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DEPARTMENT OF THE AIR FORCE

PRESENTATION TO THE
HOUSE ARMED SERVICES COMMITTEE
SUBCOMMITTEE ON STRATEGIC FORCES
U.S. HOUSE OF REPRESENTATIVES

SUBJECT: Assuring National Security Space: Investing In American Industry to End Reliance on Russian Rocket Engines

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Chairman Rogers, Ranking Member Cooper, and distinguished Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss how we deliver space capabilities to the nation's warfighters today -- and tomorrow. As Ms. McFarland and General Hyten have said, space capabilities are essential to the American way of life and to the Air Force mission. Thanks to the efforts of the men and women of the Space and Missile Systems Center, the Air Force, and our contractors and mission partners, we have multiplied the effectiveness of our forces in the land, sea, and air domains through worldwide precision navigation, protected strategic and tactical communications, and Intelligence-Surveillance-Reconnaissance capabilities provided from space.

One of the keys in providing all of that capability is space launch. If we cannot launch a satellite when we need to, we will not have those much needed space capabilities when we need them. As you know, we address the critical nature of launch through a policy of assured access to space, maintaining at least two reliable launch systems with independent technical baselines as a credible method for continued access to space, should one suffer a grounding event. Assured access to space makes sense, and it is mandated by Title 10, Section 2273 of the US Code, which requires "the availability of at least two space launch vehicles (or families of space launch vehicles) capable of delivering into space any payload designated by the Secretary of Defense or the Director of National Intelligence as a national security payload."

We purchase launch services on a commercial basis. Leveraging commercial space transportation services whenever possible is mandated by the Commercial Space Act (51 U.S.C. §50131). This is a good thing -- the market for space products and space launch continues to mature, and as in many other areas, our free market here in America is an important source of innovation and national economic strength. I applaud the success our partners at NASA have had in using public-private partnerships to reduce the cost of routine cargo deliveries to the International Space Station. Similarly, leveraging the free market through reintroducing competition for Evolved Expendable Launch Vehicle – EELV – class launches will help us reduce our costs and gain additional access to industry innovation.

The Air Force is Complying with the FY15 National Defense Authorization Act

These two concepts, assured access to space via reliable launch vehicles and competition, are the cornerstones of our national launch policy and are written into law. Section 1608 of the 2015 National Defense Authorization Act (NDAA) restricts the use of the RD-180 rocket engine. Just as decisions were made for industry to adopt the RD-180 in the 1990s, we are complying with law to reduce strategic reliance on foreign Rocket Propulsion Systems now. The Air Force is 100% committed to transitioning off of the RD-180 for national security space launch as quickly and prudently as possible.

Section 1604 of the 2015 NDAA requires that we develop a domestic next-generation rocket propulsion system suitable for national security use by 2019, that it be available for purchase by all domestic space launch providers, and that we examine the feasibility of public-private partnerships to do so. As we implement this law, we must continue to execute our two cornerstones, assured access to space and competition, to achieve the end state necessary to maintain our military effectiveness: at least two domestically-produced, commercially-viable launch providers that are also able to meet national security space requirements by the end of FY22.

Assured access to space requires space launch services and not just a rocket engine. The pending restriction on spending FY16 funds only for rocket propulsion system development will potentially delay the availability of those space launch services required to continue to assure access to space without reliance on foreign Rocket Propulsion Systems.

Procuring Launch Services is Necessary to Maintain Assured Access to Space

Our ability to maintain affordable assured access to space after 2018 is currently jeopardized. At the moment, two providers are capable of meeting some or all of our EELV launch requirements, using three families of launch vehicles. Last month, on behalf of the Air Force, I approved certification of SpaceX as a NSS launch-service provider. This milestone now means that we have more than one credible, certified launch service provider to support NSS

missions. We also currently have the certified ULA Atlas and Delta rocket families. Unfortunately, according to ULA, the Delta is not cost-competitive with either the Atlas or the Falcon 9, and they have announced plans to retire it by 2018, except for the Heavy variant which primarily launches unique national security payloads. ULA plans to transition to the new Vulcan launch vehicle, which is also intended to serve the entire range of national security space launch requirements. After 2018, and until Vulcan is certified, ULA has said that it intends to offer only Atlas. Therefore we are pursuing a number of options to ensure at least two launch systems remain available at all times in case one suffers a grounding event.

