March 5, 2014

National Security Space Launch Programs

U.S. Senate Committee on Appropriations

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Hearing of the Senate Committee on Defense Appropriations

"National Security Space Launch Programs"

Wednesday, March 5, 2014 - 10:00 AM – Dirksen Senate Office Building 192

Testimony of Dr. Scott Pace
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Thank you, Chairman Durbin, Ranking Member Cochran, members of the committee, for providing an opportunity to discuss the important topic of national security space launch programs, and in particular, the Evolved Expendable Launch Vehicle Program which is central to maintaining assured access to space for the Department of Defense.

The Evolved Expendable Launch Vehicle (EELV) program as it exists today is the result of technical, economic, and policy decisions made over several decades. After the loss of the Space Shuttle *Challenger* in 1986, the Reagan Administration limited the Shuttle to flying only those payloads that required its unique capabilities. Additional launch failures and subsequent decisions in the 1990s led to the creation of the EELV program and the Atlas V and Delta IV launch vehicles to meet U.S. national security needs for expendable vehicles. Boeing and Lockheed Martin formed United Launch Alliance (ULA) in 2006 at the behest of the government in an effort to reduce duplicative costs in separate launch vehicle programs.

In late 2012, the Department of Defense (DoD) announced that it would invite competition for its EELV-class payloads beginning in 2015. The Air Force would proceed with a "block buy" of up to 36 "launch cores" from United Launch Alliance while competing up to 14 cores from potential new U.S. entrants such as SpaceX. The Air Force separately signed a contract with SpaceX for two launches in 2014 and 2015 to support the certification process for Space X's Falcon 9 v1.1 vehicle. The criteria for certification are set forward in a Launch Services New Entrant Certification Guide. There are several potential ways to achieve certification, through combinations of successful flights and/or detailed analyses showing compliance with Air Force requirements.

Current Issues and Policies

Fiscal constraints, rising launch costs, limited demand, and strict government requirements have combined to create a complex, on-going debate about the role of competition in the procurement of EELV-class launch services by the DoD. Private companies, whether Boeing, Lockheed, or potentially SpaceX, Orbital, and other companies yet to emerge must provide these services as the Air Force does not own and operate its own launch vehicles in contrast to its ownership and operation of air cargo transports. The government clearly has an interest in getting the most value for the taxpayer dollar while at the same time requiring a high degree of mission assurance given the criticality of national security payloads. The government also has an interest in understanding the implications of its purchasing decisions on the U.S. aerospace industrial base.

Due to the size and scope of DoD launch purchases and the requirement to use U.S. suppliers, DoD decisions have a major impact on the U.S. space launch industrial base. National space policy calls for maintaining assured access to space, with the DoD having the largest share of this responsibility. NASA and commercial providers also require assured access to space and they too are concerned about the U.S. launch industrial base. However, they purchase the best available launch services meeting individual mission needs, with NASA limited to U.S. suppliers unless specifically exempted, and commercial satellite firms purchasing the best globally available launch services, unless limited by export controls or other regulations.

DoD, NASA, and commercial satellite firms all rely on the same industrial base such that decisions made in one U.S. sector nearly always affect others, often in unanticipated ways. The DoD decision to end the use of the Delta II launch vehicle meant that fixed costs that had been shared by DoD and NASA now fell completely on NASA. This increased the cost to NASA and made the Delta II uneconomic for a large class of science missions that had relied upon it for many years. Similarly, the retirement of the Space Shuttle together with the cancellation of the follow-on Constellation program by NASA ended the sharing of certain fixed costs with DoD and drove up the cost of solid and liquid rocket propulsion systems, including those used by EELVs.

The 2013 National Space Transportation Policy does not specifically address the EELV program. Rather, it directs the Secretary of Defense to: "Ensure, to the maximum extent practicable, the availability of at least two U.S. space transportation vehicle families capable of reliably launching national security payloads". This condition is met today by the existence of the Atlas V and Delta IV, and in the future may (or may not) include SpaceX, Orbital, or even NASA's Space Launch System. There is no requirement that these vehicle families be privately owned, although that is at present the most plausible assumption.

U.S. national policy addresses the space launch industry base by stating that the health the industrial base, broadly defined, is a consideration that goes beyond the needs of any specific mission in awarding contracts or setting the parameters of competition. Specifically, the policy states that:

> "To promote a healthy and efficient United States Government and private sector space transportation industrial base, departments and agencies shall:
>
> - Make space transportation policy and programmatic decisions in a manner that considers the health of the U.S. space transportation industrial base; and

- Pursue measures such as public-private partnerships and other innovative acquisition approaches that promote affordability, industry planning, and competitive capabilities, infrastructure, and workforce."

It should be noted that the policy includes both government and private sector industrial bases, although in practice is it difficult to clearly separate the two. The only government-led launch system development at present is the Space Launch System, and even in that case private contractors are doing the work in commercial as well as government facilities. With regard to private sector competition for government contracts, the policy states that:

> "U.S. commercial space transportation capabilities that demonstrate the ability to launch payloads reliably will be allowed to compete for United States Government missions *on a level playing field, consistent with established interagency new entrant certification criteria*. Any changes to these new entrant criteria shall be coordinated with the Assistant to the President and National Security Advisor and Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy before they may take effect." [Emphasis added]

I have emphasized to the phrase "level playing field" as the determination of just what this means is central to the question of competition going forward. Policy alone cannot answer the dilemma of how industrial base and competition objectives should be traded so as to assure the existence of at least two "U.S. space transportation vehicle families capable of reliably launching national security payloads." The judgment as to what constitutes acceptable reliability is left to the DoD and the Air Force. I will briefly address three primary factors that are driving possible trade-offs and the uncertainties around them: market structure, mission assurance needs, and options for reducing launch costs.

Structure of the Launch Market

Given that private firms provide U.S. launch services, how many launch providers can the market sustain? It should be recalled that ULA was formed because launch demand, U.S. and foreign, was inadequate to sustain two independent competing launch providers with separate infrastructures. The structure and size of the market has not changed in the last decade; U.S. government demand has remained flat at best. There has not been growth on the commercial side for EELV- class payloads, although there has been an increase in small "nanosats" and "cubesats."

Historically, the demand for space transportation has often been overestimated, whether from projections in the early 1980s of the need for 24 Shuttle flights per year, or the 1990s expectations of hundreds of small satellites for mobile satellite services. Virtually all of those "big LEO" and "little LEO" systems disappeared or went bankrupt in the face of the rapid expansion of ground-based cellular communications. In 2013, the FAA's commercial space transportation advisory committee (COMSTAC) predicted a small increase in commercial launches in 2014 and 2015, followed by a decline to a relatively steady state for the rest of the decade.

Mass tourism to orbit, not just suborbital flights, would be a “game changer” in terms of bringing significant new commercial demand to the space transportation market. In the government civil sector, the market for transportation of cargo and crew to the International Space Station is quite modest however, a U.S. commitment to human lunar exploration, with procurement of private launchers to deliver cargo to the Moon, could greatly strengthen demand for U.S. launchers. Both tourism and lunar logistics would occur outside of the DoD budget, and thus would have the potential to benefit DoD, but it is unknown when, if ever, either new source of demand might occur.

The recently successful SpaceX launches of communication satellites are a case in point, taking back market share from European and Russian providers that had largely driven the United States out of international competitions. A shift in demand toward the United States would, of course, drive up costs for competitors in Europe and Russia, who would have less demand for their services. This would also create partial disincentives for new countries seeking to develop launch capabilities and offset some of their costs through export of launch services. In this way, U.S. pricing power can be a barrier to entry for developing space launchers.

While the success of the SpaceX Falcon and, more recently, Orbital’s Antares launcher is welcome, it should be kept in mind that governments, not private industry, drive much of global launch demand. Most foreign government launch opportunities are inaccessible to U.S. launch providers, just as U.S. government launch opportunities are inaccessible to foreign launch providers. In general, competition is a good thing. However, the launch market is not a classic one of "many buyers and many sellers," but is instead characterized by very thin demand, few suppliers, and multiple government-driven industrial polices (U.S., European, Russian, Chinese, Indian, and Japanese). Major spacefaring countries have shown a willingness to retain their launch autonomy, even if it makes no commercial sense.

In space transportation, price is among several factors, such as schedule, reliability, and risk that affect demand. In conventional markets, falling prices create increased demand. Space launch demand has, however, proven to be remarkably flat over a very wide range of prices. Past studies have estimated that launch prices would have to fall to a few hundred dollars per pound, from the thousands of dollars per pound levels of today, to induce new demand, notably in space tourism. A consequence of flat demand is that a lower cost supplier, able and willing to offer a lower price, can displace a higher priced incumbent. However, once accomplished, the new supplier has every incentive to raise prices to gain revenue and profit margin. The buyer does not necessarily benefit from lower prices once a new set of suppliers is established. Said another way, the prices experienced by buyers in a thin market, with flat demand and high barriers to entry, generally do not drop after the exit of the former incumbent.

The attainment of lower launch costs and hence lower prices with present-day expendable launchers can create disincentives to the private development of new reusable launchers. As expendable prices drop, the economic break-even point for investing in reusable launch systems increases; that is, more flights of the reusable system are required to "pay back" the investment in its development. This is an especially difficult barrier given current and foreseeable launch markets, where demand is essentially flat. Thus, new reusable launch vehicle technology resulting in dramatically lower operational costs would seem to be out the reach of private development. It is not the availability of capital but rather the lack of an attractive business case that is the problem.

High prices and low volumes characterize today's launch market such that industry revenue is maximized when demand is (nearly) linear with prices. If prices were to be cut by half and volume only doubles, total revenue would be constant.
This creates a classic market failure in that there is no market incentive to invest. The space launch market thus has some similarity to other historical transportation technologies, from canals and railroads to automobiles and airplanes. Faced with these issues in the past, the government has taken action to overcome "market failure," with incentives that move the market to prices at which demand is capable of driving prices lower rather than higher. Thus, the early transcontinental railroads profited from the sale of former federal land, not the operation of the railroads themselves. The air transportation system enabled by government support for airports and the air traffic control system benefits the economy as a whole far more than it does the airline owners and operators.

The point of these examples is that space launch is a strategic national capability that serves public as well as private objectives. Despite its criticality, however, the economic structure of today's space launch market results in a classic "market failure" that justifies government intervention. However the purpose, degree, and scope of that intervention is a subject of debate, as we will discuss.

Mission Assurance and the Cost of Failure

Launch vehicles are a means to an end, the reliable placement of payload into space. The loss of a national security payload is unlike a commercial loss in which an insurance payout can compensate for the loss. The cost of failure in the national security arena is tremendous, in terms of direct hardware losses, failure investigations and corrective measures, replanning and rebuilding, delayed mission capabilities, and indirect loss of national and international confidence. The stakes are even higher, of course, where human life is concerned.

The EELV program has an excellent reliability record, with 68 successful launches since 2002. Launch vehicle reliability records, whether for Atlas, Delta, Titan, Soyuz, Proton, Long March, Zenit or Ariane, develop over time. A launch vehicle may be designed to be reliable, and the tools of probabilistic risk assessments can help predict relative reliabilities among different designs. But it is only with accumulated flight experience over time that one can actually know what the reliability of a vehicle is. This is a challenge for developing vehicles in which the configuration of the vehicle may be changing from flight to flight. The actual flight heritage and confidence of individual subsystems, such as engines, electrical, guidance, and separation devices, can vary substantially in a vehicle that appears outwardly unchanged.

If mission assurance is critical and the costs of failure are high, it makes sense to be willing to incur additional costs to assure launch vehicle reliability – and to want to have actual flights to prove that reliability. The current Air Force approach of requiring combinations of either demonstrated performance or documentation is a reasonable one for giving new entrants an opportunity while protecting national security interests. That said, the United States incurs considerable cost to ensure that it can place national security payloads reliably into space, with extensive documentation requirements, audits, and inspections, not only of technical matters but of financial and business processes as well. Do all of these additional costs add value for the government? What are the cost/risk/benefit trade-offs of doing something different?

Government oversight is costly, but reliance on the private sector when commercial demand is very thin is also risky. During the defense reforms of the 1990s, the government stopped requiring its standards for radiation-hardened electronics, assuming an experienced industry could and would apply more cost efficient commercial standards. Government needs proved to be both unique and limited, such that there was little economic incentive to meet government standards in the much larger commercial markets. The result was a series of costly failures in government programs that necessitated rebuilding, at public expense, an industrial capability that had withered.

I am not saying that we should accept less reliability for lower launch prices; or that some level of failure in space is acceptable. It is difficult to identify a viable product or service that thrives with low reliability. However, there is suggestive evidence that the cost of government-driven mission assurance and current Federal Acquisition Regulations (FAR) increase costs by factors of 3-5 times, not just 20-30%.[1] Thus debate should be about the cost of assuring reliability and whether than can be accomplished in a more cost-effective way.

