

CHAPTER 20

NAVAL WEAPONS SYSTEMS

LEARNING OBJECTIVES

Upon completion of this chapter, you should be able to do the following:

1. Identify the gunnery systems used on Navy ships.
2. Describe the purpose of gun fire control equipment.
3. Identify the anti-air warfare (AAW) missiles used by the Navy.
4. Identify the cruise missiles used by the Navy.
5. Identify the anti-submarine warfare (ASW) weapons used by the Navy.
6. Identify the air-to-air missiles used by the Navy.
7. Identify the air-to-ground missiles used by the Navy.
8. Identify various airborne weapons used by the Navy.
9. Identify the Navy's nuclear weapons capability.

Before the discovery of gunpowder, naval battles were fought with row-galley tactics. In general, two methods were employed. A galley could maneuver near the enemy vessel and attempt to ram it, overturn it, board it by grappling hooks, or shave off its oars by a close run. An alternative procedure was to catapult flaming sulphur, pitch, niter, or oil onto the enemy ship; row away; and watch the fire. Although crossbows and shipborne spring- or torsion-powered artillery did allow some battle action before actual ship-to-ship contact, the ram was the main weapon. Speed and maneuverability were the best defenses.

Today, however, weapons systems are extremely complex. They include both the weapon and the fire control equipment used with the weapon.

Fire control entails problem solving: the problem of destroying a target with the armament of your ship or aircraft. Solutions must be found for the three types of targets: surface, subsurface, and air targets. The effective use of any weapons system requires the delivery of a destructive device to a target. The destructive device (weapon) could

be a guided missile, gun projectile, rocket, torpedo, or depth charge.

To deliver the weapon accurately, we must know the location, direction of travel, and the velocity of the target. Since many air targets now travel faster than sound, they must be engaged at great distances. A weapon is most effective when used as part of a ship's or aircraft's weapons system against such targets.

A weapons system includes the following:

1. Units that detect, locate, and identify the target
2. Units that direct or aim a delivery unit (for example, gun or guided-missile fire control radar)
3. Units that deliver or initiate the delivery of the weapon to the target (for example, missile battery, gun battery)
4. Units termed *weapons* that destroy the target when in contact with it or near it

While this serves as a brief overview of a weapons system, let's look a little deeper

at some of the systems and equipment the Navy uses.

GUNS

The gun is the Navy's oldest and most frequently used piece of ordnance equipment. Modern improvements in the construction of guns and ammunition have revolutionized gunnery by increasing the destructive power and maximum range of this weapon. During the revolutionary war, American ships fought at ranges of only several hundred yards. Using inaccurate cast-iron guns without sights, they threw solid shots that usually failed to penetrate. Modern guns hurl explosive shells that may weigh up to 2,700 pounds. The range of the largest (16-inch) gun now in service exceeds 24 miles. This gun can destroy a ship or some other target with only one of its projectiles.

Naval guns, exclusive of small arms, are classified according to size, type of ammunition used, and method of fire.

Large guns are usually mounted in turrets, boxlike structures of armor enclosing the breech end of two or three guns. The turret rotates within and on top of a barbette, a fixed circular tube of armor extending down to the armored decks. The barbette encloses the ammunition-handling rooms, hoists, and gun-laying machinery of the turret.

Smaller guns are housed in two types of gun mounts: open and closed. The latter type resembles a turret but does not have an armored barbette.

The mounts or turrets of all naval guns except the smallest are trained (rotated in the deck plane), and the guns are elevated by electric or electric-hydraulic power drives. The power drives, which are usually automatic, move the gun to a position designated by a fire control system.

The following sections briefly describe some of the gunnery systems used by the Navy.

16"/50

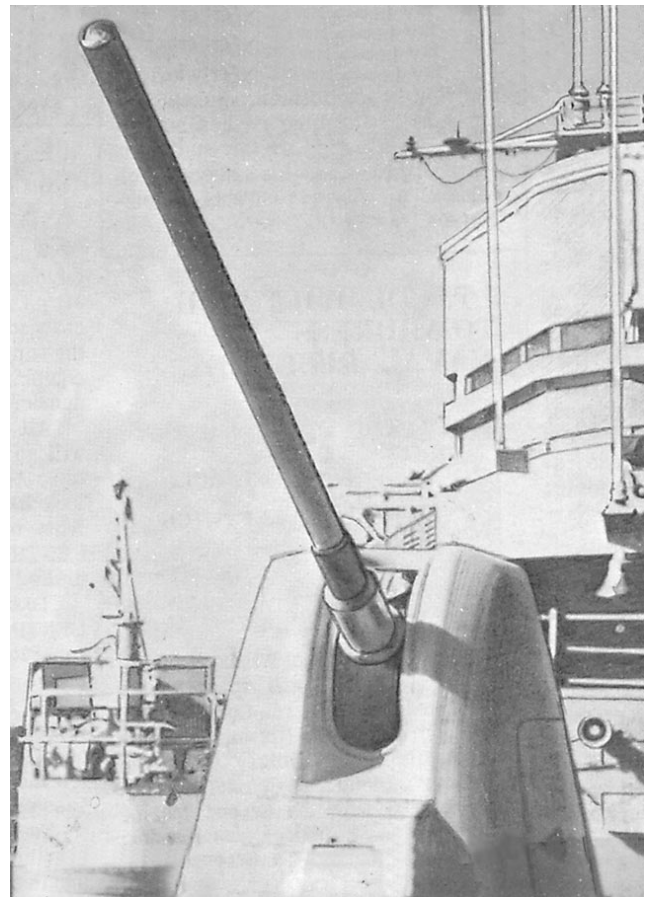
The 16"/50 turret-mounted gun is the only major-caliber weapon in the fleet today. Installed only on battleships, it can fire a 2,700-pound projectile a distance of 24 miles.

