, and Issues for Congress*, by Moshe Schwartz and Charles V. O'Connor.

¹⁹ U.S. Government Accountability Office, *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-13-294SP, March 2013, p. 60.

²⁰ U.S. Government Accountability Office, *Evolved Expendable Launch Vehicle: DOD is Addressing Knowledge Gaps in Its New Acquisition Strategy*, GAO-12-822, July 2012, p. 1.

program's life cycle from 2020 to 2030, an increase of the planned number of launch vehicles to be procured from 91 to 150 (an increase of 59%), the inherently unstable nature of demand for launch services, and instability in the industrial base.²¹ These causes related to changes in the scope of the program and reflected the industrial-base conditions under which the program was being undertaken; they did not appear to imply poor performance by the Air Force or the industry in executing the program. Even so, the overall increase in estimated program costs complicated the Air Force's challenge in funding the program within available resources without reducing funding for other program priorities, and it contributed to attention being focused on modifying their EELV acquisition strategy.

In addition, the costs of individual launches themselves came under renewed scrutiny. SpaceX and others asserted that the launch costs charged by ULA were significantly higher than what SpaceX would charge the U.S. government once it was certified by the Air Force to conduct NSS launches. Part of the problem in sorting through these claims, however, is that much of the detailed cost data are proprietary, not readily comparable, and some are speculative to the extent that there is little operational empirical data on which those costs are provided. Although the Air Force, GAO, ULA, and SpaceX have provided some launch cost data, it is not apparent the data are directly comparable, or are calculated using the same cost model assumptions. In addition, because SpaceX has limited data directly related to NSS launches, its cost figures are not likely based on a long history of actual cost, performance, and reliability. Thus, the issue of reliable and consistent cost data for comparative purposes has been a source of frustration for many in Congress.

Reliance on the Russian RD-180 Main Engine

The original impetus for licensing the Russian RD-180 as the main engine for the Atlas V launch vehicle grew out of concerns associated with the 1991 collapse of the Soviet Union. At the time, the CIA and others expressed serious concern about the potential export and proliferation of Russian scientific and missile expertise to countries hostile to U.S. interests. These concerns in turn spurred a U.S.-Russian partnership to acquire some of Russia's heavy lift rocket engine capabilities, thus expanding upon existing Cold War civil space cooperation. Initially, this took the form of a license agreement between Energomash NPO and RD Amross (of Palm Beach, FL) for the co-production of the RD-180 engine as part of the EELV acquisition strategy. This was later changed in an acquisition revision to simply purchase and stockpile roughly two years' worth of the engines for the Atlas V, an approach that was then viewed as highly cost-competitive. The existing license agreement for purchasing RD-180 engines extends to 2022.

In subsequent years, Congress and others occasionally expressed concern over the potential vulnerability of the EELV program to reliance on a single critical Russian component. For instance, the FY2005 defense authorization act (P.L. 108-375, §912) directed DOD to examine future space launch requirements.²² The resulting 2006 RAND study concluded that "the use of the Russian-manufactured RD-180 engines in the Atlas V common core is a major policy issue that must be addressed in the near term."²³ Similar concern was noted by GAO in 2011: "the EELV program is dependent on Russian RD-180 engines for its Atlas line of launch vehicles,

²¹ U.S. Government Accountability Office, *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-13-294SP, March 2013, p. 60.

²² P.L. 108-375. See Section 912.

²³ Forrest McCartney et al., *National Security Launch Report*, RAND National Defense Research Institute, Santa Monica, CA, 2006, p. 33.

which according to the Launch Enterprise Transformation Study, is a significant concern for policymakers.”²⁴

In the FY2013 defense authorization act (P.L. 112-239, §916), Congress directed DOD to undertake an “independent assessment of the national security implications of continuing to use foreign component and propulsion systems for the launch vehicles under the evolved expendable launch vehicle program.” None of these concerns, until recently, led the Air Force to change the EELV acquisition strategy or to a change in legislation governing that strategy

After Russian incursions in Ukraine triggered U.S. sanctions in 2014, Russian backlash against those sanctions heightened alarm over the potential vulnerability of the EELV program and catalyzed the need for change. In March 2014, the United States imposed sanctions on various Russian entities and persons,²⁵ including Deputy Prime Minister Dmitry Rogozin, the official who oversees export licenses for the RD-180 rocket engine. In retaliation, Rogozin announced that “we can no longer deliver these engines to the United States unless we receive guarantees that our engines are used only for launching civilian payloads.”²⁶ Precise details of what Rogozin meant, and whether any changes would be implemented, were unclear. According to the Air Force and ULA officials, there were no efforts to modify or end the licensing agreement, nor to discontinue acquisition of the RD-180 from Energomash.