The traditional FAR process is not inherently dysfunctional – nothing in the FAR requires government program managers to act inefficiently. Unfortunately, the penalties imposed on government managers who try to expedite development by tailoring the application of FAR processes can be so severe that, in practice, most

[1]Comparison of actual private costs to development costs predicted by government cost models have indicated wide gaps in some cases of small launch vehicles, communications satellites, and cargo aircraft. The data are sparse however as few direct public-private product analogues exist.

persons in authority will not take the risk. The typical government acquisition cycle is structured with far more emphasis on eliminating any possible cause of failure, than achieving success in a timely and cost-effective manner. In reality, the cost of broken hardware and the required rework can easily be less onerous in the long run than the cost and schedule overruns that so typically plague government procurement. But cost and schedule overruns, as long as they are in some sense "moderate," e.g., factors of two or less, are not considered to be "failures," whereas broken hardware emphatically is.

As a result, government procurement can become so dysfunctional that innovative approaches such as NASA Space Act Agreements are sought out for use in situations well beyond their originally intended sphere of applicability. The DoD and intelligence communities have their own "other transactional authorities" which can be used in place of FAR-based procurements, and have at times sought their own approaches to operating more efficiently in performing critical missions, such as classification and the establishment of special programs under DARPA or the Strategic Defense Initiative Organization.

Expedited approaches to Federal acquisition are structured so as to sacrifice a certain amount of formal, documented accountability for the expenditure of public funds in exchange for significantly expedited results obtained at substantially lower cost. While this has worked extremely well in particular cases, it remains broadly true that public funds must be carefully accounted for, and the government must be a "smart buyer" on behalf of the taxpayer. Experiences with programs such as the Future Imagery Architecture demonstrate the consequences of agencies having inadequate internal skills and capacities to oversee major program acquisitions.

This raises a key but widely misunderstood point: much of what has been labeled "commercial space transportation" at NASA in recent years is really just innovative contracting with new contractors. It is, largely, *not* private capital being put at risk to compete in private markets; the arrangements involved might far more accurately be described as "private-public partnerships." There is nothing inherently wrong with such arrangements, but we should use accurate terminology in describing them, and we should require that in exchange for the public funds that are advanced, the government benefits accordingly. For example, the development of two new cargo suppliers for the International Space Station – Falcon 9 and Antares – has been a success. The DoD may thus be in a position to benefit from the capabilities of SpaceX and Orbital that NASA has helped to develop with its innovative combination of public money and private talent.

By all observations, the new private entities are intensely focused on reducing costs, and this includes the cost of compliance with government regulations that are now imposed on United Launch Alliance. If a private entity can demonstrate reliability without traditional levels of government oversight, it could have a sizable cost advantage. This then raises the question of whether the government will allow one set of rules for so-called "new entrants" and a different set for incumbents. Looking forward to the potential 14-core competition, the question for the government will be what costs it wishes to impose on suppliers of national security space launch services, and whether those rules are applied on a "level playing field" as called for in U.S. policy.

Reducing Launch Costs

How does one actually reduce launch costs? Clearly, anyone with deep pockets can reduce launch *prices*—e.g., sovereign nations, wealthy entrepreneurs or philanthropists—but how can the actual *cost* of launches be cut? The rocket equation and propulsion mass fractions are as unforgiving as private capital markets. Process improvements, in design, production, and operations can help, such as vertical component integration, horizontal payload processing, and streamlined launch checkout and operations. However the amount of "touch labor" required per pound of launch vehicle is stable across a wide range of masses, so improvements tend to be of marginal, not break-through, benefit.

Increasing production volume through large buys can achieve economies of scale. However, without new demand, large buys are not sustainable without government support. As mentioned earlier, demand is relatively flat, so there are limits to the size of buys that could be justified. Launch costs might be made cheaper if some lower level of reliability could be traded for cost, but no payload owner would want to use them. Large-scale space tourism is only possible at levels of reliability and safety even greater than what we have today.

Various teams are exploring how existing engines such as the RS-68, RS-25, and even the old Saturn V F-1, could be manufactured more efficiently. The production line for Merlin engines at SpaceX is very large, with 10 engines being used on each Falcon 9 flight. This helps build operational experience more rapidly than if using a fewer number of more powerful engines. Whether this multi-engine approach is reliable and executable as flight rates increase remains to be seen.

New concepts such as reusable "flyback" boosters that return expensive elements (propulsion, avionics) for re-use are promising. Electric propulsion for in-space movement of satellites is developing rapidly. During the government shutdown last year, a space electric propulsion conference was held at my university. It attracted about 400 participants, U.S. and foreign, industry and academia. Commercial satellite companies are moving to take advantage of electric propulsion. This could have great impact on the commercial launch markets, as a dedicated upper stage would no longer be needed to place a satellite in its final orbit. I am speculating, but a two-stage vehicle with a reusable first stage could be a serious competitor in that future world.

New technology seems to be the long-term answer, in particular, advanced propulsion with much higher specific impulse, than current chemical propulsion. DARPA has pioneered work in high energy density materials that may the potential to dramatically increase the performance of chemical rockets. DARPA also does not seem to think that re-engineering existing engine designs will enable major cost reductions. Instead, they are looking at reusable systems such as two-stage to orbit concepts. Single-stage to orbit vehicles using air-breathing engines still look to be beyond the state-of-the-art. As mentioned earlier, the economic break-even point for reusable launch vehicles is greater than for expendable launchers. Assuming expendable launch prices do decline, this will make the economic case for reusable more challenging without dramatic technology advancements. Thus investments in new space launch R&D are likely going to have to come from the government, not private industry.

Concluding Observations

The United States and the DoD in particular need to decide how it best assures the existence of at least two "U.S. space transportation vehicle families capable of reliably launching national security payloads." In doing so, the DoD has to be mindful of the overriding need for mission assurance, fiscal constraints, and the need for a U.S. industrial base that can assure access to space for all payloads.

In this context, industry competition is a tool, not an end in itself. Depending on its terms and conditions, competition can result in meeting DoD needs at lower cost or failing to meet those needs and merely shifting costs to other accounts. The EELV program as managed by ULA today represents high degree of experience and capability that are vital to assuring access to space for all national security needs. As a potential competitor for national security launches, SpaceX is innovative, real, and brings an intense focus on cost control while meeting customer launch needs.

How will any new entrant, do in the future? Only repeatable, configuration-controlled flight experience will tell. The Launch Services New Entrant Certification Guide is a thoughtful and prudent approach that is being applied to SpaceX and should be to any candidate new entrant. The more difficult question is what comes after a new entrant is certified. Will current FAR-based procurements be used, or will the DoD procure future services in a more commercial-like manner, perhaps paying for additional specific services not required by private sector customers?

Will incumbents and new entrants, with very different histories, compete under the same rules? And, whether they do or do not, what may be said about the rules themselves? Do today's rules appropriately reflect the nearly 60 years of lessons learned in space transportation? I do not know the answers to these questions, and I suspect no one else does either at this time. In this connection, I am reminded of the comment made some years ago by Wayne Hale, former Space Shuttle Flight Director and, later, Program Manager – "I am not sure I know how to make space transportation more reliable, but I do know how to make it more expensive."

In the end, the policy issue is not one of SpaceX and other potential new entrants versus ULA as much as it is one of deciding what the role of the DoD should be, and what are the government's policy requirements. Should we be trying to:

- Get the lowest price for reliable transportation to orbit for a particular mission?
- Get the lowest price for all national security missions?
- Get the lowest price for all government-funded missions?
- Assure access to space for all needs with a U.S. industrial base at least cost?

The last question is a consequence of the fact that a space launch industrial base meeting all government needs, civil as well as national security, cannot presently be sustained by private market demand. Thus, a significant degree of government support will be necessary for the foreseeable future.

Reliability and readiness have been the top priorities for national security launches. Given the importance of national security missions, what is the most cost-effective way for the DoD to assure mission success? Can mission assurance be achieved at lower cost than the way we do it today? This certainly seems plausible, but careful thought needs to be given as to what responsibilities and capabilities ought to remain within the government. Will the government have the authority to order a stand-down of a vehicle family in the event of a failure? Are agencies willing to relax or modify their use of cost-accounting rules and other FAR-based requirements for all launch service providers? In short, how much is the government willing to pay for "process" in addition to "performance"?

Defense acquisition reform is a much larger topic than the present hearing, but nonetheless bears directly upon the present case. Thus, the question of how best to acquire space launch services may provide an opportunity for pilot-testing some forms of regulatory relief, as opposed to direct subsidies. The government could pay separately for non-commercial processes and deliverables, rather than having all such costs bundled into the launch cost or company overhead as is done at present. The government may still pay more for its launches than a commercial buyer would, but the costs drivers would be more visible and accountable and would more easily allow cost-benefit trades to be performed.

Most critically, the United States needs to ensure that its space policies, programs, and budgets are in alignment, since to do otherwise is to invite failure. The first consideration for any policy choice and implementing approach is that it be clearly stated and adequately funded – with clear priorities on which requirements, schedules, and goals will be relaxed if resources or regulatory relief are not forthcoming.

Thank you for your attention. I would be happy to answer any questions you might have.

Scott Pace

Dr. Scott Pace is the Director of the Space Policy Institute and a Professor of the Practice of International Affairs at George Washington University's Elliott School of International Affairs. His research interests include civil, commercial, and national security space policy, and the management of technical innovation. From 2005-2008, he served as the Associate Administrator for Program Analysis and Evaluation at NASA.

Prior to NASA, Dr. Pace was the Assistant Director for Space and Aeronautics in the White House Office of Science and Technology Policy (OSTP). From 1993-2000, Dr. Pace worked for the RAND Corporation's Science and Technology Policy Institute (STPI). From 1990 to 1993, Dr. Pace served as the Deputy Director and Acting Director of the Office of Space Commerce, in the Office of the Deputy Secretary of the Department of Commerce. He received a Bachelor of Science degree in Physics from Harvey Mudd College in 1980; Masters degrees in Aeronautics & Astronautics and Technology & Policy from the Massachusetts Institute of Technology in 1982; and a Doctorate in Policy Analysis from the RAND Graduate School in 1989.

Dr. Pace received the NASA Outstanding Leadership Medal in 2008, the US Department of State's Group Superior Honor Award, *GPS Interagency Team*, in 2005, and the NASA Group Achievement Award, *Columbia Accident Rapid Reaction Team*, in 2004. He has been a member of the US Delegation to the World Radiocommunication Conferences in 1997, 2000, 2003, and 2007. He was also a member of the US Delegation to the Asia-Pacific Economic Cooperation Telecommunications Working Group, 1997-2000. He is a past member of the Earth Studies Committee, Space Studies Board, National Research Council and the Commercial Activities Subcommittee, NASA Advisory Council. Dr. Pace is a currently a member of the Board of Trustees, Universities Space Research Association, a Corresponding Member of the International Academy of Astronautics, and a member of the Board of Governors of the National Space Society.

STATEMENT OF
ELON MUSK
CEO & CHIEF DESIGNER
SPACE EXPLORATION TECHNOLOGIES CORP. (SPACEX)

BEFORE THE
COMMITTEE ON APPROPRIATIONS
SUBCOMMITTEE ON DEFENSE
U.S. SENATE

March 5, 2014

Chairman Durbin, Ranking Member Cochran, and Members of the Committee,

Thank you for the opportunity to participate in this important hearing. I also want to thank this Committee for its continued support for competition in the Evolved Expendable Launch Vehicle (EELV) program. This Committee's commitment to reliability, transparency, and cost-effectiveness coupled with clear and sustained support for New Entrant competition will ensure mission success, reduce launch costs, spur innovation in the national security launch enterprise, and provide true assured access to space for our warfighters as they defend our Nation. To be clear at the onset, I believe that competition in the EELV program will save the taxpayers in excess of $1 billion per year.

I founded SpaceX in 2002 to radically improve the reliability, safety, and affordability of space transportation. Twelve years later, SpaceX is the fastest growing launch services company in the world, with nearly 50 missions contracted at a total contract value of approximately $5 billion. We have now successfully launched our Falcon 9 rocket eight times, including four successful launches for NASA and three successful launches for leading commercial satellite companies.[1] Our Dragon spacecraft has berthed with the International Space Station (ISS) three times, and we are scheduled to conduct another resupply mission to the ISS for NASA this month.

SpaceX has achieved massive, unprecedented reductions in the cost of launch and spacecraft development, all while achieving 100% mission success, scaling our production operations to produce 40 rocket cores and nearly 400 rocket engines annually later this year—we are today the largest rocket engine manufacturer in the world. Meanwhile, we continue to push the envelope on rocket technology as we advance toward fully reusable launch vehicles, design the safest crew transportation system ever produced, and begin testing on the world's next-generation rocket engine at Stennis Space Center. Critically, all of this innovation is occurring in the United States and our launch vehicles (including engines and fairings) and spacecraft are made in America. We do not rely upon Russia for any element of the launch vehicle.