Although it has a low firing rate (2 rounds per minute), the 16" projectile is quite destructive.

5"/54

The 5"/54 Mk 42 is an automatic dual-purpose (DP) gun carried by most frigates (FFs), destroyers (DDs), and guided-missile cruisers (CGs) built in the 1950s and 1960s. Depending on the class of ship, the weapons maybe located on one, two, or three single mounts. The gun has an effective range of 24,500 yards and fires 70-pound shells at a rate of 32 rounds per minute.

The Mk 45 (fig. 20-1) provides destroyers and large ships with an all-weather capability for support of amphibious operations. It also provides them with an all-weather capability for delivery of rapid and accurate naval gunfire against surface craft, aircraft, and shore targets. It is a shielded, single-barrel, fully automatic gun that fires 5"/54 semifixed ammunition. Total installation weight varies from 49,000 to 54,000 pounds, depending on the installation configuration. The DD-963, DDG-993, LHA-1, CGN-36,



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Figure 20-1.-Mk 45 5"/54.

CGN-38, and CG-47 classes of ships carry the Mk 45.

5"/38

The 5"/38 semiautomatic DP gun was the mainstay of the U.S. Navy from 1939 until the late 1960s. Single or twin mounts made up the secondary batteries on early cruisers and battleships. One or two single mounts are now the main battery of the older DDs, FFs, and guided-missile frigates (FFGs). The twin mounts are the secondary gun battery on battleships (BBs). For short periods, an efficient gun crew can get off 15 rounds per minute for single mounts and 30 rounds per minute for single twin mounts. The projectile weighs 55 pounds and has an effective range of 18,000 yards.

3"/50

The dual-purpose, semiautomatic 3"/50 gun was planned during World War II. The enemy's use of combat suicide planes and dive bombers prompted the need for rapid-fire weapons having a larger explosive projectile than 40-mm guns. Although the 3"/50 gun was not produced in time for wartime service, it proved to be a very effective gun. Becoming standard throughout much of the fleet, it replaced the 40-mm twin and quadruple mounts on all combat ships. Most of the mounts installed were open twin mounts; however, a few single mounts were installed. The 3"/50 fires 45 rounds per minute per barrel and has a range of 14,200 yards. A few of these mounts remain on major combatant ships, but most are found on auxiliary and amphibious landing ships.

76-MM/62

The Mk 75 76-mm/62-caliber, rapid-fire, dual-purpose gun mount was developed in the late 1960s to combat increased aircraft target speeds and the cruise missile threat. Because of its light weight, it is suitable for installation on the new guided-missile frigates and missile hydrofoil boats. It is a water-cooled single mount with a rate of fire of 85 rounds per minute and a maximum range of 17,800 yards. The gunhouse, which is not manned, requires only three handlers to reload the magazine.

CLOSE-IN WEAPON SYSTEM (CIWS)

The close-in weapon system (CIWS) was developed to provide the fleet with a close-range, hard defense against antiship cruise missiles, fixed-wing aircraft, and surface targets. The system is an automatic, fast-reaction, computer-controlled radar with a rapid-fire 20-millimeter gun. It combines a single-mount fire control radar and a six-barrel Gatling gun that fires depleted-uranium projectiles at a rate of 3,000 rounds per minute. Its projectiles are 2.5 times heavier than those made of steel. The system has a high-kill probability. This system is suitable for installation on most ships as a single unit. It permits smaller ships to have a degree of self-protection never before possible. (See fig. 20-2.)

GUN FIRE CONTROL EQUIPMENT

Gun fire control equipment must solve a difficult problem. It must direct the guns to hit

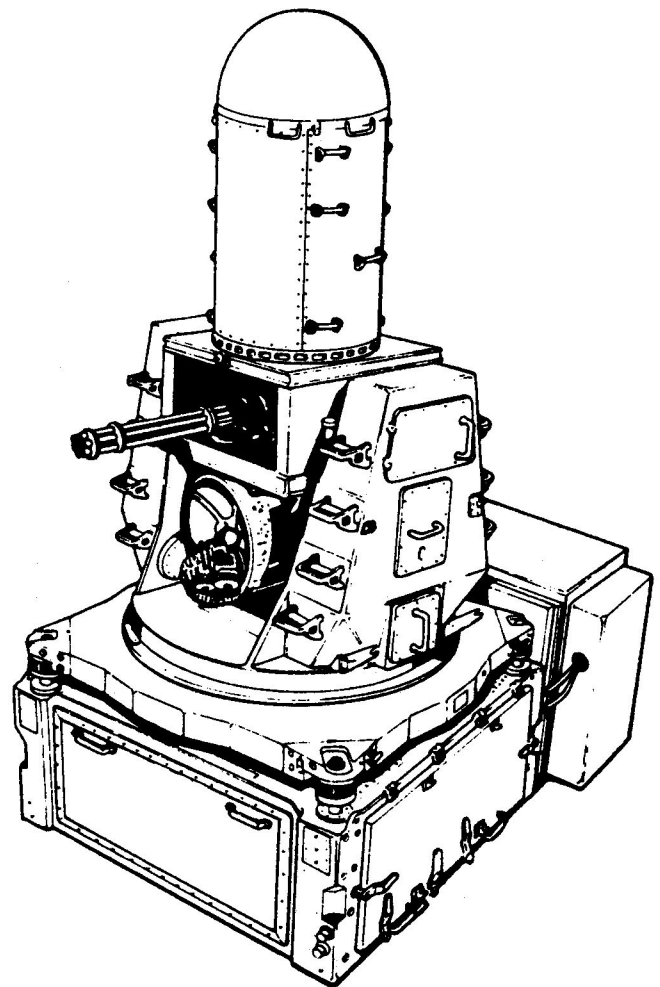


Figure 20-2.—Close-in weapon system (CIWS).

a moving target with a projectile that takes a considerable length of time to arrive at its destination. Accordingly, the gun cannot be aimed at the point where the target is when detected. It must be aimed at the point where the target will be when the projectile gets there; that is, the predicted position of the target. Furthermore, the path of the projectile is not a straight line but is curved by gravity. Wind, variations in atmospheric density, and other forces also affect the path of the projectile. In addition, the guns and the fire control equipment are mounted on a ship that is rolling, pitching, and moving through water.

