

[Rail gun uses kinetic energy to deliver Mach 5 wallop](#)

February 2, 2008 12:46 PM PST

รวบรวมโดย น.อ.รัชฎาพงศ์ ชีรเนตร เสธ.ภฟก.๒



The U.S. Navy is installing an electro-magnetic laboratory [rail gun](#) at its [Surface Warfare Center](#) in Dahlgren, Va., bringing it one step closer to developing a ship-mounted version of this [futuristic cannon](#).

The 32-megajoule weapon appears to be the largest rail gun ever built, according to defense contractor [BAE](#) Systems. A joule is what's needed to produce one watt of energy for one second.

It uses a magnetic "rail" instead of a chemical propellant like gunpowder to heave projectiles at Mach 7 for what could be up to 220 miles down range--that's 10 times farther than what contemporary naval guns. The projectile hits at Mach 5, destroying the target with [kinetic](#) energy instead of conventional explosives.

Ship building and design are expected to benefit should the new gun prove feasible, mainly because new vessels won't be forced to haul tons of explosives. But while the rail gun uses no gunpowder, it can hardly be called energy efficient. A planned 64-megajoule system would suck around 6 million amps.

In addition to developing new onboard capacitors or pulsed alternators to power the weapon, the Navy must come up with new materials to secure the gun, firing it can dislodge the conducting rails--or even rip the gun barrel apart, according to some reports. The Navy, which has already tested smaller versions, as seen in the video, wants a rail gun onboard a ship as early as 2020.

World's Most Powerful Rail Gun Delivered to Navy



For true sci-fi fans, any mention of a real-world rail gun will draw an instant, slightly audible gasp. Instead of relying on chemical propellants -- such as gunpowder -- a rail gun uses magnetic "rails" to launch a solid, nonexplosive projectile at incredible speed. Theoretically, rail guns would be able to precisely strike targets at extreme ranges, and would negate the risks associated with carrying around tons of explosive ammo. More to the point, they're cool-sounding, just like lasers.

Which is why the news that BAE Systems has delivered a functional, 32-megajoule Electro-Magnetic Laboratory Rail Gun (32-MJ LRG) to the U.S. Naval Surface Warfare Center in Dahlgren, Va., is exciting. Installation of the laboratory launcher is currently under way, and according to BAE, this is the first step toward the Navy's goal of developing a tactical 64-megajoule ship-mounted weapon.

The lab version doesn't look particularly menacing -- more like a long, belt-fed airport screening device than like a futuristic cannon -- but the system will fire rounds at up to Mach 8, drawing on tremendous amounts of electricity to generate the current for each test shot. That, of course, is the problem with rail guns: Like lasers, they're out of step with modern-day generators and capacitors. Eight and 9-megajoule rail guns have been fired before, but providing 3 million amps of power per shot has been a limitation. At 32 megajoules, this new system appears to be the most powerful rail gun ever built, and the Office of Naval Research is installing additional capacitors at the Dahlgren facility to support it. The planned 64-megajoule weapon, if it's ever built, could require even more power -- a staggering 6 million amps.

According to Dr. Amir Chaboki, the program manager for Electro-Magnetic Rail Guns at BAE Systems, "The power is available. The challenge is how you use it." The Navy's electrically propelled DDG 100 Destroyer, Chaboki says, is a prime candidate for the final 64-megajoule system. Around 72 megawatts (MW) of the vessel's power can be used for propulsion. But during combat, the destroyer's speed could be brought down, freeing up energy for a rail gun. Chaboki calculates that firing the 64-megajoule weapon six times per minute would require 16 MW of power, which would be supplied by either onboard capacitors or pulsed alternators. The more daunting challenge is the force of the rail gun

itself: A few shots can dislodge the conducting rails -- or even damage the barrel of the gun.

While the 32-MJ LRG should start firing soon, it could take another 13 years for a 64-megajoule system to be built and deployed on a ship. The Marines, in particular, are interested in the potential for rail guns to deliver supporting fire from up to 220 miles away -- around 10 times further than standard ship-mounted cannons -- with rounds landing more quickly and with less advance warning than a volley of Tomahawk cruise missiles.

Effective rail guns will require a major breakthrough in materials between now and 2020, to keep the guns themselves from being shredded by each high-velocity barrage. Which means that for now, rail guns are precisely like lasers in one crucial way: They're Holy Grails, irresistible precisely because they're out of reach.

U.S. Navy Demonstrates World's Most Powerful EMRG at 10 Megajoules



NSWC Dahlgren, VA - The Navy's Office of Naval Research successfully conducted a record-setting firing of an electromagnetic railgun at Naval Surface Warfare Center, Dahlgren, VA. An invited audience, including the Chief of Naval Operations, ADM Gary Roughead, witnessed this revolutionary technology in action.

ADM Roughead noted, "We should never lose sight of always looking for the next big thing, always looking to make our capability better, more effective than what anyone else can put on the battlefield."

He went on to emphasize, "I never ever want to see a Sailor or Marine in a fair fight. I always want them to have the advantage."

ONR's EMRG Program is part of the Department of the Navy's Science and Technology investments, focused on developing new technologies to support Navy and Marine Corps war fighting needs.

ONR has facilitated a key partnership between leading scientists and engineers from BAE Systems, Boeing, Charles Stark Draper Lab, Inc., General Atomics, Department of Energy (Lawrence Livermore National Laboratory), U.S. Naval Academy, Naval Postgraduate School, Naval Sea Systems Command (PMS 500), Naval Surface Warfare Center - Carderock and Dahlgren Divisions, the U.S. Army and United Kingdom. "We are seeing the culmination of years of

research coming together to bring focus to exciting new technology," said Chief of Naval Research, Rear Admiral Bill Landay. "Here at ONR we are striving to move S&T from vision to results."