SpaceX today is serving the Nation's space program by routinely resupplying cargo to and from the International Space Station with our Dragon spacecraft and integrating numerous satellites for government launches to occur in the next 2 years. We are restoring America's competitive position in the global commercial space launch market, recapturing market share that U.S. launch companies long ago surrendered to our French, Russians, and Chinese competitors. With NASA, we are poised to develop a new human spaceflight system that will restore America's domestic capability to launch our astronauts from our own soil. And we are dedicated—if given a fair opportunity—to successfully executing missions

[1] The first launch of the Falcon 9 was a successful SpaceX-funded demonstration flight, which occurred on June 4, 2010.

in furtherance of the Nation's defense and space priorities, while offering the Air Force and other defense agencies the means to achieve mission success at a fraction of the cost they are paying for launch today.

To that end, SpaceX is working aggressively to achieve Air Force certification to become a certified provider of national security space launches with our Falcon 9 and Falcon Heavy launch vehicles. As a threshold matter, we have been required to successfully launch three upgraded Falcon 9 launch vehicles, two consecutively. Importantly—in just five months—we successfully and consecutively launched all three of the three required Falcon 9 launches as required by the Cooperative Research and Development Agreement (CRADA) with the Air Force and the New Entrant Certification Plan. One has already been declared a successful certification flight. We continue working with our Air Force partner as they conclude the data and engineering reviews from the remaining two flights, and we look forward to timely certification of the Falcon 9 so that we may compete for EELV missions in 2014 for missions to be ordered in Fiscal Year 2015.

Although the aggressive reintroduction of competition into the EELV Program is now the established policy of the Defense Department, the details related to creating a fair, full, and open competitive acquisition environment remain unresolved. Fair competition in the EELV Program will lower the costs of launch, result in a higher quality of customer service, drive contractor-funded innovation, increase operational flexibility for the Air Force, and relieve congestion on the Air Force launch manifest. Indeed, the EELV Program was initiated in 1995 in part to introduce affordability, customer service, and flexibility to national security space launch. Unfortunately, as this Committee well-knows, these goals have not been achieved as launch costs have grown dramatically since the EELV Program was established, and there is congestion in the ULA manifest.

By Fiscal Year 2013, the Government was forced to budget in excess of $380 million per launch, while subsidizing ULA's fixed costs to the tune of more than $1 billion per year if the company never launches a rocket.[2] Several recent cost analyses have determined the EELV Program will double in price over initial estimates to $70 billion.[3] This sustained cost growth triggered multiple "critical" Nunn-McCurdy breaches, most recently in 2012 when the program exceeded 58 percent unit cost growth.[4] These cost increases have been exacerbated by an opaque and confusing contracting structure that made it difficult to understand the true cost of a launch service to the Government. By contrast, SpaceX's Falcon 9 price for an EELV mission is well under $100M—a $280 million per launch difference – and SpaceX seeks no subsidies to maintain our business.

Recently, some have claimed that the Air Force's block buy of 36 booster cores from the incumbent will save the taxpayer "$4.4 billion over the next several years." Any "savings" resulting from a block buy of 36 rocket cores from the incumbent provider are derived directly from a 50 percent year-over-year budget projection increase in FY2012, which was purposefully based on worst-case assumptions for a single-Launch buy, and acknowledged at the time by the incumbent as being inflated.[5] If SpaceX had contracted for these missions, using the same baseline, we would have saved the taxpayer a total of $11.6 billion. That is a 77 percent reduction from the projected $15B procurement total from which ULA is claiming its

[2] Department of Defense, "Fiscal Year (FY) 2014 President's Budget Submission, Missile Procurement, Air Force." Apr. 2013. Vol. 1, 232.
[3] Department of Defense OUSD (AT&L) ARA/AM, "Selected Acquisition Report (SAR) Summary Tables," December 2012, 6; U.S. Government Accountability Office, "Defense and Civilian Agencies Request Significant Funding for Launch-Related Activities," September 2013, 2.
[4] U.S. Government Accountability Office, "Uncertainties in the Evolved Expendable Launch Vehicle Program Pose Management and Oversight Challenges," September 2008, 7; 20-21. U.S. Government Accountability Office, "Assessments of Major Weapon Programs," March 2013, 59.
[5] Svitak, Amy. "Rising Engine Costs, Uncertainty Drive Up Atlas 5 Prices for NASA." Space News. Feb. 2, 2011. http://www.spacenews.com/article/rising-engine-costs-uncertainty-drive-atlas-5-prices-nasa.

savings. If we all use the same baseline, it is accurate to say that the absence of full and open competition actually has resulted in a $7.2 billion penalty to the taxpayer, and untold consequences for important defense priorities that might otherwise have been funded.

Despite the continuing promise of lower costs since 2006, the fact is that the current situation of sole-source providers has become unsustainable, a fact now recognized by most observers and the Defense Department. The EELV program is now the largest single item in the unclassified Air Force space budget, comprising more than 40 percent of all Air Force space funding. General William Shelton, the head of U.S. Air Force Space Command, acknowledged that these costs are "unsustainable."[6] These issues stem from the current reliance on a single-provider, and a contracting structure that disincentivizes affordability, innovation, and adherence to schedule.[7] Further, the Government Accountability Office (GAO) has commented in depth on these problematic aspects of the program.[8]

Mr. Chairman, we appreciate this Committee's timely review of the EELV Program. We commend the Air Force and NRO efforts to reintroduce competition into the EELV Program as a means to counter the rising costs of national security space launch and the stagnant innovation in this critical sector. In order for true, meaningful competition to occur, we respectfully suggest the EELV Program be further reformed to adopt contracting practices and other acquisition reforms consistent with a competitive procurement environment, as follows:

1) Most importantly, every single mission capable of being launched by qualified new entrants should be competed this year and every year moving forward. There should be no reason that a mission is sole-sourced to ULA, whether as part of the recent 36-core deal or any other arrangement. And if competition opportunities are being delayed, we should understand why that is so, and we should fix it immediately;

2) Introduce a FAR Part 12 commercial contract structure that creates rational incentives for both the contractors and the government to achieve reliable, cost effective on-time launches;

3) Leverage commercial practices wherever possible – a philosophy and acquisition approach that NASA has successfully employed in its launch programs. Fundamentally, the Air Force should establish clear requirements for launch services and associated activities, but it should not dictate how those requirements are implemented. Rather, contractors should be empowered to meet requirements in a manner best suited to their organization's strengths; and

4) Eliminate payments—more properly called subsidies—under the EELV Launch Capability (ELC) contract line item that are exclusively in support of the incumbent provider. And when conducting competitions for launches, properly account for the subsidies that the incumbent enjoys so that an even playing field is created. The long-term elimination of the ELC is paramount if an efficient acquisition approach is to be created. As was noted in DOD's recertification of the EELV program after its 2012 "critical" Nunn-McCurdy breach, cost-plus

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[6] "Department of Defense Fiscal Year (FY) 2014 President's Budget Submission, Missile Procurement, Air Force." Apr. 2013.

[7] Wydler, Ginny, Su Chang, and Erin M. Schultz. "Continuous Competition as an Approach to Maximize Performance." Proc. of Defense Acquisition University Research Symposium. McLean: MITRE Corporation, 2012, 3.

[8] U.S. Government Accountability Office, "DOD Needs to Ensure New Acquisition Strategy is Based on Sufficient Information," September 2011, 10-12.

contracting and the ELC has funded "effectively idle personnel" at ULA.[9]

I. SpaceX Commitment to Reliability and Mission Success

Mission success is paramount to SpaceX, as our eight consecutive successful Falcon 9 launches to date have demonstrated. The Falcon 9 is designed for the highest reliability starting at the architectural level. Because 91 percent of launch vehicle failures in the past two decades can be attributed to engine failures, avionics failures or stage separation anomalies, the Falcon 9 design incorporates robust, fault-tolerant propulsion systems, fault-tolerant avionics and controls systems with internal triplication and redundant harnessing, and a minimum number of separation events. With its nine-engine configuration, Falcon 9 features a unique engine-out capability, and is designed to permit the loss of up to two engines in flight without compromising the mission. The Falcon 9 is the only American rocket since the Saturn V with any engine-out capability; any other launch vehicle in the world, including the current EELV fleet, that encounters a major engine anomaly on ascent will almost certainly fail its mission.

The Merlin engine—which is designed and manufactured by SpaceX and powers the Falcon 9 first and second stages—is a human-rated engine with high structural margins and a highly reliable, redundant ignition system. A hold-before-release system verifying nominal operations of the first-stage engine before liftoff has been successfully demonstrated multiple times. Rigorous qualification and acceptance testing from the component to the vehicle system level are part of SpaceX's "test what you fly" approach, and the company uses liquid-fueled engines and non-pyrotechnic, resettable separation systems that allow testing of actual flight hardware before flight. Notably, SpaceX does not rely on any foreign companies for critical components or subsystems. There is absolutely zero dependence on Russia with this rocket. To state the obvious, the same cannot be said of ULA.

Demonstrating our long-held commitment to launching national security payloads, SpaceX designed the Falcon 9 and its follow-on, the Falcon Heavy, from the outset to meet the EELV design specifications, including the EELV Standard Interface Specification (SIS) and System Performance Requirements Document (SPRD), at no charge to the U.S. Air Force. Separately, SpaceX has passed rigorous certification efforts by NASA in order allow the Dragon spacecraft to berth with the International Space Station, as it has now successfully achieved three times, with another mission scheduled later this month. This accomplishment demonstrates that SpaceX can be trusted with extremely critical national and international assets.

The Falcon Heavy, which SpaceX will debut in 2015, will leverage the same engines, tooling, and launch facilities to enhance reliability, while also being the most powerful launch vehicle in the world.

II. EELV New Entrant Certification

To validate our singular emphasis on mission success and to earn the confidence of the Air Force, SpaceX formally submitted Statements of Intent to become a certified provider of national security space launches with our Falcon 9 and Falcon Heavy launch vehicles. SpaceX subsequently entered into a formal CRADA with the Air Force to become certified under the EELV Program for the Falcon 9, with plans to execute a similar agreement for the Falcon Heavy. The Falcon 9 certification will enable SpaceX to compete for the 14 EELV missions that have been identified for competition, and with the Falcon Heavy certification, SpaceX intends to compete in 2018 and beyond for the entire spectrum of national security space missions.

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[9] Kendall, Frank. "Evolved Expendable Launch Vehicle Nunn-McCurdy Certification: Basis of Determination and Supporting Documentation." Memorandum to Congressional leadership. 12 Jul. 2012.

As part of our certification plan for the Falcon 9, SpaceX was required to conduct three successful flights, with two consecutive successes. I am proud to say that SpaceX successfully completed the third flight needed for EELV certification on January 6, 2014, and we achieved 100 percent mission success for each flight. Importantly, all three missions were for commercial customers, eliminating any risk or cost to the Government for these certification flights. In early February, the Air Force recognized our CASSIOPE mission, launched on Sept. 29, 2013, as having met all mission requirements and qualified the flight under the EELV Certification CRADA; we are now awaiting an Air Force decision on the subsequent two flights. Here, it bears noting that the New Entrant Certification requirements that SpaceX must live up to exceed the requirements that the Atlas V and Delta IV launch vehicles had to meet in 1998, prior to their ability to compete for and be awarded EELV launch service orders**.**

At this point, the Air Force must complete independent verification activities, audits of our processes, and engineering review boards (ERBs) to conclude the certification process. SpaceX has committed personnel and resources to support these technical interchanges. The Air Force kicked off the first ERB process as of late February of 2014, but there are many more to conduct and we hope that the Air Force will be able to support the schedule to conclude the certification process in 2014. This will allow SpaceX to compete for the FY2015 missions. Consistent with DOD and Air Force directives, these risk reduction activities can and should occur in parallel with the early competition phases for the Phase 1A competed missions.[10] This method is consistent with NASA's Launch Services Program (LSP), which requires certification prior to launch rather than contract award.

SpaceX has taken multiple other actions to ensure we meet all EELV certification requirements, including:

- Building and debuting a new launch facility last year at Vandenberg Air Force Base (VAFB), CA with a successful September 2013 Falcon 9 launch. This was self-funded by SpaceX;
- Agreeing to incorporate the ability to provide vertical integration at both launch sites for NSS payloads that require their space vehicles to be processed in this manner. SpaceX will self-fund this capability;
- Providing the Air Force with the ability to observe or receive data from our contracted commercial launch service activities at no cost to the Government; and
- Being awarded and working on a lease with NASA for the use Launch Complex 39A to increase SpaceX's ability to meet a growing launch manifest and outfitting the launch pad to serve additional customers, including the national security community, at our own expense to further reduce EELV manifest congestion.