The fire control equipment that solves this problem is usually known as a gun fire control system. Each battery frequently has more than one of these systems. The whole battery may be controlled by one system or may be broken down into smaller groups, each controlled by a separate system.

A gun fire control system generally consists of two parts, one above deck and the other below deck in a protected position. The above-deck portion consists principally of a gun director that acts as the eyes of the battery. It is trained and elevated so that its optics and radar are always directed toward the target, thus establishing a line of sight. Directors vary in size and complexity. Some are large rotating structures with complex electrical driving equipment while others are small, hand-operated devices.

Introduction of radar into the fire control system has greatly enhanced its flexibility and accuracy. Radar provides more accurate range as well as target direction data that is almost as good as the best optics.

The below-deck components of the system usually consist of a computer and other related equipment, although the computer is sometimes part of the director. The computer receives data about target coordinates from the director and/or radar. It uses built-in data about the wind, motion of the ship, atmosphere, and the projectile path. It then computes this data into orders needed for the guns to aim properly to hit the target. These orders are transmitted directly to the train and elevation power drives of the gun mounts or turrets.

Computers make use of complex electrical and mechanical components to perform continuous complex calculations. Some are entirely mechanical, with quantities represented by positions of shafts; others are electromechanical, with quantities represented by both positions and voltages.

All naval ships now use gun fire control equipment.

SURFACE-LAUNCHED ANTI-AIR WARFARE (AAW) MISSILES

The Navy uses surface-launched missiles both as offensive and defensive weapons. Surface-launched missiles are used to destroy surface, land, and air targets. The following sections briefly describe some of the Navy's surface-launched missiles.

In an anti-air warfare (AAW) operation, guided missiles are the second line of defense. The first line of defense is aircraft. The AAW missiles in the Navy's current inventory include the Standard and Sea Sparrow missiles.

STANDARD

The Standard family of missiles is one of the most reliable in the Navy's inventory. Entering the fleet more than a decade ago, it replaced the Tartar and Terrier missiles. The Standard missile can be used against missiles, aircraft, and ships.

Some of the older guided-missile destroyers (DDGs) and the Oliver Hazard Perry-class frigates use the SM-1(MR) as a medium-range defense weapon. The SM-2(MR) is a medium-range defense weapon for Ticonderoga-class Aegis cruisers, California- and Virginia-class cruisers, Arleigh Burke-class destroyers, and Kidd-class destroyers.

Characteristics of the SM-1(MR) and SM-2(MR) missiles:

Length:	14 feet, 7 inches
Diameter:	13.5 inches
Wing span:	3 feet, 6 inches
Weight:	SM-1-1,100 pounds; SM-2-1,380 pounds
Range:	More than 15 nautical miles

The SM-2(ER) is an extended-range area defense weapon for the Leahy, Belnap, Bainbridge, Truxton, and Long Beach classes of cruisers.

Characteristics of the SM-2(ER) missiles:

- Length: 26 feet, 2 inches
- Diameter: 13.5 inches
- Wing span: 5 feet, 2 inches
- Weight: 2,980 pounds
- Range: More than 30 nautical miles

SPARROW

The AIM/RIM-74 is a much-improved and highly successful air-to-air and surface-to-air version of the Sparrow missile. It has considerably greater invulnerability to electronic countermeasures (ECM) and better target-tracking capability. The fifth operational missile of the Sparrow family, it can be employed against attacking aircraft at all tactical speeds and altitudes in all weather. With folding wings and clipped tail fins, it is compatible with the North Atlantic Treaty Organization (NATO) Sea Sparrow launcher. Entering the Navy's inventory in 1983, this latest version of the Sparrow family continues to be one of the Navy's most heavily procured missiles.

Characteristics of the Sparrow:

- Length: 12 feet
- Diameter: 8 inches
- Wing span: 3 feet, 4 inches
- Weight: 510 pounds
- Speed: More than 2,660 miles per hour
- Range: More than 30 nautical miles

