

Hypervelocity projectile (HVP) is being tested for hypervelocity missile defence from large missile salvos by Russia and China

The Navy described HVP in September 2012 as is a next generation, common, low drag, guided projectile capable of completing multiple missions for gun systems such as the Navy 5-Inch, 155-mm, and future railguns. Types of missions performed will depend on gun system and platform.

HVP's low drag aerodynamic design enables high velocity, maneuverability, and decreased time-to-target. These attributes coupled with accurate guidance electronics provide low cost mission effectiveness against current threats and the ability to adapt to air and surface threats of the future.

When fired from 5-inch powder guns, the projectile achieves a speed of roughly Mach 3, which is roughly half the speed it achieves when fired from Electro Magnetic Rail Guns (EMRG) , but more than twice the speed of a conventional 5-inch shell fired from a 5-inch gun. This is apparently fast enough for countering at least some ASCMs. Their impact force—their mass times the square of their velocity—can destroy expensive missiles and multiple warhead. The Navy states that “The HVP—combined with the MK 45 [5-inch gun] —will support various mission areas including naval surface fire support, and has the capacity to expand to a variety of anti-air threats, [and] anti-surface [missions], and could expand the Navy's

engagement options against current and emerging threats.”

The weapons are not only devastating in their speed, but at \$86,000 per round are much cheaper than their explosive counterparts such as the Tomahawk or Harpoon, which can cost up to \$1 million each. It is also cheaper compared with precision ammunition \$800,000 to \$1 million per Long Range Land Attack Projectile (LRLAP) round. “It is a fantastic program,” Will Roper, Strategic Capabilities Office director, said in a March 28 interview with reporters, who said the project aims “to completely lower the cost of doing missile defense” by defeating missile raids at a lower cost per round and, as a consequence, imposing higher costs on attackers.

An April 11, 2016, press report states: The Pentagon wants to take a weapon originally designed for offense, flip its punch for defense and demonstrate by 2018 the potential for the Army and Navy to conduct missile defense of bases, ports and ships using traditional field guns to fire a new hypervelocity round guided by a mobile, ground variant of an Air Force fighter aircraft radar. The Pentagon’s Strategic Capabilities Office will test-fire a radical new missile defense system in less than a year said report in Jan 2018. The Hyper Velocity Projectile, a supersonic artillery round, is fired from ordinary cannon at 5,600 miles per hour and can kill incoming threats for a mere \$86,000 a shot.

A September 19, 2016, press report states: After much deliberation, both public and private, the Pentagon, which has shifted emphasis away from the electromagnetic rail gun as a next-generation missile defense platform, sees a new hypervelocity powder gun technology as the key to demonstrating to potential adversaries like China and Russia

that U.S. military units on land and sea can neutralize large missile salvos in future conflicts...

“If you do that, you change every 155 [mm] howitzer in the U.S. Army in every NATO country into a cruise missile and tactical ballistic missile defender and, oh by the way, you extend their offensive range,” [Deputy Secretary of Defense Robert] Work said.

A May 19, 2017, press report states: An Army Howitzer is now firing a super high-speed, high-tech, electromagnetic Hyper Velocity Projectile, initially developed as a Navy weapon, an effort to fast-track increasing lethal and effective weapons to warzones and key strategic locations, Pentagon officials said.

“Hypervelocity projectile” (HVP)

As the Navy was developing EMRG, it realized that the guided projectile being developed for EMRG could also be fired from 5-inch and 155mm powder guns. Navy cruisers each have two 5-inch guns, and Navy Arleigh Burke (DDG-51) class destroyers each have one 5-inch gun. The Navy’s three new Zumwalt class (DDG-1000) destroyers, the first of which entered service in October 2016, each have two 155mm guns

BAE Systems states that HVP is 24 inches long and weighs 28 pounds, including a 15-pound payload. BAE states that the maximum rate of fire for HVP is 20 rounds per minute from a Mk 45 5-inch gun, 10 rounds per minute from the 155mm gun. DDG-1000 class destroyers (called the Advanced Gun System, or AGS), and 6 rounds per minute from EMRG.

HVP's firing range, BAE Systems states, is more than 40 nautical miles (when fired from a Mk 45 Mod 2 5-inch gun), more than 50 nautical miles (Mk 45 Mod 4 5-inch gun), more than 70 nautical miles (155mm gun on DDG-1000 class destroyers), and more than 100 nautical miles (EMRG).

The high velocity compact design relieves the need for a rocket motor to extend gun range. Firing smaller more accurate rounds improves danger close/collateral damage requirements and provides potential for deeper magazines and improved shipboard safety. Responsive wide area coverage can be achieved using HVP from conventional gun systems and future railgun systems.