Many in the United States were increasingly concerned, however, that Russia could suddenly ban all exports of the engine to the United States, or ban exports for military use to some degree. To many outside of the Air Force and ULA, that uncertainty raised serious questions about the longer-term viability of the EELV program, and dictated the need to completely shed U.S. reliance on the RD-180 as soon as practicable. Congress has since taken strong steps in each of the past several defense authorization bills (described below) to end this reliance and develop an alternative, domestic-produced U.S. main engine.

Although the Air Force has committed in principle to this ultimate outcome, some in Congress are not satisfied that Air Force efforts are proceeding at an acceptable pace. As the Air Force pursues the congressional mandates to eliminate dependence on the RD-180 engine and continue to transition to a truly competitive launch market, it sees major challenges. These include the plan by ULA to retire the Delta IV Medium in 2016, the fact that SpaceX is currently certified for only some NSS mission requirements, and restrictions on acquisition of the RD-180 engine during this interim period that affect the Atlas V launch schedules.

SpaceX Challenges to the EELV Acquisition Strategy

SpaceX has filed several protests and lawsuits challenging the absence of competition in the EELV program. These included, for instance, a 2005 challenge to the Air Force position that Boeing and Lockheed were the only capable providers of EELV launch services and arguing in 2006 against the anti-competitive merger of ULA. SpaceX did not prevail.

In 2014, SpaceX sued the Air Force, challenging its 2013 sole-source contract with ULA for a block-buy of 35 launch cores. A federal claims court issued a preliminary injunction questioning

²⁴ U.S. Government Accountability Office, *Evolved Expendable Launch Vehicle: DOD Needs to Ensure New Acquisition Strategy is Based on Sufficient Information*, GAO-11-641, September 2011, p. 22, <http://www.gao.gov/new.items/d11641.pdf>.

²⁵ CRS Insight IN10048, *U.S. Sanctions on Russia in Response to Events in Ukraine*, coordinated by Dianne E. Rennack.

²⁶ <http://www.government.ru/en/news/12363>.

the legitimacy of ULA's imports of the Russian-made RD-180 for its Atlas V launch vehicle during sanctions,²⁷ but lifted the injunction after the Departments of State, Treasury, and Commerce determined that payments to Energomash did not constitute violations.²⁸ SpaceX then filed an amended complaint asserting that the Air Force did not provide proper pricing data on the RD-180 in the 2013 bid, and may have shut SpaceX out of potential business when it placed an order with ULA earlier than usual for a 2017 military satellite launch.²⁹ In response, the Air Force requested that the federal court dismiss the suit, arguing that SpaceX had lost its right to protest the ULA block-buy by not challenging the contract award earlier.³⁰ The Air Force also argued that at the time of the contract award SpaceX had not completed the necessary certifying flights for its Falcon 9, and thus was far from having a launch vehicle that could meet the Air Force's requirements.³¹

This debate has since moved into the realm of congressional legislative debates to determine a course forward.

Legislative and Industry Options to Replace the RD-180

After the Russian-sanctions incident in spring 2014, DOD brought together various experts to focus on the risks, costs, and options for dealing with the potential loss of the Russian RD-180 rocket engine in the EELV program.³² This 2014 Mitchell Commission recommended accelerating buys of the RD-180 under the existing licensing agreement to preserve the EELV Phase 1 block-buy schedule and to facilitate competition in Phases 1a and Phase 2. The commission did not recommend co-producing the RD-180 in the United States, but instead recommended spending \$141 million to begin development of a new U.S. liquid rocket engine to be available by 2022, to coincide with the end of Phase 2 in the current EELV acquisition strategy.

Congress has been supportive of sustaining current space access capabilities while working toward developing a U.S.-made main rocket engine to replace the RD-180. The FY2015 NDAA³³ permitted ULA to use five RD-180 Russian engines purchased before Russia's intervention in Ukraine for continued national security launch missions, if the Secretary of Defense determined it was in the national security interest of the United States to do so. The FY2016 NDAA³⁴ increased this number to nine RD-180s in order to help maintain competitors in the NSS launch market for a longer period, while the market transitions away from the RD-180 and toward a new domestic-produced rocket engine for NSS launch.

The FY2016 omnibus appropriations³⁵ could be seen to effectively forestall the application of the RD-180 nine-engine restriction in the FY2016 NDAA through the end of the fiscal year. The

²⁷ <http://s3.documentcloud.org/documents/1150679/spacex.pdf>.