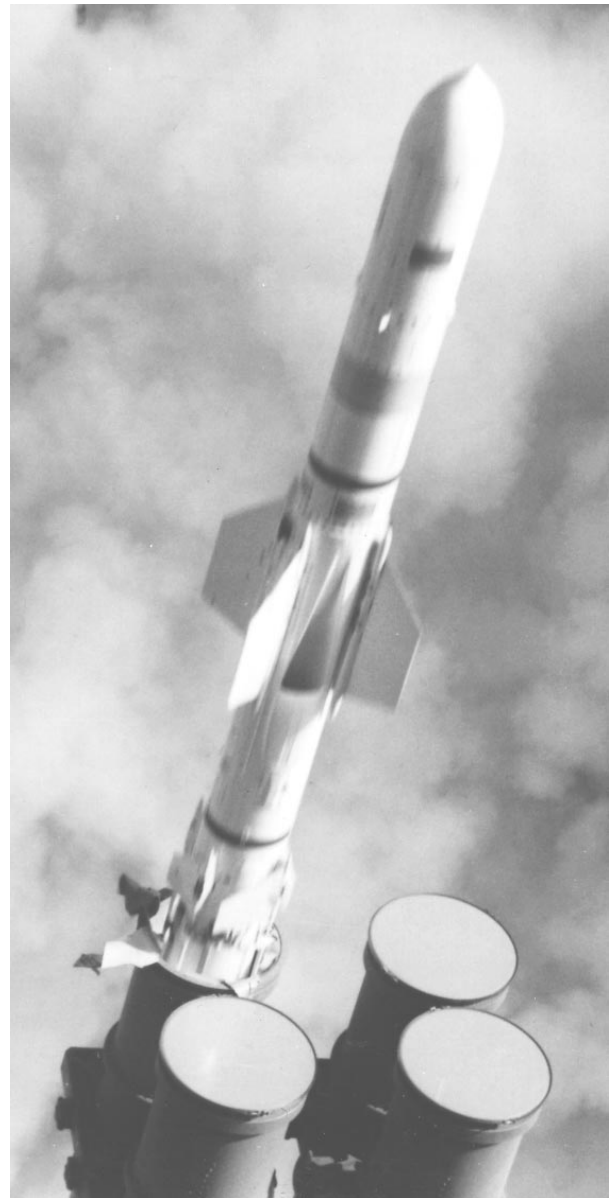
CRUISE MISSILES

Since World War II the U.S. Navy has relied upon carrier aircraft to maintain sea control. Other navies, not having the money for carriers, developed antiship missiles. These missiles were first used successfully by the Egyptians to sink the Israeli destroyer *Elath* in 1967. The battle opened a new era in naval warfare. Any nation with a relatively modest investment could successfully challenge the most powerful naval forces.

The United States did not start development of a similar weapon until 1971. At that time the United States realized our Navy did not have the benefit of an equal weapon against ships equipped with antiship missiles. This led to the development of the Harpoon cruise missile. Further research eventually led to the development of the Tomahawk cruise missile.

HARPOON

The Harpoon (fig. 20-3) is a medium-range, rocket-boosted, turbo-sustained, antiship cruise



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Figure 20-3.-Harpoon missile being launched from a canister launcher aboard USS Leahy (CG-16).

missile. Its primary mission is to destroy hostile surface targets such as combatants, surfaced submarines, or other vessels. The Harpoon can be launched from surface ships, submarines, or aircraft (without the rocket booster).

It was introduced in the fleet on ships and submarines in 1977 and on the P-3 series aircraft in 1979. The Harpoon is being improved to add range and to decrease altitude in its sea-skimming mode. The Harpoon was used effectively in attacks on Libyan targets in the Gulf of Sidra in 1986. The Navy is now developing a new infrared Harpoon variant called the Standoff Land Attack missile (SLAM).

Characteristics of the Harpoon:

- Length: 15 feet (surface/submarine-launched); 12 feet, 7 inches (air-launched)
- Diameter: 14 inches
- Wing span: 3 feet (with booster fins and wings)

TOMAHAWK

The Tomahawk (fig. 20-4) is an all-weather submarine/surface-combatant-launched, long-range, subsonic, antiship or land-attack cruise missile. It can be conventionally armed for antisurface warfare and conventionally and nuclear armed for land-attack versions. After launch, a solid-propellant rocket booster propels the missile until a small turbofan engine takes over for the cruise portion of the flight.

The land-attack version of the Tomahawk has an inertial and terrain contour-matching

(TERCOM) guidance system. The TERCOM system compares a stored map reference with the actual terrain to determine the missile's position. If necessary, it then makes a course correction to guide the missile to the target.

The antiship version has a modified Harpoon cruise missile guidance system. This system permits the launching and flying of the Tomahawk in the general direction of an enemy ship at low altitudes. At a programmed distance, the missile begins an active radar search to seek, acquire, and hit the target ship.

Tomahawk is a highly survivable weapon against predicted hostile defense systems. Radar detection of the Tomahawk is difficult because the missile has a very small cross section and can fly at extremely low altitudes. Similarly, infrared detection is difficult because the turbofan engine emits a low level of heat.

Characteristics of the Tomahawk:

- Length: 20 feet, 6 inches (with booster)
- Diameter: 20.4 inches
- Wing span: 8 feet, 9 inches
- Weight: 3,200 pounds (with booster)
- Speed: About 550 miles per hour
- Range: Land-attack, nuclear warhead—1,350 nautical miles
Land-attack, conventional warhead— 600 nautical miles
Antiship configuration-250 nautical miles



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Figure 20-4.-The first fully guided Tomahawk cruise missile in flight after being launched from an A-6 Intruder aircraft.

SUBMARINE-LAUNCHED MISSILES

Fleet ballistic missile submarines (SSBNs) carry the missiles the United States uses to ensure it has a second-strike capability in case of nuclear war. As discussed in chapter 11, SSBNs make up one leg of the TRIAD. These submarines carry the Trident (C-4 and D-5) missiles. Some of the older submarines carry the Poseidon (C-3) missiles.

Submarines are also capable of launching the Harpoon and Tomahawk cruise missiles discussed previously in this chapter.

TRIDENT II (D-5)

The Trident II (D-5) (fig. 20-5) is the sixth-generation member of the U.S. Navy's Fleet Ballistic Missile Program that started in 1956. Since then, the Polaris (A-1, A-2, and A-3), Poseidon (C-3), and Trident I (C-4) have served as a significant deterrent to nuclear aggression.

The Trident II is a three-stage, solid-propellant, inertially guided ballistic missile with a range of more than 4,000 nautical miles (4,600 statute miles). A considerable increase in payload . . . was incorporated into the Trident II. This was



Figure 20-5.—Trident II (D-5) missile.

