**Risk Mitigation Consulting Inc.**

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# WHITE PAPER SERIES

# The Cruise Missile Threat to the U.S.

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INTENT

This white paper is designed to provide analysis of relevant, publicly available information on threat and hazard events/trends and their potential impacts to the interests of the United States, both at home and abroad. This product is not intended to be an all-encompassing assessment of the subject.

# The Cruise Missile Threat to the U.S.

## Introduction

Cruise missiles pose a unique challenge to the United States and its allies. With their ability to fly at lower altitudes at up-to hypersonic speeds, the weapon has been integrated into the stockpiles of over 70 countries since their inception in the early 20th century. In casual parlance, they fly too low, too quickly to easily intercept, and they can be launched from a wide range of platforms. This has made them a favorite weapon for lightning fast tactical strikes. The United States' own Tomahawk missile can hit targets from over 1,000 miles away in crowded airspace. The United States Navy is preparing to upgrade its Block IV Tactical Tomahawk to a trio of missiles called the Block V series, with upgraded navigation, guidance, and warhead deployment. In 2018, the Navy launched 66 Tomahawks at chemical weapons factories in Syria.[1] But the nation's greatest challenge regarding cruise missiles is not in our ability to deploy them. Russia and China are rapidly preparing hypersonic models that can reach Mach 5 and above, rendering American missile defense systems inconsequential. Iran's Islamist Revolutionary Guard is providing terror groups with advanced missile technology that has led to even greater destruction in the region. And DoD efforts to counter these threats are undermined by a combination of slow development and slow acquisition. The U.S. needs equivalent weapons and cutting-edge defense strategies and technology—and waiting isn't an option.[2]

## Definitions

Cruise missiles were originally designed as a sort of unmanned plane that could reach targets too distant or too dangerous for a manned vehicle. Unlike ballistic missiles, cruise missiles fly along a pre-set path, parallel to the earth, using a guidance system. More recent advanced models are able to strike moving targets. Cruise missiles consist of an engine, a fuel tank, a warhead, and a guidance system. They can be launched from land, air, or sea, including from submarines. They are used by over 70 nations, including the United States.[3] Their propulsion system uses a small jet engine (Turbofan and Turbojet for subsonic, which travel up to 0.8 mach, or less than the speed of sound). They can also use Ramjet or Scramjet engines for supersonic (2.3 mach, or faster than the speed of sound) or hypersonic (5 mach and above, currently in development). For guidance, some cruise missiles use "Terrain Contour Mapping," (TERCOM); others use GPS, which is dependent upon satellite functionality.[4] TERCOM uses prerecorded map of terrain that the missile follows. This is often combined with Digitized Scene-Mapping Area Correlator (DSMAC), which compares the terrain with stored images in order to maintain its flight path.[5] Other guidance systems include inertial, TV, infrared, and radar.[6] A cruise missile's payload size varies according to missile.[4] Payload types can include High Explosive Incendiary, High Explosive Fragmentation, Semi-Armor Piercing, Submunitions Dispenser, and Nuclear.[7]

## Potential Threats from Cruise Missiles

Unlike ballistic missiles, cruise missiles have historically been best suited for attacking stationary targets, particularly in the beginning of a conflict. These include infrastructure, command and control sites, weapon assembly and storage facilities, communications sites, and air defense

systems.[5] However, advances in guidance and propulsion have made cruise missiles an increased threat for a wide range of targets, including vehicles in motion and personnel. The flight trajectory of a cruise missile depends on its launch platform, guidance system, and target. They can follow three different trajectories: sea-skimming or terrain hugging, mixed-altitude profile, and high-altitude profile. With lower altitude than ballistic missiles, both detection and prevention are significant challenges. The presence of a robust arsenal of cruise missiles by a FNSM is enough to exert leverage over the U.S. and its allies.[7]

## Cruise Missile Defense

Traditional ballistic missile defense systems are not designed to protect against cruise missile attacks. Cruise missiles fly at lower altitudes and can often evade radar by virtue of their speed and their lower altitude. This leaves both civilian and DoD targets vulnerable, and the U.S. has been slow to respond to this emerging threat. Russia currently possesses the capability to launch cruise missiles against the East Coast from a submarine. It is also developing hypersonic missiles and nuclear-powered cruise missiles with nearly unlimited range. Russia's armed forces have made testing hypersonic weapons a priority (see Case Studies). China is also developing hypersonic missiles. In October 2019, the DF-17 hypersonic ballistic missile was revealed as part of the country's 70th anniversary celebration, after initial tests reaching back to 2013. To the surprise of the international community, in December 2019, the state-run *Global Times* revealed that the Chinese government had also nearly completed development of a second, deadlier weapon, the Xingkong-2 hypersonic cruise missile, the development of which predates the DF-17. The U.S. and its allies already lack the capabilities to circumvent a cruise missile attack at hypersonic speeds. The technology requires space-based sensor systems and other in-development technologies.[8,9]

The United States is approaching cruise missile defense from multiple angles. The US Army purchased two of Israel's "Iron Dome" rocket interceptors in 2018. The system boasted a 90% success rate.[10] However, two years later, the Army was unimpressed with the results. Army acquisition chief Bruce Jette stated about defense contractor Rafael, "They have espoused, and to some degree demonstrated, the ability to deal with some cruise missiles…The problem is we have to deal with all cruise missiles, and we don't think we've gotten there yet."[11]