²⁸ <http://www.spacepolitics.com/wp-content/uploads/2014/05/01511754922.pdf>.

²⁹ Mike Gruss, "U.S. Air Force Seeks Dismissal of SpaceX Suit," *SpaceNews*, July 1, 2014, online edition.

³⁰ <http://www.spacepolitics.com/wp-content/uploads/2014/07/01511783886.pdf>.

³¹ Mike Gruss, "U.S. Air Force Seeks Dismissal of SpaceX Suit," *SpaceNews*, July 1, 2014, online edition.

³² *RD-180 Availability Risk Mitigation Study Summary*, Mitchell Commission, http://www.spacepolitics.com/wp-content/uploads/2014/05/Mitchell_Report_May2014.pdf.

³³ FY2015 NDAA (P.L. 113-291). §1608. Prohibition on contracting with Russian suppliers of rocket engines for the Evolved Expendable Launch Vehicle Program.

³⁴ FY2016 NDAA (P.L. 114-92). §1607. Exception to the prohibition on contracting with Russian suppliers for the Evolved Expendable Launch Vehicle Program.

³⁵ FY2016 omnibus (P.L. 114-113). §8048.

omnibus, as the later-enacted measure in this instance, would likely be seen to control, insofar as its provisions are seen to irreconcilably conflict with those of the earlier measures.³⁶ A practical effect of such a conflict could be that ULA would be able to compete for competitive launches and be awarded NSS launch missions regardless of engine country of origin. Depending on the timing of bid announcements by the Air Force for 2016, this could include ULA's competition for up to two national security launch contracts before the end of this fiscal year.

In the event Congress does not adopt a new annual appropriations measure (either reproducing the language of the prior year's measure, or making alternate provisions), the terms of the most recent appropriations measure are often carried over in some type of continuing resolution. If an annual appropriations measure were to be adopted, the relationship between that measure and any other enactments could be seen to depend upon their order of enactment, with the last-enacted measure potentially being seen to control insofar as there are "irreconcilable conflicts" between the measures. If no further actions are taken by either the authorizers or the appropriators on this issue, then the language of the FY2016 NDAA would appear to control once the provisos of the FY2016 appropriations measure expire (i.e., at the start of FY2017).

Rocket Engines: Goods or Services³⁷

In the Commercial Space Act of 1998 (CSA),³⁸ Congress expressed its preference that federal agencies purchase space transportation services on the commercial market rather than operating or developing their own space transportation systems.³⁹ As such, the CSA expressly requires the government to acquire "space transportation services" from "United States commercial providers" whenever such services are "required in the course of its activities" unless certain exceptions apply.⁴⁰ Recently, some have questioned whether this requirement applies to engines used in space transportation vehicles (i.e., rocket engines) that launch national security satellites. More specifically, some have questioned whether engine development must be included as part of "space transportation services" procured from commercial sources or whether the government may independently develop and manufacture rocket engines.

The resolution to this question may turn on whether rocket engines are treated as "goods" or "services" for purposes of the CSA. If rocket engines were understood to be included within the meaning of "space transportation services" in the CSA, the CSA could be construed to require the government to procure them from commercial sources.⁴¹ On the other hand, if engines were seen as "goods," potentially separable from the service of providing transportation into space, the CSA would not appear to contain the same mandate, and nothing in the CSA would appear to preclude the government from manufacturing the engines without utilizing the commercial market.⁴²

³⁶ See CRS Report 97-589, *Statutory Interpretation: General Principles and Recent Trends*, by Larry M. Eig.

³⁷ Written by Stephen Mulligan, Legislative Attorney, American Law Division.

³⁸ See P.L. 105-303, 112 Stat. 2843 (1998) (currently codified at 51 U.S.C. §§50101-50134).

³⁹ See 51 U.S.C. §50133 (stating that the NASA Administrator "shall prepare for an orderly transition from the Federal operation, or Federal management of contracted operation, of space transportation systems to the Federal purchase of commercial space transportation services for all nonemergency space transportation requirements for transportation to and from Earth orbit, including human, cargo, and mixed payloads."); 51 U.S.C. §50131(a) (requiring the government to acquire space transportation services from commercial providers and to plan missions to accommodate the space transportation services capabilities of United States commercial providers).

⁴⁰ See 51 U.S.C. §50131(a). The CSA lists seven circumstances in which the government is not required to acquire space transportation services from commercial providers, so long as the NASA Administrator or Secretary of the Air Force makes specific determinations. See 51 U.S.C. §50131(b)(1)-(7).

⁴¹ See 51 U.S.C. §50131(a).

