



# Keeping Naval Guns Ready

*David L. Rogers*

**C**lose a major maritime chokepoint and “the price of gasoline would quadruple in six weeks,” Secretary of the Navy Raymond Mabus said. Therefore, U.S. naval ships operate forward, partnering with other navies to protect maritime routes and the global economy.

This protection depends on keeping these forward naval ships ready, particularly their guns and ammunition—the weapons of choice for countering a multitude of threats. That gun readiness is assured with responsive technical support. It is done fast, and as far forward as possible, aided by civilian engineers from Naval Surface Warfare Center Indian Head Explosive Ordnance Disposal Technology Division in Maryland. This is a service that will be needed more as operating environments intensify and budgets tighten.

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A look at the  
work of the  
Naval Surface  
Warfare Center  
Indian Head  
Explosive  
Ordnance  
Disposal  
Technology  
Division

Between 1990 and 2014, the world economy doubled, rising from \$35 trillion to \$75 trillion, lifting billions of people out of poverty, according Pulitzer Prize winner and economic researcher Dr. Daniel Yergin. “Seaborne trade is the backbone, basis and foundation of this globalization,” accounting for 75 percent of total global trade. It will grow even more, as tanker capacity expands to meet world energy demands that are predicted to increase by between 35 percent and 40 percent over the next 2 decades.

Disruption means global crisis. Even with oil prices falling, “Blocking a chokepoint, even temporarily, can lead to substantial increases in total energy costs and world energy prices,” the U.S. Energy Information Administration reported in December 2014. And, threats are real—terrorism, piracy, territorial disputes, crime and more. Consider the 2010 suicide boat attack with an improvised explosive that damaged the Japanese oil tanker, *MVM Star*, in the Straits of Hormuz between Oman and Iran.

Working with other naval forces, the U.S. Navy and Coast Guard have a central role in protecting these global maritime trade arteries. U.S. naval ships possess an array of weapons to meet a wide spectrum of threats. These weapons include missiles, torpedoes, and aircraft-launched munitions. And the ships’ guns help protect sea lanes, as well as U.S. vessels:

**Counterpiracy:** Among other examples, the *USS Mason* (DDG 87) used its 20 millimeter (mm) Close in Weapons System and 25 mm gun to sink pirate skiffs in the Arabian Sea in 2011; the *USS Ashland* (LSD 48) used its 25 mm gun to do the same in the Gulf of Aden in 2011, as did *USS Farragut* (DDG 99) in the Somali Basin in 2010 and the *USS Porter* (DDG 78) within Somali waters in 2007.

**Small boat threats:** In 2012, the *USNS Rappahannock* (T-AO 204) used its gun initially to warn a small boat speeding toward it in the Strait of Hormuz, and then fired on the boat and stopped it. In 2014 in the Persian Gulf, a U.S. Coast Guard vessel’s gun fired a warning shot at an Iranian dhow after the latter’s crew trained a .50-caliber machine gun on the U.S. vessel. This ended the confrontation.

**Countering maritime crime:** “The MK75 [76 mm gun] is invaluable to accomplishing [U.S. Coast Guard (USCG) Cutter] *Thetis*’ primary missions of counter-drug and alien and migrant interdiction operations,” stated the cutter’s weapons officer. “In addition, it actively provides for the safety and security of U.S. and foreign-flagged vessels in U.S. waters and on the high seas.”

**Clearing hazards from sea lanes:** In 2012, the USCG Cutter *Anacapa* (WPB-1335) used its 25 mm gun to sink a 164-foot derelict ship adrift in the Gulf of Alaska’s busy shipping lanes.

Naval guns complement other ship’s weapons. They provide warning shots, which missiles don’t do as well; and, within

their ranges, guns typically engage faster. In cluttered, narrow waterways, speed is critical to countering many land-based weapons and seemingly ambiguous vessels that become threats. Such threats are exemplified by Egyptian jihadists who fired rocket-propelled grenades at ships in the Suez Canal in 2013, and Yemen’s Houthi rebels, who reportedly were positioning small, armed boats, long-range cannons and missiles on Perim Island in the 20-mile wide Bab El Mandeb Strait.

Guns also produce a high volume of fire. The 5-inch Mk 45 gun’s firing rate is 16 to 20 rounds a minute; the 57 mm Mk 110 can fire 220 rounds a minute; and the 20 mm Mk 15, Close-In Weapons System, is capable of firing 3,000 to 4,500 rounds a minute. Relative to other naval weapons, gun ammunition is cheaper and easier to supply.

“Guns are not irrelevant,” stated U.S. Naval Institute author and naval expert, Eric Wertheim. “They’re more important now than perhaps at any time since World War II.”

They also are more complex, reflecting the intense competition to “fire effectively first,” the longstanding naval axiom. Most naval guns are linked to fire-control systems and are remotely controlled. In fractions of a second, they load, interact with ammunition fuzes, and fire. Complexity increases as guns are developed to shoot faster, farther and more precisely.

