The U.S. Navy Warship Series

THE NAVY OF THE NUCLEAR AGE 1947–2007

Paul H. Silverstone

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THE U.S. NAVY WARSHIP SERIES

The Sailing Navy, 1775–1854 Civil War Navies, 1855–1883 The New Navy, 1883–1922 The Navy of World War II, 1922–1947 The Navy of the Nuclear Age, 1947–2007

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First published 2009 by Routledge 270 Madison Avenue New York, NY 10016 Simultaneously published in the UK by Routledge 2 Park Square Milton Park, Abingdon Oxon OX14 4RN

Routledge is an imprint of the Taylor & Francis Group, an informa business

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Typeset in New Baskerville by RefineCatch Limited, Bungay, Suffolk Printed and bound in the United States of America on acid-free paper by Edwards Brothers, Inc.

ISBN10: 0-415-97899-8 (hbk) ISBN10: 0-203-87773-X (ebk)

ISBN13: 978–0–415–97899–6 (hbk) ISBN13: 978–0–203–87773–9 (ebk)

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Library of Congress Cataloging-in-Publication Data

Silverstone, Paul H.
The Navy of the Nuclear Age, 1947–2007 / Paul H. Silverstone.
p. cm.—(U.S. Navy warship series)
Includes bibliographical references and index.
ISBN13: 978–0–415–97899–6 (hardback : alk. paper)
ISBN10: 0–415–97899–8 (hardback : alk. paper)
I. Warships—United States—History—20th century. 2. Warships—United States—History—21st century. 3. United States. Navy—Lists of vessels. I. Title.

VA61.S546 2008 359.8'3097309045—dc22

2008015307

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INTRODUCTION

The sixty years after World War II were a period of world peace punctuated by a series of brutal local wars. The United States Navy was aggressively active throughout the period. In between the routine peacetime cruises and training, wars in Korea, Vietnam, and the Middle East occurred, and during most of the period the cold war with the Soviet Union was omnipresent.

After 1945 the United States demobilized most of the huge armed forces built up for combat operations. For the Navy this meant decommissioning a large percentage of its ships, many finding their way laid up into reserve fleets, while the older and acquired ships were taken off the Navy List.

With the outbreak of war in Korea in 1950, many of the laid-up ships were brought back into service. The war lasted about three years; the Navy actively supporting the ground troops with air operations and coastal bombardments. The Navy was not unscathed, suffering casualties of 505 killed, 1,576 wounded, and 286 prisoners-of-war. Seven Medals of Honor were awarded to Navy personnel, five posthumously. Several ships were sunk and more were damaged.

The tension between the Soviet Union and its allied countries resulted in a competition for superiority at sea. In 1949, the North Atlantic Treaty Organization (NATO) was established to counter Soviet threats. At sea, trouble points appeared in the Mediterranean, Arctic, and the waters off China. The Soviet Union built a large fleet of both submarines and surface warships, which soon appeared in all parts of the world. American and Soviet Navies played a cat-and-mouse game in the North Atlantic between their submarines and our anti-submarine forces. The climax occurred with a crisis in Cuba when Soviet missiles were positioned in that country and American forces challenged the Soviets. Through diplomacy a dangerous situation was defused.

In the Far East, the cold war became hot as military operations expanded in Vietnam. After the truce settlement between north and south in 1954, guerrillas from the north threatened the stability of the government in South Vietnam. Gradually, the United States became involved in ground operations. The falselyreported Gulf of Tonkin incident in 1962 led to the introduction of large American military forces into what was essentially a civil war. As the enemy, North Vietnam and the Viet Cong, had no navy to fight, the U.S. Navy was involved in carrier operations, coastal bombardments, and riverine operations. Despite the Navy's vital but peripheral role in the war, casualties amounted to 1,631 killed, 4,178 wounded, and 401 missing, plus about 150 taken as POWs. Navy personnel were awarded eleven Medals of Honor, five posthumously. The tragic outcome after ten long years of fighting led to a rethinking of American military strategy.

After Vietnam, incidents at sea involving American sea power continued to occur. Both sides sent out intelligence collectors to learn about the opposing fleets. On many occasions Soviet vessels intruded into American fleet operations, leading in a few instances to actual physical contact between ships at sea. American submarines carried out highly secret operations in or near to Soviet harbors.

In the Middle East, there was continuous tension among the various parties, alternately hot or cold. The U.S. Navy was a continuing presence in the Mediterranean and Indian Oceans. American forces became involved to safeguard American citizens when fighting broke out in Lebanon, Israel, Iran and Iraq. In 1991 after Iraq invaded Kuwait the United States led a multinational group which forced Iraq forces to withdraw and then invaded Iraq itself. The situation in the Persian Gulf smoldered on for a decade.

After the terrorist attacks on New York and Washington in September 2001, the American government took an aggressive stance first in Afghanistan, and then culminating in the decision to invade Iraq and depose the dictator Saddam Hussein. This in turn led to a long drawn-out war in the area. Navy casualties (to February 2008) total 92 killed and 600 wounded.

During these turbulent years, many drastic changes took place in the Navy. Unparalleled technological advances occurred in ships and weapons resulting in major changes in overall strategy and tactics. Faced with major innovations such as nuclear weapons and guided missiles, the early postwar years saw the first steps in using and defending against these weapons. A major event at this time was the unification of the armed forces. The traditional armed services were unhappy with the proposal which finally led to them being joined together in a new Department of Defense in 1947. The Army Air Force (formerly Air Corps) became an independent arm as the United States Air Force, and a struggle took place over which service was to take the lead in guided missiles. Long range missiles went to the Air Force, while short range (tactical) missiles were developed by the Army. The Navy lost the first round in developing a new aircraft carrier with the cancellation of the *United States* in 1949 immediately after construction started.

The Navy's first postwar program showed the new priorities calling for construction of one attack aircraft carrier (CVB, *United States*), two hunter-killer cruisers (CLK, *Norfolk*), three hunter-killer submarines, six high-speed submarines (*Tang*), and four high-speed destroyers. Existing and unfinished ships were converted to new plans, two *Essex*-class carriers, two CVL for ASW, twelve destroyers to escort destroyers (DDE), six destroyers for ASW, two DEs to radar pickets, one cargo submarine (SSA), one oiler submarine (SSO), one radar-picket submarine (SSR), and one submarine, one cargo ship and two LSDs for polar exploration.

The development of guided missiles caused great changes in the development of ships. Initial research used war-built German rockets and developments proceeded from these early weapons. In 1947 the submarine *Cusk* fired a Loon missile, the first time a guided missile was fired from a ship. Rapid advances were made. By 1950 several submarines had been adapted to fire missiles. By the end of the 1950s, missile-armed ships had replaced gun-armed ships. The destroyer *Gyatt* was refitted to carry missiles in 1956 and a number of World War II cruisers were rearmed with missiles. In 1961 the cruiser *Long Beach* was completed armed only with missiles. By the 1960s guided missiles had become the main armament of surface warships.

With the cruisers gone, the only big-gun ships left were the *Iowa*-class battleships. At the beginning of the Korean War only the *Missouri* remained in commission. Her three sisters were recommissioned for Korea, but by 1958 all were laid up. The *New Jersey* was used again in Vietnam. They were the subject of controversy, with arguments made for the retention of their 16-inch guns, and they remained on the Navy list. The only big-gun ships remaining, two were reactivated for the Gulf War in 1991. Despite a last-ditch stand by their advocates, they were finally stricken from the list by the 2006.

During the decades after World War II a divergence occurred in the nomenclature of ships as the Navy built a new larger destroyer type which was designated a frigate. At the same time the number of ships in the category designated cruisers was declining. Other navies used a different nomenclature, with the result that the U.S. Navy seemed inferior to the Soviet Navy in the cruiser type, although its frigates were of similar size and power. In 1975, the U.S. Navy revised its nomenclature, so that ships in the frigate category (DL/DLG) were redesignated as cruisers (CG) or destroyers (DDG) according to size. The Leahy and Belknap classes, and the nuclear Bainbridge, Truxtun and California and Virginia classes were reclassified as cruisers, while the smaller Farragut class ships were reclassified as guided missile destroyers. Ocean escorts (DE) were also redesignated as frigates (FF), which corresponded to foreign practice for a type smaller than destroyers.

The resulting cruiser classes were a odd mixture of World War II type cruisers and the new former destroyer types. At the same time attack carriers (CVA/CVAN) became multimission carriers (CV/CVN).

The use of nuclear power to fuel surface ships was first tried with the cruiser *Long Beach*, and then extended to aircraft carriers with the revolutionary USS *Enterprise*, completed in 1961. A few other nuclear cruisers were built but for surface ships nuclear power was retained only for the giant *Nimitz*-class aircraft carriers of which ten were built.

The change in the submarine fleet was most dramatic. With the introduction of nuclear powered submarines, the changeover from diesel was rapid. The last diesel submarines were built in 1959 and by 1980 almost all active submarines were nuclear-powered. The combination of nuclear power and ballistic missiles produced the SSBN. These ships could remain at sea submerged for weeks on end with their nuclear-armed long range missiles providing a major deterrent to an enemy during the cold war.

Huge new amphibious assault ships, some larger than World War II aircraft carriers enable the United States to deliver combat-ready units with their equipment, including armor, directly to the point of assault. These ships combine the attributes of transport, helicopter carrier, floating dock and supply ship.

The rise of electronic warfare is evidenced by the tangle of masts and radars which has grown on all types of ships. Starting with the early radar and sonar of World War II for detection of the enemy, new equipment was developed for intelligence, countermeasures, fire control, and navigation.

In 1949 the Military Sea Transportation Service (MSTS) was established to operate transports and supply ships. The similar ships operated by the Army were transferred to this service in 1950. In 1970 it was renamed the Military Sealift Command (MSC). Starting in the 1980s large ships were acquired which were filled with military equipment and supplies and positioned at overseas points to be ready in case of an emergency.