⁴² Note that other provisions of law or policy beyond the CSA could affect agencies' ability to manufacture engines, among other things. See, for example, Office of Management and Budget Circular A-76 Revised, Performance of Commercial Activities §4 (May 29, 2003), https://www.whitehouse.gov/omb/circulars_a076_a76_incl_tech_correction/ ("The longstanding policy of the federal government has been to rely on the private sector for needed commercial services. To ensure that the American people receive maximum value for their tax dollars, commercial activities should be subject to the forces of competition."). These other provisions are outside the scope of the discussion here.

The Air Force has apparently taken the view that rocket engines cannot be acquired separate and apart from space transportation services, and therefore must be acquired from commercial sources. In its *Evolved Expendable Launch Vehicle (EELV) Frequently Asked Questions*, the Air Force stated it cannot separately create a “‘plug and play’ engine” for space launch vehicles because “[b]y statute (Commercial Space Act of 1998 ...) the DoD procures commercial launch services rather than rockets or engines used in those services.”⁴³ Notably, the view expressed in this informal document is presented in a single sentence without elaboration as to its underlying reasoning. While the Air Force’s position described above does not appear to be a legally authoritative representation of the agency’s position, it could be seen as consistent with the text of the CSA insofar as the CSA defines “space transportation services” to include “the preparation of a space transportation vehicle[.]”⁴⁴ and the definition of “space transportation vehicle” includes “any component of such vehicle not specifically designed or adapted for a payload.”⁴⁵ To the extent an adjudicating body were to interpret this provision as demonstrating congressional intent that the use of a space transportation vehicle, including its engine, is a service,⁴⁶ then 51 U.S.C. §50131 would require the government to obtain the engine from a commercial source.

To the extent the CSA may be seen as ambiguous on this issue, a judicial or administrative tribunal might defer to the interpretation of the agency under the framework established in *Chevron U.S.A., Inc. v. National Resources Defense Council, Inc.*⁴⁷ When courts apply *Chevron* deference to an agency’s interpretation of a statutory provision, the agency’s interpretation will generally be upheld so long as it is based on a reasonable construction of the statute.⁴⁸ However, the Supreme Court has imposed certain threshold limitations on the types of agency interpretations that qualify for *Chevron* deference.⁴⁹ *Chevron* deference will only be afforded to an agency’s interpretation if Congress delegated authority to the agency to “speak with the force of law” and the agency’s interpretation was “promulgated in the exercise of that authority.”⁵⁰ Informal agency interpretations “lacking the force of law” do not satisfy this requirement.⁵¹ Here, the Air Force prepared a “Frequently Asked Questions” document, but CRS has not identified an official statement under final agency authority from the Air Force or any other government agency on this issue that would qualify for *Chevron* deference. Nevertheless, if *Chevron* does not apply, a reviewing tribunal might still afford the Air Force’s informal interpretation some weight and respect pursuant to *Skidmore v. Swift*, which directs courts to accord certain agency interpretations an amount of deference correlated to the strength of the agency’s reasoning.⁵²

⁴³ See *Evolved Expendable Launch Vehicle (EELV) Frequently Asked Questions*, Roundtable on Assured Access to Space and the RD-180 (Feb. 2016), <http://forum.nasaspaceflight.com/index.php?action=dlattach;topic=39322.0;attach=1108208>.

⁴⁴ See 51 U.S.C. §50101(4) (defining “space transportation services”).

⁴⁵ See 51 U.S.C. §50101(5) (defining “space transportation vehicle”).

⁴⁶ A judicial or administrative tribunal will generally look first to the plain text of the statute to determine congressional intent. See *Chevron U.S.A., Inc. v. Nat’l. Res. Def. Council, Inc.*, 467 U.S. 837, 842-43 (1984) (stating that “the court, as well as the agency, must give effect to the unambiguously expressed intent of Congress”).

⁴⁷ See *Chevron U.S.A.*, 467 U.S. at 843-44 (recognizing the “principles of deference to administrative interpretations” in the face of a statutory ambiguity).

⁴⁸ See *Chevron U.S.A.*, 467 U.S. at 844 (“[A] court may not substitute its own construction of a statutory provision for a reasonable interpretation made by the administrator of an agency. We have long recognized that considerable weight should be accorded to an executive department’s construction of a statutory scheme it is entrusted to administer....”).

⁴⁹ See CRS Report R43203, *Chevron Deference: Court Treatment of Agency Interpretations of Ambiguous Statutes*, by Daniel T. Shedd and Todd Garvey (discussing “Threshold Limitations on What Interpretations Qualify for *Chevron* Deference”).

⁵⁰ *United States v. Mead Corp.*, 533 U.S. 218, 226-27, 229 (2001).