III. Challenges to EELV Competition

The Air Force is now taking a major step forward in addressing the challenges of reintroducing competition into the EELV Program by outlining a plan that takes advantage of the recent significant advances that have taken place in the U.S. launch services business. SpaceX commends the Air Force for moving to certify New Entrants and take advantage of new, commercially-developed reliable launch systems. As the Air Force moves to restructure the EELV program to on-ramp New Entrants for competition in the intermediate term, and contemplates the format for full and open competition beginning with the FY2018 Phase 2 acquisition, a number of key issues must be addressed to ensure a fair and level competition:

[10] Kendall, Frank. "Evolved Expendable Launch Vehicle Program Quantity Buy Decision Acquisition Decision Memorandum." Memorandum to the Secretary of the Air Force and the Director, Cost Assessment and Program Evaluation. 27 Nov. 2012. Secretary Kendall directs the reintroduction of competition into the EELV Program "as soon as possible." 2

- **Number of Competitive Missions.** In his November 27, 2012 Acquisition Decision Memorandum (ADM), Under Secretary of Defense Frank Kendall clearly directed that up to 14 missions be made available for competition to certified New Entrants. This directive was designed to "aggressively introduce a competitive procurement environment in the EELV program." SpaceX strongly supports the decision to compete these 14 missions, but remains concerned that, faced with a difficult budget environment, the Air Force may push many of the 14 missions out of the FY2015-FY2017 competition, even while leaving the 36-core block buy for the incumbent untouched. Such a decision would materially slow progress toward the ADM's goal of aggressively transitioning to a competitive environment and further delay real savings that can be realized with competition. Undersecretary Kendall's acquisition directive is quite specific about the need to "aggressively" introduce competition. His directive does not require buying 36 cores from ULA. Rather, every mission capable of being launched by qualified new entrants should be competed this year and every year moving forward.

- **EELV Launch Capability Funding.** ULA receives on average $1.2 billion annually primarily on a cost-plus basis to fund "facility and facility support costs, launch and range operations, mission integration, mission unique development and integration, subcontract support engineering, factory engineering, etc."[11] ULA receives these "EELV Launch Capability" (ELC) payments whether they launch zero rockets or eight; if they launch more than eight times, they are paid additional funds. Essentially, the Government supports all of ULA's fixed costs. Such funds are not provided to SpaceX, and SpaceX has not sought them. Rather, SpaceX has self-funded its EELV efforts.

  ELC funding provides ULA with a major competitive advantage for national security missions, as well as civil and commercial missions. ULA can, and most likely will, marginally price launch services for commercial and civil customers because ELC funding allows ULA to maintain its operations and covers its fixed costs. In fact, ULA appears to have marketed a marginal launch services price for the MEXSAT mission. Here, it appears the Mexican government will be paying substantially less for an Atlas launch service than does the Air Force. In these challenging economic times—or any economic times for that matter—why should American taxpayers subsidize a launch for the Mexican government or a commercial purchaser of launch services?

- **Sole Source, Non-Compete Block Buy to ULA.** The Air Force's decision to provide ULA with a sole-source block buy guarantee of 36 rocket booster core from FY2013-FY2017 provides the incumbent with unprecedented business stability and presents New Entrants with a substantial competitive disadvantage. An early reason for the block buy was to save on launch costs, but it is not clear that the Air Force has created savings over the last acquisition, known as "Buy 3." In a head-to-head competition against New Entrants, the incumbent is well-positioned to leverage this guaranteed order to impact the competition outcome. The 36 core block buy gives ULA an extreme and unfair competitive advantage relative to New Entrants by allowing ULA to allocate its operating costs to the block buy and offer marginally-priced launches to other customers (e.g. NASA, commercial customers) as well as future bids for EELV missions.

- **Cost-Plus Contract Elements.** The EELV Launch Services contract line item, which basically represents the cost of the launch vehicle hardware and production, is structured as a fixed-price, incentive fee (FPIF) line item. The ELC, which funds the engineering and infrastructure costs to actually execute the launch, is now contained in multiple contract line items, many of which are

[11] "Department of Defense Fiscal Year (FY) 2014 President's Budget Submission, Missile Procurement, Air Force." Apr. 2013. Vol. 1, 230.

cost-plus types. It should be noted that the EELV Program is the only U.S. Government launch program that utilizes any cost-plus features. As a New Entrant provider, SpaceX does not seek out similar ELC funding. Rather, SpaceX believes that the utilization of a FAR Part 12 commercial contracting structure, with payments based on achievement of results at pre-negotiated prices—rather than costs expended, which has no limit—should be the preferred acquisition approach for the EELV Program. This contracting mechanism rewards organizations that spend more time and more money, rather than being efficient and achieving results. A contracting mechanism that drives efficiency and innovation will improve quality of service at much better value for the customer. It bears noting that the current contract structures add substantial overhead cost to the taxpayer for oversight of a largely mature booster core. Further, New Entrants will be forced to adopt these higher overhead cost structures or be at a disadvantage to the incumbent. In today's budget environment, it would be far better to buy these mature products as commercial systems and use lower overhead procedures such as FAR-based commercial contract structures.

- **Government-funded Upgrades to Incumbent Systems.** The Air Force continues to provide ULA with development funding for numerous items, such as the RL-10C, common upper stage, and has discussed potential funding for dual payload adaptors and other efforts which give ULA a competitive advantage relative to New Entrant competitors. Launch service providers are also affected by range modernization and programs such as Automatic Flight Termination Systems or GPS metric tracking. ULA is funded by the Air Force to upgrade their launch vehicles for these programs while New Entrants are expected to bear the burdens of these costs. ULA should be required to self-fund these upgrades in a competitive procurement environment.

IV. Recommendations to Reform the EELV Program

To achieve real and continuous competition and address the challenges outlined above, the EELV Program must transition from its current sole-source, non-commercial contracting structure to an acquisition approach that employs competition and makes use of meaningful aspects of commercial business practices and contract structures that reward success, efficiency and innovation.

The Air Force should begin the transition to a standard, commercially-oriented procurement process which can be supported by a commercial business model, and place its emphasis on achieving mission success rather than maintaining legacy contract structures that give its incumbent provider a competitive advantage. As it has done with other major procurements, such as the Wideband Global Satcom (WGS), the Air Force can achieve significant capability at substantially lower costs by incorporating competitive, commercial practices into its acquisition approach. A commercial approach, however, is hindered by the contractual structures that are currently in place and which provide a material competitive advantage to the incumbent provider. Should the Air Force transition to a new model and fully embrace competition, it will be in a position to support U.S. launch companies as they win commercial business from foreign competitors, while leveraging the broader launch services market to absorb fixed costs and reduce the overall costs to the U.S. Government. Congress should continue robust oversight of the program to ensure these acquisition reforms are implemented.

(a) Eliminate the ELC

No competition will be fair, full, and open so long as the Air Force continues to utilize contract line items to fund ULA's fixed costs to maintain its launch capability. There are reasonable ways to address this competitive inequity now. At minimum, the fixed cost funding must be accounted for in a meaningful way in competitions for EELV launches and must be completely offset in non-EELV competitions. This near-term approach should be leveraged as the ELC is ultimately phased out. The Air Force must eliminate the funding of ULA's launch capability prior to the Phase 2 EELV Acquisition or there can be no fair competition, and Congress should conduct continuous oversight to ensure the elimination of the ELC.

The original rationale for incorporating the ELC concept in the EELV program was to maintain the capability and assured access to space with Atlas and Delta when both Lockheed and Boeing threatened to exit the launch business. With the later formation of ULA, the Air Force implemented the ELC as a means to secure assured access to space in a single-supplier environment, opting to insulate its provider from market conditions by fully funding its infrastructure and business overhead. In addition, many national security space programs were having development challenges that were resulting in significant delays in satellite delivery, resulting in a low launch rate and supporting arguments in support of a launch capability payment structure. Notwithstanding whether or not the ELC was an appropriate mechanism to achieve assured access to space when it was instituted, it is clear now that the prevailing conditions which were used to justify it no longer exist. Critically, the newly revised National Space Transportation Policy eliminates a 2005 policy that called for the DOD to fund the annual "fixed costs" of the EELV provider.

In 2014, these conditions have materially changed in virtually every respect. For example, as the Air Force determined in the course of adjusting its Acquisition Strategy to support a transition to competition, most national security satellites are out of development and into production, with delivery now being somewhat predictable. The rate of national security space launch has increased significantly, which eliminates the need for continuous launch capability funding support and enable a transition to a fully-loaded launch services price offered by each competitor. Finally, the EELV program is emerging from its reliance on a single provider with a limited ability to compete on the open market, and transitioning to a model with potentially multiple certified providers. With respect to the commercial market, the market is robust and forecasts are predicated on rational market assumptions and analysis. With the onset of at least two viable new entrants, the existence of a robust and durable commercial launch market, and stability achieved in major NASA space programs with cargo resupply, commercial crew, SLS and numerous science missions, there is no remaining rationale for maintaining the ELC.

SpaceX recognizes that a transition away from the ELC will take significant planning and time. In the intervening period, however, as the Air Force on-ramps New Entrants and allows those certified to compete for 14 identified missions beginning to be ordered in FY2015, the Air Force must require the incumbent provider to account for the derived financial and non-financial benefits it is afforded through the ELC payments it receives from the Government. The ELC contract line items total roughly $1B annually in direct payments to ULA to fund its annual sustaining engineering, manufacturing, operations, and overhead costs. These payments constitute a substantial competitive advantage for ULA, and Congress should insist that actions to mitigate this structural competitive inequity be imposed on ULA.

(b) Return to Fixed-Price Services for the EELV Program

Unlike the past 10 years, the commercial space launch market is robust, stable, and predictable, and the U.S. is recapturing market share previously surrendered to international competitors. The Air Force should change its existing contracting structure to leverage the commercial market and allow for alternate business models to be utilized for the acquisition of launch services. While potentially appropriate in a development or sole-source environment, cost-plus contracting does not incentivize contractors or the government to control and reduce cost, nor does it foster contractor innovation, as the EELV Program has plainly demonstrated. The requirements associated with launch services and mission assurance for the EELV Program are well-understood at this time. Indeed, prior to the execution of the "Buy 3" contracts, the EELV program fully and successfully implemented the enhanced mission assurance requirements that are used today based upon the recommendations from the Space Launch Broad Area Review (BAR 1). However, given the continued existence of legacy contracting structures like the ELC, the EELV Program is currently the only U.S. Government program utilizing a cost-plus arrangement for the execution of launch services. Consistent with the direction in the FAR and pursuant to Public Law 103-355, SpaceX recommends that the EELV Program be transitioned back to a FAR Part 12 commercial-item acquisition approach, which will then achieve parity in the contracting structure among all potential competitors.

Although the FAR Part 12 acquisition authority was employed in 1998 in the EELV program, it was not the use of FAR Part 12, or any shortcomings resulting from its use, that prompted the restructure of the EELV program. The need to restructure the program was driven by the original business decisions of the EELV contractors 1998, which included an overly optimistic forecast of the commercial market. Today, the situation is materially different in two significant ways. First, the commercial market is far more predictable, robust and stable than it was in the early 2000s.[12] Second, the commercial market has largely moved overseas as foreign competitors have filled the commercial space launch services business in light on uncompetitive pricing by U.S. launch providers. Bringing competition and continuous improvement to the EELV program, along with additional manifest availability, will help enable U.S. launch providers win back that business from foreign competitors. This is, in fact, what SpaceX is doing right now.

In 2005, both the launch vehicles used by EELV lacked flight-proven maturity in their designs and the number of executed launches on the EELV program was low. Eight years later, the EELV Program has now demonstrated performance in managing a complex launch and mission integration environment, successfully launching all "first of a kind" satellite payloads. Future launches will be for satellites that have all been previously integrated, with some (WGS, GPS IIF, DMSP) launched on both EELV Systems provided by ULA. Consequently, most requirements are well-understood and the need to continue on a cost-plus basis no longer exists.

A separate rationale for maintaining cost-plus elements has been the uncertainty in launch schedule. Clearly, the situation existed in 2005 when the Air Force could not necessarily predict when new satellites would be ready for launch, and when they would be, there was a sense of urgency for these systems to be launched to replace aging national security assets or to provide new capabilities in order to support national need. In 2011, the EELV Program began the transition to a "launch slot concept" that enables the Air Force to have improved flexibility to determine as late as six months prior to launch which satellite has the highest priority for the launch slot. Up until that point, the Air Force maintains through the integration process the ability to consider alternative missions as "back-ups" should the primary mission encounter a schedule problem. Further, as the Air Force has recently assessed, most satellites today are moving out of development and into production, which should have a positive impact with respect to on-time satellite delivery and the ability to launch on time. As a result, this rationale for a cost-plus contract element is no longer valid.

Consequently, the use of a commercially-focused contracting approach for the integration, mission assurance, and launch operations elements of the EELV Program is appropriate and consistent with the guidance contained in FAR Part 16. In addition, as referenced above, the FAR plainly instructs (see FAR Part 12.101) the Government to acquire commercial items when they are available to meet the needs of the agency. Launch services are clearly commercially available and are routinely sold on the commercial market. Nearly 60 percent of SpaceX's manifest of 50 launches is for commercial customers. Indeed, Lockheed Martin Commercial Launch Services (LMCLS) recently sold an Atlas V launch vehicle commercially to the Mexican government, subcontracting with ULA to execute the launch service. LMCLS has stated publicly its intent to market at least two Atlas vehicles annually, leveraging the

[12] The commercial launch market available for U.S. competition is stable and averages approximately 30 satellites per year, with a total value of nearly $3 billion annually.