A large number of cargo ships are owned or chartered by the Navy as a Rapid Reserve Force to be used to bring supplies overseas when needed. Most of these are manned by civilians and are unarmed. Both the prepositioning ships and the Sealift ships have been used to great advantage during the wars in the Persian Gulf area starting in 1991. In addition the Navy has gradually decommissioned its large number of auxiliaries and replaced their Navy crews with civilians which are more economic and efficient.

The size of the Navy has changed dramatically. Reaching a peak of 550 ships in 1990, the number declined to 450 in 1994 and only 300 in 2001. New ships are increasingly automated so as to greatly reduce crew size. New designs are streamlined into stealth designs to reduce recognition by enemy radar.

This fifth volume of the U.S. Navy Warships Series brings the compilation of the ships of the U.S. Navy up to the present. The Navy system of nomenclature has simplified the task of listing all the ships of the period, but changes have made it more complicated. In addition the Navy has not followed its own system at times, skipping numbers, and sometimes using numbers wholly out of sequence, such as with the *Seawolf* class submarines. The accounting numbers assigned to the Sealift ships are included mainly to distinguish the many ships from each other.

The pictures used in this volume are predominantly official U.S. Navy photographs. Again, despite the number of photographs included, it has been impossible to illustrate every type and every change made during the period.

I appreciate the assistance of Ernest Arroyo, James Flynn, the

late Martin Holbrook, William Jurens, Norman Polmar, the late William Rau, William A. Schell, the late Ted Stone, Chris Wright, and the resources of the Naval Photo Club, International Naval Research Organization (INRO), the U.S. Navy History Division, the U.S. Ship Cancellation Society, the World Ship Society.

EXPLANATION OF DATA

The ships of the Navy for this period are listed according to the type of vessel as designated by the Navy. Combatant vessels are listed first, with auxiliaries following. Listings are also given for some other government departments, the Coast Guard, and the National Oceanic and Atmospheric Administration (NOAA) (formerly the Coast and Geodetic Survey). In most cases, a ship is listed only once under its initial classification and later changes are noted.

In this book, information for ships built or acquired before 1947 is provided only where it pertains to the period after that year. Full particulars and earlier history may be found in the fourth volume of this series on the World War II Navy.¹

Particulars are given for each ship as follows.

Number. The official Navy number according to the official nomenclature.

Name. Navy name as completed with former names (naval or merchant) given below. Further changes of name, if any, are indicated in the Service Record with new Navy names in **bold** type.

Builder. The builder's abbreviated name. The full name and location of most builders are given in the appendix.

Construction Dates. For Navy-built ships dates given are for laying down of the keel, launching and commissioning. For acquired vessels, dates given are date of launching, acquisition by the Navy and commissioning. For ships of the MSTS/MSC and Sealift ships, as these ships were not commissioned, the final date is the date the ship was placed in service. If the ship was completed as converted or for a foreign navy, the date is in *italics*.

Tonnage. For Navy built ships, tonnage is light displacement, and/or full load displacement. For acquired ships it is gross tonnage (grt), actually a measurement of volume rather than weight.

Dimensions. Standard dimensions given in feet (') and inches (") are length × beam × draft. Where known, length is specified as

overall (oa), between perpendiculars (bp)—that is between foreside of stem and aftside of rudder post, or on the waterline (wl). Where no type of length is given, registered dimensions are provided.

Machinery. Number of propellers, mode of propulsion, type and maker of engines and number and type of boilers where known, horsepower and speed. For submarines the surface and submerged figures are separated by a slash (/).

Endurance. Maximum distance a ship could steam at the speed indicated.

Complement. Normal figure for officers and crew. For some ships, where sources vary, a range (50/75) is given. There was often a large variance between peacetime and wartime complements.

Armament. Original number and type of guns or missiles is given first. Later significant changes are given with date, either by listing the entire complement of armament, or by indicating modifications as additions or subtractions from the previous data shown. The date reflects the date of survey rather than when changes were actually made. Minor variations are not necessarily given. Guns are described by size of bore in inches and caliber. Missiles are described by number of launchers.

Armor. Thickness of armor for the areas noted.

Notes. Additional information pertaining to design, construction or later modifications, acquisition, or earlier historical notes of interest, not included in other categories. Changes in Navy type are denoted as reclassified ("Rec").

Service Record. A capsule history of each ship's naval service showing assignment and war service including participation in engagements or operations, major damage to vessel or loss. Casualties are given in parentheses. Changes in Navy name are given here in **bold** type. Also final disposition by the Navy, loss, sale, or transfer to another agency or a foreign country. The term "returned" means returned to previous owner, often WSA or MC.

Battle stars (\bigstar) were awarded for the conflicts in Korea and Vietnam. The number of stars is indicated for each ship together with the time periods involved. For the Korean War these are

¹ Paul H. Silverstone, *The Navy of World War II, 1922–1947* (New York: Routledge, 2008).

shown as numbers for which the time period is shown in the Chronology. Where no number is given, that ship received only one star.

For the Vietnam War these are shown as time periods which can be aligned with the time periods shown in the Chronology. It has not been possible to find a complete list of stars awarded for Vietnam so no number appears for some ships.

In general, dates for deployments to foreign areas are shown only where ships and crew were entitled to wear campaign ribbons for deployments involving actual or possible combat; these are indicated by a diamond (\blacklozenge). Areas of the world where deployments were made are indicated as follows, although the operations may have been more widespread. Cuba, Taiwan Straits/ Quemoy-Matsu, Korea, Indian Ocean/Iran, Libya, Lebanon, Somalia.

Later history. Brief details of the ship's career after leaving Naval service including later merchant names, service in other government departments or in foreign navies. The name in the foreign navy is followed by the pendant number or numbers if changed, separated by a slash (E12/F12). In some cases where the trans-

literation of foreign characters has changed over the years, both styles of the name are given.

Ultimate fate is given where known, or the year the ship disappeared from shipping registers (RR). Occasionally a date is given for the last published reference (SE = still existing). The notation NDRF.SE means the ship was laid up in the reserve fleet at time of writing.

The traditional term Navy Yard was discontinued and the yards were redesignated Naval Shipyards on 30 Nov 1945. The naval districts were also realigned.² The word "vessel" discontinued in the nomenclature, 25 Aug 1960.

² In 1948 they were:

Ist Me, Vt, NH, Mass, RI; 2nd abolished; 3rd NY, Ct, NJ; 4th Pa, NJ, Del; 5th Md, Va, WV; 6th NC, SC, Ga, Ala, Miss, Tenn; 7th abolished; 8th Tex, La, Ark, Okla; 9th Great Lakes—Mich, Ohio, Minn, Ind, Ill, Ky, Wis, ND, SD, Neb, Kans, Colo, Wyo; 10th PR, Caribbean; 11th NM, Ariz, S Cal; 12th N Cal, Nev, Utah; 13th Wash, Ore, Ida, Mont; 14th Hawaii; 15th CZ; 16th Alaska

ABBREVIATIONS

*	battle stars (Korea, Vietnam)	GUPPY	greater underwater propulsive power
•	campaigns/expeditions	h/c	helicopter
AAW	anti-air warfare	HMS	Her Majesty's Canadian Ship
AC	Allis-Chalmers	HMS	Her Majesty's Ship
ARG	Amphibious Ready Group	IPDMS	Improved Point Defense Missile System
ASDS	Advanced SEAL Delivery System	IS	in service
ASROC	anti-submarine rocket	L	launched
ASW	anti-submarine warfare	LAMPS	light airborne multi-purpose system
B&W	Babcock & Wilcox	LASH	Lighter aboard ship
bbls	barrels	lchr	launcher
BG	Battle Group	LD	laid down
BHP	brake horsepower	LU	laid up
bp	length between perpendiculars	m/v	merchant vessel
BPDMS	basic point defense missile system	MAP	Military Assistance Program
BU	broken up, breaking up	Marad	Maritime Administration
CE	combustion engineering (boilers)	MC	U.S. Maritime Commission
CODOG	combination diesel or gas turbine	MG	machine guns
comm	commissioned, commission	MPF	Maritime Prepositioning Force
CT	conning tower	MPS	Maritime Prepositioning Ship
CTL	constructive total loss	MSC	Military Sea Command
DASH	drone anti-submarine helicopter	MSP	Mutual Security Program
decomm	decommissioned	MSTS	Military Sea Transportation Service
DET	diesel-electric trandem motor drive (Cannon class	MV	motor vessel
	DEs)	NASA	National Aeronautics and Space Administration
DTRC	David Taylor Research Center	NATO	North Atlantic Treaty Organization
EPA	Environmental Protection Agency	ND	Naval District
evac	evacuation	NDRF	National Defense Reserve Fleet
FBM	fleet ballistic missile	NECPA	National Emergency Command Post Afloat
f/l	full load	NFAF	Naval Fleet Auxiliary Force
FFU	further fate unknown	NOAA	National Oceanic and Atmospheric
FM	Fairbanks-Morse		Administration
FMR	geared diesel, Fairbanks-Morse reverse gear drive	NYd	Navy Yard
	(<i>Edsall</i> class DEs)	NRF	Naval Reserve Force
FRAM	fleet rehabilitation and modernization	NRT	naval reserve training
f/v	fishing vessel	NSP	non-self-propelled
grt	gross registered tons	NSYd	Naval Shipyard
GT	geared turbines	oa	length overall

xiv ABBREVIATIONS

OPDS	Offshore Petroleum Discharge System	SS2007	Strategic Sealift, active Apr 2007
o/s, OS	out of service	SSM	surface-to-surface missile
OSP	Offshore Procurement Program	ST	steam turbines
pdr	pounder	SURTASS	Surveillance Towed Array Sonar System
PPF	Prepositioning Force	SWATH	Small Waterplane-Area Twin Hull
PPS	Prepositioning Ships	SWPS	Stabilized Weapons Platform System
PRC	People's Republic of China	TACAN	Tactical Air Navigation
PUC	Presidential Unit Citation	TE	turbo-electric drive (Buckley class DEs)
R(year)	stricken from foreign navy	TEV	turbo-electric drive (DEs)
reacq	reacquired	tkr	tanker
RDF	Rapid Deployment Force	trfd	transferred
rec	reclassified	TS	training ship
recomm	recommissioned	TT	torpedo tubes
RO/RO	roll-off/roll-on	USA	U.Ŝ. Army
ROS	Reduced Operational Status	USAF	U.S. Air Force
RR(year)	removed from merchant register	USAHS	U.S. Army Hospital Ship
RRF	Ready Reserve Force	USAT	U.S. Army Transport
SAM	surface-to-air missile	USC&GS	U.S. Coast and Geodetic Survey
SCAJAP	Shipping Control Administration Japan	USCG	U.S. Coast Guard
schr	schooner	USCGC	U.S. Coast Guard Cutter
SE(year)	still existing	USMA	U.S. Military Academy
SEAL	Sea-Air-Land (team)	USMG	U.S. Military Government
SF	Sea Frontier	USN	U.S. Navy
SHP	shaft horsepower	VLS	vertical launch system
SLEP	Service Life Extension Program	VTE	vertical triple expansion
SOSUS	Sound Surveillance System	WGT	geared-turbine drive (John C. Butler class DEs)
SS	steam ship	wl	length on waterline