The modular design will allow HVP to be configured for multiple gun systems and to address different missions. The hypervelocity projectile is being designed to provide lethality and performance enhancements to current and future gun systems. A hypervelocity projectile for multiple systems will allow for future technology growth while reducing development, production, and total ownership costs.

The tungsten "hypervelocity projectile" (HVP) is being tested in the Army's 105mm Howitzers, and test fires from the Navy's deck-mounted 5-inch guns are expected as well, according to a report from Scout Warrior.

Hypervelocity Missile Defence

Today's missile defenses are "brittle," "inflexible," and "expensive," said Vincent Sabio, the HVP program manager at the Pentagon's Strategic Capabilities Office. "We need to be able to re-engineer (missile defense) from the bottom up (and) go back to Congress and say, 'We have a choice here: We can either have an effective defense, or we can continue inching along the way we are with our heads in the sand.'"

The most basic problem is a simple, if daunting one: we can't afford many interceptors. In addition, current systems require bulky launch systems an enemy can easily detect: a trailer for Patriot, a truck for THAAD, a silo for GBI. Since real-world reliability rates and "shot doctrine" require firing two interceptors at each incoming threat, an adversary can probably run us out of ammo by firing *half as many* offensive weapons as we have interceptors. What's more, a typical offensive missile – which just has to hit the right coordinates on the ground – is much cheaper than a defensive missile – which has to hit a rapidly moving target.

Today's missile defense interceptors are ultra-high-performance systems, Sabio said, designed to take out an incoming threat in a single shot with a high Probability of Kill (Pk). But there's another way to get a high Probability of Kill, Sabio says: Fire lots of cheap weapons, each with a low Pk on its own, but a high probability that one will hit eventually.

That projectile has been independently costed – not by me, I wouldn't expect to you believe my costing – but ... by Navy IWS at about \$85,000 a round," Sabio said. "You can shoot a lot of

those things and not feel badly about it.” In rough terms, for the \$3 million price of one late-model Patriot, you could buy about 35 HPVs.

“That projectile is being designed to engage multiple threats,” Sabio said of the HVP. “There may be different modes that it operates in (in terms of) how does it maneuver, how does it close on the threat, and whether it engages a (explosive) warhead or whether it goes into a hit-to-kill mode. Those will all be based on the threat, and we can tell it as it’s en route to the threat, ‘here’s what you’re going after, this is the mode you’re going to engage in.’”

“We need to be able to address (all) types of threats: subsonic, supersonic; sea-skimming, land-hugging; coming in from above and dropping down on top of us,” said Sabio. “There are many different trajectories that we need to be able to deal with that we... cannot deal with effectively today.”

Distributed Lethality

One advantage of the HVP/5-inch gun concept is that the 5-inch guns are already installed on Navy cruisers and destroyers, creating a potential for rapidly proliferating HVP through the cruiser-destroyer force, once development of HVP is complete and the weapon has been integrated into cruiser and destroyer combat systems. This would implement one the US nav’s concept of distributed lethality.

Navy surface fleet leaders in early 2015 announced a new organizing concept for the Navy’s surface fleet called

distributed lethality. Under distributed lethality, offensive weapons such as Anti Ship Cruise Missiles (ASCMs) are to be distributed more widely across all types of Navy surface ships, and new operational concepts for Navy surface ship formations are to be implemented.

The aim of distributed lethality is to boost the surface fleet's capability for attacking enemy ships and make it less possible for an enemy to cripple the U.S. fleet by concentrating its attacks on a few very high-value Navy surface ships (particularly the Navy's aircraft carriers), according to Congressional Research Service Report.

"Although Navy surface ships have a number of means for defending themselves against anti-ship cruise missiles (ASCMs) and anti-ship ballistic missiles (ASBMs), some observers are concerned about the survivability of Navy surface ships in potential combat situations against adversaries, such as China, that are armed with advanced ASCMs and with ASBMs," observes CRS report: Navy Lasers, Railgun, and Hypervelocity Projectile: Background and Issues for Congress.

Research Challenges & Opportunities [include]:

- High acceleration tolerant electronic components
- Lightweight, high strength structural composites
- Miniature, high density electronic components
- Safe high energy propellants compatible with shipboard operations

– Aerothermal protection systems for flight vehicles

References and Resources also include:

<http://www.scout.com/military/warrior/story/1675096-most-read-2016-howitzer-fires-rail-gun-round>

<https://fas.org/sgp/crs/weapons/R44175.pdf>

<https://breakingdefense.com/2018/01/86000-5600-mph-hyper-velocity-missile-defense/>