Government's 36-core block buy and the Launch Capability payments to reduce its price for commercial customers.[13]

As such, the Air Force should execute launch services procurement under a FAR Part 12 commercial-item acquisition, as is required under the FAR. This approach will allow for the elimination of the non-valued items that have no impact to mission success, but add costs to program execution.

SpaceX intends to demonstrate the benefits associated with competition—including timely support to the warfighter, contractor-funded improvement and excellent value—and provide truly assured access to space through two distinct launch providers. By providing launch services on a commercially-available, proven launch vehicle under a FAR-based commercial-item contract, SpaceX can help alleviate manifest congestion and reintroduce cost competition and the accompanying improvements it provides. As a commercial launch services provider with a manifest of almost 50 launches representing over $4 billion in contracts, SpaceX is able to share its fixed cost among a strong customer base in national and international commercial and government markets.

(c) Competitive, Commercial Acquisition Model for Space Launch is Proven

In the mid-2000s, NASA, like the DOD, faced the challenge of unacceptably high launch costs. To contain this problem, the agency partnered with private industry to produce new launch vehicles that were not only highly reliable, but also affordable. This collaboration, known as the Commercial Orbital Transportation Services (COTS) program, was structured under firm fixed-price, milestone-based development agreements that leveraged private sector innovation and capital with Government investment and technical expertise. For less than the cost of a single Space Shuttle flight, COTS produced two new launch vehicles and spacecraft and reestablished American capability to reach the International Space Station (ISS). The SpaceX Dragon developed under this program is currently the only spacecraft in the world capable of bringing substantial cargo both up and back from space.

NASA further endorsed this approach when it awarded 20 ISS cargo missions to multiple providers under the Commercial Resupply Services (CRS) program. Using firm fixed-price, FAR Part 12 contracts, NASA is able to ensure the safety of the astronauts and equipment onboard the $160 billion International Space Station, while also maintaining cost-control and benefiting from contractor innovation. This contracting approach is an unmitigated success, with SpaceX's cargo delivery prices the lowest per pound in the history of the ISS. SpaceX has already completed its first two CRS missions and is on track to conduct its third in the coming weeks.

NASA properly approached launch acquisition as a "commercial item," consistent with the FAR and the Commercial Space Act of 1998.[14] There exists a robust and competitive global launch market that grants the Government deep insight into price reasonableness. This approach has proven highly successful for the agency. It conducts many science missions through the NASA Launch Services (NLS) II program (and its predecessor NLS I program), where launch services are competed between a stable of providers operating under indefinite delivery, indefinite quantity (IDIQ) task order contracts. This structure enables

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[13] Fester, Warren. "New ULA-Lockheed Relationship Helps Atlas 5 Compete for Commercial Launches." *Space News.* September 23, 2013. "Robert Cleave, president of Lockheed Martin Commercial Launch Services, said . . . the company expects to be able to capture two commercial contracts per year starting in 2015." And: "Cleave credited the U.S. Air Force's planned block buy of up to 36 Atlas 5 and Delta 4 launch vehicle cores from ULA for Lockheed Martin's ability to bring its commercial launch prices to more competitive levels. The block buy is intended primarily to generate volume-based price discounts for government customers.

[14] "Special Requirements for the Acquisition of Commercial Items," FAR Part 12, Subpart 2, Section 207; "To encourage the development of a commercial space industry in the United States, and for other purposes (Brief title: Commercial Space Act of 1998)." (PL 105-303, 28 Oct. 1998). NASA Office of the General Counsel.

NASA to weigh a variety of factors, including risk, technical capability, and price prior to issuing any mission award. It further encourages launch providers to continually innovate throughout program life by permitting them to "introduce launch vehicles or technologies that were not available at the time of the award of the initial contract."[15] Consequently, NASA is able to take advantage of a continually refreshed portfolio of launch vehicles for its diverse missions without resorting to arcane contracting approaches. Importantly, NASA does not pay for the ELC, but rather pays for each launch service. ULA, Orbital Science, and SpaceX are all part of this competitive launch services contract.

In 2012, the Air Force awarded SpaceX two missions under the Orbital/Suborbital Program (OSP-3). These EELV-class missions, which were designated as New Entrant missions for EELV, utilized a firm fixed-price contracting approach requiring compliance to Air Force mission assurance, mission integration, and launch operations requirements, with performance-based payment structure. It is important to note that for CRS, NLS II, and OSP-3, NASA and the Air Force conduct mission assurance (MA) activities on a firm fixed-price basis. This demonstrates a strong confidence that safety and reliability can be achieved without compromising affordability.

V. Benefits of Competition for DOD Launch

The Air Force has attempted to contain cost-growth through an economic order quantity "block buy," sole-sourced to ULA for 36 rocket booster cores to be ordered through 2017. Although SpaceX is pleased that the Air Force made the decision to reinstate competition for 20 percent of the DOD launch manifest through 2017 (though would far prefer fair and open competition for all missions), the competitive advantage created by its sole-source block buy of 36 rocket booster cores to ULA must be recognized. It is a factor that challenges a level playing field for competition and one which will have limited long-term impacts on cost reduction. As has been recognized by numerous Government and independent reports, competition is the only true mechanism for achieving both performance and affordability. This approach is consistent with "commercial item" requirements under the FAR and the Defense Federal Acquisition Regulation Supplement (DFARS).[16] The Weapon Systems Acquisition Reform Act of 2009 (WSARA) further requires competition as "a means to improve contractor performance" through program lifecycle, and the DOD's Better Buying Power 2.0 initiative calls competitive procurement and firm fixed-price contracting "the motivation to control and reduce cost."[17]

Competition drives notably lower costs than a block buy when multiple certified companies exist in a program. If launches were awarded today, the DOD would save at least one billion dollars per year by selecting SpaceX over the incumbent. Competitive pressures will further induce certified providers to continually improve on both cost and reliability. These savings would not result in diminished Government insight into provider processes and mission assurance, as commercial item acquisitions still include substantial insight between companies and relevant agencies. There is no connection between cost-plus contracting and consistent mission assurance, as has been successfully demonstrated in NASA's COTS, CRS, and NLS programs and the Air Force's OSP-3 program. However, there is a direct correlation between complicated, opaque cost-plus contract structures and higher program costs.

Consistent with the initial goals of the EELV program, competition ensures that in the event of a launch vehicle anomaly or national emergency, the U.S. still maintains its access to space with another independent launch vehicle capability, something which is absent with the consolidation of ULA and the

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[15] U.S. Government Accountability Office, "Medium Launch Transition Strategy Leverages Ongoing Investments but Is Not Without Risk," November 2010, 4.
[16] Ibid. 8-9.
[17] "Weapon Systems Acquisition Reform Act of 2009," Pub. L. no. 111-23, 22 May 2009, Sec. 202 (a)(1); Kendall, Frank. "Better Buying Power 2.0: Continuing the Pursuit for Greater Efficiency and Productivity in Defense Spending." Memorandum to the Defense Acquisition Workforce. 13 Nov. 2012. 5.

increasing commonality between the Atlas and Delta launch vehicles. An independent report by the MITRE Corporation in September 2012 affirms that multiple providers establish an "insurance for transition in case of performance failure."[18] Even without any anomalies, multiple providers with separate launch sites decrease manifest congestion at a time when DOD's launch needs are at their highest in years. The recently issued National Space Transportation Policy (NSTP) dictates that "competition among providers" is critical to "assure access to space for [the] United States Government."[19] -

Critically, competition also reduces national dependence on a foreign supply chain. The Atlas V rocket utilizes the first stage Russian RD-180 engine and a Swiss 5 meter payload fairing. Further, the Delta IV is dependent on Japanese suppliers for its upper stage liquid hydrogen tanks. This foreign reliance introduces obvious risk into the national security launch enterprise. Indeed, it was reported late last year that Russia's Security Council was considering discontinuing the supply of the RD-180 engine for the Atlas V over unrelated foreign policy issues with the United States.[20] As mentioned previously, Falcon 9 and Falcon Heavy are manufactured entirely in the United States and do not rely on foreign companies for major subsystems and components.

Much is made of the shrinking defense industrial base, specifically with respect to space industrial base. Competition is one remedy to this challenge. Excluding SpaceX, the U.S. industrial base averages only five liquid rocket engines per year capable of lifting a medium- or heavy-lift payload. In contrast, SpaceX produces 120 such rocket engines per year, with annual manufacturing capacity growing to 420 engines by the end of this year, far exceeding all other liquid rocket engine producers in the United States and Russia combined. This all-American production maintains critical skills in the U.S. and sustains important suppliers around the country.

In the monopoly cost-plus environment that has existed in the EELV program since just prior to the 2006 formation of ULA, there is little incentive for contractor innovation, and little has been seen. Any launch vehicle upgrades, most recently with the RL-10C, were initiated and paid for by the Government with little return to the taxpayer. Reestablishing competition in the program will return the spirit of self-funded innovation by forcing providers to consistently invest in launch vehicle improvements to win contracts, else they be awarded to their competitors. NASA has certainly benefited from this approach, with both companies in the COTS program putting their own capital into the program; as a result, Falcon 9 emerged as the lowest cost medium-to-intermediate lift launch vehicle in NASA's portfolio.

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Mr. Chairman, I appreciate your invitation to testify before the committee today. Leveraging SpaceX's current Air Force, NASA, and commercial contracts, SpaceX plans to demonstrate heritage, reliability, and safety over a relatively short period of time. SpaceX has demonstrated its commitment to support national security space launches with significant internal investments in launch vehicle improvements and launch infrastructure to support the full spectrum of EELV program requirements, as well as the commitment and allocation of resources to the Air Force New Entrant Certification process.

With fully American-made launch vehicles and launch sites on both East and West coasts, SpaceX's objective is to establish an enduring U.S. launch industry, consistent with the National Space Transportation Policy and the Commercial Space Launch Act. As a result, SpaceX seeks to provide the U.S. Government with true assured access to space with a new launch vehicle family and launch

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[18] Wydler, Chang, and Schultz, 17.
[19] The Executive Office of the President, "National Space Transportation Policy," November 2013, 3.
[20] "Russian Rocket Engine Export Ban Could Halt US Space Program." RT, 27 Aug. 2013. Web.

infrastructure and without reliance on foreign suppliers for rocket engines, fairings or other major launch vehicle components.

With a mature commercial launch market ready to support national security launch needs, the time has come for the EELV program to live up to its name and *evolve*. Conducting competition in a fair and level playing field will significantly and immediately reduce costs for the Government, while enhancing vehicle reliability and national assured access to space capability.

Space Launch Vehicle Competition

Briefing to the Senate Homeland Security and Governmental Affairs Committee

Permanent Subcommittee on Investigations

January 28, 2014

Contents

- Introduction
- Objectives
- Background
- Findings
- Scope and Methodology

Introduction

- The Department of Defense's Evolved Expendable Launch Vehicle (EELV) program is the primary provider of launch vehicles and services for U.S. military and intelligence satellites. The launch vehicles used by the EELV program are also used to launch civilian and commercial satellites.
- GAO was asked to examine issues related to DOD's effort to introduce competition into EELV acquisitions. Doing so is a significant challenge given the way contracts are currently structured, the fact that new providers are not yet certified to carry sensitive national security satellites and sensors—or payloads—into space, and other complications. The issues GAO was asked to examine include the way that DOD determines costs for launch services with its current contractor and how DOD will compare future offers from different launch services contractors.

Introduction: Program Description and History

- The EELV program started in 1995 when DOD awarded contracts to four companies for preliminary launch vehicle system designs; at that time, DOD's acquisition strategy was to select the one company with the most cost-effective design.
- Given commercial forecasts that predicted sufficient demand to support two launch vehicle providers, in 1997 the Secretary of Defense approved maintaining competition between the two top companies: Lockheed Martin, and what would become Boeing.
- In 2006, following years of projected commercial demand for launch vehicles that did not materialize and increasing launch costs, the two EELV contractors formed a separate company as a joint venture—the United Launch Alliance (ULA).
- From 2006-2013, DOD had two types of contracts with ULA, the sole-source provider, to support the EELV program:
  - a cost-plus-incentive-fee EELV launch capability contract (ELC);[1] and
  - a firm-fixed-price EELV launch services contract (ELS).[2]

1 In July 2011, the EELV program awarded a Launch Capability contract as a cost-plus incentive fee contract; the prior Launch Capability contract was a cost-plus award fee contract. A cost-plus incentive fee contract is a type of cost reimbursement contract that pays the contractor for allowable costs to the extent prescribed in the contract, and allows for the initially negotiated fee to be adjusted later, based on a formula in the contract. The fee is based on the relationship of total allowable costs to total target cost.