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done by encasement of the first two stages in epoxied graphite and the third stage in the filament-wound Kevlar. The range of the missile was also increased by the aerospike, a telescoping outward extension that reduces frontal drag by about 50 percent. The new Trident and Ohio classes of submarines carry 24 Trident II missiles that can be launched under water or on the surface.

Upon firing, the Trident II is ejected by the pressure of expanding gas within the launch tube. When the missile reaches the proper distance from the submarine, the first-stage motor ignites, the aerospike extends, and the boost stage begins. After about 65 seconds the first-stage motor and interstage separate from the missile. This allows the second-stage motor to ignite and continue the boost phase for approximately 65 seconds. With separation, the third stage burns for nearly 40 seconds, concluding the boost phase. At this point the missile is traveling more than 20,000 feet per second (13,600 mph). The post-boost control system provides thrust and control to the equipment section until all reentry bodies have been deployed.

Characteristics of the Trident II:

Length: 44 feet

Diameter: 83 inches

Weight: 130,000 pounds

Range: Over 4,000 nautical miles

TRIDENT I (C-4)

The Trident I (C-4), first deployed in 1979, will remain on patrol until phased out in the late 1990s. This missile was designed to have the same dimensions as the Poseidon (C-3) missile. This enabled the existing Poseidon submarines as well as the newer Trident submarines to use the Trident I. Trident I has a range almost double that of the Poseidon. It uses a three-stage, solid-fuel rocket instead of the two-stage, solid-fuel rocket used by the Poseidon.

Characteristics of the Trident I:

Length: 34 feet

Diameter: 74 inches

Weight: 73,000 pounds

Range: 4,000 nautical miles

POSEIDON (C-3)

The Poseidon (C-3) missile, though being phased out, is still in active use in the Navy. The Poseidon was the fourth missile in the Navy's Fleet Ballistic Missile Program. The physical dimensions of the Poseidon are identical to the Trident I. The key differences are in weight, range, propulsion, and warhead, all of which were improved in the Trident I missile.



Figure 20-6.—An F/A-18 Hornet With Sidewinders missiles.

Characteristics of the Poseidon:

Length: 34 feet
Diameter: 74 inches
Weight: 65,000 pounds
Range: 2,500 nautical miles

AIRBORNE WEAPONS

In today's high-performance aircraft, the trend is toward versatility by means of rockets; bombs; missiles; and, in some aircraft, guns. The Navy's Research and Development team is constantly seeking ways to improve existing airborne weapons while working simultaneously on new weapons. This section briefly describes some of the existing airborne weapons.

AIR-TO-AIR MISSILES

The Navy uses four air-to-air missiles. These missiles include the Sparrow, Sidewinder, Phoenix, and AMRAAM.

Sparrow

Although earlier described as a surface-to-air missile, the Sparrow missile is also used as an air-to-air missile. In this role, it provides Navy fighter aircraft with air superiority in a hostile environment.

Sidewinder

The Sidewinder air-to-air missile (fig. 20-6) is a short-range, dogfight missile used by all Navy fighters and attack aircraft against hostile aircraft.

The Sidewinder is one of the oldest, least expensive, and most successful missiles in the entire U.S. weapons inventory. The prototype of this heat-seeking missile was fired more than 30 years ago; since then various versions of it have been produced for more than 27 nations. The latest version has a significantly improved infrared countermeasure capability.

Characteristics of the Sidewinder:

Length: 9 feet, 5 inches
Diameter: 5 inches
Wing span: 2 feet, 1 inch
Weight: 195 pounds
Speed: More than 1,900 miles per hour
Range: More than 3.5 nautical miles

Phoenix

The Phoenix missile (fig. 20-7) is an all-weather air-to-air missile designed to destroy



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Figure 20-7.—Two AIM-54A Phoenix missiles mounted on the undercarriage of an F-14A Tomcat aircraft.

multiple hostile air targets at great range. The Phoenix missile was introduced into the fleet with the F-14A aircraft and AN/AWG-9 weapons control system in 1974. The AN/AWG-9 system is capable of long-range tracking of multiple hostile air targets. It can launch up to six missiles against six targets simultaneously. In addition to the great range of the Phoenix missile, it has excellent intercept capability against high-speed maneuvering targets at both high and low altitudes.

Characteristics of the Phoenix:

Length:	13 feet
Diameter:	15 inches
Wing span:	3 feet
Weight:	1,024 pounds
Speed:	More than 3,040 miles per hour
Range:	More than 104 nautical miles

AMRAAM

The advanced medium-range air-to-air missile (AMRAAM) (fig. 20-8) is an all-weather, radar-guided, beyond-visual-range missile. It is designed to provide launch-and-leave capability as well as multiple-target engagement capability. The AMRAAM missile, a follow-on to the Sparrow missile, is used by F-14 and F/A-18 aircraft. It is faster, smaller, lighter, and better able to attack at a lower altitude than the Sparrow. With AMRAAM, the pilot can aim and fire several missiles at multiple targets simultaneously.

Characteristics of AMRAAM:

Length:	12 feet
Diameter:	7 inches
Wing span:	13 inches
Weight:	335 pounds
Speed:	More than 760 miles per hour
Range:	More than 35 nautical miles



Figure 20-8.—An AIM-120A advanced medium-range air-to-air missile (AMRAAM) being readied for loading on an F/A-18A Hornet aircraft. 134.57

AIR-TO-GROUND MISSILES

The Navy is currently developing two new air-to-ground missiles, the Tacit Rainbow missile, and the IR Maverick missile. However, these missiles are not yet operational. Air-to-ground missiles in current inventory include the Harpoon and Harm missiles.

Harpoon

The Harpoon missile discussed previously in this chapter under surface-to-surface missiles can also be used as an air-to-ground missile. Many naval aircraft are capable of carrying the Harpoon.