U.S. NAVY TYPE DESIGNATIONS

Aircraft Carriers

aircraft transport/training carrier
aircraft carrier/multipurpose carrier
attack aircraft carrier
nuclear attack aircraft carrier
large carrier
escort carrier
assault helicopter aircraft carrier
escort helicopter aircraft carrier
small aircraft carrier
nuclear carrier
support aircraft carrier (ASW)
training carrier
utility aircraft carrier

Battleships

BB	battleship
BBG	guided missile capital ship (proposed)

Cruisers

CA	heavy cruiser
CAG	guided missile heavy cruiser
CB	large cruiser
CBC	large tactical command ship
CC	command ship
CG	guided missile cruiser (xDLG)
CGN	nuclear guided missile cruiser
CL	light cruiser
CLAA	anti-aircraft cruiser
CLC	tactical command ship
CLG	guided missile light cruiser
CLGN	nuclear guided missile cruiser
CLK	hunter-killer cruiser

Destroyer Types

DD	destroyer
DDE	escort destroyer
DDG	guided missile destroyer
DDK	hunter-killer desetroyer
DDR	radar picket destroyer
DE	escort
DEC	escort, control
DEG	guided missile escort
DER	radar picket escort
DL	frigate
DLG	guided missile frigate
DLGN	nuclear guided missile frigate
FF	frigate (xDE) (30 Jun 1975)
FFG	guided missile frigate (xDEG)
FFT	frigate (reserve training)

Submarines

AGSS	auxiliary research submarine
APSS (LPSS)	transport submarine
(SSP)(ASSP)	•
ASSA	cargo submarine
IXSS	unclassified submarine
SS	submarine
SSAG	auxiliary submarine
SSBN	ballistic missile submarine
SSG	guided missile submarine
SSGN	nuclear guided missile submarine
SSK	anti-submarine submarine
SSN	nuclear submarine
SSO (AOSS)	oiler submarine
SSR	radar picket submarine
SSRN	nuclear radar picket submarine
SST	target & training submarine
X	submersible craft

Large Amphibious Vessels (old)

AGC	amphibious force flagship/
AGF	flagship
AKA	amphibious cargo ship
APA	amphibious transport
APD/LPR	high speed transport
IFS	inshore fire support ship
LSD	landing ship, dock
LS(FF)	landing ship, flotilla-flagship
LSI(G)	landing ship, infantry (gunboat)
LSI(L)	landing ship, infantry (large)
LSI(M)	landing ship, infantry (mortar)
LSM	landing ship, medium
LSM(R)	landing ship, medium (rocket)
LSS(L)	landing ship, support (large)
LST	landing ship, tank
LST(H)	landing ship, tank (evacuation)
LSU	landing ship, utility
LSV	landing ship, vehicle

Large Amphibious Vessels (new)

LCC	amphibious command ship
LCS	littoral combat ship
LFR	inshore fire support ship
LKA	amphibious cargo ship
LHA	amphibious assault ship (general)
LHD	amphibious assault ship (multipurpose)
LPA	amphibious transport
LPD	amphibious transport dock
LPH	amphibious assault ship (helicopter)
LPR	amphibious transport,/small
LCAC	air cushion landing craft
LCU	utility landing craft

Patrol Vessels

PC	submarine chaser (steel)
PCC	submarine chaser (control)
PCE	submarine chaser escort
PCEC	submarine chaser escort (control)
PCER	submarine chaser escort (rescue)
PCF	patrol craft (fast)
PCG	patrol chaser (missile)
PCH	submarine chaser hydrofoil
PCS	submarine chaser sweeper
PF	frigate
PG	gunboat
PGG	patrol gunboat (missile)
PGH	gunboat (hydrofoil)
PGM	motor gunboat
PHM	patrol combatant missile (hydrofoil)
PT	motor torpedo boat
PTF	fast patrol craft
SC	submarine chaser (wood)

Mine Vessels (old)

CM	minelayer
DM	destroyer minelayer
DMS	destroyer minesweeper
ACM	auxiliary minelayer
AM	fleet minesweeper
AMCU	coastal minehunter
AMS (ex-YMS)	coastal minesweeper

Mine Vessels (new) (7 Feb 1955)

mine countermeasures ship
fleet minelayer
auxiliary minelayer
coastal minelayer
destroyer minelayer
fleet minelayer
mine warfare command & support ship
coastal minehunter
minesweeping boat
coastal minesweeper, old
coastal minesweeper
fleet minesweeper
mine hunter
minesweeper, inshore
ocean minesweeper
minesweeper, special (device)

Auxiliaries

AB	crane ship
ACS	crane ship
AD	destroyer tender
ADG	degaussing ship
AE	ammunition ship
AF	store ship
AFS	combat store ship
AG	miscellaneous auxiliary
AGB	ice breaker
AGDE	escort research ship
AGDS	deep submergence support ship
AGEH	hydrofoil research ship
AOE	fast combat support ship
AGER	environmental research ship
AGF	command flagship
AGI	intelligence collector (unofficial)
AGL	lighthouse tender
AGM	missile range instrumentation ship
AGMR	major communications relay ship
AGOR	oceanographic research ship
AGOS	oceanographic surveillance ship
AGP	patrol craft tender
AGR	radar picket ship
AGS	surveying ship
AGSc	coastal surveying ship
AGSL	satellite launching ship (not used)
AGTR	technical research ship
AH	hospital ship

AK	cargo ship	YCK	open cargo lighter
AKD	cargo ship, dock	YCV	Aircraft Transport Lighter
AKE	dry cargo/ammunition ship	YD	Floating Derrick (Crane)
AKL	light cargo ship	YDG	Degaussing Vessel
AKN	net cargo ship	YDT	Diving Tender
AKR	vehicle cargo ship	YF	Covered Lighter
AKR	large medium-speed RO/RO ship	YFD	Yard floating dry dock
AKS	stores issue ship	YFN	Covered Lighter (NSP)
AKV	cargo ship & aircraft ferry	YFNB	large covered lighter
AL	lightship	YFND	dry dock companion craft
AN/ANL	net laving ship	YFNX	lighter (special purpose)
AO	fleet oiler; tanker	YFP	Floating Power Barge
AOG	gasoline tanker	YFB	ferry boat or launch
AOR	replenishment fleet tanker	YFR	covered lighter, reefer
AOT	transport oiler	YFRN	covered lighter, reefer (NSP)
AP	transport	YFRT	covered lighter, range tender
APB	self-propelled barracks ship	YFT	Torpedo Transport Lighter
APC	small coastal transport	YFU	harbor utility craft (1957)
APH	evacuation transport	VG	Garbage Lighter
AR	renair shin	VGN	Garbage Lighter (NSP)
ARB	hattle damage renair shin	VHR	house hoat
ARC	cable repairing or laying ship	VM	Dredge
ARC	internal combustion engine repair ship	VMP	Mine Planter
ARH	heavy hull repair ship	VMS	motor minesweeper
	landing craft repair ship	VNg	gate vessel
	salvage lifting ship	VNT	gate vessel
ARSD	salvage mung snip	VO	fuel eil barre
ARSI	salvage crait tender	IO	fuel oil barge (NSD)
ARS	salvage vessel	YON	nuel oli barge (NSP)
	aircraft repair ship	YOGN	gasolina harra (NSD)
ARVA	aircraft repair ship (aircraft)	YOGN	gasonne barge (NSP)
ARVE	aircraft repair snip (engine)	YOS	oll storage barge
ARVH	nelicopter maintenance ship	YP VDD	district patrol vessel
AS	submarine tender	YPD	Pile Driver (floating)
ASK	submarine rescue vessel	үрк	pontoon stowage barge
AIA	auxiliary ocean tug	YR	floating workshop
ATF	fleet ocean tug	YRB	submarine berthing barge
ATR	ocean tug, rescue	YRBM	repair-berthing-messing barge
ATS	salvage & rescue ship	YRD(H)	floating workshop, drycock (hull)
AV	seaplane tender	YRD(M)	floating workshop, drydock (machinery)
AVB	advance aviation base ship (1957)	YRR	radiological repair ship
AVP	small seaplane tender	YS	stevedoring barge
AVS	aviation supply ship	YSD	seaplane wrecking derrick
AVΤ	auxiliary aircraft transport	YSP	salvage pontoon
AW	distilling ship	YSR	sludge removal barge
IX	unclassified vessel	YTB	harbor tug, big
		YTL	harbor tug, little
Floating D-	v Docks	YTM	harbor tug, medium
Floating Dr	y DUCKS	YTT	torpedo testing barge
AFDB	floating dry dock, big	YV	drone aircraft catapult/control craft
AFDL	floating dry dock, little	YW	water barge
AFDM	floating dry dock, medium	YWN	water barge (NSP)

