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Testimony to the House Committee on Armed Services

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Mr. Chairman and Members of the Committee, thank you for the opportunity to appear today to update you on efforts by United Launch Alliance (ULA) to develop a new generation of space launch capabilities to support the warfighter and our Intelligence Community. As part of my remarks, I will highlight certain geopolitical developments that have brought assured access to space to the fore, our efforts to help develop a new engine as part of our process of developing a new rocket system that will assure our nation's continued ability to deliver critical satellites to space, and will conclude by highlighting the role of competition in supporting assured access to space.

The Country and the Congress owe this Committee a great deal of thanks for approaching this subject in a responsible manner at a time when it is easy to confuse our views about Russian aggression with the need to provide for our own National Security. The current Congress did not create the situation we find ourselves in with use of a Russian engine for U.S. access to space. Half the current Congress, you Mr. Chairman and your fellow Committee members, have taken on the job of fixing this very important problem in your bill which passed with such overwhelming bipartisan support.

ULA agrees with the stated U.S. goal to rely on American-made rocket engines to ensure access to space. ULA finds itself using a Russian-made engine for its Atlas V rockets in the near term as a result of the larger U.S. post-Cold War environment of Russian proliferation threats

and the de facto policy of the last three Presidential Administrations to reduce and eliminate those threats. The use of the Russian engine contained this critical space technology from being shared with rogue nations. In response to the changing international political climate, ULA is now aggressively working with domestic partners to field an American-made rocket engine for the Atlas V as soon as is practicable but still ensuring an ability to meet national security launch needs.

ULA also supports competition in the space launch business. However, if current law is not modified, America will no longer be compliant with its assured access to space policy as competition will have been unintentionally eliminated. Our efforts to field a new launch system with an American-made engine hinge on our ability to close a business case justifying the significant corporate investment we will have to make to field this system. We are unable to do this if we cannot have access to all 29 engines for which we contracted from our partner RD AMROSS prior to the outbreak of hostilities in Crimea.

I thank this Committee for its willingness to modify this current law with respect to access to the RD-180 engine in the Fiscal Year 2016 National Defense Authorization Act. Without a change to Sec. 1608 of the Fiscal Year 2015 National Defense Authorization Act, ULA will no longer be allowed to use the Atlas V's space launch capabilities, capabilities that have been integral to 96 successful launches without a failure, by as early as 2019. The Delta IV rocket, while domestically produced, is 35% more expensive to build and launch. It is not a "solution" to the problem of Atlas V's RD-180 engines, as it cannot be fabricated as quickly or as cheaply as the Atlas V. Delta is neither a cost effective solution for the DOD nor cost competitive against new entrants that feature less capable and smaller launch systems.

As you know, ULA announced it is moving forward in investing its own resources in developing a next generation domestic engine to launch our new Vulcan rocket. ULA is working with Blue Origin of Kent, Washington to develop a new American-made engine that will be powered by liquid oxygen and liquefied natural gas to power the rocket. At the same time, to reduce developmental risk, ULA is also working with Aerojet Rocketdyne of Sacramento, California on the development of the AR-1 engine; a kerosene powered rocket engine.

ULA will have enough confidence to make a down-select of the desired rocket engine in late 2016. The Vulcan launch system, powered by this new engine, will have increased performance to deliver a wider range of payloads to space. Despite congressional desire for developing a new engine by 2019, co-development of a new engine and launch system is both complex and requires sufficient schedule to perform correctly. While I am optimistic the Vulcan engine will be ready for testing in 2017 and available for commercial purposes by 2019, the Vulcan launch system will not be certified by the Air Force to support National Security Space missions until 2021 at the earliest.

As the Air Force has testified to Congress earlier this year, a new engine takes anywhere from six to eight years to develop, test, certify and have ready to use for operational missions. After an engine is developed, it must be integrated into a launch vehicle system, while manufacturing capability to mass produce the engines must be increased in a manner meeting the stringent quality assurance standards set by the DOD.

It is also important to remember that a next-generation space launch system is more than just a new engine. One cannot just plug in a new “form-fit-function” engine into a rocket and expect the system to perform. Neither engine under development by our partners would

automatically work as a "drop in" replacement for the RD-180. All rockets must be designed around a specific engine, as all engines have different characteristics based on their weight, fuel types and thrust capabilities. Our objective is a Vulcan system with more thrust than the Atlas V, and we are designing our Vulcan rocket to take full advantage of this capability.