Harm

The Harm missile was designed to destroy or suppress enemy electronic emitters. It was designed especially to suppress those associated with radar sites used to direct anti-aircraft guns and surface-to-air missiles. Harm is a high-speed antiradiation missile that succeeds the Shrike and Arm missiles as the Navy's primary defense-suppression air-to-surface missile. The Harm missile proved effective against Libyan targets in the Gulf of Sidra in 1986.

Characteristics of Harm:

Length:	13 feet, 8 inches
Diameter:	10 inches
Wing span:	3 feet, 8 inches
Weight:	807 pounds
Speed:	More than 760 miles per hour
Range:	More than 50 nautical miles

OTHER AIRBORNE WEAPONS

Other airborne weapons used by naval aircraft include 20-mm guns, rockets, and bombs.

20-mm Guns

The only 20-mm gun now used by operational fleet aircraft is the internally mounted, six-barrel, M61A1 20-mm gun. It has an electrically controlled and hydraulically operated ammunition drum. The gun fires at a rate of 6,000 rounds per

minute in the GUNHI position and 4,000 rounds per minute in the GUNLOW position. The AV-8B Harrier uses a similar 25-mm gun.

Aircraft Rockets and Bombs

The Navy is currently developing new rockets and bombs to meet today's operational requirements. The new advanced rocket system will provide a high volume of air-to-ground fire from standoff ranges against a broad target spectrum. The new advanced bomb family (ABF) will provide two bombs to meet the general-purpose bombing requirements for increased blast, fragmentation, and penetration effects. The ABF will replace the Mk 80-series bomb with a 500-pound-class bomb optimized for blast fragmentation and a 1,000-pound-class bomb with improved penetration capabilities.

ANTISUBMARINE WARFARE WEAPONS

The Navy's primary operational weapons are (1) antisubmarine rockets (ASROCs), (2) submarine rockets (SUBROCs), and (3) torpedoes.

ASROC

The ASROC missile is a subsonic, shipboard-launched, solid-fuel, rocket-propelled, anti-submarine ballistic projectile. The missile has two configurations—one with a depth charge and one with a torpedo.

The purpose of the ASROC is the destruction of submarines at long ranges. To achieve this, it delivers a torpedo or nuclear depth charge through the air to a specific point in the water. From that point, it can either attack under the most favorable circumstances or have the submarine within its lethal radius. Because of its stand-off range, the ASROC enables the antisubmarine warfare (ASW) ship to launch its weapons before the submarine discovers it is under attack.

ASROC launchers are installed in FFs, DDs, DDGs, and CGs. On most ships, the launcher is

a boxlike device containing eight cells, as shown in figure 20-9, each containing a missile.

SUBROC

The SUBROC, an antisubmarine rocket with a nuclear warhead, is launched from a submarine torpedo tube by conventional methods. After clearing the submarine, a rocket motor ignites and propels the weapon upward and out of the water. An inertial guidance system then directs the SUBROC toward its target. At a predetermined range, the motor and depth bomb separate, the latter continuing toward the target area. Upon reentry into the water, the bomb sinks to a preset

depth, where the warhead explodes. The target may be a surface ship as well as a submarine. The SUBROC system can fire missiles in rapid succession, an important defense against enemy tactics.

SUBROC systems are installed in the Permit, Sturgeon, and Los Angeles classes of attack submarines (SSNs).

TORPEDOES

A torpedo can be launched from submarines, surface ships, or aircraft. The two primary torpedoes in the Navy inventory are the Mk 46 and the Mk 48. A new Mk 48 advanced capability (ADCAP) and Mk 50 torpedo are being phased into the fleet.

Mk 46

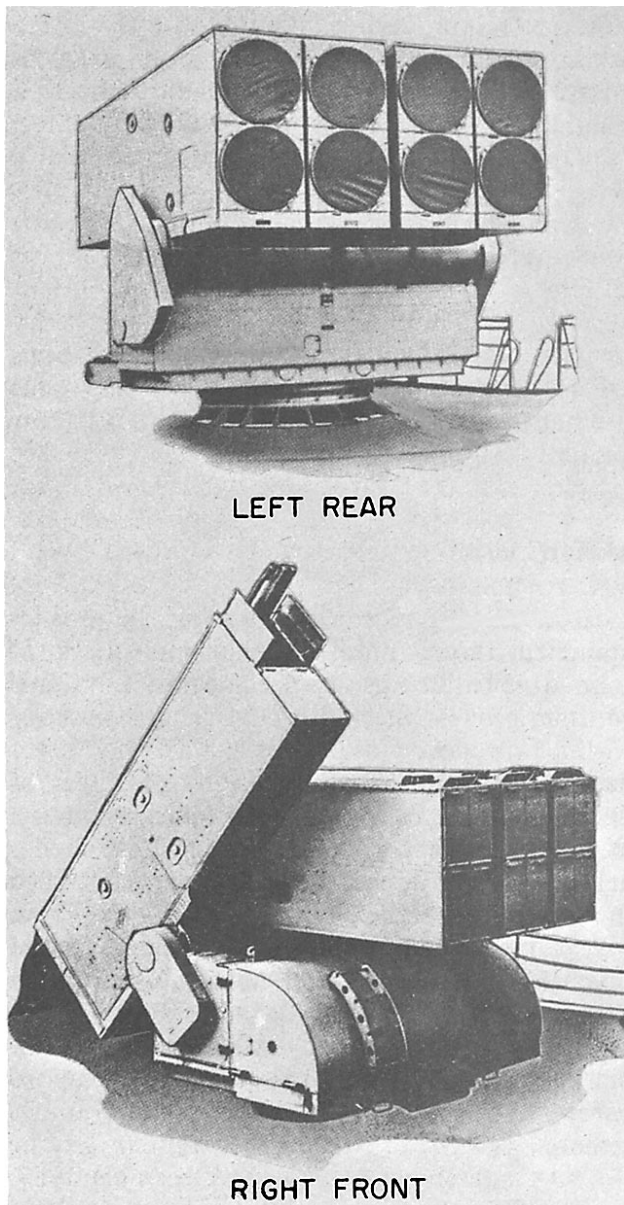
The Mk 46 torpedo is a lightweight ASW torpedo designed to attack high-performance submarines. The Mk 46 torpedo is presently identified as the NATO standard torpedo. Since introduction of the Mk 46 in 1967, navies of several other countries have acquired it. The Mk 46 torpedo is designed to be launched from surface combatant torpedo tubes, ASROC missiles, and fixed- and rotary-wing aircraft.