Small Amphibious Vessels LCC landing craft, cont

Service (Craft	LCC LCM	landing craft, control landing craft, mechanized
YAG	District Auxiliary Miscellaneous	LCP(L)	landing craft, personnel (large)
YC	Open Lighter	LCP(N)	landing craft, personnel (nested)
YCF	car float, railroad	LCP(R)	landing craft, personnel (ramp)

auxiliary repair dry dock medium auxiliary repair dry dock

ARD ARDM

xviii U.S. NAVY TYPE DESIGNATIONS

LCR(L)	landing craft, rubber (large)	WSC	patrol boat
LCR(S)	landing craft, rubber (small)	WSES	surface effect ship
LCS(S)	landing craft, support (small)	WTGB	icebreaking tug
LCV	landing craft, vehicle	WTR	training ship
LCVP	landing craft, vehicle-personnel	WYT	harbor tug
LVT	landing vehicle, tracked	WYTL	small harbor tug
LVT LVT(A)	landing vehicle, tracked landing vehicle, tracked (armored)	WYTL	small harbor tug

U.S. Coast Guard

WAGB	icebreaker
WAGL	lighthouse tender
WAGO	oceanographic cutter
WAGW	weather ship
WAK	cargo cutter
WARC	cable ship
WAT	tug
WAVP	tender type cutter
WAVR	air rescue boat
WDE	destroyer escort
WIX	training cutter
WLB	offshore buoy tender
WLI	inshore buoy tender
WLIC	inland construction tender
WLM	coastal buoy tender
WLR	river buoy tender
WLV	light vessel
WHEC	high endurance cutter
WMEC	medium endurance cutter
WMEH	medium endurance cutter, hydrofoil
WMSL	maritime security cutter (large) 2004
WMSM	maritime security cutter (medium) 2004
WOLE	offshore law enforcement vessel
WPB	maritime patrol boat 2004
WPBH	patrol boat, hydrofoil
WPC	maritime patrol coastal cutter 2004
WPC	patrol craft
WPG	gunboat

WSES	surface effect ship
WTGB	icebreaking tug
WTR	training ship
WYT	harbor tug
WYTL	small harbor tug
NOAA	
R	research
c	
3	survey

experimental
nuclear
MSTS/MSC (civilian manned)
parentheses not used after 1968
Word "vessel" not used after 1960

Maritime Administration Classification

First letter (ship type) (number indicates size)

С	cargo
Р	passenger
R	refrigerator
S	special type
Т	tanker
V	tug
VC	victory ship
EC	liberty ship

Second letter (propulsion) (number indicates shafts)

Μ	motor (diesel)
MET	diesel-electric
S	steam
SE	turbo-electric

U.S. NAVAL ORDNANCE, 1947–2007

William J. Jurens

Ordnance development in the U.S. Navy since the end of the Second World War has been characterized by a) the successive replacement of relatively short ranged large caliber gun-type systems with rocket propelled terminally-guided weapons of greatly extended range and equivalent accuracy, b) the replacement of relatively large, high-cost, high-maintenance manned aircraft with disposable missiles having a much lower impact on the delivery platform, and c) the introduction and deployment of nuclear weapons. Overall, the trend in weapons might be characterized as "fewer, but better"; current weapons are individually much more capable than their predecessors, but there are far fewer of them.

Although reliable data on many older weapons is easy to obtain, it is difficult to obtain and/or publish similar information on more recently deployed weapons, many details of which remain security classified. Precise evaluation of more modern weapon performance is also inhibited by the fact that the practical efficiency of many modern weapons is largely dependent upon electronic systems and computer software which, can (and is) modified without having an impact on exterior appearance. In that regard, information on weapons currently in service must be considered approximate and subject to continuous revision.

The sheer number of weapons that have been developed and deployed over the sixty-year span of this volume means that details of many low-production air-to-air missiles, bombs, and other items, including weapons primarily employed by the Marine Corps, have necessarily been omitted from this analysis.

GUNS

Although some smaller warships continued to mount light weapons intended to interdict unarmed or lightly armed vessels, by the late 1970s almost all guns with a caliber exceeding six inches had been retired from the fleet. Most of the light (six-inch) cruisers were gone by 1965; though some—partially converted to carry missiles—lasted until the early 1970s. Some of the heavy (eight-inch) cruisers, again partially or fully converted to carry missiles, lasted until the late 1970s. One 8" cruiser, using special ammunition, achieved gun ranges of about 70,000 yards in tests conducted during the Vietnam War. The last post-war designed large-caliber gun appears to have been the 8"/55 Mk 71, unsuccessfully mounted aboard destroyer *Hull* from 1975–79.

The 16"/50 mounted on the Iowa class was retired and resurrected several times, notably during the Korean War, the Vietnam War, and the Gulf War. Although a special Gunnery Improvement Program in the 1980s greatly improved the capability of the 16"/50 gun, the ships—and the guns—were finally retired in 1991 after a tragic explosion aboard USS Iowa two years before. The last of the old 5''/38s, representing a design then 66 years old, were retired at the turn of the twenty-first century, although some ships continued to mount single multipurpose 5" caliber weapons-in mounts of considerably greater complexity and capabilitythereafter. Although missiles remained the weapon of choice for engaging air targets at long ranges, their size and complexity meant that saturation attacks, i.e. simultaneous attacks by multiple aircraft approaching from various bearings, coupled with the inability of missiles to activate and maneuver in time to engage targets at close range mean that many U.S. Navy warships continue to mount small-caliber (under 3") weapons for close-in defense against missiles and small attack craft. The most notable of these is the 20 mm "Phalanx" CIWS "SeaWhiz" (Close-in Weapons System). Available in several models, this relatively light (14,500 lb) weapon is capable of engaging closing-i.e. potentially dangerous-targets entirely without human intervention, using onboard radar and computers to correct the stream of depleted uranium or tungsten bullets so long as the target continues to close. At 30,000 or 4,500 rounds per miniute, however, the 1,500 round magazine is depleted quite rapidly. Phalanx deployed in 1977 and remains in front-line service today (2008). The rapid development of missiles and aircraft meant that the old 20 mm and 40 mm guns installed on ships built during World War II did not last long; most of the 40 mm twin and quad mounts had been retired to the "mothball" fleet or had been replaced with 3" weapons by 1955. By 1975 the only 20 mm guns left remained aboard auxiliaries. Guns had disappeared completely from submarines by about 1960 as their conventionally-powered platforms disappeared.

The conflict in Vietnam, which lasted roughly from 1965 to 1975, saw a brief period of extensive installation and application of automatic small-caliber weapons aboard riverine craft, some adopted from Army and Marine inventories.

The emphasis on missiles and terminal guidance meant there were few really major developments in large-caliber gunnery fire control during the period; in fact the Mk 8 rangekeepers introduced during World War II were retained-and used-aboard the Iowa class ships until the 1990s. Fire control for anti-aircraft gun systems fared much better. Radars were, of course, greatly enhanced during this period, although their relatively poor resolution in azimuth and their inability to positively discriminate targets meant that they never completely replaced optical spotting. During the 1980s, unmanned remote piloted vehicles (RPVs), which essentially replaced the aircraft and helicopters previously used for such purposes, permitted battleship spotters to spot fall of shot visually from very close range. The first of these, basically remotely controlled model airplanes, have slowly morphed into the "Predator" type vehicles that are so popular and useful today.

A summary of the most important gun-type weapons of the period is given in Table 1.

ANTI-SUBMARINE WEAPONS

Post-war anti-submarine weapons began with trainable and and stabilized versions of Hedgehog. Mk 15 was mounted on old 40 mm quad mounts. "Weapon Alfa," never really very successful, was introduced in about 1949. It employed a single 12.5" rocket launcher to deliver a number of 250 lb fast-sinking charges to a range of about 750 yards, mimicking the pattern of Hedgehog. Weapon Alpha was the last variant of the Hedgehog gun-type weapons that shot "dumb" depth charges; subsequent weapons employed homing torpedoes instead. The rocket assisted torpedo (RAT) debuted about 1957; early versions carried a Mk 43 torpedo out to about 5,000 yards (with problematical accuracy); later versions, e.g. RAT C, could take a 30 knot Mk 44 out to 10,000 yards. RAT eventually evolved into "ASROC," which used a Talos booster and a JATO second-stage to deliver a Mk 46 homing torpedo out to about eight nautical miles. ASROC became operational about 1958; early versions used a "pepperbox" launcher; later versions used vertical launchers instead. "SUB-ROC," similar to ASROC, but launched from submarines, carried a 1-5 Kt warhead out to a range of about 30 nautical miles. Many destroyers retained above-water torpedo tubes in the form of new mounts designed for anti-submarine rather than anti-surface ship engagements.

The diminutive Drone Anti-Submarine Helicopter (DASH), represented an interesting (though basically unsuccessful) innovation which used an unmanned remote-controlled miniature helicopter to deliver an anti-submarine homing torpedo to ranges much greater than ASROC could reach. After 1983 DASH was replaced by the much larger, heavier (and much more capable) Light Airborne MultiPurpose System (LAMPS) which uses a manned SH-60 "Seahawk" helicopter equipped with MAD (Magnetic Anomaly Detector), dipping sonar, sonobuoys, and Mk 46 or Mk 60 homing torpedoes to deliver weapons out to ranges exceeding 200 miles.

As before, torpedoes could be launched from aircraft, surface ships, or submarines. Although anti-ship capability was maintained, the vast majority of post-World War II weapons were intended for use in anti-submarine roles.