2 A firm-fixed-price contract provides for a price that is not subject to any adjustment on the basis of the contractor's cost experience in performing the contract.

Introduction: Program Description and History, cont.

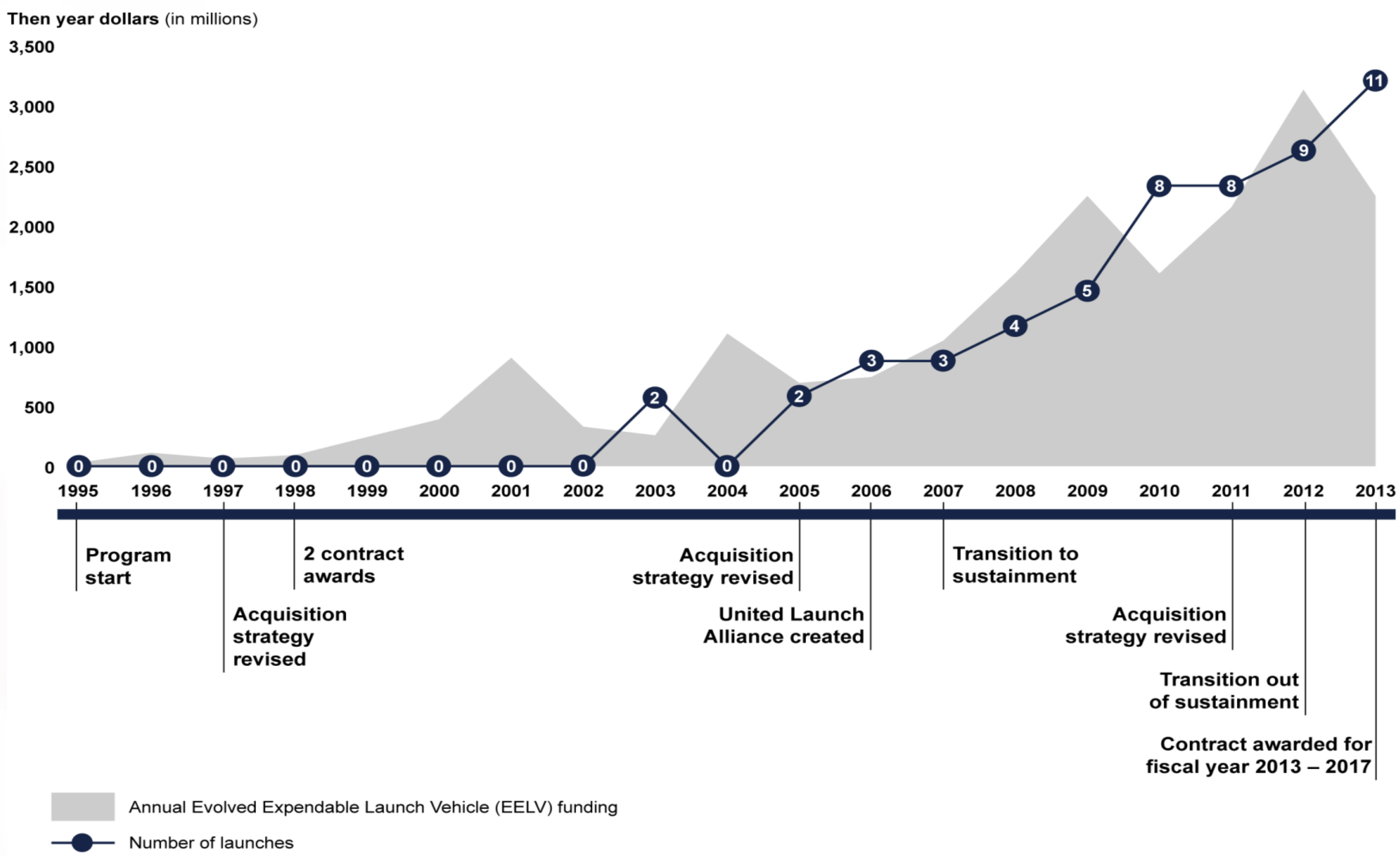
- Since 2006, ULA has launched 50 government missions on EELVs, with an extremely high rate of success, and DOD values this reliability. However, in 2010, program cost estimates indicated launch prices were expected to increase at an unsustainable rate, and DOD began an effort to develop a new EELV acquisition strategy.
- The November 2011 strategy was designed to maintain mission success and incentivize price reductions through steady production rates, long-term commitments, opportunities for competition and reductions in workforce redundancy.
- In December 2013, DOD and ULA signed a contract modification, committing DOD to buy 35 launch vehicle booster cores from ULA over a five-year period, and to pay ULA for the associated capability to launch them.[3]
- According to DOD, two primary goals of this long-term sole-source commitment were to increase production stability for ULA and its suppliers, and to reduce the price per launch vehicle.
- The most recent independent cost estimate projects the program will cost close to $70 billion through 2030.[4]

3 The booster core is the main body of a launch vehicle. In the EELV program, common booster cores are used to build all of the Atlas V and Delta IV launch vehicles. Medium and intermediate launch vehicles use one core each, while the Delta IV Heavy launch vehicle requires three.

4 The Office of the Secretary of Defense, Cost Assessment and Program Evaluation conducted an independent cost estimate based on the EELV programmatic forecast dated June 2012.

Introduction: Program Description and History, cont.

Figure 1: EELV Program Timeline



Source: GAO analysis of Air Force data.

Introduction: Reimbursement to DOD for Use of ULA Facilities by Other Customers

- DOD has historically paid all fixed costs for ULA. Prior to the December 2013 contract modification, when ULA sold a launch to another customer, and not through the EELV program office, ULA provided a small reimbursement to DOD for the other customer's use of ULA facilities and infrastructure. There have been concerns that the reimbursement was too small.

GAO

Introduction: New Entrants to the Launch Market

- In recent years, companies other than ULA have begun developing new launch vehicles to compete with ULA for EELV-class payloads, and DOD set aside up to 14 launch vehicle booster cores from fiscal years 2015 to 2017 for competition.[5] This competition is expected to begin in fiscal year 2015.
- In order to compete for any of the 14 additional launches these cores represent, new entrant companies have to follow the process outlined by DOD in its Launch Services New Entrant Certification Guide to certify a new vehicle to launch national security missions.
- At this point, none of the likely competitors are able to launch the full range of EELV-class payloads, though at least one company plans to meet the full requirements through further launch vehicle development.

5 EELV-class payloads range from 6,000 to 28,000 lbs to Geosynchronous Transfer Orbit (GTO). They are divided into intermediate (6,000-18,000 lbs to GTO), and heavy (18,000-28,000 lbs to GTO) classes.

Introduction: New Entrants, cont.

- Given the use of different contract types and launch vehicle cost allocation practices among contractors, DOD is currently developing a methodology for comparing proposals from all competitors. DOD officials may include this methodology as part of their first request for proposal from launch companies in the competition.

Objectives

This briefing addresses the following questions:

(1) What insight did DOD have into launch costs under past EELV contracts?

(2) How do recent changes to EELV contracts affect accounting for costs?

(3) How is DOD compensated for costs when ULA sells launches to other customers?

(4) What are the implications if DOD requires competitors to submit offers using the same structure it currently uses with ULA or a commercial approach?

Summary of Findings

GAO found:

(1) The previous two-contract structure paid ULA for continuing launch capability to enable the U.S. to readily gain access to space, but one consequence of the structure was that DOD had difficulty determining the cost of an individual launch, as direct launch costs were not separated from other costs.

(2) In the December 2013 EELV contract modification with ULA, DOD leveraged better insight into contractor costs to negotiate lower prices, and incentivized ULA to increase efficiencies, but DOD may have difficulty identifying the total cost of an individual launch.

(3) The December 2013 contract modification stipulates that when ULA sells a launch to customers outside the EELV program office, ULA will adjust the value of the EELV contract by a pre-negotiated amount for each outside launch it sells. Historically the reimbursements have been small compared to the overall launch capability paid for, but DOD recently negotiated larger reimbursements with some direct costs tied to individual launches.

(4) Even with greater insight into contractor costs, DOD may not be immediately poised to take full advantage of competition in the launch market, because, in part, it cannot determine an accurate price for an individual ULA launch.

Background

Background: Past GAO Findings on EELV

- In 2008, we reported that the EELV program faced numerous oversight challenges, including uncertain launch vehicle reliability, disruption from the consolidation of Boeing and Lockheed Martin manufacturing and operations under the ULA joint venture, and limited programmatic insight due to the elimination of various reporting requirements resulting from the designation of the program as in sustainment. We also reported that DOD was adjusting the EELV budget using premature savings estimates, and made three recommendations to improve DOD oversight.
- DOD reinstated reporting requirements and completed a new life-cycle cost estimate, but did not assess the EELV program's staffing needs to confirm whether shortages exist (GAO-08-1039).

GAO

Background: Past GAO Findings on EELV, cont.

- In 2011, we found that DOD was using insufficient data, particularly data on costs and on the launch industrial base, and relying on contractor-supplied information to inform the development of a new EELV acquisition strategy. We recommended seven actions that would help address critical knowledge gaps.
- In response, DOD reassessed the block buy contract, examined broader launch issues, incentivized the contractor to implement efficiencies without affecting mission success, indicated it does not intend to waive future data requirements, is working with the National Aeronautics and Space Administration (NASA) on heavy launch decisions and conducting an independent assessment of the launch industrial base, but has not developed a science and technology plan for evolving launch technologies (GAO-11-641).

Background: Past GAO Findings on EELV, cont.

- In 2012, we reported that DOD had numerous efforts in progress to address the knowledge gaps and data deficiencies we identified in our 2011 report, and that these improvements would allow DOD to make more informed decisions on how to proceed with the EELV program (GAO-12-822).
- Additionally, in 2013, we reported that DOD's implementation of its New Entrant Certification Guide, while generally satisfactory to the new entrants, posed some challenges to launch vehicle certification (GAO-13-317R).

Objective 1:

Accounting for Costs Under Past EELV Contracts

Objective 1: Accounting for Costs under Past EELV Contracts Reasons for the Two-contract Structure

In 2005, DOD modified the way it contracted for EELV launches.

- The need for flexibility in launch schedules encouraged DOD to pay for launch capability (primarily labor) separately from the launch hardware, as DOD wanted to avoid additional costs associated with the frequent launch delays they were experiencing as new satellites were being developed and produced.[6]

By paying for a capability to launch, or “standing army” of personnel (particularly engineers), separately from the launch hardware, DOD believed it was ensuring itself access to space in a timely manner, regardless of payload delays.

6 We have frequently reported that many of these satellite development and production delays could have been reduced or avoided by using best practices in space acquisition processes.

Objective 1: Accounting for Costs under Past EELV Contracts
Basic Contract Structure of Past EELV Contracts

From 2006-2013, ULA had two types of contracts with DOD through which it provided launch services for national security space launches:

- EELV launch capability (ELC): cost-reimbursement contracts which funded items that, according to DOD officials, were not easily acquired under a fixed-price contract, such as overhead on launch pads and engineering support.[7]
- EELV launch services (ELS): firm-fixed-price contracts that paid for launch vehicle hardware and labor directly associated with building and assembling launch vehicles.

7 As previously noted, in July 2011 DOD awarded a Launch Capability contract as a cost-plus incentive fee contract; prior to that award, the contract was a cost-plus award fee contract.

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Objective 1: Accounting for Costs under Past EELV Contracts

Table 1: Details of the EELV Two-contract Structure

	EELV Launch Capability (ELC)	EELV Launch Services (ELS)
Contract type	Cost-plus incentive fee	Firm-fixed-price
Purpose	To acquire launch capability - the “standing army” required to maintain assured access to space for 8 launches per year.	To acquire launch hardware.
Items covered by the contract	Includes items not included in ELS such as: mission integration, systems engineering, production management, propellants, transportation, labor to conduct launches, etc.	Launch vehicle hardware, production, and directly associated touch labor.
Number of active contracts	Only one contract active at any time.	Multiple contracts with ULA active at any time.
Length of contract term	The contract covers one year of launch capability.	Varies; ELS contracts can be for one launch or multiple launches, and some can last for many years as the launches included in the contract are launched.

Source: GAO analysis of DOD contracts and related documents, and discussions with DOD officials

Objective 1: Accounting for Costs under Past EELV Contracts Obscured Costs under the Two-contract Structure

ELC contracts did not require the contractor to break out costs associated with each launch, therefore, DOD was unable to calculate specific costs for individual EELV launch missions. For example, while each of the following costs could have been tied directly to an individual launch, DOD contracting officials included these items in the scope of the ELC—a cost-type contract—but did not require the contractor to separate them by individual launch:

- Propellants – fuel expenses for each launch.
- Transportation – the cost of transporting a completed launch vehicle from the factory to the launch site.
- Mission integration – the work involved in mating the satellite to the launch vehicle could be tied to the overall costs of a specific launch.