And these complex systems are used often. To maintain tactical proficiency, Navy surface combatants have been directed to conduct daily exercises, firing .50 caliber to 5-inch guns. Because of their extensive use in the severe naval environment, shipboard guns eventually break and repairs require technical expertise beyond what available onboard the ships.


### Gun Down, Naval Engineers Forward

In March 2015 on Guam: Responding to a request from the Navy’s Regional Maintenance Center in Yokosuka, two civilian engineers boarded the *USS Fitzgerald* (DDG 62). The ship’s 5-inch gun, “Jenny,” was out of service due to a problem that eluded the ship’s force and regional maintenance center. After troubleshooting the problem, the engineers replaced the firing circuit card assembly, along with associated wiring and relay components. On March 23, 2015, Jenny fired successfully.

The engineers were from Naval Surface Warfare Center Indian Head Explosive Ordnance Disposal Technology Division (NSWC IHEODTD), which researches and develops “energetics”—energy-releasing, chemical materials for explosives, propellants and pyrotechnics. It’s an expertise, critical to defense, not found in industry to the same degree because of cost, risk and limited applicability. This expertise also enables NSWC IHEODTD to serve as “In-Service Engineering Agents” for the following naval guns and their ammunition:

- 20 mm, Mark 15 Close-In Weapon System, on all Navy surface combatant ships





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- 25 mm, Mark 38, on Navy aircraft carriers, cruisers, destroyers, frigates, dock landing ships, amphibious transport dock ships, amphibious assault ships, amphibious command ships, patrol ships, offshore support vessels, and Coast Guard fast response cutters
- 30 mm, Mark 46 on LPD-17 class dock landing ships, Littoral (coastal) Combat Ship Surface Warfare Mission Modules, and identified for Zumwalt-class guided missile destroyers (DDG 1000s)
- 57 mm, Mark 110 on LCS and Coast Guard National Security Cutters and offshore patrol cutters
- 76 mm, Mark 75 on frigates and Coast Guard cutters
- 5-inch, Mark 45, on destroyers and cruisers

Repairing forward-deployed ships has long been imperative for the U.S. Navy. "Only in the most serious cases of major injuries beyond the ability of local facilities to repair, should a combat vessel be sent back to a Navy yard or shipyard," wrote World War II, Navy logistics czar Rear Adm. Worrall R. Carter. That mandate hasn't changed in principle. What continually changes is how repairs are done locally. It's a never-ending quest to do more repairs and upgrades forward, faster and more cost effectively.

That's especially so in naval gun upkeep, which is critical to the Navy's readiness. Today, this effort relies on a vast system that rapidly provides technical expertise to Navy ships and Coast Guard Cutters deployed across the globe, as well as Navy regional maintenance centers in Norfolk, Virginia; San Diego, California; Mayport, Florida; Puget Sound, Washington; Pearl Harbor, Hawaii; Naples, Italy; and their detachments in Bahrain in the Persian Gulf and in Rota, Spain. This expertise includes online manuals from NSWC IHEODTD that enable ships' forces and maintenance centers to do as much as they can in forward deployments.

When ships' forces report gun casualties, technical expertise moves fast. The associated regional maintenance centers assess the problem, and usually resolve it, with spares and technical expertise. If not, the NSWC IHEODTD is contacted and its engineering teams assigned to each gun weapon system spring into action using a scaled-up approach. Initially, they interact with ships forces and/or centers, via phone and email.

If the problem still can't be solved, this very specialized technical expertise physically moves to the gun. NSWC IHEODTD

rapidly dispatches its engineers and technicians either from its Picatinny, New Jersey, detachment, or those stationed in fleet concentration areas. Some engineers will address a gun's problem on a ship in port. Some will sail with the ship, diagnosing and fixing the gun while under way. Others will fly to an overseas port, helicopter out to a ship, and stay aboard until the gun is up.

Whatever the case, the goal is to get the gun up fast.


### **Guns With Fast "Pit Crews"**

Winning in stock-car racing requires identifying and eliminating bottlenecks and weaknesses that can shave tenths of a second off lap time—and that includes pit stops. "If you don't have a well-performing pit crew that executes well on pit road, you are going to affect the overall outcome of the race," said Greg Morin, head coach of 48 pit crew, which helped driver Jimmie Johnson win six championships.

The same rule applies to ship overhauls. Like pit crews, naval gun engineers continually seek to overhaul faster and cheaper, thereby enabling ships to redeploy quickly. The difference is that the parts are bigger than those in NASCAR.