TORPEDOES

The end of World War II saw seven weapons in common use, Mk 13, Mk 14, Mk 15, Mk 18, Mk 27, Mk 28, and (mine) Mk 24. Of the 15 types in development in 1945, only only three saw actual service; navol-powered submarine-launched Mk 16, aircraft or destroyer-launched active-homing anti-submarine torpedo Mk 32, and Mk 34, an aircraft-launched passive homer. Torpedoes Mks 27, 32, and 34 were largely seen as "interim" weapons, released for immediate use while newer torpedoes were being developed. Mk 32, a small destroyer-launched active-homer, was replaced by Mk 43. Mk 35 was an active/passive homer, originally intended for delivery by aircraft, ships and submarines (the aircraft delivery requirement was deleted in 1948). Mk 41, a stripped down aircraft-launched version of the old Mk 35 developed in 1944, was unsuccessful, and was quickly replaced by Mk 37 and Mk 43. Mk 37, also a variant of Mk 35, and also an active-homer, became the standard submarine weapon post-war, and was for a time, also issued to destroyers.

Old torpedoes were retired regularly. By 1955, the Navy employed Mk 14, Mk 16, and Mk 37 torpedoes aboard submarines, Mk 37 and Mk 43 aboard destroyers, and Mk 43 aboard aircraft. These were good weapons; Mk 16 was not retired until the mid-1970s, and Mk 14 remained in service until about 1980. Mk 37 began as an electrically-powered two-speed active homer, and retired about 1967. Commencing about 1973, some of the old Mk 37s were refitted with wire guidance and 90 hp thermochemical rotary piston engines, re-emerging as the NT 37 series.

Limitations on the weight that could be carried by aircraft meant that aircraft-launched torpedoes tended to be smaller and much less capable than their submarine- and surface-launched counterparts. The best example was was Mk 43, an electricallypowered active-homer which weighed only 250 lbs and was capable of being carried by virtually any aircraft in the fleet.

Work on Mk 44, an inexpensive 445 lb battery-powered activehomer began about 1952, but it did not reach the fleet until ten years later. Development of Mk 46, intended to replace the old battery-powered Mk 44s, commenced in the late 1950s. Mk 46 Mod 0 used a solid fuel motor that was unsuccessful; later mods were equipped with a 5-cylinder monopropellant cam engine. Mk 46, the successor to Mk 44, went in to production about 1963, with the first units employing a swash-plate engine powered by a solid propellant grain for propulsion. This did not work well, and after some experimentation with a seawater activated battery system, Mk 46 emerged with a liquid-fueled monopropellant cam engine.

In the mid-1950s some old Mk 27 torpedoes, then near retirement, were converted to Mk 39, and used to investigate the use of wire guidance. Wire guidance was formally introduced in torpedo Mk 45, a high-speed, long-range submarine launched weapon capable of carrying a nuclear warhead (which required positive control all the way to the target). Mk 45 was also the first successful submarine-launched weapon to employ a seawater activated battery propulsion system.

Wire-guided torpedo Mk 48 wire, a long-range anti-submarine and anti-ship torpedo, entered service in 1972. Powered by a 500 hp axial-flow liquid-propellant swashplate pump-jet engine, Mk 48 can reach a speed of 55 knots and depths of about 2,500 feet. The ADCAP (ADvanced CAPability) verson, with all digital electronics, has greater speed, range, and target tracking and detection capabilities. Mk 48 Mod 3 allowed two-way communication with the torpedo while it was running.

Torpedo Mk 50, specifically designed to similar dimensions to Mk 46, is designed for deployment from aircraft and surface ships. Propulsion is reportedly via a Rankine-cycle engine using lithium and sulfur-hexaflouride to generate steam.

The most common torpedoes employed during the post-World War II period are described in Table 2.

MINES

The delivery of mines via surface ships was largely abandoned after World War II, with almost all mines now laid via submarines or aircraft. Most newer mines are equipped with multiple activation features, making them very difficult to sweep using older conventional methods.

Mine Mk 52, a modified 1,000 lb aircraft bomb, carrying a 595 lb HBX warhead, first deployed in 1961. It could detect targets passing at less than 5 knots, and, in order to engage passing submarines, could cover depths up to about 600 feet. Mine Mk 55, is similar, but carries a 1,270 lb warhead. Mines Mks 56 and 57 are moored mines specifically designed to attack submerged submarines down to 1,200 feet.

Mine Mk 60, a.k.a. "Captor," specifically designed as an antisubmarine weapon, is basically a moored mine which automatically deploys a modified Mk 46 homing torpedo carrying a 98 lb warhead instead of simply exploding when activated. Development of Captor began in 1961, with the first units entering service in 1979. It is capable of operating at depths up to about 3,000 feet.

Mines Mks 62, 63, and 64—the "Quickstrike" series—were basically modified 500, 1,000, and 2,000 lb bombs, and would appear to be capable of operation at depths up to about 600 feet. Warhead weight is 192, 450, and approximately 1,000 lbs respectively. Mk 65, first deployed in 1983, weighs about 2,400 lbs and probably carries about a 1,000 lb warhead.

The Mk 67 Submarine Launched Mobile Mine (SLMM), introduced to the fleet in 1992, uses a small torpedo-like submarine to carry a Mk 37 torpedo (fused as a mine) into locations that would otherwise be inaccessible to conventional submarines or aircraft.

The most common mines employed during the post-World War II period are described in Table 2.

MISSILES

The first real U.S. naval missile, Loon, arguably the world's first cruise missile as well, was a slightly modified version of the Ger-



Figure 0.1: USS Mississippi (EAG 128), the old battleship now a gunnery training ship firing a Terrier missile during at-sea tests, about 1954.



Figure 0.2: A Terrier missile being fired from forward launcher on the cruiser *Long Beach*.

man V-1 "buzzbomb." Built in the United States during the latter months of World War II, Loon was originally manufactured to support the planned landings on the Japanese homeland in 1945. The missile could be launched from submarines and surface ships, and—unlike the original—could be actively controlled all the way to the target, when a radio signal from the firing ship sheared off the wings and put the vehicle into a terminal dive. Although range was nominally 150 miles, the radar horizon from submarines rarely allowed tracking to that distance. Too small to carry nuclear payloads, and never more than experimental, Loon was soon superseded by "Regulus," a much larger and more capable weapon which could still be launched from submarines or large surface ships. Regulus, first deployed in 1953, represented the Navy's primary nuclear deterrent prior to Polaris, and eventually morphed into Harpoon and Tomahawk.

The 1960s were dominated by members of the so-called "3-T" program, Tartar, Terrier, and Talos, all introduced about 1959. These three formed a complimentary anti-aircraft group, Tartar (RIM 24) (essentially Terrier without the booster) reaching 9 nautical miles, Terrier (RIM2) reaching 17 nautical miles, and Talos (RIM8) reaching 55. The latter two, i.e. Terrier and Tartar, were capable of carrying a nuclear warhead. Although policy required that nuclear-tipped variants remain under positive control at all times, versions with conventional warheads were granted much more autonomous flight regimes.

The first version of Talos, 6b, was designed to intercept incoming aircraft at ranges up to 70,000 yards. Within a few years the slightly larger "6bl" model effectively doubled this range. Version 6cl, the "unified Talos", was introduced about 1962 and could carry either nuclear or conventional warheads interchangeably. Unfortunately each Talos required the continuous attention of a dedicated guidance radar during flight, making the simultaneous engagement of multiple targets somewhat problematical. Further difficulties lay in the relatively large size of the missile, and its inability to respond quickly enough to protect against short ranged threats, e.g. missiles fired from nearby submarines, destroyers or small craft. Talos was powered by a ram-jet engine which took over after an initial launch by a solid rocket booster.

Terrier, a compact (and by most accounts relatively unreliable) variant of Talos, entered service about 1952. Although it also required full-time radar attention during flight, its small size made it much easier to install on missile frigates or destroyers— Talos generally required a cruiser. The first models, BW-0 and BW-1 were effective out to 20,000 yards; BT-3A, which debuted about 1956, had an improved control system, a 40,000 yard range and could be used as a surface to surface missile as well. Terrier was a two-stage weapon, with booster and sustainer motors.

Tartar, which entered service about 1961, was seen as a shortranged single-stage version of Terrier, sharing many components, and with shipboard requirements and impact about equivalent to a 5" twin gun mount. Early versions could reach about 15,000 yards, later versions more than twice this range. All could be used in either surface to air or surface to surface modes.

It was always recognized that the 3-T systems (arguably less Tartar), which required dedicated illuminators for each missile in the air, were vulnerable to being overloaded by saturation attacks "Typhon", a new missile with Talos performance squeezed into a Terrier-sized platform, was an early attempt to replace individual missile beam-riding and illumination with transponders, an idea which would in principle allow less directional radars to control a much larger number of missiles, much as an air traffic controller currently controls airplanes. Development of Typhon was abandoned in 1964 when the giant SPG-59 radar that would be required to control it—an item which would have consumed some 10,000 horsepower—proved too expensive and difficult to build. Funds were thereafter re-directed towards improving Tartar, Terrier, and Talos.

Commencing about 1967, the 3-T missiles were slowly replaced by successively improved (and enlarged) variants of the Standard missile (RIM66), which started out using basically the same airframe as Tartar. Early units had ranges of 16 to 25 nautical miles. SM-2 (RIM-67) which replaced Terrier, deployed about 1981 and could reach 90 nautical miles. Newer versions, e.g. RIM-156, are still in service, and can reach 200 nautical miles.

