NOT FOR PUBLICATION UNTIL RELEASED BY THE COMMITTEE

STATEMENT OF

DR. JAMES WEBER

PRINCIPAL DIRECTOR FOR HYPERSONICS, OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE FOR CRITICAL TECHNOLOGIES

AND

MR. GEORGE RUMFORD

DIRECTOR, TEST RESOURCE MANAGEMENT CENTER

BEFORE THE HOUSE ARMED SERVICES COMMITTEE

SUBCOMMITTEE ON STRATEGIC FORCES

ON U.S. AND ADVERSARY HYPERSONICS PROGRAMS

MARCH 12, 2024

Chairman Lamborn, Ranking Member Moulton, and distinguished members of the subcommittee, thank you for inviting us to provide testimony for the House Armed Services Subcommittee on Strategic Forces' hearing on U.S. and Adversary Hypersonic Programs. As the Principal Director for Hypersonics and the Director of the Test Resource Management Center (TRMC) under the Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)), we are honored to be here today and appreciate the opportunity to provide an update on the state of hypersonics.

Introduction

As the Department of Defense has articulated in the most recent National Defense Strategy, the world today faces unprecedented threats to the longstanding rules-based international order. The United States faces competitors who threaten rapid military intervention against the United States and our allies and partners across the globe. Our potential adversaries have deployed high-end defensive and anti-access systems that will challenge our ability to deter and defend against these attacks in the time necessary to prevent military, diplomatic, or political *faits accomplis*.

As noted in the DoD's 2023 Report to Congress on *Military and Security Developments Involving the People's Republic of China*, "The PRC has a robust and redundant integrated air defense system (IADS) architecture over land areas and within 300 nautical miles (556 kilometers) of its coast that relies on an extensive early warning radar network, fighter aircraft, and a variety of surface-to-air missile (SAM) systems." Additionally, "The PRC's deployment of the DF-17 HGV-armed medium-range ballistic missile (MRBM) will continue to transform the PLA's missile force ... and is intended to strike foreign military bases and fleets in the Western Pacific."

The United States is developing counter-hypersonic systems and conventionally-armed, survivable, long-range hypersonic strike systems to counter these adversary capabilities and to complement our other warfighting approaches. Hypersonic strike systems sustain flight at or above Mach five (five times faster than the speed of sound, roughly one mile per second), allowing a U.S. response to a contingency or a strike on a time-critical target in minutes rather than hours. The hypersonic systems we are developing are survivable by design. They fly at high altitudes and speeds, and they maneuver to

evade defenses. This allows hypersonic systems to credibly threaten and, if necessary, defeat heavily defended targets. Their range allows us to deter an adversary while operating from relative sanctuary, hundreds or thousands of miles away. In concert with other U.S. weapon systems, hypersonic weapons are a powerful tool for convincing a potential adversary that peace is their best option.

Strategic Approach and Priorities for Hypersonics

The establishment of the OUSD(R&E) in 2018 was timely. The Senate Armed Services Committee noted that the Under Secretary of Defense for Research and Engineering (USD(R&E)) would be "particularly important in a time when U.S. technological dominance is eroding" and would drive the technological development required to secure the homeland and warfighters deployed abroad. Hypersonics was one of six key technologies that Congress recognized in 2018, and the OUSD(R&E) has maintained its focus on hypersonics as a critical technology area for the Department today.

The Department is implementing an integrated strategic approach to accelerate the development and delivery of hypersonic systems to our warfighter to provide game changing capabilities. This approach is focused on three capability goals: (1) defeat time critical and heavily defended targets from survivable standoff range; (2) defeat adversary hypersonic threats; and (3) conduct responsive strike and intelligence, surveillance, and reconnaissance (ISR) missions.

The Department's ability to achieve our goals in hypersonics will be enabled by focusing and investing in four priorities to ensure we stay on track in executing our strategic approach.

Priority 1: Demonstrate and transition our hypersonic and counter-hypersonic systems through successful testing

In the National Defense Authorization Act for Fiscal Year (FY) 2017, Congress stated its expectation that the USD(R&E) "would take risks, press the technology envelope, test and experiment, and have the latitude to fail, as appropriate." Pressing the technology envelope is exactly what we are doing. In the mid-twentieth century, the term applied to breaking the sound barrier, which we achieved only after relentless testing and experimentation. Today, the hypersonic systems the Department is developing operate over five times faster than the supersonic pioneers in the 1940s, and testing remains

just as critical. We conducted more than 10 hypersonic flight tests last year and more than 35 flight tests since 2020. Both in the short- and long-term, it is critical for the nation to be able to test and rapidly iterate on the design of hypersonic and counter-hypersonic systems.