The technology uses high power electromagnetic energy instead of explosive chemical propellants (energetics) to propel a projectile farther and faster than any preceding gun. At full capability, the rail gun will be able to fire a projectile more than 200 nautical miles at a muzzle velocity of mach seven and impacting its target at mach five. In contrast, the current Navy gun, MK 45 five-inch gun, has a range of nearly 20 miles. The high velocity projectile will destroy its targets due to its kinetic energy rather than with conventional explosives.

The safety aspect of the rail gun is one of its greatest potential advantages, according to Dr. Elizabeth D'Andrea, ONR's Electromagnetic Railgun Program Manager. Safety on board ship is increased because no explosives are required to fire the projectile and no explosive rounds are stored in the ship's magazine.

Science and technology challenges met by ONR in the development of the rail gun include development of the launcher, pulse power generation and the guided projectile design. The program's goal is to demonstrate a full capability, integrated railgun prototype by 2016-2018.

'Record' rail gun test today

By Zachary M. Peterson - Staff writer
Posted : Thursday Jan 31, 2008 18:31:25 EST

The Navy plans a "record-breaking" test shot of its developmental electromagnetic railgun Thursday at the Naval Surface Warfare Center in Dahlgren, Va.

The gun fires a projectile with electricity, rather than gunpowder. A shell is launched at Mach 7 through the electromagnetic rails into the atmosphere for about one minute, flies out of the atmosphere for four minutes, and then descends to Earth toward its target at Mach 5 in approximately one minute. The projectile is guided using the Global Positioning System.

In November, defense contractor BAE Systems delivered a 32-megajoule laboratory gun and launcher to the Naval Surface Warfare Center in Dahlgren. A joule is the work needed to produce one watt of energy for one second — a megajoule is 1 million joules. Eventually, the Navy wants to produce a 64-megajoule railgun that will be able to hit targets on land from over 200 nautical miles away.

The test firing Thursday will expend far less energy than the lab gun is designed to handle, but will exceed the eight megajoule output attained in a previous test.

"More than 75 [railgun] firings have occurred at the Dahlgren facility this year, but this firing event is the next step forward in the development of this technology as the gun will be fired at over 10 [megajoules] of energy — a power level never before achieved by an [railgun]," according to a statement by the Office of Naval Research.

The previous record of 9 megajoules is held by the Center for Electromagnetic Materials and Devices at the University of Texas, according to ONR. The Institute for Advanced Technology, also at the university, certifies electromagnetic railgun launches.

As the Navy gun is tested, the amount of energy the gun uses is being increased, Roger Ellis, the EM railgun deputy program manager for ONR, told Navy Times in August 2007.

The program wants to demonstrate more than 100 shots by fiscal 2011. The objective is to fire 3,000 rounds per gun barrel. The barrels should be changeable onboard ship, according to program officials.

Officials say an EM railgun onboard a ship could increase ship design options because the gun weighs less and requires less infrastructure than traditional guns that use gunpowder and magazines.

Traditional fire-protection and ammunition-handling requirements are not necessary using an electromagnetic-pulse power system, Ellis said.

The end result could be a more cost-effective and highly lethal weapon, program manager Elizabeth D'Andrea said at an industry conference in August, adding that the railgun program strives to provide "missile ranges at bullet prices."

The Navy plans to have an EM railgun onboard a ship, potentially its next-generation cruiser CG(X), between 2020 and 2025.

The Marine Corps is particularly interested in the EM railgun because it could provide high-speed, over-the-horizon fire support from the sea.

BAE Systems awarded \$14.7 million in contracts for electro-magnetic gun programs

06 Jul 2006

MINNEAPOLIS BAE Systems was awarded two contracts for development of an electro-magnetic gun system capable of deployment on board naval surface combatant ships.

The development work includes a \$9.3 million contract from the Office of Naval Research (ONR) to develop technologies and preliminary design for an Electro-Magnetic (EM) railgun prototype and a \$5.4M contract from Naval Special Warfare Center-Dahlgren for the design and fabrication of the U.S Navy's 32 megajoule (MJ) Laboratory Launcher.

An electro-magnetic railgun uses electrical energy to accelerate projectiles to extreme velocities. Railguns do not require powders or explosives to fire the round and therefore free magazine space for other mission areas. In addition, electro-magnetic guns provide a highly consistent and uniform explosive charge that gives much greater accuracy.

BAE Systems was selected by ONR to advance to the next phase of the Innovative Naval Prototype Program. Under this 30-month phase, BAE Systems will take the state-of-the-art Electro-Magnetic Railgun technologies through technology maturation and develop a preliminary design of a 32-MJ EM Railgun. Thirty-two megajoule is equivalent to a firing speed of Mach 8 or eight times the speed of sound. This will be an intermediate step on the road to a 64-MJ Tactical System capable of deployment on-board naval surface combatant ships.

The design and fabrication of the 32-MJ Laboratory Launcher will serve as a major step towards development of a full-scale tactical EM Gun weapon system for the U.S. Navy.

BAE Systems will execute these contracts in conjunction with teammates IAP Research, Inc., Dayton, Ohio and Science Applications International Corporation, Vienna, Va.

BAE Systems has a long history of supporting the U.S. Navy and were proud to continue that tradition by playing a key role in the EM Gun Program, said Keith Howe, BAE Systems vice president and general manager Armament Systems.

About BAE SYSTEMS

BAE Systems is the premier transatlantic defence and aerospace company delivering a full range of products and services for air, land and naval forces, as well as advanced electronics, information technology solutions and customer support services. With more than 100,000 employees worldwide, BAE Systems sales exceeded GBP 15.4 billion (US\$28 billion) in 2005.