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STATEMENT OF

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SUBCOMMITTEE ON STRATEGIC FORCES

ON U.S. AND ADVERSARY HYPERSONICS PROGRAMS

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Chairman Lamborn, Ranking Member Moulton, and distinguished members of the subcommittee, I want to thank you for inviting me to provide testimony for the House Armed Services Committee hearing on U.S. and Adversary Hypersonics Programs. I am honored to be here today and appreciate the opportunity to discuss and provide an update on the state of hypersonics.

The Department of Defense (DoD) is focused on defending the nation against advanced threats by innovating across the Department. As highlighted in the National Defense Strategy (NDS), a critical part of the strategy is making the right technology investments and accelerating development. In February of last year, Under Secretary of Defense for Research and Engineering Heidi Shyu established a new technology vision that included 14 Critical Technology Areas to emphasize, including hypersonics. As Under Secretary Shyu wrote in her memo, “In the ever shifting and fast-moving global environment, technological advantage is not stagnant and the Department cannot rely on today’s technology to ensure military technological dominance tomorrow.” Hypersonic capabilities are a key contributor to overall superiority as they directly contribute to the three pillars of the Department’s NDS: Integrated Deterrence, Campaigning, and Building Enduring Advantages.

Hypersonic systems travel for a significant portion of their trajectory in the upper reaches of the atmosphere at sustained speeds at or above Mach 5 (five times faster than the speed of sound, or approximately 3700 mph). Their combination of speed, maneuverability, long range and high altitude provide clear and distinct operational advantages enabling highly survivable and responsive defeat of time-critical, heavily defended, and high-value targets from outside of an adversary’s defensive perimeter. Offensive hypersonic systems will be especially critical on a battlefield where the adversary has deployed high-end defensive and anti-access systems

designed to limit the effectiveness of traditional U.S. weapons on the timescales needed to avoid military, diplomatic, or political faits accomplis.

Like any military technology, hypersonic systems are not a be-all and end-all. However, as the battlefield environment becomes increasingly more contested, hypersonic systems will be a critical tool to supplement, and sometimes enable, our more traditional capabilities. We are moving with urgency to put advanced technologies and new operating concepts, including hypersonic strike and defensive capabilities, in the hands of the Joint Force to ensure that we have the right mix of capabilities to deter potential adversaries and, if necessary, defeat aggression.

DoD's Strategic Approach

The Department's vision, strategy, and execution plan for hypersonics accelerates the development and transition of transformational warfighting capability based on hypersonic systems to our Armed Forces. The vision describes a future that includes three capability areas and desired outcomes. First, a joint force equipped with air, land, and sea-launched conventionally armed hypersonic strike weapons for highly survivable, long-range, time-critical defeat of targets of strategic importance on a highly contested battlefield. Second, a comprehensive layered defeat capability to defend U.S. Forces and interests against adversary use of hypersonic strike capabilities. Third, the ability to perform responsive pulsed operations with missions such as intelligence, surveillance, reconnaissance, strike, and rapid access to space.

The Department's strategic approach establishes a four-phase framework to realize the Department's objective for near-term operational capabilities with increasing capability over

time to help ensure U.S. battlefield dominance for decades to come. The four-phase framework to accelerate the development and fielding of capabilities includes: 1) Technology Maturation and Concept Development, 2) Weapon System Prototype Development, 3) Accelerated Fielding of Prototype Weapon Systems, and 4) Acquisition Programs with Capability Phasing Plans.

Critical enablers support the four phases of the development strategy. These enablers include; an integrated Department-wide science and technology (S&T) strategy, an integrated strategy for development of test and evaluation capabilities and infrastructure, an aggressive collaboration with our allies, focused investments in the hypersonics industrial base, a commitment to enhancing our workforce, and advancement of the long-range fires kill chain and the defensive fire control loop.