In the six years since 2018, the Department has invested over $12 billion in the development of hypersonic strike weapon systems to provide diverse capabilities on land, at sea, and in the air. These systems include the Army Long-Range Hypersonic Weapon (LRHW), the Navy Conventional Prompt Strike (CPS) system, the Air Force Air-Launched Rapid Response Weapon (ARRW), the Air Force Hypersonic Attack Cruise Missile (HACM), and the Navy Hypersonic Air Launched Offensive Anti-Surface (HALO) weapon. These are essential to our nation's ability to rapidly project power in defense of the homeland, U.S. warfighters abroad, allies, and partners in the face of advancing adversary anti-access/area-denial strategies.

The Army's LRHW and the Navy's CPS systems are intermediate-range boost-glide hypersonic weapon systems that use a common all-up round missile. The common round includes a two-stage solid rocket booster and a hypersonic glide body armed with a kinetic energy projectile warhead. The LRHW will be deployed in newly developed Army batteries. The CPS system will be deployed aboard the *Zumwalt*-class destroyers and *Virginia*-class attack submarines. To develop the LRHW and CPS all-up round missile, the Army and the Navy successfully collaborated to transition production of the Common Hypersonic Glide Body (CHGB) from Sandia National Laboratories to Dynetics, a commercial contractor. The CHGB was successfully demonstrated in flight in 2020, paving the way for integration into an operational missile system. In September 2021, the Army delivered its first battery of LRHW launchers, support vehicles, and other ground support equipment to an active-duty unit. In 2022, the first flight test of the complete all-up round missile demonstrated numerous firsts, less than four years after the initiation of the program. The USS Zumwalt (DDG 1000) is now at Huntington Ingalls Industries – Ingalls Shipyard in Mississippi for installation of the full CPS weapon system. While en route to the shipyard in FY 2023, the U.S. Strategic Command (USSTRATCOM) tested and evaluated weapon system-to-ship interface design, kill-chain concepts of operations, and operator interfaces.

In the near term, Army tactical missiles for the first LRHW battery are projected to begin delivering in 2024, complementing the launcher and other ground support equipment that was delivered in 2021. Additionally, the USS Zumwalt (DDG 1000) will deploy the full CPS weapon system in the mid-2020s, to be followed by CPS deployment on *Virginia*-class attack submarines.

The Department is also pursuing air-launched hypersonic weapons through two programs executed by the Air Force. These programs are built upon joint Defense Advanced Research Projects Agency (DARPA) and Air Force Research Laboratory (AFRL) advanced technology development efforts, the Tactical Boost Glide (TBG) and Hypersonic Air-breathing Weapon Concept (HAWC) programs, that conducted flight tests of multiple missile designs from FY 2020-FY 2024. The Air Force's ARRW hypersonic boost-glide missile program awarded a contract in 2018 to develop the world's most advanced hypersonic glide body and demonstrate a B-52-launched hypersonic weapon prototype. The ARRW program has now nearly completed flight testing, resulting in the first end-to-end U.S. demonstration of an air-launched hypersonic weapon. Earlier this year, the Air Force completed its production readiness review and has delivered prototype all-up-round missiles from a low-rate production line. The ARRW program will complete its final flight test in 2024, providing valuable data to further our hypersonics programs.

The Air Force is also developing HACM, a smaller form factor weapon capable of employment from tactical aircraft. The small form factor is made possible by once again leveraging DARPA's and AFRL's success in flight testing advanced scramjet cruise missile concepts. Under the Southern Cross Integrated Flight Research Experiment (SCIFiRE) partnership with Australia that was established in 2021, HACM engaged three weapons manufacturers, executed three preliminary design reviews, and competitively down selected to Raytheon in September 2022. This program recently conducted wind tunnel testing of the all-up round and static fire ground tests for its new rocket motor. In collaboration with Australia, the Air Force HACM program is on track to meet warfighter needs.

The Navy is also developing an air-launched, carrier-based, high-speed long-range weapon designated the HALO weapon. In March 2023, the Navy awarded contracts to Raytheon and Lockheed

Martin for prototype development. Recently, the program released a request for proposals for engineering and manufacturing development and initiated a manufacturing risk reduction study.

The Department has also invested over $4 billion in critical defensive programs to counter potential adversaries' development and deployment of their own hypersonic strike weapons. As the executive agent for defense against hypersonic missile threats, Missile Defense Agency (MDA) accomplishments have included: 1) developing an operational capability to engage threats in the terminal phase; 2) modifying existing missile defense capabilities to track hypersonic threats; 3) designing, developing, and launching two competing Hypersonic and Ballistic Tracking Space Sensor (HBTSS) prototypes; 4) transferring HBTSS requirements and prototype data to the U.S. Space Force for inclusion into the Proliferated Warfighter Space Architecture; and 5) establishing the Glide Phase Intercept (GPI) program to provide an Aegis Sea-Based capability to detect, track, and defeat hypersonic threats in the glide phase in support of layered defense. MDA will continue development of advanced tracking and targeting systems, including HBTSS, as well as terminal and glide-phase defense capabilities, to include early flight experimentation and collaboration with allies on the GPI program.