Faced with an aggressive development timeline, and the costs associated with the development of a new engine and vehicle, it is essential that ULA have access to all RD-180 engines on contract prior to the initiation of Crimea hostilities to enable an orderly transition from Atlas V to the new Vulcan rocket. The design, development and testing of a new engine and vehicle will require ULA to have access to government and private sector investment and revenue from continued Atlas V launches. With access to all 29 engines on contract authorized by the Committee in H.R. 1735, the Fiscal Year 2016 National Defense Authorization Act, ULA can eliminate U.S. dependence on the Russian engine rapidly and efficiently, with no impact to schedule and reliability, a sentiment articulated by Chairman Thornberry.

Without a change to the law, as Secretary Carter and Director Clapper note, "…loss of access to Atlas V and medium/intermediate class Delta IV capabilities, we could be faced with a multi-year gap where we have neither assured access to space nor an environment where price based competition is possible." Assured access to space requires two entities that can support the launch of the entire range of high-value space assets into space. Should Sec. 1608 of the Fiscal Year 2015 National Defense Authorization Act not be modified, America will lose assured access.

If this provision is not modified, SpaceX, a new entrant to the market, will be the only entity able to carry out medium/intermediate National Security Space lift missions but is not

capable of providing all the capability of an Atlas V. In essence, Sec. 1608 grants SpaceX a monopoly for the launch of critical satellites to support warfighters. Without amending the law, ULA will be unable to move forward with providing business continuity and continued development of the U.S. designed and manufactured Vulcan launch system. Secretary of Defense Ash Carter and Director of National Intelligence James Clapper have written Congress to note they support modification of Sec. 1608 to "enable a smoother transition to new launch capabilities."

The proposed language in section 1603 of the House version of the 2016 NDAA addresses our concerns by allowing ULA to use all rocket engines contracted for prior to the outbreak of hostilities in Crimea. In contrast, the Senate version of the NDAA allows access to only two thirds of those engines – dramatically limiting our ability to compete for national security missions beyond 2018 and inhibiting a business environment conducive to an orderly transition to the Vulcan launch system.

Until this uncertainty is resolved, ULA may invest in the Vulcan rocket only on a quarterly basis, clarifying how critical legislative relief is to having the financial footing to proceed with developing the Vulcan launch system.

As I mentioned to this Committee earlier this year, ULA will retire the Delta IV medium/intermediate launch vehicle in the 2018-2019 timeframe. ULA will retain the Delta IV Heavy rocket for as long as our government customers have the need for this specialized launch capability.

I would like to take this opportunity to reiterate that development of a next generation domestic engine and vehicle is a complicated and challenging long endeavor that includes research, new design decisions, development of new technologies and manufacturing techniques, extensive testing and finally government certification. This is not a "one to two year" endeavor as some have suggested. While most knowledgeable rocket engineers estimate a new domestic rocket engine and launch system can be developed in five to seven years, we know of several examples where it has taken significantly longer. NASA's Space Shuttle program was officially announced in 1972, started orbital test flights in 1981, and ultimately started operational flights in 1982. The Space Shuttle Main Engine (SSME) development program faced several delays and problems, the most vexing of which was the high-pressure liquid oxygen pumps that experienced problems threatening success of the entire program. NASA optimistically believed the Space Shuttle could begin flights in 1977 but these unforeseen problems led to numerous engine test malfunctions and delays.

ULA's parent companies experienced similar delays firsthand. While Atlas V and Delta IV rockets were being designed, the existing US launchers, which had been developed and begun their service lives, experienced a spate of six failures over a period of 10 months in the 1998-1999 timeframe, including a shocking three consecutive Titan IV failures on very high priority national security missions. These failures resulted in the Air Force significantly increasing its oversight of the Atlas V and Delta IV programs.

Even SpaceX, who asserts that development of a replacement for the RD-180 and Atlas V should not take beyond 2019, experienced similar development and test problems with its engines and vehicles. In 2006, the Falcon 1 caught fire shortly after its launch and crashed after

34 seconds of flight[1]; in 2007, the rocket rolled after launch, was unable to reach orbit, and was unable to be recovered because its GPS locator failed[2]; in 2008, the rocket failed to separate properly, a design flaw that caused the loss of three government satellites.[3] In 2010, the Falcon 9 rolled out of control after launch because an attempted restart of the engine failed[4]; and in 2012, one of the Falcon's engines shut down midflight, resulting in the loss of a $10 million Orbcomm satellite.[5] Because of these and other development and early test problems, SpaceX was significantly delayed in providing contracted launches to NASA through the commercial cargo program. It would be best to take their aggressive estimates for development of an RD-180 replacement with skepticism.