Update on Our Progress

Over the past year or so, we have made significant progress, in part building upon knowledge gained by overcoming challenges faced in our early flight tests. We are maturing hypersonic weapon concepts on an accelerated path to prototype weapon demonstration and delivery. For example, the Air Force Air-launched Rapid Response Weapon, or ARRW, program completed two successful booster test vehicle flights followed in December 2022 by the first flight test of their full prototype operational missile, launched from a B-52 aircraft. The ARRW hypersonic glide body was developed under the Air Force and Defense Advanced Research Projects Agency (DARPA) Tactical Boost Glide program and is the most sophisticated hypersonic glide body in the world.

Under the Hypersonic Air-breathing Weapon Concept (HAWC) program, DARPA and the Air Force successfully demonstrated in flight two distinct hypersonic cruise missile demonstrator vehicles (one by Raytheon and one by Lockheed Martin) informing the Air Force

Hypersonic Attack Cruise Missile (HACM) program. HACM is now accelerating the development and delivery of an air-launched hypersonic cruise missile prototype weapon system based on the Raytheon configuration.

The Army and Navy have demonstrated on the ground, and then in flight, the tactical rocket motor that will launch the already demonstrated common hypersonic glide body for the Army Long Range Hypersonic Weapon (LRHW) and the Navy Conventional Prompt Strike (CPS) weapon system. Additional flight tests are planned this year and the first missiles will be fielded later in the year in an Army battery that has been fielded and in training for the past 18 months.

The Navy, Army and Missile Defense Agency (MDA) have worked together to conduct a High Operational Tempo for Hypersonics (H4H) campaign to increase the rate of flight testing for experimental payloads. They performed five sounding rocket flights over a span of two test days with over fifty experiments gathering critical information on technologies that will enhance future hypersonic systems.

We are preparing to deploy hypersonic weapon systems as soon as they are delivered to the warfighter. Mission planning work is well underway for Air Force, Army and Navy capabilities and the United States Strategic Command has been developing a concept of operations for support of the Army's first fully armed LRHW Battery when it is fielded later this year.

We have significantly increased the pace of flight testing across the hypersonics portfolio, from once every two years to over a dozen flight tests this past year. We have also increased ground test capability and throughput. Led by the Test Resources Management Center

(TRMC), we continue to make significant investments in both ground and flight-test infrastructure to meet increasing demand. We are building new arcjet facilities for testing high temperature materials and new air-breathing propulsion wind tunnels that will allow us to increase the pace of testing for full-scale hypersonic cruise missile configurations. TRMC is also significantly increasing the capabilities on our test ranges. As an example, there have been investments in airborne and space-based instrumentation, and we have expanded our flight test range options to include both Atlantic Ranges as well as the traditional Pacific ranges.

We are also working to ensure the U.S. remains a global leader in hypersonics far into the future. The Joint Hypersonic Transition Office (JHTO) continues to invest in future technologies and train the next generation workforce. The JHTO's University Consortium in Applied Hypersonics (UCAH) has participation from over 100 universities working closely with industry, Government labs, Federally Funded Research and Development Centers (FFRDCs) and University Affiliated Research Centers (UARCs) across the country.

Over the past year we have dramatically increased the pace of our discussions with allies and partners. In April of last year, the White House announced the inclusion of hypersonics and counter hypersonics in the trilateral Australia-UK-US (AUKUS) partnership. Under AUKUS, we are looking at near, mid and far term opportunities for collaborative development and fielding of hypersonic and counter-hypersonic capabilities. We continue to execute a cooperative effort with Australia under the Southern Cross Integrated Flight Research Experiment (SCIFiRE) aimed at accelerated design, develop, and test for a prototype hypersonic cruise missile. Last fall we worked with Norway to successfully complete two successful solid-fueled ramjet flight tests under the Tactical High-speed Offensive Ramjet for Extended Range (THOR-ER) program.

These tests showed the viability of advanced solid-fuel ramjet propulsion technology for future high-speed missile applications.

Even with all the positive progress described above, there is still much to do to deliver hypersonic capabilities at a capacity to meet warfighting requirements and to continue on a path of accelerated development for next-generation and leap ahead systems. In order to do this we are implementing the next phase of our strategic approach with four pillars.