Take the 5-inch, Mk 45 gun, which weighs 45,000 pounds and costs \$22 million each. Like all guns, it must be overhauled after firing in a corrosive maritime environment. The original maintenance philosophy was to remove a gun from the ship and send it back to the depot for renovation twice in its lifetime. The cost was \$8 million per gun per overhaul, with two such overhauls expected in the gun's 35-year lifespan. As Defense Department budgets began to shrink in the 1990s, the Navy conceived a new concept of operations—pierside maintenance and repair. The goal was to reduce costs over the gun's life cycle. By making more frequent and focused repairs, the need for a depot-level repair could be extended to the gun's midlife and then done just once. The program was a success, and today a Standard Pier-Side Maintenance and Repair saves the Navy approximately \$11.5 million over the life of each Mk 45 Gun.

In order to expedite the process, NSWC IHEODTD engineers go aboard ships before scheduled overhauls. They assess all the guns' varying material conditions, determine maintenance needs and order replacement parts, which often take a long time to arrive. When the ship and a team of gun engineers hit



## Repairing forward-deployed ships has long been imperative for the U.S. Navy. “Only in the most serious cases of major injuries beyond the ability of local facilities to repair, should a combat vessel be sent back to a Navy yard or shipyard.”

the yard, maintenance needs are known, replacement parts are available, and the gun overhaul begins. Some guns, like the 25 mm Mk 38 Mod 2, are small enough that they can be removed from the ship, sent to manufacturers for reworking and then be reinstalled by the Navy. This normally occurs when the ship is in port for an extended scheduled maintenance.

This expedited process, with gun engineers jumping on ships before overhaul, saves time and money. In comparison, the 5-inch gun’s overhaul now takes 6 to 9 weeks and costs approximately \$750,000—significantly faster and less expensive than previous practices.

Guns also must be upgraded. The 20 mm Close-In Weapons System (CIWS) has a 20-year roadmap for upgrades, which enables it to engage surface vessels in addition to air threats. This roadmap entails tracking and enabling gun upgrades across the fleet. When depot maintenance is performed, NSWC IHEODTD sends fleet service technicians to a ship that needs an upgraded gun. That ship may be in Norfolk, San Diego, Japan or elsewhere. Once on site, NSWC IHEODTD technicians coordinate upgrades of the existing system or, in some cases, removal of an old gun and installation of a new one.

That expertise is applied to installing guns on new ships, as will be done for the “upgunned littoral combat ship, with 57 mm Mk 110, 25 mm Mk 38, and 30 mm Mk 50 guns.” Again, emphasis is given to being faster and more cost effective. Previously, guns for new ships were manufactured in Louisville, Kentucky, and transported for shake-out tests at Fort Knox, Kentucky, which could test one to two guns a week. The guns were then returned to the manufacturer for adjustment, and sent to ships for installation. Today, guns go to NSWC IHEODTD’s detachment at Picatinny, with its own range and engineering facility. There as many as five to six guns can be tested daily and then adjusted if necessary.

Readiness of ships and their guns is tied to ammunition. Keeping the guns ready for use is a challenging task in forward areas. At sea, ammunition is transferred from logistics ships to combatant ships by helicopter or by connected replenishment, where it is subject to salt water spray and considerable handling. On forward bases, the required amounts of ammunition might be stored for several years in magazines without

temperature and humidity controls. Consequently, ammunition and its packaging can become corroded or damaged and deemed unserviceable.


To keep that ammunition ready, NSWC IHEODTD sends teams of engineers and technicians to forward ammunition storage sites in Guam, Hawaii, Italy, Spain and other locations. There, these “Mobile Ammunition Evaluation Reconditioning Units” inspect, refurbish and repackage ammunition. These units not only ensure the ammunition’s readiness, they also save millions of dollars by avoiding the demilitarization and replacement of ammunition that otherwise would be unserviceable.

### Top Four Reasons This Service Matters

(1) Success at sea depends greatly on the support behind it. That’s especially so for naval guns, which play a key role in protecting sea lanes, which is very vital to the global economy. The readiness of these guns is tied to naval regional maintenance centers and NSWC IHEODTD’s in-service engineering.

(2) There are no good substitutes. At the start of World War II, a Navy captain said, “Contractors would solve all the problems,” a view that has persisted. Industry does many things more cost effectively than defense personnel, but there would be a huge cost involved in replicating and performing in-service engineering for various guns across globally distributed Navy and Coast Guard fleets. And, long-term support cannot be assured because of corporate and marketplace uncertainties.

(3) The need for this in-service engineering will increase in the growing intensity of the operating environment. In response to increasing maritime threats, the Navy is shifting to a concept of “distributed lethality.” This means putting guns and missiles on more ships, including logistics vessels. It also means keeping more ships’ guns ready.

(4) The need for this service will increase as budgets become more constrained. The readiness of naval guns and ammunition is not end-state. Rather, it’s a journey to continually do more forward, faster and more cost effectively. Such improvements come from continually doing, learning and changing. And that’s what we do at NSWC IHEODTD. 

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