Objective 1: Accounting for Costs under Past EELV Contracts Challenges Encountered under the ELC/ELS Structure

The EELV program under the ELC/ELS structure had some significant outcomes, but presented challenges to the program:

- Through the ULA joint venture and subsequent consolidation of operations, the government realized some significant savings. However, given the lack of incentive to identify efficiencies in the program's prior cost-reimbursement contract structure, and in an environment where no viable competition existed, program cost estimates showed launch prices were expected to rise.
- The program earned a record of consistent launch successes but, according to DOD, the focus of the program became primarily mission success, and not efficiencies or cost savings.
- According to DOD officials, the ELC contract structure was not transparent, and DOD had limited insight into some contractor costs, leading to:
  - insufficient knowledge to negotiate fair and reasonable launch prices,
  - lack of understanding of the total costs of any given launch, and
  - inadequate ability to account for costs reimbursed to DOD when ULA sold launches to non-DOD customers.

Objective 2:
Recent Changes to EELV Contracts and Impacts

Objective 2: Recent Changes to EELV Contracts and Impacts Better Information to Support Contract Negotiations

- As part of its effort to re-evaluate the EELV acquisition strategy, DOD has taken significant steps between 2010 and 2013 to obtain information to help it better identify the costs of EELV launches, and has made progress in reducing contract prices.
- We reported in 2012 that detailed investigations, or "deep-dives," into engine prices and other subcontractor costs have provided DOD better information with which to support contract negotiations with ULA. This insight was absent in past contract negotiations, in part because DOD waived rights to some contractor data in exchange for lower prices from large commercial hardware purchases.
- Additionally, DOD has scrutinized launch processes to identify and eliminate potentially redundant activities.

GAO

Objective 2: Recent Changes to EELV Contracts and Impacts Better Information to Support Contract Negotiations, cont.

- DOD had better information in its recent contract negotiations with ULA, affording DOD a stronger bargaining position to lower overall contract costs than in recent years. As noted earlier, we recommended DOD obtain better data to strengthen DOD's bargaining position.
- Gaining greater insight into contractor costs and reducing inefficiencies could have also benefited the program from the start of the joint venture in 2006, as program costs continued to rise.
- Additionally, we reported in 2011 that competition could spur ULA efficiencies and incentivize ULA pricing. The presence of potential competition for launch services—a recent development—likely provided the context to help DOD negotiate lower prices.

GAO

Objective 2: Recent Changes to EELV Contracts and Impacts
Key Tenets of the New Contract

The December 2013 contract modification with ULA, sometimes referred to as a “block buy” contract, represents a major change from past year-to-year contracting approaches, and buys:

- Production of 35 launch vehicle booster cores over 5 years, from fiscal years 2013 through 2017
- Launch capability for six years, from fiscal years 2014 through 2019

Instead of two separate ELC/ELS contracts, the new single contract structure covers the entire EELV program, with contract line items for different aspects of the program, such as:

- launch vehicle hardware
- launch capability, including systems engineering and production management
- mission integration
- propellants

Objective 2: Recent Changes to EELV Contracts and Impacts Key Tenets, cont.

According to DOD, some changes to the modified contract include:

- Better attribution of direct costs to launch vehicles, such as propellants and mission integration, into separate contract line items.
- More representative compensation to DOD when ULA sells a launch to a non-DOD customer
  - Compensation to DOD is roughly three times what it was under previous contracts with ULA (dollar amount is proprietary).
- DOD officials estimate about $4.4 billion savings over the fiscal year 2012 President's Budget estimate.
- Stable unit pricing for all launch vehicles.

However, while DOD can identify the cost of launch capability by year, it may be unable to determine the total cost of an individual launch because the majority of launch capability costs are not allocated to individual launches. Additionally, according to DOD, it is to pay for launch capability for 8 launches, even if fewer launches actually take place that year.

Objective 3: Compensation to DOD for Non-DOD Launches

Objective 3: Compensation to DOD for Non-DOD Launches Historical Reimbursements

- The 2004 U.S. Space Transportation Policy instructed DOD to fully fund the fixed costs of the EELV program. However, the 2013 National Space Transportation Policy does not instruct DOD to fully fund the fixed costs of the EELV program.
- Prior to the December 2013 contract modification,
  - ULA provided a small reimbursement to DOD for the resources used to launch missions sold to other customers, such as NASA or other government or commercial customers.
  - DOD and ULA annually negotiated the value of the reimbursement.
  - Reimbursements, also known as offsets:
    - represented the average 30-day cost of launch vehicles boosters on the launch pad for a given fiscal year, and not actual expenses.
    - differed based on which launch vehicle is used, and from which launch range the vehicle is flown.
    - were made through price reductions on the invoices ULA submitted to DOD.

GAO

Objective 3: Compensation to DOD for Non-DOD Launches Changes Under the December 2013 EELV Contract Modification

- According to DOD officials, the December 2013 contract modification changes how launches sold to other customers are handled.
- One significant change is the method by which DOD is to be compensated when ULA sells launches to other customers. Specifically, ULA and DOD will adjust the EELV contract value at the start of each fiscal year, based on the number of non-DOD launches ULA expects to sell that year.
- DOD officials told us the EELV program intends to pay only for the capability it requires, that is, 8 launches per year for the duration of the contract.
- The contract also includes provisions for more representative compensation for non-DOD launches. For example, compensation to DOD will:
  - be based in part on discrete, allocable costs per launch, and
  - amount to roughly three times what is was under previous contracts, though it still represents a small percentage of total capability paid for
- Although DOD negotiated larger dollar amounts in the current contract, DOD may not know if it is receiving fair and representative compensation because many ELC costs are not allocated by launch.

Objective 4:

Implications of Requiring Competitors to Bid Launch Proposals Using an ELC/ELS Structure or Commercial Approach

Objective 4: Implications of Requiring Competitors to Bid Launch Proposals Using an ELC/ELS Structure or Commercial Approach
Best Value Comparison

Based on our discussions with DOD, DOD plans to conduct a best value procurement where price is not the only consideration. DOD will likely consider several factors when comparing proposals for up to14 additional launches available for competition between ULA and new entrants, including the following:

- Price—companies may be required to offer proposals that include capability (cost-reimbursement) and launch hardware (fixed-price) components, similar to the current ELC/ELS contract structure with ULA;
- Mission risk—DOD will likely take past launch performance into account;
- Mission integration—DOD will likely consider any additional work required to integrate satellites onto each company's launch vehicles.

DOD has not yet decided whether to require competitors to submit offers using an ELC/ELS structure, a commercial approach, or some other type of proposal.

Objective 4: Implications to DOD of Requiring an ELC/ELS Structure for Launch Proposals

Benefits to DOD

•DOD is familiar and experienced with the ELC/ELS approach of funding launches; this approach would not disrupt the current contractual arrangement with ULA.

•By requiring all companies to bid using an ELC/ELS structure, DOD would have a straightforward basis on which to compare proposals.

•Greater insight into contractor cost or pricing data could lend itself to a better bargaining position in future contract negotiations.

Challenges to DOD

•DOD has greater insight into current EELV costs than in the past, but may find itself funding an under-utilized launch capability with ULA if they select a new entrant for some or all of the 14 launches. This is because the current contract pays for annual ULA launch capability for 8 launches, even if fewer launches actually take place in a given year. If DOD buys a launch from another provider, it may be paying for duplicate capabilities.

•Allowing new entrants to compete on a commercial, fixed-price basis could yield more efficient business practices and cost savings to DOD than it would otherwise obtain through cost-type contracts. This is because government cost-type contracts require more data and government insight than commercial contracts, which can be expensive.

Objective 4: Implications to ULA if DOD Requires an ELC/ELS Structure for Launch Proposals

Benefits to ULA

•DOD's recent block buy contract with ULA buys launch capability for six years, and affords ULA the opportunity to offer only the incremental cost to ULA of launching any of the 14 available missions. This is because under the current EELV contract, DOD has already bought ULA launch capability for 8 launches per year, even if fewer launches actually take place.

•ULA may get the benefit of an excellent launch record of 67 consecutive successful launches of government (defense and civil) and commercial missions on Atlas V and Delta IV launch vehicles since 2002.[8]

•Satellite integration requirements for ULA's Atlas V and Delta IV launch vehicles are generally known, given ULA's role as the EELV program's sole launch provider.

Challenges to ULA

•New entrants are expected to compete for up to 14 launches before they have been certified to launch the full range of EELV missions, meaning they have not paid the developmental costs of standing up their heavy launch vehicles and pads. This could give new entrants a price advantage over ULA, which is required to provide launch services for all variants of EELVs, including heavy launch vehicles, the most expensive to build and launch.

8 Lockheed Martin and Boeing launched Atlas V and Delta IV launch vehicles, respectively, beginning in 2002, prior to the formation of ULA in 2006.

Objective 4: Implications to New Entrants if DOD Requires an ELC/ELS Structure for Launch Proposals

Benefits to new entrants

•New entrants are expected to compete for up to 14 launches before becoming certified to conduct the full range of EELV missions. This affords them a potential price advantage over ULA, as new providers have not yet had to pay for the development, production, and demonstration of each type of launch vehicle.

•While new entrants cannot demonstrate a long past performance record for EELV-class launches as can ULA, the Federal Acquisition Regulation (FAR) prohibits a lack of a performance history from being considered a negative.[9]

Challenges to new entrants

•DOD does not currently fund launch capability for new entrant companies, as it does for ULA. If DOD requires a similar structure for new entrants, they may ultimately have to stand up their own capability to meet DOD requirements, which could be costly.

•New entrants prefer to submit proposals on a commercial, fixed-price basis instead of duplicating ULA's ELC/ELS business model, which they view as inefficient and expensive. Particularly, the cost-reimbursement portion of the contract would require development and installation of business systems to gather required data, at additional cost to the new entrants.

9 FAR §15.305(a)(2)(iv).

Objective 4: Using a Commercial Approach for Launch Proposals

- New entrants would prefer to submit proposals on a commercial, fixed-price basis in accordance with FAR Part 12, in order to focus the EELV competition on price without DOD having to pay separately for ELC costs.[10]
- DOD is reluctant to use a FAR Part 12 approach because DOD believes this approach limits DOD's insight into contractor costs. Officials indicate a lack of insight into these costs led to problems in the past.
- DOD also points out that a FAR Part 12 approach would have fewer cost and data reporting requirements for new entrants than are currently placed on ULA, leading to an unfair cost advantage for the new entrants who would not have to develop and install business systems to manage a cost-reimbursement contract.
- However, if a robust competitive environment exists in the post-block buy phase beginning in fiscal year 2018, DOD has noted that it may depart from the ELC/ELS construct while requiring all companies to submit offers in a full and open competition for launch services.

10 FAR Part 12 outlines processes for acquiring commercial items, which are defined as items that are customarily used by the general public or by non-governmental entities for purposes other than governmental purposes. Some features of FAR Part 12 contracts include less insight into cost or pricing data, and fixed-price contract types.

Objective 4: Using a Commercial Approach, cont.

Potential benefits to DOD	Potential challenges to DOD
•Use of a fixed-price contract identifies the cost of the contract at time of award. •Could facilitate a straightforward comparison of launch vehicle prices between companies without having to account for ULA's ELC contract structure. •Full and open competition could help to decrease launch prices and increase efficiencies.	•Under a fixed-price commercial-type contract, DOD access to cost data would be very limited. •DOD believes there may not be sufficient demand in fiscal year 2018 and beyond to support multiple launch providers. •Given the national imperative for an assured access to space, DOD may be forced to continue funding for launch capability if multiple launch providers cannot be sustained by the launch market, making a commercial approach impractical. •DOD may lose some flexibility in its launch schedule, as rearranging and rescheduling launches due to satellite delays or other factors could incur added cost, according to DOD officials.

Scope and Methodology

We interviewed or obtained information from:

- Air Force Space Command, Peterson Air Force Base, Colorado Springs, Colorado
- Air Force Space and Missile Systems Center, Launch Systems Directorate, Los Angeles Air Force Base, El Segundo, California
- Defense Contract Audit Agency, Littleton, Colorado
- Defense Contract Management Agency, Littleton, Colorado
- Office of the Secretary of Defense, Cost Assessment and Program Evaluation, Washington, District of Columbia
- Orbital Sciences Corporation, El Segundo, California
- Program Executive Officer for Space Launch, Washington, District of Columbia
- Space Exploration Technologies, Inc., Hawthorne, California
- United Launch Alliance, Centennial, Colorado

Scope and Methodology, cont.

To determine the insight DOD had into launch costs under past EELV contracts:

- We reviewed the two most recent ELC and ELS contracts and examined the contract structure and breakdown of costs included in the contract.
- We received an in-depth verbal and written briefing on the ELC contract from DOD, and discussed with senior Air Force officials the history, context, and makeup of the EELV contracts.
- We interviewed other DOD and incumbent contractor officials regarding direct launch vehicle and other supporting activities performed under the contracts.
- We reviewed Defense Contract Audit Agency audit reports of EELV launch contracts, report dates ranging from 2005 to 2012.
- We reviewed past GAO reports and identified previous recommendations and their implementation to determine DOD insight into contracts.