Pillar 1) Affordable Capacity: Streamline the Government-industry fusion necessary to develop and deliver **affordable** hypersonic weapons at necessary quantities.

Pillar 2) Advanced Capabilities: Identify and mature advanced concepts that enable future disruptive capabilities.

Pillar 3) Excellence: Increase invests in applied R&D and workforce development.

Pillar 4) Execution: Enhance the capability of the Nation's wind tunnel and flight test infrastructure to enable accelerated learning through an increased operational tempo for hypersonic system ground and flight tests.

Under Pillar 1 our goal is to enable the nation's industrial base to manufacture hypersonic systems affordably and at the capacity necessary to provide the warfighter decisive advantage on the battlefield. To build hypersonic weapons more affordably, we are working to leverage commercial production practices and drive cost down to a level comparable to traditional weapon systems. We are looking at options for cost reduction by implementing design for manufacture approaches, using automated manufacturing processes, and identifying alternate material solutions. One example is in the America Makes Manufacturing Innovation Institute's efforts to use additive manufacturing to shorten manufacturing time from six months to 30 days

for many critical rocket motor components. To increase scalability, we seek to engage non-traditional suppliers, increase production capacity at current suppliers, and make investments to enable significant increases in manufacturing throughput. The recently signed Presidential Directives authorizing Defense Production Act (DPA) Title III investments for kinetic weapons and hypersonic systems will be key enablers for achieving our industrial base goals.

Under Pillar 2 we are also working to continuously generate and prioritize innovative next-generation hypersonic system concepts to further achieve transformational capability. We seek to engage directly with the warfighting requirements and strategy community to drive candidate leap-ahead hypersonic technology development efforts that meet compelling warfighter needs. This work complements the standard evolutionary system development under our existing programs with new, revolutionary disruptive capabilities that advance the state of the art. By gathering input from operational commanders, and by engaging our FFRDCs, UARCs, DoD laboratories and industry we will identify and invest in future disruptive capabilities to significantly enhance weapon effectiveness and increase the inventory of weapons available for use on the future battlefield. We must embark upon the next set of accelerated development efforts to rapidly burn down risk and demonstrate future advanced concepts and capabilities.

For Pillar 3 we are building the foundation for future game-changing hypersonic capabilities through focused science and technology backed by a competent, diverse and well-trained workforce. Our goal is to provide: 1) targeted and reliable S&T for future prototyping programs, 2) dedicated support for innovative ideas and next-generation hypersonic programs, 3) coordinated efforts that maximize knowledge sharing and minimize duplication of effort across

the hypersonics enterprise, and 4) a workforce adequately sized and prepared to support the development of future high-speed systems.

To build a more prepared and agile workforce we will increase efforts performed under the University Consortium for Applied Hypersonics (UCAH), include opportunities for hands-on systems design and flight-testing of UCAH-developed technologies, and develop a continuing education curriculum to enhance the existing hypersonics workforce.

In Pillar 4 our goal is to increase further the operational tempo for hypersonic system test and evaluation. The goal is to remove test and evaluation delays from program schedules while improving the quality of the data collected. Key components of this pillar include revolutionary changes to how the DoD conducts long range flight tests, improved hypersonic air-breathing propulsion engine ground test throughput and accuracy, improved high-temperature material ground test throughput and accuracy, accelerated development of lethality and survivability test infrastructure, and a dedicated hypersonic systems analysis team. The analysis team will help collect, archive, and analyze vehicle designs and act as a resource for capturing critical hypersonic knowledge. The team will also guide modeling and simulation tool set development, verification, and validation for the community.

As I hope you can see from this update, we have accomplished much across the Department, yet there is still much to do. Our goal is to develop and field the hypersonic warfighting capabilities necessary to complement traditional systems and field the right mix of capabilities to ensure battlefield dominance for decades to come. On behalf of the Department, I appreciate the continued interest and support we receive from Congress for accelerating the delivery of transformational capability based on hypersonic systems and look forward to

continued support as we begin to field hypersonic offensive and defensive capabilities in the near future. I look forward to your questions.