Priority 2: Reduce the cost of hypersonic weapons and increase industrial capability to build warfighting inventories

We must invest in the design and production of affordable hypersonic weapons that can be manufactured at high rate. Our goal is to enable the nation's industrial base to manufacture hypersonic systems at a cost comparable to traditional weapon systems and at the capacity necessary to achieve a decisive advantage for the warfighter on the battlefield.

The Department has invested over $125 million in the hypersonics industrial base to reduce cost, increase production rates, and ensure a resilient supply chain. Since 2018, the Office of the Secretary of Defense (OSD) Manufacturing Technology (ManTech) Program has supported the industrial base in addressing carbon-carbon composite, advanced materials, and subsystem manufacturing challenges for hypersonics. The OSD Innovation Capability and Modernization Office is taking steps to improve production timelines and capacity and increase supply chain resiliency for the CPS and LRHW programs

through the Industrial Base Analysis and Sustainment (IBAS) Program. The IBAS program is also establishing a second source of large solid rocket motors for hypersonic weapons. Additionally, the OSD Defense Production Act Investments Office has invested in projects to increase capacity and manufacturability of high temperature material components and printed circuit board assemblies.

We will continue efforts to reduce cost and increase production rate by leveraging commercial production practices, implementing design for manufacture approaches, using automated manufacturing processes, and identifying alternate materials. We will also expand our partnerships with entrepreneurs and non-traditional suppliers to leverage the United States' asymmetric advantages in manufacturing innovation while using novel contracting vehicles, such as Other Transactional Authority contracts, to more quickly adopt and implement manufacturing technologies.

Priority 3: Grow and sustain our critical enablers – Test and Evaluation, Science and Technology (S&T), Workforce, and Allied Partnerships

These enablers are key to the short- and long-term success of the nation's hypersonics efforts. We are building the foundation for future game-changing hypersonic capabilities through focused investments in test and evaluation and S&T backed by a competent, diverse, and well-trained workforce. Underpinning these investments are 1) over $2 billion in the test and evaluation infrastructure enabling rapid iteration during the design and development of our hypersonic strike and defense systems; and 2) over $2 billion in foundational S&T, including technology to enable future reusable hypersonic platforms.

The OUSD(R&E) has taken a "whole of nation" approach to not only improve test and evaluation capabilities within the Department but also in the National Aeronautics and Space Administration, academia, research institutions, and the private sector, while leveraging significant advancements made by commercial space companies. With the resources Congress has provided for hypersonic test infrastructure, the Department has substantially increased the tempo of flight testing, enabling more than 35 flight tests since 2020. Led by the TRMC, the OUSD(R&E) continues to make significant investments to improve hypersonic ground and flight test capabilities and throughput to meet increasing demand. These investments include: 1) new aeroshell test facilities to produce the extreme temperatures

and pressures of hypersonic flight for next-generation materials; 2) new propulsion wind tunnels that replicate the air flow into hypersonic scramjet engines; 3) increased ground test facility throughput to reduce test data wait times; 4) Multi-Service Advanced Capability for Hypersonics – Test Bed (MACH-TB) to enable more frequent and earlier flight testing of hypersonic weapon technologies including communication, navigation, guidance, sensors, and seekers; 5) retrofitting SkyRange RQ-4 Global Hawks and equipping MQ-9 Reapers with instrumentation so the Department can quickly position data collection capabilities to conduct hypersonic flight tests anywhere in the world; and 6) additional long-range flight test corridors to better evaluate end-game performance of hypersonic systems against realistic threats.

The Department's hypersonic test investments are already paying dividends and increasing test throughput. The Department is establishing, upgrading, and refurbishing test capabilities in 14 states: Alabama, Arizona, California, Florida, Illinois, Indiana, Maryland, Minnesota, New Mexico, New York, North Dakota, Ohio, Tennessee, and Virginia. Additionally, this past year, the Department conducted a hypersonic test over the Atlantic Ocean and then repositioned our instrumentation to conduct a different hypersonic test over the Pacific Ocean 10 days later, which previously would have required several weeks between tests.

To continue advancing our nation's hypersonic test and evaluation capabilities, the Department must develop methods of collecting higher quality data from our ground and flight test capabilities; improve range and test facility readiness as well as capability and capacity; accelerate development of the lethality and survivability test infrastructure; and continue to develop the hypersonic workforce. We have much more to do and are moving expeditiously towards supporting 50 hypersonic flights tests a year, coupled with a ground test capacity five times greater than our nation's capability in 2020.