I have been asked by some why President Kennedy was able to get to the moon within a decade, yet ULA cannot develop a new domestic engine by 2019. I would remind those using this reasoning that the United States had been developing rocket technologies like the Saturn-1 and the Mercury spacecraft well before the President's announcement. One of the greatest accomplishments in human history, leveraged heavily on preexisting propulsion technology. There is no doubt that landing on the moon was a remarkable achievement, but it would have been almost impossible to do so in that timeframe without the years of research and development that came before the announcement. Mercury flew on Redstone and Atlas missiles, Gemini on Titans, Saturn 1 on existing RL10s. The F-1 engines on Saturn V were static fired in 1959 and certified in 1964. The engines for Apollo, Mercury, and Gemini had similar

[1] "New commercial rocket failed because of fuel leak," The Associated Press. July 18, 2006.
[2] Greg Zsidsin, "SpaceX confirms stage bump on Demoflight 2," Space Daily, March 23, 2007.
[3] "Final frontier for Star Trek star James Doohan's ashes is…bottom of the Pacific," Daily Record, August 6, 2008.
[4] Miles O'Brien, "This Week in Space," True/Slant, June 6. 2010.
[5] Damon Poeter, "Satellite aboard SpaceX ISS flight lost due to engine mishap," PC Magazine, October 12, 2012.

development spans as today. There is a misconception that it was a cold start in 1962. While ULA is also not starting from scratch with development of the Blue Origin or Aerojet Rocketdyne engine, there are still years of design and testing ahead of us. As often happens when designing technologies with this level of advancement, ULA will not have a clear new engine development timeline until full scale testing has begun. At that juncture, we will know if the design concept requires fundamental changes.

Others have asked why ULA cannot simply build the RD-180 in America, as we have a license to do so. Unfortunately, despite having the design of the engine, the rocket engine industry in the United States currently lacks the manufacturing capability and tooling capacity to easily reproduce the RD-180. Soon after the Atlas V began its operational life the government evaluated producing the RD-180 domestically but ultimately abandoned the plan due to the level of required investment. There was a conscious decision to continue to procure RD-180 engines because Russia could produce them cheaper, thereby saving the DOD money while maintaining ties to the Russian rocket industry and dissuading the supply of such technologies to rogue regimes. To build RD-180s in the United States, ULA would need to build a supplier and manufacturing network from the ground up, overcome specific manufacturing hurdles we likely are not aware of and put them through a costly test and certification process, which would not be accomplished by 2019.

The Air Force, Department of Defense, and the Intelligence Community have already expressed concern to Congress about trading one monopoly for another, a result of language in Section 1608 of the FY15 NDAA that prevents ULA from competing with the Atlas V for future national security launches until the Vulcan launch vehicle and new engine are developed. As

you know, the Air Force recently certified a new entrant, SpaceX, and their Falcon 9 launch vehicle to compete for these same launches. Before the Committee and Congress potentially grant a new monopoly to SpaceX and Falcon 9, it must examine the record of SpaceX's promises and actual performance that have defined the company to date.

The space and business press is awash in stories that chronicle the history of SpaceX over-promising and under-delivering on both cost and schedule. In 2011, SpaceX claimed it could build a rocket for 75 percent less than its competitors, yet costs for SpaceX launches have climbed at an alarming rate since the company website's original quote of $61.2M for a Falcon 9 launch. Recent awards for three additional NASA International Space Station resupply missions, and military launches once the company achieved certification to launch national security payloads, have been quoted as $150M and $180M respectively[6]. In 2010, SpaceX founder Elon Musk estimated his company could build rockets for human space flights for less than $350 million. After industry observers strongly disputed this estimate as being unrealistic, Mr. Musk eventually admitted it was "naively low."[7] SpaceX fares no better in estimating schedule. In 2012, Mr. Musk stated SpaceX aimed "to begin taking people to the Space Station by 2015,"[8] and in 2014 he said he was hopeful that "the first people could be taken to Mars in 10 to 12 years."[9] Despite this, launch of the Falcon 1 was delayed by two years[10,11] and SpaceX missed five target dates for the rocket's inaugural launch.[12] The Falcon 9 launch was delayed by