"Harpoon"-the current version of "Loon"-introduced in various models from 1977 to 1981, is an active-homing turbojetpropelled sea-skimming short range cruise missile that can be launched from aircraft, surface ships and submarines (aircraftlaunched versions dispense with the rocket booster used on the surface ship and submarine variants). Surface ship deployment is from Mk 140 or Mk 141 canister launchers, or older Mk 112 ASROC, or Mk 26 (standard) launchers. Block 1B variants deployed in 1982, fly a slightly different profile. Block 1C versions, deployed in 1985 used improved fuel for longer range. Block 1E, the Stand-off Land Attack Missile (SLAM), amounted to an entirely new design and became operational in 1988-1990, just in time for the First Gulf War. Block 1D, represents a larger variant which cannot be launched by submarines; Block 1Gs are Block 1C missiles upgraded to Block ID. Block 1H is an improved Block 1E.

The "Tomahawk" Sea Launched Cruise Missile (SLCM), first deployed in 1980, entered full service in 1983. The vehicle can be launched from both submarines and surface ships, and can carry a variety of conventional and nuclear warheads out to ranges exceeding 1,300 nautical miles. Block 1 came in two variants, BGM-109A Tomahawk Land Attack Missile-Nuclear (TLAM-N), carrying a 5-200 kT W-80-0 nuclear warhead, and BGM-109B Tomahawk Anti-Ship Missile (TASM), with a 100 lb conventional warhead. Tomahawks can be launched from conventional boxlaunchers or vertical launch systems (VLS). The launch sequence utilizes a rocket booster to attain initial speed, after which a turbofan cruise engine takes over and powers the vehicle on the remainder of its flight. Missiles used against land targets use sophisticated guidance systems to lead them directly to the intended target(s); missiles used against surface ships use a Harpoon-like radar seeker to approach in sea-skimming mode, and may be programmed to attack from above using a terminal "pop-up" mode. Many variants are now in service, with upgrading typically done at three- to four-year intervals. The latest variant as of this writing (2006) is RGM-109E, the Tactical Tomahawk, an economical three-fin version using a cheaper engine and a lighter structure which deployed in 2004; earlier variants, if not expended in combat or testing, were retired in the early 1990s.

Many naval units have been equipped with extremely low-impact "Stinger" missiles for close-in defence. These small missiles, which can be shoulder-fired by one or two men, employ an infrared homing system to deliver a 6.6 lb warhead to vertical ranges exceeding 15,000 feet. "Stinger"—manufactured in a number of variants over the years, first deployed about 1976.

Commencing with "Polaris" in 1962 the U.S. deployed—and continues to deploy—nuclear-tipped ballistic missiles aboard submarines, although numbers were considerably reduced after the fall of the USSR. In a natural evolution, Polaris was replaced by Poseidon in 1972, which was in turn superseded by Trident in 1979 and Trident II in 1989, each missile bigger and more capable than the last. Polaris and its successors were intended as strategic, rather than tactical weapons, primarily intended to deter the possibility of nuclear warfare with the Soviet Union. Commencing about 1990, i.e. with the end of the cold war, many submarines were equipped with vertically-launched land attack missiles which have been subsequently employed in tactical roles. A summary of the most important missile type weapons is given in Table 3.

NUCLEAR WEAPONS

Many nuclear weapons have been deployed by the Navy during the period covered by this volume. These were intended to be delivered as bombs or depth charges by aircraft, in torpedo warheads from surface ships and submarines, in missiles launched from submarines, aircraft, and surface craft, and, in one case, via a conventional gun. As might be expected, interchangeability and flexibility was much sought after; the A3D "Skywarrior" aircraft for example, was certified to carry no fewer than 13 discrete types of nuclear ordnance.

The early 1950s marked a period of rapid development in nuclear weapons as the Army, Navy, and Air Force battled for design control of these new and powerful devices. The first real "Navy" weapon was the Mk 8 "Elsie" (for "Light Case"), a 3,500-lb gun-type earth penetrator designed to destroy buried fortified structures at depths up to about 100 feet. Mk 8 came in two versions, one for internal and one for external stowage aboard AJ and A4D aircraft. Only about 40 were made. "BOAR" The Bureau of Ordnance Atomic Rocket (BOAR), introduced in 1956, was basically a modified Mk 7 bomb equipped with a rocket motor, one of the first air-to-surface stand-off missiles. BOAR, equipped with a 15,000 lb thrust motor could reach Mach 1, and-in versions designed to explode amongst enemy bomber formationsreach altitudes of 40,000 feet. About 225 were produced. The same Mk 7 warhead used in BOAR was installed aboard "Betty", a half-ton depth charge deployed in 1953. "Betty" was replaced by "Lulu," a much smaller weapon, with a much smaller yield, in 1959.

Nuclear weapons installed aboard missiles included the W-30 warhead which was used in Talos and Terrier. The first Submarine Launched Ballistic Missile (SLBM) weapons deployed aboard submarines were cursed with reliability problems. Polaris, which deployed in 1960 armed with a single (and fairly unreliable) W-47 warhead, and later equipped with three (slightly more reliable) independently targetable 200 Kt W-58 warheads, had a C.E.P. (Circular Error Probable) of about 6,100 feet. Poseidon could deliver anywhere between 6 and 14 independently-targetable W-68 warheads, each with a yield of about 45 Kt, to within about 600 feet, but again reliability was a problem. Trident I could deliver about eight 95 Kt W-76 warheads to within about 500 yards, and Trident II can deliver 8-15 475 Kt W-88 warheads within about 500 feet. It has been reported that the accuracy of nuclear weapons delivery systems (and warhead yields) were, at times, deliberately degraded in order to reassure potential enemies-i.e. the Russians-that they could not be effectively used in first-strike attacks against buried missile silos.

A summary of the most important nuclear weapons deployed by the Navy is given in Table 4.

AIRCRAFT

The development of aircraft over this period saw the more-or-less complete replacement of propeller-driven combat aircraft with jets, although piston-engined aircraft continued—and continue—to serve remarkably well in supportive roles or in situations where endurance is critical. The spotter/scout float-planes mounted aboard cruisers and battleships of World War II were at first replaced with helicopters, then—as carrier-based air became increasingly capable—abandoned altogether. Most propellerdriven fighters were gone by 1955, by then either worn-out or considered obsolete (a notable exception being the AD-1 "Skyraider," which deployed until near the end of the Vietnam War). The twin piston-engined AJ "Savage," produced only in small numbers, was the first aircraft capable of deploying nuclear weapons from carriers. After brief service in that role, most were converted to tankers.

The 1950s and 1960s marked a period of rapid development of jet aircraft, characterized by the sequential introduction of large numbers of usually rather short-lived aircraft, each in turn quickly superseded by a more capable successor. In later years the number of new aircraft introduced decreased in both type and absolute quantity ("fewer, but better"). This, coupled with the ability to upgrade weapons systems without rebuilding the airframe, meant that longevity increased by almost an order of magnitude over aircraft deployed during World War II. Over the years, aircraft armament evolved from the installation of machine guns and "dumb" bombs during the early 1950s to the current (and almost ubiquitous) employment of missiles and so-called "smart bombs" which in their later incarnations have essentially blurred the distinction between unmanned aircraft and missiles. In that context, it is interesting to note that the conventional gun-albeit in much improved form-continues in regular service, with even the most modern fighters continue to mount rapid fire 20 mm cannon.

A summary of the most important aircraft deployed is given in Table 5.

ARMOR

A general shift towards active rather than passive defensive postures—a feeling it was better not to get hit in the first place rather than to minimize damage after a hit had been received—meant that conventional armor in substantive thicknesses was hardly ever mounted aboard ships designed after 1945. As the likelihood of attack by large-caliber kinetic energy penetrators disappeared—to be replaced by the threat of very high speed fragments—thick conventional steel armors were in turn replaced by thin flexible membranes such as Kevlar, and lightweight (though relatively voluminous) ceramic and composite armors similar to those employed in armoured fighting vehicles.

Table 1 U.S. Naval Guns, 1945–2006

Gun	Weight (lbs)	Length (inches)	Initial Velocity (ft/sec)	Projectile Weight (lbs)	Charge Weight (lbs)	Range (yds) at Elevation (deg)	Dates in Service
16"/50 Mk 7	267,900	816	2,690 2,500	1,900 HC 2,700 AP	664 664	41,600@45 42,350@45	1942–1991
16″/45 Mk 6	192,300	736	2,625 2,520 2,300	1,900 HC 2,240 AP 2,700 AP	$544 \\ 544 \\ 544$	40,180@45 40,200@45 36.900@45	1940–1958
8"/55 Mk 9–14	67,200	449	2,800 2,800	260 HE 260 AP	90 90	31,860@41 31,860@41	1930–1947
8"/55 Mks 12, 15, 16	38,500	449	2,700 2,500	260 HE 335 AP	86 86	29,800@41 30,050@41	1939–1980
6"/47 Mk 16	9,632	232.3	2,500 2,800	130 AP 105 HE	32 32	26,100@47 23,500@47	1948–1958
5″/38 Mk 12	7,170	224.0	2,500	55.0	15.5	17,300@45	1934-1990
5″/54 Mk 16	5,360	249.0	2,650	69.3	18.5	25,800@45	1945-1980
5″/54 Mk 42	5,662	c.280	2,650	c.70	18.3	25,900@45	1954-1985
5″/62 Mk 45 Mod 4	unk	310	2,725-3,450	64-110*	18-26	26,000-100,000+*	2000-2007+
5″/62 Mk 45 Mod 0–2	3,560	310	c.2,700	c.68	18.25	25,300 @47	1971-2000
3″/50 Mks 22, 27, 33, 34	1,760	160	2,700	13	3.7	14,600@45	1948-1990
76.2 mm/62	1,686	unk	3,000	c.14.0	7.85	c.20,100@45	1964 - 2007 +
57 mm/70	unk	unk	3,120-3,360	c.14.0	2.60	15,000-19,000@45	1968-2007+
40 mm/56	1,150	98.4	2,890	2.00	0.70	c.10,500@45	1942-1960
20 mm/70	150	87	2,750	0.27	0.06	c.4,800@45	1941-1960
M-61 20 mm "Vulcan Phalanx"	13,000 (complete mount)	74	c.3,500	0.22	c.0.08	c.6,000@45 c.1,625@5	1980–2006
0.50 cal. machine gun BMG M2 GAU-18	c.90	c.63	2,850	0.11	0.03	c.7,500@45	1920–2007†
0.50 cal. machine gun GAU-19	139	47	2,910	0.11	0.03	c.7,500@45	1885–2007†

Notes: Only the most significant guns are listed; guns with short service lives or low procurements are generally omitted. * Lower range refers to conventional munitions, upper range to extended range rocket-assisted projectiles. † Still in service 2007.