The acquisition of the Iron Domes was part of the Army's efforts to "reboot" its Indirect Fire Protection Capability (IFPC). The Army foresaw a more mobile approach to missile defense, particularly in light of China and Russia's efforts to develop hypersonic cruise missiles. This included vehicle-mounting and relocating the Iron Domes as needed.[12] In light of this, the Army has broadened and eased requirements on defense contractors, seeking a multi-tiered approach to the problem, allowing for the use of an array of "missiles, lasers, high-powered microwaves and other technologies."[13] This take-all-comers approach will include a literal shoot-off next fiscal year at the Army's White Sands Missile Range, where defense contractors can present and demonstrate their ideas.[13]

The very nature of cruise missiles makes them difficult to track and intercept. The United States Missile Defense Agency requested $32.1 million for its Space Program for fiscal year 2021, along with an additional $34.1 million for its Space Tracking and Surveillance System. Satellite tracking

may provide the U.S. and its allies with the most accurate way to track and intercept cruise missiles, particularly as hypersonic weapons come on line. The only way to adequately address the cruise missile crisis may literally be from "the top down."[14]

## Case Studies

The following case studies detail recent cruise missile strikes and developments, insofar as they affect the U.S., its assets, and its allies. The following cases do not constitute an all-inclusive of cruise missile attacks, but rather they provide a baseline overview of strikes and the continued push towards hypersonic weapons.

### *Iran*

The vulnerability to the U.S. and its allies to cruise missile attacks was demonstrated in September of last year. Yemen's Houthi rebels, likely sponsored by the Iranian government, used unmanned aerial vehicles (UAVs or "drones") and cruise missiles to target two Saudi energy facilities. The attack significantly hindered the Kingdom's oil production and elevated the price of crude oil on international markets.[15] The United States and Saudi Arabia both admitted that the technology to stop low-flying cruise missiles is inadequate.[16]

In the aforementioned case, Iran's Islamist Revolutionary Guard has provided both Hezbollah and the Yemeni Houthis with C-802, Quds, and Soumar missiles manufactured by Iran's defense industry, the AIO Company. While terrorist organizations usually prefer portable rockets, Stinger missiles, and other surface-to-air missiles, nations hostile to the U.S. already possess cruise missiles. In short, the threat will remain present for the foreseeable future.

### *Russia*

Russia, China, and the United States are in an arms race to develop hypersonic weapons, including cruise missiles. At the moment, research and development in the U.S. are woefully lagging behind Russia's efforts. Per the American Association for the Advancement of Science, on 26 December 2018, Russia launched a ballistic missile carrying a hypersonic glide vehicle (HGV) called Avangard in the Ural Mountains, sending it 6000 kilometers across Siberia before it smashed into a target on the Kamchatka Peninsula.[17] On 10 December, earlier that month, Russia again successfully tested its ship-launched hypersonic cruise missile "Tsirkon." The missile reached Mach 8 and can be fired at targets on land as well as at sea. Anonymous sources confirmed that the test was the fifth one since 2015.[18]

As of March 2020, Russia has continued to test the Tsirkon, expanding its launch platforms to include the *Yasen*-class submarine *K-329 Severodvinsk.* Most recently the missile was test-fired from the frigate *Admiral Gorshkov* in January 2020, with 3 or 4 more launches planned prior to the submarine tests.[19] This puts Russia well ahead of development by the United States, now armed with a weapon that is, by the admission of Shari Feth of the Missile Defense Agency, unstoppable. The technology to track and, hopefully, intercept hypersonic weapons is itself still in development.[17]

### *China*

The Chinese People's Liberation Army unveiled the hypersonic ballistic missile DF-17 at a parade for the country's celebration of the 70th anniversary of the People's Republic. It was long understood that the Xingkong-2 hypersonic cruise missile was in development, but the presence of a second hypersonic weapon surprised the international community. In December 2019, the state-run *Global Times* revealed that the Chinese government had also nearly completed development of the Xingkong-2 hypersonic cruise missile after successful tests dating back to 2018. Using an air-breathing scramjet engine, officials in the U.S. and Japan have bluntly stated that the weapon is too fast for current missile defense systems to track or intercept.[20, 22]

The DF-17 can reach 1,800-2,500 km at a speed of Mach 5-10.[21] It is mounted on a hypersonic glide vehicle. The Xingkong-2, however, can only fly up to Mach 6. But it can reach 10,000 km with a less predictable flight pattern, which covers the distance from Beijing to Los Angeles.[22] Despite the destructive capabilities of both weapons, along with new UAVs and the new Dong-Feng 21 rocket (DF-21, dubbed "the carrier killer") that were presented at the 70th anniversary parade, Chinese President Xi Jinping called his country's continued armament "peaceful development."[20]

## Outlook

Cruise missiles are, in many ways, becoming a new source of mutually assured destruction among the world's superpowers. While earlier models had the advantage of avoiding radar through lower altitude, they were best suited for attacking larger stationary targets. New developments have improved guidance and navigation, making the weapon a viable option for a wide range of targets. They can be launched from anywhere and they can hit anything. Hypersonic weapons have made this unfortunate truth even more evident. The United States' efforts to incorporate the Iron Domes into its missile defense strategy are understandable, but the technology of warfighting moves quickly, as nations seek additional leverage over each other. The U.S. cannot afford to wait in developing and acquiring space-based tracking. In most cases, the only way to stop a cruise missile is to detect and engage as soon as possible. Using outdated systems designed for ballistic missiles means that the enemies of the U.S. and its allies have their pick of targets. With hypersonic weapons now in play, China has the ability to strike the East Coast and Russia has the ability to strike the West Coast. And while no one anticipates a conflict of that scale in the immediate future, the availability of older models of cruise missiles allows terrorist organizations such as Hezbollah and the Houthi rebels to strike at targets in the Middle East with relative ease. At the moment, the United States is vulnerable to the threat of cruise missiles, and it has a significant path ahead to both defending and countering their threat around the globe.

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