Foundational S&T, critical to our development of the next generation of hypersonic systems, is supported by the military service laboratories, DARPA, MDA, the OSD Joint Hypersonics Transition Office (JHTO), and others across the Department and interagency. Within the OUSD(R&E), the JHTO leads hypersonic S&T and workforce development enablers. Investments range from basic research through advanced technology development and span all technical areas needed for hypersonic flight. Our

S&T investments are driven by key mission and system capability needs for vehicle performance, navigation, mission planning, and effectiveness.

The JHTO has established the University Consortium for Applied Hypersonics (UCAH) with participation from over 100 U.S. universities, 10 universities in Australia and the United Kingdom, 17 university affiliated research centers (UARCs) and federally funded research and development centers (FFRDCs), and 197 industry partners. The goals of the UCAH are to develop and transition relevant technologies to our national hypersonic programs and grow, diversify, and balance our hypersonics workforce. UCAH efforts include veteran engagements, internships with a wide range of institutional partners including national and military research labs, outreach to community colleges and technical schools, and science, technology, engineering, and mathematics outreach. The JHTO efforts are designed to coordinate and complement investments in S&T and workforce development across the Department.

To build a more prepared and agile workforce we will increase efforts performed under the 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.

The OUSD(R&E), along with OUSD(Policy) and the Military Departments, continues to increase the pace of our discussions with allies and partners. In August 2023, the United States and Japan announced a bilateral plan to pursue a GPI cooperative development program to counter high-end hypersonic threats. The development of a counter-hypersonic capability is a pressing need for both countries to address challenges in the Indo-Pacific region. Under the Australia-UK-U.S. enhanced trilateral security partnership, known as AUKUS, the Department is pursuing collaborative opportunities to accelerate the development of advanced hypersonic and counter-hypersonic capabilities. The OUSD(R&E) continues to execute the cooperative air-launched cruise missile effort with Australia under the SCIFiRE program. The OUSD(R&E) successfully completed two solid-fueled ramjet flight tests under the JHTO-funded Tactical High-speed Offensive Ramjet for Extended Range (THOR-ER) program

with Norway and continues to mature the solid-fueled ramjet technologies for future high-speed missile applications.

Priority 4: Develop and demonstrate next generation, leap ahead capabilities

While our primary focus must be on deploying our first generation of hypersonic weapons this decade, we cannot lose sight of the fact that adversaries will continue to advance their strategies, capabilities, and technologies. Therefore, we need to generate and prioritize innovative leap-ahead hypersonic system concepts and to mature the enabling technologies to outpace the evolving threat. As an example, the DARPA Advanced Full Range Engine program has successfully conducted development and ground tests on the major components of a turbine based combined cycle propulsion system to power an aircraft from take-off to hypersonic speeds. In the future, DARPA will demonstrate additional innovative technologies to continue advancing the state-of-the-art for reusable hypersonic aircraft. By gathering input from the Joint Staff, Combatant Commands, and Military Services, and by engaging our FFRDCs, UARCs, Military Service laboratories and industry, we will identify and invest in next generation hypersonic capabilities to keep pace with the evolving threat.

Conclusion

In closing, the Department has accomplished much and is at the threshold of delivering cutting-edge hypersonic and counter-hypersonic capabilities to our soldiers, sailors, airmen, and guardians. The Department is postured for long-term success, but there is still much work to do and the nation must remain committed to this mission to be successful. The United States faces competitors who are continually seeking to challenge our ability to project power and our ability to deter and defend against attacks on the homeland, U.S. warfighters abroad, and allies and partners across the globe. Hypersonic strike systems will provide a means for U.S. forces operating from relative sanctuary, hundreds or thousands of miles away, to deter and, if necessary, respond rapidly with lethal capability. Meanwhile, the Department is developing missile defense capabilities that will counter the hypersonic weapons that our potential adversaries are developing and fielding. Finally, the Department will leverage the United States' asymmetric advantage in innovation and the commercial marketplace by partnering with venture-

backed entrepreneurs and non-traditional companies to accelerate the delivery of hypersonic systems to the warfighter and address critical needs for cost, production, industrial base resiliency, flight testing, and leap ahead capabilities.

On behalf of the Department, we appreciate the continued interest and support we receive from Congress and specifically this subcommittee for accelerating the delivery of transformational capability based on hypersonic systems. With your continued support we will field the hypersonic and counter-hypersonic capabilities the nation needs to counter threats from the PRC, Russia, or any potential adversary. We look forward to your questions.