Mk 48 and Mk 48 Advanced Capability (ADCAP)

The Mk 48 torpedo is carried by all Navy attack and ballistic missile submarines. The improved version—the Mk 48 ADCAP—is carried by the SSN 688 and SSN 637 classes of attack submarines. The Mk 48 ADCAP will also be used by the Seawolf-class attack submarines and Ohio-class ballistic missile submarines.

These torpedoes enable U.S. submarines to sink hostile surface ships or submarines in the presence or absence of torpedo countermeasures. The design of both of these weapons enables them to combat fast, deep-diving nuclear submarines and high-performance surface ships. Both torpedoes can operate with or without wire guidance and use active and/or passive homing. When launched they execute preprogrammed target-search, acquisition, and attack procedures. Both will conduct multiple reattacks in the unlikely event they miss the target.

The Mk 48 has been operational in the U.S. Navy since 1972. The Mk 48 ADCAP became operational in 1988 and was approved for full production in 1989. The ADCAP has significantly increased capabilities over the Mk 48. These capabilities allow its employment against the most advanced Soviet submarines.



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Figure 20-9.—The ASROC cellular launcher.

Characteristics of the Mk 48 and the Mk 48 ADCAP:

Length:	19 feet
Diameter:	21 inches
Weight:	3,434 pounds (Mk 48) 3,695 pounds (ADCAP)
Speed:	More than 28 knots
Range:	More than 5 nautical miles
Depth:	More than 1,200 feet

Mk 50 Torpedo

The Mk 50 torpedo is an advanced, light-weight torpedo for use against the faster, deeper-diving, and more sophisticated submarines being developed and operated by the Soviet Union. The Mk 50 can be launched from all ASW aircraft and from torpedo tubes aboard surface combatant ships. The Mk 50 uses an active/passive acoustic homing guidance system. The Mk 50 is being phased in to replace the Mk 46 torpedo as the fleet's lightweight torpedo.

Characteristics of the Mk 50:

Length:	9 feet, 4 inches
Diameter:	12.75 inches
Weight:	750 pounds
Speed:	More than 40 knots

NUCLEAR WEAPONS

The United States has pursued a policy of making the fewest number of nuclear weapons cover as wide a range of military applications as possible. This capability is achieved by planned interchangeability. Nuclear warheads can be employed with rockets, torpedoes, missiles, and depth bombs by use of adaptational kits. Several Navy weapons (ASROC, for instance) have both conventional and nuclear capability.

The primary air-launched nuclear weapon is, of course, the nuclear bomb, of which little can be said regarding specific characteristics. Major operational components and nuclear components contained in a basic assembly are considered part of the bomb. A complete stockpiled weapon, however, may consist of more than one package. The reason is additional assemblies, such as the

fuze, firing set, radar, and power supply, maybe required to makeup the complete nuclear weapon.

Because of the radioactive mushroom-type cloud resulting from a nuclear bomb, the deploying aircraft crew must be protected once a bomb is dropped. A safe separation time is provided by two methods. One is the use of a timing mechanism inserted in the bomb to delay detonation. The second is the use of a parachute to slow the bomb (retarded free-fall bomb). Either method allows the aircraft to reach a point of safety before weapon detonation.

AEGIS WEAPONS SYSTEM

Any discussion of the Navy's weapons systems would not be complete without a look at the shipboard integrated AAW combat weapons system (Aegis). For more than 40 years, the U.S. Navy has developed systems and tactics to protect itself from air attacks. Since the end of World War II, several generations of antiship missiles have emerged as an air threat to the fleet. The first combatant ship sunk by one of these missiles was an Israeli destroyer, hit by a Soviet-built missile in October 1967. The threat posed by such weapons was reconfirmed as recently as April 1988. At that time two Iranian surface combatants fired on U.S. Navy ships and aircraft in the Persian Gulf. The resulting exchange of antiship missiles led to the destruction of an Iranian frigate and corvette by U.S.-built Harpoon missiles. Modern antiship missiles can be launched several hundred miles away. Air, surface, and subsurface launches can be coordinated so that the missiles arrive on target almost simultaneously. Some cruise missiles have both nuclear and conventional variants.

The U.S. Navy's defense against this threat has continued to rely on the winning strategy of defense in depth. Guns were replaced in the late fifties by the first generation of guided missiles in our ships and aircraft. These missiles continued to perform well until the late sixties. By that time, we realized our reaction time, firepower, and operational availability in all environments did not match the threat. The Navy then started a comprehensive engineering development program to meet an operational requirement for an advanced surface missile system (ASMS). ASMS was renamed the Aegis weapons system (after the mythological shield of Zeus) in December 1969.