Model	Diameter (inches)	Length (inches)	Weight (lbs)	Charge Weight (lbs)	Speed (knts) at Range (yds)	Dates in Service
Mk 13 (aircraft)	22.5	161	2,216	600	6,300@33.5	1936-1950
Mk 14 (submarine)	21.0	246	3,209	643	9,000@31 4,500@46	1931–1975
Mk 15 (surface)	21.0	288	3,841	825	15,000@26 10,000@33 6,000@45	1935–1975
Mk 18 (submarine)	21.0	245	3,154	575	4,000@29	1943-1950
Mk 23 (submarine)	21.0	246	3,209	643	4,500@46	1931-1980
Mk 24 "Fido" (aircraft)	19.0	84	680	92	4,000@12	1942-1948
Mk 28 (submarine)	21	246	2,800	585	4,000@20	1945-1960
Mk 32 (surface)	19	23	700	107	9,600@12	1950-1955
Mk 34 (aircraft)	21	125	1,150	116	3,600@17 12,000@11	1948–1958
Mk 35 (submarine/surface)	21	162	1,770	270	15,000@27	1949-1960
Mk 37 (submarine/surface)	19	135	1,430	330	10,000@26 23,500@17	1957-1970
Mk 37 NT (submarine/ surface)	19	135	1,430	330	15,000@36	1975–1984
Mk 43 Mod 1 (aircraft)	10	91.5	260	54	4,500@15	1951-1960
Mk 43 Mod 3 (aircraft)	10	91.5	265	54	4,500@21	1951-1960
Mk 44 (ASROC) (surface)	12.75	112	425	75	6,000@30	1960-?
Mk 45 "Astor" (submarine)	19	226	c.2,250	Nuclear	15,000@40	1963-1976
Mk 46 (multi-platform)	12.75	102	517	98	8,000@28+	1966–present
Mk 48 (submarine)	21	228	3,430	650	35,000@55	1972-с.1990
Mk 48 "ADCAP" (submarine)	21	228	3,700	650	35,000@63?	1988–present
Mk 50 ALWT "Barracuda" (air/surface)	12.75	112	750	100	17,000@46(?)	1981–present
Mine Mk 52	19	61	c.1,200	595	-	1961-present(?)
Mine Mk 55	23.5	79	c.2,075	1,270	_	1961-present(?)
Mine Mk 56	23.4	113	2,135	357	-	1964
Mine Mk 57	21	128	2,060	340	-	1966
Mine Mk 60 "Captor"	21	145	2,320	98	See Mk 46 Torpedo	1979–present
Mine Mk 62	10.8	49	c.560	192	-	1980–present
Mine Mk 63	14	113	c.1,000	450	-	1981
Mine Mk 64	18	152	c.2,000	1,000(?)	_	1983(?)
Mine Mk 65	20.9	110	2,400	1,000(?)	_	1983
Mine Mk 67 (SLMM)	21	161	1,760	529	5	1992

Table 2U.S. Naval Torpedoes and Mines, 1945–2006

Note. Weapons are listed by Mark number. Missing Mark numbers represent unsuccessful weapons or weapons which did not see extensive service. Performance details of currently operational torpedoes have been estimated from unclassified sources.

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Table 3 U.S. Missiles, 1945–2006

Designation	Weight (lbs)	Diameter (inches)	Length (inches)	Range (naut miles)	Payload Weight (lbs)	Dates in Service
JB-2 "Loon"	5,000	34	325	140	2,000	1946–1952
SSM-N-8 "Regulus"	13,700	56.5	386	500	3,000c W5 or W27 Nuc	1955–1964
SAM-N-7 RIM 2 "Terrier"	2,350-3,000	13.5	162–177	10–40	218c W45 Nuc	1956–1988
SAM-N-6 RIM-8 "Talos"	c.7,800	28	456	50-100	300c W30 Nuc	1959–1979
RIM-24 "Tartar"	c.1,300	13.5	181–186	7–18	c.125c	1962-1990
RIM-66 "Standard"	1,100-1,400	13.5	175	17–25	137c	1970-2004
RIM-67 "Standard"	2,980	13.5	315	65-100	250c	1981–present
RIM-7 "Sea Sparrow"	c.500	8	144	8	86	1976–present
AGM-84 "Harpoon"	1,470	13.5	180	60+	488c	1977–present
FIM-2 "Stinger"	22	3	60	3.5	6.6	1970–present
RUR–5 ASROC	c.1,000	13.25	177	5.0-8.7	Mk 44 or Mk 46 Torpedo or W44 Nuc	1960-present
RUM139 ASROC	c.1,400	16.6	193	7.5	Mk 46 or Mk 48 Torpedo	1962–present
UUM-44 SUBROC	4,000	21	252	30	W55 Nuc	1965-1992
BGM/UGM/RGM-109 "Tomahawk"	4,200	20.5	219-246	250-1,350	1,000c W80 Nuc	1978–present
UGM-27 "Polaris"	35,000	54	388	1,200-2,500	$3 \times W80$ nuc	1962–1974
UGM-73 "Poseidon"	65,000	74	408	2,500-3,200	10–14 MIRV Nuc	1971-1979
UGM-96 "Trident"	70,000	74	408	4,350	8 MIRV Nuc	1979-2002
UGM133 "Trident II"	130,000	83	528	6,000	7 MIRV Nuc	1990-present

1st symbol		2nd	symbol	3rd	3rd symbol	
A	air	G	surface attack	М	missile	
В	multiple	Ι	air intercept	R	rocket	
М	mobile	U	underwater attack			
R	ship					
U	underwater					

Model	Diameter (inches)	Length (inches)	Weight (lbs)	Yield	Deployed in
	c.42	76	c.2,500	6–120 Kt	Regulus missile
W-7	30.25	55	983	32 Kt	Mk 90 "Betty" depth charge + Mk 7 bombs
W-23	16	64	c.1,700	c.15 Kt	"Katie" 16″ gun round
W-27	30.25	75	2,800	2Mt	Regulus missile, Mk 27 bomb
W-30	22	48	c.450	300–500 t	Talos missile
W-34	17	32	c.315	10–15 Kt	"Lulu" depth charge, Mk 44 "Astor" torpedo
W-44	13.75	25.5	170	10 Kt	Asroc missile
W-45	11.5	27	150	500 t–15 Kt	Terrier missile
W47	18	46.5	c.730	600 Kt-1.2Mt	Polaris missile
W-55	13	39.4	470	1–5 Kt	SUBROC missile
W-58	15.6 conical	40.3	260	200 Kt	Polaris A-3 missile
W-68	12.5 (?) conical	60(?)	367	c.45 Kt	Poseiden Mk-3 missile*
W-76	c.12.5 conical	48-60	363	100 Kt	Trident missile*
W-80	11.8	31.4	290	c.180 Kt	Tomahawk missile
W-88	21.8	68.9	750 (?)	475 Kt	Trident II missile*
Bomb Mk-4	60	128	10,300	1–31 Kt	B-29, AJ
Bomb Mk-5	44	129-132	3,100	6–120 Kt	Many aircraft
Bomb Mk-7	30.5	183	c.1,675	8–61 Kt	FJ-4, F2H, F-84, A4D-1 aircraft
Bomb Mk-8 "Elsie"	14.5	116–132	3,250	25–30 Kt	AJ & A4D aircraft
Bomb Mk-12	22	155	c.1,150	c.15 Kt	Many aircraft
Bomb Mk-15	34.7	139	7,600	c.1.8 Mt	A3D
Bomb Mk-28	20	170	1,885	70 Kt-1.5 Mt	A3J (A-5) "Vigilante" aircraft
Mk 1 Rocket "BOAR"	30.5	189	2,070	c.32 Kt	Many aircraft
Mk 90 "Betty" Nuclear depth charge	31.5	122	1,250	c.32 Kt	Many aircraft
Mk 101 "Lulu" Nuclear depth charge	18	92.4	1,200	10–15 Kt	Many aircraft

Table 4U.S. Naval Nuclear Weapons, 1945–2006

Table 5	U.S. Nava	l Aircraft,	1945-	-2006
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Name	Туре	Number Procured	Gross Wt (lbs)	Span (ft) Length (ft)	Range (naut miles)	Speed (knots)	Dates in use
Douglas AD-1 "Skyraider"	Bomber	3,180	18,250	50'-0" 38'-2"	800	280	1945–1972
Gyrodyne DSN-1 (QH-50) DASH	Drone Helicopter	c.700	885-2,300	rotor dia 20'–0″	26-40	67–92	1962–1970
Lockheed P2V "Neptune"	Patrol	1,036	61,000-75,000	100'–0" 77'–10"	c.4,000	300	1947–1982
Grumman F9F-2 "Panther"	Fighter	1,388	18,800	38′–0″ 35′–10″	1,128	502	1949–1962
North American FJ-4 "Fury"	Fighter	1,115	23,700	39'–1″ 36'–4″	1,750	465	1953-1962
Grumman F9F-6 "Cougar"	Fighter	1,985	19,750	34'-6" 41'-9"	561	1,050	1954–1969
McDonnell Douglas A4D "Skyhawk"	Fighter	2,876	24,500	27'-6" 40'-4"	450	580	1956–1994
Vought F-8 "Crusader"	Fighter	1,264	34,100	35′–8″ 54′–3″	985	1,250	1957–1982
McDonnell-Douglas F-4 "Phantom II"	Fighter	4,261	56,000	38′–5″ 58′–4″	1,900	1,230	1960–1989
Grumman E-2C "Hawkeye"	Patrol	215	51,200	81′–0″ 58′–0″	1,525	270	1966–present
Bell UH-1N "Huey"	Helicopter		5,550	45'-10"	250	110	1967–present
Grumman EA-6B "Prowler"	Patrol	890	65,000	53'-0" 60'-0"	2,085	565	1971–present
Grumman F-14 "Tomcat"	Fighter	700	74,000	64'-2" 62'-8"	1,800	1340	1973–2006
McDonnell Douglas F/A18A "Hornet"	Fighter	750	36,000	37′5″ 56′–0″	2,100	1,180	1983–present
McDonnell Douglas F/A18E "Super Hornet"	Fighter	350+	66,000	44'-9" 60'-1"	600	1,180	1999–present
Sikorsky SH-60 "Seahawk"	Helicopter	204	22,500	64'-8"	200	135	1986–present
Douglas A3D "Skywarrior"	Bomber	c.280	82,000	72'-6" 76'-4"	c.700	2,100	1956–1989