Simply replacing the RD-180 with a new engine is not the answer. Rockets are built around engines. To accelerate a payload to orbital velocity, rocket engines must release and direct tremendous amounts of energy, while the rocket structure itself must be kept as light as possible. Each RD-180 produces more than four times as much power as all four of a Boeing 747's engines combined, while an empty Atlas V only weighs about one-and-a-half times as much as that same empty 747. Vibrations from the rocket engine ripple through the launch vehicle as it travels, potentially damaging the payload, or the vehicle itself. To prevent that, every rocket is heavily influenced by the design of its engine. To do otherwise produces outcomes that are suboptimal in terms of performance, safety, cost, and development timelines. You cannot simply drop in a replacement rocket engine without extensively re-engineering the entire launch system.

To be clear, even a drop-in replacement which closely matches the RD-180 physical interfaces and performance would require modifications to the launch vehicle structures, the fuel and oxidizer feedlines, and the heat shields to accommodate even minor differences in performance. The thrust vector control and throttling of the RD-180 engine is a critical characteristic of the Atlas V. The new engine's thrust vectoring and throttling will require changes to the electronic control systems and significant engineering analysis to develop new flight profiles to launch the various satellites. Finally, a small difference in the performance of the replacement engine may have significant impact in the ability of the launch system to lift payloads to orbit.

A byproduct of this is that a rocket engine specifically engineered to replace the RD-180 on the Atlas, would most likely be usable only for ULA's Atlas, and not by another launch service provider without significant modifications to the engine and the launch vehicle. We also do not believe this would meet the intent of open competition. Additionally, from our market research, we found that if the Air Force procured an engine not designed for a specific launch vehicle, commercial providers would be unlikely to build a rocket around it without the Government also funding the redesign on the launch vehicle. So, in my opinion, an engine alone, even if made available to all launch service providers, would not solve the problem of maintaining assured access to space. In addition, this approach would limit competition at the launch vehicle level, where we need it most.

So, the Air Force is pursuing a strategy of shared investment with industry using public-private partnerships, which is consistent with the intent of the FY15 NDAA, at the launch service level, which includes rocket propulsion system development. Partnering with industry ensures that they share some of the cost burden, offers the best chance of solving technical challenges to meet schedule goals, and provides the opportunity to harness industry's creative ideas in ways to achieve propulsion and launch system performance requirements. Additionally, it will improve assured access by using commercial providers to develop domestic, commercially-viable launch systems, including the accompanying rocket propulsion systems, be they liquid fueled engines or solid rocket motors.

The 4-Step Plan Reduces Risks to Assured Access While Transitioning off RD-180

We are moving fast on this. We are developing an acquisition strategy to reach this end state as quickly as possible. Since the Mitchell Report was released last summer, we have conducted extensive market research, including an RFI to industry in August 2014 and a formal follow-up in February 2015; an independent review led by retired Air Force General Tom Moorman in February 2015; and consultations with NASA about the lessons learned from their shared investments in Commercial Orbital Transportation Services, Commercial Cargo, and Commercial Crew Transportation. The Air Force has gained tremendous insight into, and respect

for, what NASA has accomplished with industry in the past ten years, and we plan to leverage its successful strategies and processes where appropriate.

In our research, we assess that industry timelines predicting complete rocket propulsion systems by 2019 are aggressive. History has consistently shown that developing, testing, and maturing an engine takes 6 to 7 years with another year or two beyond that to be able to integrate into the launch vehicle. Testing, in particular, is essential to successful engine development, and it takes time.

To minimize that risk while meeting our overarching goal of competitive assured access to space with domestic engines by FY22, we have developed a four-step plan to use a launch service approach to eliminate strategic reliance on foreign Rocket Propulsion Systems. The end goal is two or more domestic, commercially viable launch providers that also meet the more stressing national security space requirements.