To determine how recent changes to EELV contracts affect accounting for costs:

- We discussed the new EELV contract with DOD contracting officials and received an in-depth briefing on the structure of the new contract, including changes from previous contracts.
- We reviewed the modified EELV contract, and compared its contents and dollar amounts to previous versions of EELV contracts.
- We discussed the modified EELV contract, and changes from previous contracts, with the incumbent contractor.

Scope and Methodology, cont.

To determine how DOD is reimbursed for costs when the incumbent provider sells launches to other customers:

- We examined ELC contracts from fiscal years 2012-2014 to determine reimbursements.
- We interviewed DOD and incumbent contractor officials to identify how any reimbursement amounts were calculated and the extent to which ELC costs were included.
- We analyzed the reimbursement amounts and calculated the percentages of total ELC costs that the reimbursements represented annually.

To determine the implications of possible DOD approaches to comparing launch proposals between the incumbent and new launch providers:

- We discussed DOD's plans to make the comparison in interviews with DOD officials who are developing the plan.
- We reviewed draft DOD performance work statement related to the proposed EELV competition.
- We discussed the implications of DOD’s plan with DOD officials, new entrant launch service providers and the incumbent provider.
- We reviewed FAR requirements for various types of contracts, including fixed-price and cost—reimbursement-type contracts.

We obtained technical comments from DOD to ensure the accuracy of the slides, and incorporated changes as appropriate.

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Embargo until 10am March 5

Testimony of
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Chief Executive Officer
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Subcommittee on Defense
Committee on Appropriations
United States Senate

Chairman Durbin, Ranking Member Cochran and Members of the Subcommittee, thank you for the opportunity to appear today to discuss the Evolved Expendable Launch Vehicle (EELV) program and the future of space launch.

On behalf of the men and women of United Launch Alliance and the entire EELV supplier team, we are honored to be entrusted with the responsibility of safely delivering critical national security satellites to orbit. These satellites provide capabilities vital to nearly every aspect of U.S. national security. ULA also supports customers outside of national security. For NASA, we have launched science missions to the Moon, Mercury, Jupiter, and Pluto, and even sent the rovers on their way to Mars. Our customers extend beyond government to the commercial sector with nine commercial missions to date and several more on the manifest.

I am pleased to report that ULA and the government team have consistently delivered 100 percent mission success over 68 launches since the inception of the program. We are currently at a tempo of about one launch every month. ULA's Atlas V and Delta IV rockets are the most powerful and most reliable in the world. They are the only rockets that fully meet the unique and specialized needs of the national security community.

The Air Force EELV program was competed in the late 1990's with a unique acquisition strategy that required significant upfront investment by industry. Lockheed Martin's Atlas and Boeing Company's Delta products were the winners. Over the past 17 years the program has continued to deliver. Meeting the needs of our nation effectively and efficiently – delivering capabilities on time, on budget and while delivering on all of the programs original requirements.

Looking forward, the EELV program is entering a new era. The Air Force's new acquisition strategy aims to maintain reliability and stabilize the industrial base, while reducing costs and introducing competition. We welcome the new strategy, as the previous approach of buying rockets one-at-a-time was highly inefficient and costly.

The Air Force implemented the first phase of the new strategy with a block-buy commitment which will save several billions of dollars over the next five years. The block-buy created efficiency through economies of scale, eliminated repetitive administrative contracting actions, and provided stability and predictability that enabled informed investment decisions on product and process improvements that were incorporated into our pricing.

The next phase of the Air Force strategy is to introduce competition. I believe there are substantive questions about how EELV competitions will be structured to ensure the competition is fair and open and whether it will actually deliver savings to our nation. Ultimately, the central question is whether savings from competition will be sufficient to offset the cost of duplicating existing capabilities. ULA was formed to enable assured access to space with two separate launch systems, with recognition the that market demand was insufficient to sustain two competitors. We went from two competing teams with redundant and underutilized infrastructure to one team that has delivered the expected savings of this consolidation.

Looking to the future, we are investing in new technology and concepts to make our products better and more affordable. We are investing internal funds to develop a capability to launch two GPS satellites at a time which will cut launch costs almost in half. ULA, along with our government customers, is reviewing every requirement and every process to eliminate any unnecessary or inefficient elements.

ULA is also aggressively expanding its customer base, both at NASA and in the commercial sector with additional launches because improved utilization of the fixed infrastructure improves the cost for all customers. ULA and our industry partners are going to work closely with NASA's SLS, and other DoD programs to find opportunities to improve product designs and utilize industrial base infrastructure more efficiently to lower the cost for all programs.

On a more personal note, I have been in this business for 35 years. I have worked with the government in every imaginable approach to buying launch services, from traditional DoD contracting approaches to commercial approaches; from buying rockets in blocks to buying them individually. I've also worked extensively in the international and commercial sectors. I was there in the 1990s when the commercial demand for launch was projected to be dozens of launches per year, only to have the projected commercial demand evaporate overnight. I believe leveraging the demand from the commercial sector is smart, but relying on commercial demand to enable national security carries huge risks, both to the rocket supplier and to its government customers.

I've also experienced some of the launch industry's darkest days, such as in the late 1990s when the U.S. suffered a series of six major launch failures over a 10-month period. These included three consecutive Titan IV failures and the loss of some of the nation's most critical systems. Those losses totaled many billions of dollars and were a harsh reminder that launch is risky and extremely unforgiving. It's difficult to overemphasize the depth of the loss to national security those failures caused.

I believe the impressive successes we've achieved on EELV stem from the difficult lessons-learned from the 1990s. These lessons include sustaining a laser focus on technical rigor, the importance of an open and transparent relationship with our government customers, and acquisition strategies that align with our customers' priorities.

In summary, I believe the EELV program has been a major success for the nation. We will continue to provide the assured access the nation needs to deliver critical capabilities to orbit reliably and on-schedule. We look forward to working with our government customers and stakeholders to significantly drive down cost further while maintaining reliability and readiness.

Thank you for the opportunity to appear before you today. I will be honored to answer your questions.

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EELV Flight History

Updated: 2/21/13

EELV	Launch Date	Vehicle	Customer	Mission	Outcome
1	08/21/02	Atlas V	Commercial	Hot Bird 6 – Commercial Comm	Mission Success
2	11/20/02	Delta IV	Commercial	Eutelsat W5 – Commercial Comm	Mission Success
3	03/11/03	Delta IV	Air Force	DSCS-3 A3 – Military Communications	Mission Success
4	05/13/03	Atlas V	Commercial	Hellas Sat – Commercial Comm	Mission Success
5	07/17/03	Atlas V	Commercial	Rainbow 1 – Commercial Comm	Mission Success
6	08/29/03	Delta IV	Air Force	DSCS-3 B6 – Military Communications	Mission Success
7	12/17/04	Atlas V	Commercial	AMC 16 – Commercial Comm	Mission Success
8	12/21/04	Delta IV-Heavy	Air Force	DemoSat – 1st flight of Delta IV-Heavy	Mission Success
9	03/11/05	Atlas V	Commercial	Inmarsat 4-F1	Mission Success
10	08/12/05	Atlas V	NASA	Mars Reconnaissance Orbiter	Mission Success
11	01/19/06	Atlas V	NASA	New Horizons - Pluto	Mission Success
12	04/20/06	Atlas V	Commercial	Astra 1KR	Mission Success
13	05/24/06	Delta IV	NASA/NOAA	GOES-N - Weather Satellite	Mission Success
14	06/28/06	Delta IV	NRO	NROL-22 (Classified)	Mission Success
15	11/04/06	Delta IV	Air Force	DMSP-17 - Weather Satellite	Mission Success
16	03/08/07	Atlas V	Air Force	STP-1 - Technology Satellite	Mission Success
17	06/15/07	Atlas V	NRO	NROL-30 (Classified)	Mission Success
18	10/11/07	Atlas V	Air Force	WGS-1 - Military Communications	Mission Success
19	11/11/07	Delta IV-Heavy	Air Force	DSP-23 - Missile Warning	Mission Success
20	12/10/07	Atlas V	NRO	NROL-24 (Classified)	Mission Success
21	03/13/08	Atlas V	NRO	NROL-28 (Classified)	Mission Success
22	04/14/08	Atlas V	Commercial	ICO G1 - Commercial Communications	Mission Success
23	01/18/09	Delta IV-Heavy	NRO	NROL-26 (Classified)	Mission Success
24	04/04/09	Atlas V	Air Force	WGS-2 - Military Communications	Mission Success
25	06/18/09	Atlas V	NASA	LRO - Moon Mission	Mission Success
26	06/27/09	Delta IV	NASA/NOAA	GOES-O - Weather Satellite	Mission Success
27	09/08/09	Atlas V	DoD	PAN - Communications	Mission Success
28	10/18/09	Atlas V	Air Force	DMSP-18 - Weather Satelltie	Mission Success
29	11/23/09	Atlas V	Commercial	Intelsat 14 - Commercial Comm	Mission Success
30	12/06/09	Delta IV	Air Force	WGS-3 - Military Communications	Mission Success
31	02/11/10	Atlas V	NASA	Solar Obervatory - Science	Mission Success
32	03/04/10	Delta IV	NASA/NOAA	GOES-P - Weather Satelltie	Mission Success
33	04/22/10	Atlas V	Air Force	X-37B Orbital Test Vehicle-1	Mission Success
34	05/28/10	Delta IV	Air Force	GPS-IIF-1 Navigation Satellite	Mission Success
35	08/24/10	Atlas V	Air Force	AEHF-1 Military Communications	Mission Success
36	09/21/10	Atlas V	NRO	NROL-41 (Classified)	Mission Success
37	11/21/10	Delta IV-Heavy	NRO	NROL-32 (Classified)	Mission Success
38	01/20/11	Delta IV-Heavy	NRO	NROL-49 (Classified)	Mission Success
39	03/05/11	Atlas-V	Air Force	X-37B Orbital Test Vehicle-2	Mission Success
40	03/11/11	Delta IV	NRO	NROL-27 (Classified)	Mission Success
41	04/14/11	Atlas V	NRO	NROL-34 (Classified)	Mission Success
42	05/07/11	Atlas V	Air Force	SBIRS-GEO-1 Missile Warning System	Mission Success
43	07/16/11	Delta IV	Air Force	GPS IIF-2 - Navigation Satellite	Mission Success
44	08/05/11	Atlas V	NASA	Juno - Mission to Jupiter	Mission Success
45	11/26/11	Atlas V	NASA	Mars Science Lab/Curiosity Rover	Mission Success
46	01/20/12	Delta IV	Air Force	WGS-4 - Military Communications	Mission Success
47	02/24/12	Atlas V	Navy	MUOS 1 - Military Communications	Mission Success
48	04/03/12	Delta IV	NRO	NROL-25 - (Classified)	Mission Success
49	05/04/12	Altas V	Air Force	AEHF-2 Military Communications	Mission Success
50	06/20/12	Atlas V	NRO	NROL-38 - (Classified)	Mission Success
51	06/29/12	Delta IV-Heavy	NRO	NROL-15 (Classified)	Mission Success
52	08/30/12	Atlas V	NASA	RBSP - Heliophysics	Mission Success
53	09/13/12	Atlas V	NRO	NROL-36 (Classified)	Mission Success
54	10/04/12	Delta IV	Air Force	GPS IIF-3 - Navigation Satellite	Mission Success
55	12/11/12	Atlas V	Air Force	X-37B Orbital Test Vehicle-3	Mission Success
56	01/31/13	Atlas V	NASA	TDRS-K - Communications	Mission Success
57	02/11/13	Atlas V	NASA	LDCM - Landsat	Mission Success
58	03/19/13	Atlas V	Air Force	SBIRS-GEO-2 Missile Warning System	Mission Success
59	05/15/13	Atlas V	Air Force	GPS IIF-4 - Navigation Satellilte	Mission Success
60	05/24/13	Delta IV	Air Force	WGS-5 - Military Communications	Mission Success
61	07/19/13	Atlas V	Navy	MUOS 2 - Military Communications	Mission Success
62	08/08/13	Delta IV	Air Force	WGS-6 - Military Communications	Mission Success
63	08/28/13	Delta IV-Heavy	NRO	NROL-65 (Classified)	Mission Success
64	09/18/13	Atlas V	Air Force	AEHF-3 Military Communications	Mission Success
65	11/18/13	Atlas V	NASA	MAVEN - Mission to Mars	Mission Success
66	12/05/13	Atlas V	NRO	NROL-39 - (Classified)	Mission Success
67	01/23/14	Atlas V	NASA	TDRS-L - Communications	Mission Success
68	02/20/14	Delta IV	Air Force	GPS IIF-5 - Navigation Satellite	Mission Success