Based on the latest technology—particularly in digital computers and radar-signal processing—the Aegis weapons system was designed as

a total weapons system, from detection to kill. The heart of the system is an advanced, automatic detect-and-track, multifunction phased-array radar—the AN/SPY-1. This high-power (4 megawatt) radar can perform search, track, and missile-guidance functions simultaneously with a track capacity of well over 100 targets. After several years of development and land-based testing, the first Engineering Development Model (EDM-1) was installed in the test ship, USS *Norton Sound* (AVM 1) in 1973. Within weeks the Aegis weapons system had successfully engaged the most difficult targets possible in extremely demanding anti-air warfare scenarios intended to stress it to its limit.

The Aegis weapons system is the most capable surface-launched missile system the Navy has ever put to sea. It can defeat an extremely wide range of targets from wave top to directly overhead. It is extremely capable against anti-ship cruise missiles and manned aircraft flying in all speed ranges from subsonic to supersonic. The Aegis is effective in all environmental conditions. It has both all-weather capability and outstanding abilities in chaff and jamming environments.

The computer-based command-decision element is the core of the Aegis weapons system. It is this interface that makes the Aegis capable of simultaneous operations against a multimission threat: anti-air, anti-surface, and anti-submarine warfare. This combat system can also be used for overall force coordination.

The Aegis weapons system brings a revolutionary multimission combat capability to the U.S. Navy. Aegis-equipped ships are capable of engaging and defeating enemy aircraft, missiles, submarines, and surface ships. Aegis-equipped ships are key elements in modern carrier and battleship battle groups.

Several shipboard applications were studied before the design of the first Aegis ships was chosen. The design chosen was based on the hull and machinery designs of Spruance-class destroyers. Originally identified as a guided-missile destroyer (DDG-47), the class was redesignated a guided-missile cruiser. The first ship of the class, USS *Ticonderoga* (CG-47), was christened by Mrs. Nancy Reagan on Armed Forces Day 1981 and commissioned on 23 January 1983.

USS *Ticonderoga* deployed to the Mediterranean with the USS *Independence* battle group in October 1983. It supplied outstanding air defense coverage to our ships off the coast of Lebanon. Commenting on the ship's performance, the Chief of Naval Operations said,

"*Ticonderoga* provided to the Eastern Mediterranean Task Force an impressive new tactical dimension which included 100 percent weapon system availability and a coherent air picture allowing the anti-air warfare coordinator (AAWC) (embarked in *Ticonderoga*) to manage, rather than react to a difficult situation."

Since 1983 additional Aegis cruisers have joined USS *Ticonderoga* in the fleet. The 27th and final CG-47-class cruiser will be commissioned in 1994.

The commissioning of USS *Bunker Hill* (CG-52) opened a new era in surface warfare as the first Aegis ship outfitted with the vertical launching system (VLS). This system allowed greater missile selection, firepower, and survivability. The improved SPY-1B radar went to sea in USS *Princeton* (CG-59), ushering in another advance in Aegis capabilities.

In 1980 the preliminary plans for a smaller ship with Aegis capabilities were studied. Because of advanced technology, we can now build an Aegis weapons system compatible with a smaller ship while maintaining the multimission capability vital to modern surface forces. As a result, a contract was awarded in 1985 for construction of the first DDG-51-class ship.

The lead ship of the DDG-51 class bears the name of a living person—the legendary Admiral Arleigh "31-knot" Burke. He was the most famous destroyerman of World War II. Admiral Burke has attended each design phase of the DDG-51 and observed its keel laying in Bath, Maine.

The DDG-51s will be built in cycles, which allows incorporation of technological advances during construction. This allows for "forward-fitting" technology rather than very expensive "back-fitting" technology during scheduled overhauls. In other words, this allows for advanced planning to prevent costly changes after the completion of the ship. CG-47-class cruisers are also constructed by this method.

The surface Navy's Aegis ships provide area defense for the battle group as well as a clear air picture for more effective deployment of F-14 and F/A-18 aircraft. At present, the Aegis weapons system enables fighter aircraft to concentrate more on the outer air battle while cruisers and destroyers concentrate on battle group area defense. Technological advances in missile and computer battle management systems will soon permit Aegis-equipped ships to join carrier air assets in outer air defense. The highly accurate firing of Aegis will result in a decrease of asset expenditures.

As long as our Navy must steam “in harm’s way” to carry out its assigned missions, it will require a formidable anti-air warfare capability. The Aegis weapons system gives surface AAW forces a decided edge against the sophisticated modern air threat. Planned upgrades to standard missiles and evolving improvements to the Aegis weapons system promise the fleet an extremely capable AAW system well into the 21st century.

SUMMARY

To meet present and future threats, the Navy develops new weapons systems and improves existing systems. It often develops new weapons with physical characteristics similar to their predecessors to preclude designing a new system. This practice has the advantage of being both cost effective and time saving.

Many weapons are capable of being used by different types of ships and aircraft. This practice is also cost effective. During periods of budget reductions, this policy just makes good sense.

One fact about our weapons and weapons systems, however, will always remain constant—the Navy will always use every resource available to meet any threat.

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DEVIL TO PAY

TODAY THE EXPRESSION “DEVIL TO PAY” IS USED PRIMARILY AS A MEANS OF CONVEYING AN UNPLEASANT AND IMPENDING HAPPENING. ORIGINALLY, THIS EXPRESSION DENOTED THE SPECIFIC TASK ABOARD SHIP OF CAULK THE THE SHIP’S LONGEST SEAM.

THE “DEVIL” WAS THE LONGEST SEAM ON THE WOODEN SHIP, AND CAULKING WAS DONE WITH “PAY” OR PITCH. THIS GRUELING TASK OF PAYING THE DEVIL WAS DESPISED BY EVERY SEAMAN, AND THE EXPRESSION CAME TO DENOTE ANY UNPLEASANT TASK.