[6] www.usaspending .gov, and Ms. Shotwell testimony before the House Armed Services Committee, March 17, 2015
[7] Andy Pasztor, "SpaceX illustrates privatization risk," The Wall Street Journal, June 7, 2010.
[8] "SpaceX Dragon capsule splash lands in Pacific," Agence France Presse, May 31, 2012.
[9] Sebastian Anthony, "SpaceX says it will put humans on Mars by 2026, almost 10 years ahead of NASA," Extreme Tech, June 18, 2014.
[10] "Aerospace Daily & Defense Report," Aviation Week, February 14, 2005.
[11] "New rocket by California company fails on maiden launch," The Mercury News, March 24, 2006.
[12] Mult.

three years[13,14] and SpaceX missed seven target dates for the rocket's inaugural launch.[15] While SpaceX promises that it can significantly lower costs for the DOD and handle the full spectrum of national security launches by 2019, these promises rely on two future assumptions – the ability to reuse a rocket's first stage, which SpaceX has attempted several times now unsuccessfully, and the ability of SpaceX to develop a "heavy" variant of the Falcon. The first test flight of the Falcon Heavy has been billed as occurring later this year, but given SpaceX' s crowded manifest for the Falcon 9, that may prove impossible as the Falcon 9 Heavy requires 27 Merlin engines that may be needed for other near term launches. In addition, Space X's Merlin engine upper stage, fueled by kerosene, may be unable to inject key national security payloads into geosynchronous orbit because kerosene freezes during the time required to reach a geosynchronous location. For these reasons, we would respectfully urge Congress to carefully consider the track record of SpaceX for delivering on-time and for promised costs, given current policies in the NDAA may lead to granting them a monopoly by 2019.

While ULA serves the government and private sectors, it is most well-known for its pedigree in national security launches, which was the rationale for the creation of ULA. While SpaceX complains bitterly about "government subsidies" ULA receives to conduct national security launches, that contract pays for legitimate government requirements to provide various recurring efforts and for ULA to maintain launch infrastructure supporting two different classes of rockets at two separate launch facilities on either coast. SpaceX has been the

[13] Patrick Peterson, "SpaceX launch reset to June 2009," Florida Today, February 29, 2008.
[14] Miles O'Brien, "This Week in Space," True/Slant, June 6, 2010.
[15] Mult.

beneficiary of significant federal and state government support itself[16]. SpaceX has relied on contracts to develop new capabilities and the use of low- or no-cost leases of previously developed launch infrastructure in Florida and California that were paid for by taxpayers. SpaceX's privately held ownership, coupled with no Defense Contract Audit Agency audits of its programs, yields little insight into transactions such as the company's purchase of $90M in SolarCity bonds, potentially putting the taxpayer at risk.

ULA would like to continue its unparalleled service to our nation's warfighter and Intelligence Community, but it can only do so if the launch vehicle replacement for Atlas V is "cost competitive". For that to happen, the following must occur in the next several years:

1. Ensure use of all 29 RD-180 engines under contract to allow ULA to compete for national security and other launches while development of Vulcan is ongoing. This means Congressional legislation to ensure ULA has access to all 29 engines for which we contracted with RD AMROSS prior to the outbreak of hostilities in Crimea. Without these engines, the business case to develop the new Vulcan launch system does not close and we will be forced from the space launch business.

2. Retirement of the Delta IV – this is necessary so multiple launch facilities and pads on the East and West coasts for Atlas V (and its variants) and Delta IV can be closed to reduce personnel, maintenance, and equipment costs. For ULA to offer reduced

[16] "Elon Musk's Companies Fueled by Government Subsidies," Los Angeles Times, June 1, 2015.

prices for launch services, it must shed infrastructure commensurate with its fewer vehicle configuration options.

3. Successful development of a new launch system that incorporates a U.S. designed and manufactured engine with enough power to meet launch requirements for all national security payloads previously handled by the Atlas V and Delta IV medium/intermediate systems. In order to cost-effectively satisfy national security and civil government requirements, as well as future commercial demands in a single family of launch vehicles, ULA must design the Vulcan to be significantly more capable than the current Atlas V. This remains the single biggest reason why simply reproducing "an American made version of the RD-180" will not suffice for ULA to be competitive as an American launch provider in the decades to come.

The fact is we are truly faced with decisions of "Rocket Science" complexity. It takes time, money, and a dedicated team of scientists and engineers to execute major developments on schedule while retaining a flawless record of mission assurance. The nation and ULA possesses those abilities and have the unblemished record of success to prove it. ULA stands ready as your partner in this task and we are happy to answer any questions you might have.