⁵¹ See *Christensen v. Harris Cnty.*, 529 U.S. 576 (2000). In a series of cases, the Supreme Court has examined a number of factors in determining whether *Chevron* deference is appropriate. An important factor is the formality of the procedures used when issuing the interpretation. See *Mead*, 533 U.S. at 226-27. However, informal agency interpretations might still meet the “force of law standard” and qualify for *Chevron* deference if the “[a]gency’s interpretation is one of long standing[.]” and based upon the “interstitial nature of the legal question, the related expertise of the Agency, the importance of the question to administration of the statute, the complexity of that administration, and the careful consideration the Agency has given the question over a long period of time[.]” *Barnhart v. Walton*, 535 U.S. 212, 221-22 (2002).

⁵² See *Skidmore v. Swift & Co.*, 323 U.S. 134, 140 (U.S. 1944); see also footnote 49 (discussion of “What if *Chevron* Deference Does Not Apply?”).

SpaceX is currently certified to launch into four of the eight NSS orbits using its Falcon 9 launch vehicle. The company first announced plans for a Falcon Heavy launch vehicle in early 2009, and originally planned for demonstration flights at the end of 2012 or early 2013. SpaceX now plans a first launch of the Falcon Heavy later in 2016. This will allow SpaceX to compete for some, if not all, of the other four mission orbits once the Falcon Heavy is certified by the Air Force for NSS launches.

Similarly, ULA is the only company with certified launch capability able to lift the full spectrum of NSS payloads, using its Atlas V and Delta IV launch vehicles. Only the Delta IV Heavy variant can lift the largest critical NRO payloads. ULA plans to retire the Delta IV Medium in 2016.

The main focus for ULA is on developing a next-generation launch vehicle called the Vulcan. In July 2014, ULA signed commercial contracts with multiple U.S. liquid rocket engine manufacturing companies to investigate next-generation engine concepts. “In collaboration with ULA, each company will conduct technical feasibility analyses, develop high fidelity plans, identify schedule, cost and technical risks, as well as cost estimates to meet aggressive recurring cost targets. All concepts will support a first launch by 2019.”⁵³ ULA has partnered with Blue Origin (Kent, WA) to deliver its first-stage main engine (BE-4) by 2018, and a first flight test is scheduled in late 2019. Certification is planned starting in 2020.

ULA also is providing some assistance to Aerojet Rocketdyne, which is developing a new liquid rocket engine (called the AR-1) that could replace the RD-180⁵⁴ and has said that the engine could be fully developed in four years for less than \$1 billion.⁵⁵ The Air Force funded Aerojet Rocketdyne this year for \$115 million for the AR-1 project and ULA contributed about \$57 million. Aerojet Rocketdyne remains ULA’s alternative to the outcome of the BE-4 program. The AR-1 could be available for a first flight on a ULA Vulcan about a year after the BE-4 Vulcan first flight planned for late 2019.

Conclusion

Although there are important differences in how to get there, widespread support appears to exist across the space community and within Congress for the NSS requirement for robust competition and assured access to space. The recurring theme since the start of the EELV program has been how best to pursue this requirement while driving down costs through competition and ensuring launch reliability and performance. This remains true today as well.

Efforts to transition away from the RD-180 to a domestic U.S. alternative engine or launch vehicle are not without technical, program, or schedule risks. A combination of factors over the next several years, as a worst-case scenario, could leave the United States in a situation where some of its national security space payloads will not have a certified launcher available. These factors could include some or all of the following:

- no more available RD-180s;
- ULA discontinues the Delta launch vehicle;

⁵³ <http://www.ulalaunch.com/ula-signs-multiple-contracts-for-.aspx?title=ULA+Signs+Multiple+Contracts+for++Next-Generation+Propulsion+Work+>.

⁵⁴ W.J. Hennigan, “Political Turmoil could give California rocket firm edge over Russians,” *Los Angeles Times*, June 14, 2014, online edition.

⁵⁵ Mike Gruss, “As Momentum Build for U.S. Rocket Engine, White House Pushes Back,” *Space News*, June 23, 2014, p. 3.

- ULA has trouble certifying the Vulcan launch vehicle;
- SpaceX has trouble certifying the Falcon Heavy;
- the AR-1 has developmental trouble; or
- the BE-4 has developmental trouble.

Even with a smooth, on-schedule transition away from the RD-180 to an alternative engine or launch vehicle, the performance and reliability record achieved with the RD-180 to date would likely not be replicated until well beyond 2030 because the RD-180 has had 68 consecutive successful civil, commercial, and NSS launches since 2000.

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