All four of these steps take place within what we call Phase 2 of our EELV program strategy. Phase 1 of the overall strategy was composed of entering into a block buy with ULA, while certifying New Entrants to compete for launches. The purpose of this phase was to stabilize the industrial base to provide significant cost savings and to initiate competition with emerging EELV class launch providers. Phase 2 started at the beginning of FY15, and is a time of transition for the EELV program which must be managed very carefully to control costs while maintaining space capabilities.

The first step of the Phase 2 four-step plan is technical maturation and risk reduction activities for the highest-risk aspects of developing a rocket propulsion system. We have heard from industry that there are areas where the underlying science and technology needs to be advanced, such as modeling combustion stability in high-performance engines, improving the level of understanding of oxygen-rich staged combustion technologies here in the United States, developing additive manufacturing processes for engine production, and even in developing advanced solid motors. In the Fall and Winter, we initiated a large scale combustion stability test leveraging NASA's and the Air Force Research Labs' competitively awarded contracts and the

test stands at NASA's Stennis Space Center. In late May, we awarded a contract to academia to develop much needed combustion stability tools. On June 2nd, we released a Broad Area Announcement for investments that will advance the state of art across the entire domestic rocket propulsion industry and we are currently evaluating the initial responses.

The second step is shared investment in rocket propulsion systems. On June 2nd, we also released a Request for Proposals, soliciting partners to enter into Other Transaction Authority (OTA) agreements to develop rocket propulsion systems, as authorized by the NDAA. We contemplate awarding a portfolio of up to four agreements worth a total of about $160 million. Because we are encouraging commercial systems, they require a non-governmental investment to cover at least a third of the costs going forward. The intent of this step is to mature rocket propulsion systems, in partnership with launch vehicle providers, through technical and programmatic reviews and demonstrations, including tests at the component, subscale, or engine level. We do not plan on waiting to make all the awards at once. We will make rolling awards from September through December.

The third step is to transition our shared investment in propulsion systems to launch systems. We plan to release this RFP late this year, with awards in the spring of 2016, using FY16 funding. Like the OTAs used to initiate rocket propulsion development, these will be competitively awarded to multiple vendors using a shared investment approach. Additionally, launch system development will include technical and programmatic reviews and demonstrations, including component, subscale, or full-scale testing. We intend for the activities under this award to occur in parallel with certification activities for the launch systems to minimize the time between the end of development and the use of the system for national security space launch.

The fourth step is to actually acquire launch services using currently certified systems, while on-ramping new launch systems as they complete certification. These awards will be made using Federal Acquisition Regulation-compliant contracts for launch services. We plan to begin these procurements in FY18 and run through FY22, for launches occurring from FY20 to FY24. Both in response to Congressional direction, and because it better aligns with our goal of

procuring commercially viable launch services, we anticipate to award these procurements on a fixed-price basis, without additional launch capability contracts.

By following this four step plan, we intend for a smooth transition from this step to the fully competitive environment of Phase 3. The shared investment with our industry partners in the second and third steps will define technical solutions and schedules for achieving domestically manufactured rocket propulsion systems. Based on their progress, the Government and Industry will have data to confirm whether the business case closes for pursuing these partnerships before entering step four.

Conclusion

Mr. Chairman, Mr. Ranking Member, Members of the Subcommittee, rocket science is hard. The history of rocket development has resulted in amazing accomplishments and catastrophic failures, as seen both here and abroad within the past year, with sometimes tragic results. This highlights the success of the Delta IV and Atlas V launch systems, with a combined 83 launches without a catastrophic failure resulting in the loss of a primary payload, and the Falcon 9, which is now up to 18 launches.

As we move forward, we need to maintain our laser-focus on mission success, to protect the safety of the American people and to deliver battlefield capability to our warfighters. We believe the best way to do that is through partnering with launch service providers to share the burden of development and reduce risks. If we do that, we will be on a path to transitioning off of the RD-180 and having at least two domestically-produced, commercially-viable launch providers that are certified to meet national security space requirements by the end of FY22. Thank you for your support in helping us get there.