Notes: Aircraft are listed in order of introduction. Generally only aircraft of particular significance or aircraft procured in numbers exceeding 1,000 are listed. Aircraft primarily produced for or used by other services, e.g. those employed exclusively by the Marine Corps, are generally omitted. Many aircraft with similar/ identical designations went through a number of model changes and, particularly with more recent aircraft, significant variations in dimensions and capabilities are common. Dates of withdrawal from service are approximate, as aircraft were often retired to training or expended as drones long after they were in active service. For aircraft procured before c.1990, the best general reference remains the third edition of Swanborough and Bowers *United States Navy Aircraft Since 1911*. The Naval Historical Center website contains valuable information as well.

BIOGRAPHY

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William Jurens has been an associate editor and staff draftsman of the Journal *Warship International* since 1986, and is a Silver Member of the United States Naval Institute. He has been a member of the Society of Naval Architects and Marine Engineers (SNAME), Marine Forensics Panel (SD-7) since 1995, and has published several papers on the loss and wreck examination of various warships, including "The Loss of HMS *Hood*—A Reexamination" (1987), and "A Marine Forensic Analysis of HMS *Hood* and DKM *Bismarck*" (2002). He has, to date, acted as a consultant and contributor in the production of four television programs concerning the loss of HMS *Hood*, DKM *Bismarck*, and the British battle-cruisers sunk at Jutland, and participated in the investigation into the explosion aboard USS *Iowa* in 1989. He has also published a number of papers on ordnance and ballistics, most notably "The Evolution of Battleship Gunnery in the U.S. Navy, 1920–1945" (1991). He regularly collaborates with well-known authors on the production of full-length books dealing with historical naval technology.

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Figure 0.3: USS St. Francis River (LSMR 525) serving as mother ship for small craft in the Mekong Delta during Operation Deckhouse, Jan 1967. Coast Guard cutter *Point Kennedy* (WPB 82320) and PCF-98 are alongside.



Figure 0.5: LSTs beached after the landings at Inchon, Korea, 15 Sep 1950. Right to left are LST-715, LST-845, and LST-611.



Figure 0.4: USS *Tutuila* (ARG 4), with a floating drydock alongside, serving as tender for fast coastal patrol boats, Vietnam, November 1967. Notice the PCF boats clustered at left.



Figure 0.6: The heavy cruiser *Helena* (CA 75) bombarding targets at Chong-Ji, Korea, Oct 1950.



Figure 0.7: Interior of docking well of USS Shreveport (LPD 12), March 1972, with mechanized landing craft preparing for an assault landing.



Figure 0.8: LCU-1643 with American citizens on board enters the docking well of *USS Coronado* (LPD 11) during the evacuation from Beirut, Lebanon, 27 July 1976.

	1946	Dec–4 Mar 1947	Operation High Jump, exploration of Antarctica
	1947	18 Feb	Submarine Cusk is the first U.S. Navy (USN) ship to launch a guided missile, a Loon
		18 Sep	National Military Establishment (later Defense Department) becomes effective, unifying the armed services
	1948	24 Jun	Soviet forces blockade Berlin; Berlin Airlift begins; blockade ends 9 May 1949, but airlift continues until
	1040	4.4 mm	30 Sep 1949 NATO satablished becomes effective 24 Aug 1040
	1949	4 Api 18 Apr	NATO established, becomes enective 24 Aug 1949
		18 Apr 95 Amr	Reel faid for alrefall carrier <i>United states</i> , canceled 25 Apr by Secretary of Defense Johnson
		25 Aug	Solver Union defonates an atomic bomb
		26 Aug	Submarine <i>Cochino</i> sinks in Arctic north of Norway
		1 Oct	Army Transportation Corps ships are transferred in 1950
		8 Dec	Chinese Nationalist government of Chiang Kai-shek moves to Taiwan, abandoning mainland China
Korea	1950	25 Jun	Korea: North Korea invades South Korea; U.S. armed forces ordered to support South Korea, 27 Jun, under auspices of the United Nations
Inchon		13-14 Sep	Kores I and instant Actions
Wonsan		15-14-50p	Korea: Landings at Monora
wonsan		94 Nov	Korea: Chinese armed forces start offensive operations in Korea
		1 Dec	Korea: Evacuation of Chosan 37 Dec 1950: evacuation of Wonean
		10_94 Dec	Korea: Evacuation of Hungman: 328 000 traces and 01 000 refusees and equipment were transported
	1051	7 Apr	Korea: Ceneral MacArthur relieved of command by President Truman
	1551	10 Iul	Korea: Cease fire talks at Kaeson berin mared 8 Oct to Pannuniom
	1059	10 Jul 1 Nov	First U.S. thermonuclear bomb is detonated at Enjoyetek
	1952	97 Iul	Korea: Armistica imped at Pannuniom anding Korean War hostilities
	1955	27 Jui 91 Jan	The Martilles first puscher personal submarine is lounched
On Castle	1554	Ech Mov	<i>Description Castle</i> , high indef the monopulate is faunched
Op.Gasue		95, 96 Jul	Denum Casta - ingin yield thermonuclear devices are tested at Distin
		20–20 Jui	Taiwan Statis, U.S. tailet antiat attacked by I.K. antiat on Infantan
		Aug 16 Aug	Taiwan stratis: 1st fatvan stratis crisis, guernoy-watsu rassage to Freedom.
		10 Aug	vienam: fransfer of vienamese from north to south starts 293,002 civinans and 17,640 mintary personner area transported until 18 may 102 m (of the transport of Fundam)
		20 Sam	are transported unit to May 1955 (Operation Fussage to Freedom)
	1055	50 Sep	Os matura, institucien powered submarine, commissioned
	1955	1 FCD 6 12 Eab	Operation Deep Freeze, Anarcuca
	1056	0-15 Feb 90 Oct	Lawan Statis, Cost evaluates troops and chinais non rachen Islands on Chinese Coast
	1950	29 Oct	Suez Canai nauonanzeu. Brusin & Freich troops tano in Egypt
Labanan 1059	1956	Api 14 Iul	Admospheric futcheat tests (<i>Operation Futurata</i> (x)
Centre of Materia		14 Jul 99 Jul 1 Jun 1069	Lebanon : U.S. forces sent to Lebanon (10 30 Sep 1938)
Quemoy-Matsu	1050	25 Jui-1 Jun 1962	aiwan straits: Seventh Free operations on Quemoy and Matsu and in the Taiwan straits
	1959	50 Dec	George washington, first ballstic missile submarine, commissioned
	1960	10 May	Submarine <i>Triton</i> completes circumnavigation of the world submerged
	1901	17 Apr	Cuba: Landing at bay of Figs, Cuba
		э мау 1 Т	rinst man in space—Aian Snepard is launched in Mercury capsule
		1 Jun	Zha neet ordered on southern Dominican Republic
		13 Aug	berlin waii erected
	1000	9 Sep	Long Beach, first nuclear surface warship, commissioned.
	1962	Feb-Oct	Cuba: Patrol operations off Cuba

Cuban missile crisis	1962	4 Oct	Cuba: Cuban missile crisis; nuclear warheads arrive in Cuba; quarantine of Cuba by USN forces, 24 Oct
	1963	10 Apr	Nuclear submarine Thresher lost with all hands east of Cape Cod
	1964	Oct 2 Aug	Relief operations in Haut after Hurricane Flora Vietnam: Destroyer Maddox attacked by North Vietnamese torpedo gunboats in Gulf of Tonkin; a second
	1965	11 Mar	Vietnam: Operation Market Time begins; U.S. Navy operation to stop troops and supplies from flowing by sea
		97 Apr	to South Vietnam from the north Marines land in Dominican Republic to evacuate U.S. citizens, withdraw
		26 May	Dominican Rep.: operations to prevent a government friendly to Cuba from regaining power (<i>Oberation</i>
		1 0 may	Powerback)
	1967	1 Apr	Coast Guard incorporated into new Department of Transportation
		8 Jun	Israeli forces attack USS Liberty north of Sinai Peninsula
	1968	21 Jan	Vietnam: Siege of Khe Sanh, lasts until April 14
		22 Jan 20 Jan	USS Pueblo seized by North Koreans off east coast
		50 Jan 99 May	Nuclear submarine Scorbion is lost in North Atlantic
		8 Oct	Vietnam: Operation Sealords—intended to disrupt North Vietnamese supply lines in and around the
			Mekong Delta (to 1970)
		1 Nov	Vietnam: President Johnson orders cessation of hostilities in North Vietnam (later resumed 6 Apr 1972 until 30 Dec 1972)
	1969	1 Jan	Amphibious ships are reclassified to new L-series designations
		13 Jan	Vietnam: Operation Bold Mariner-largest amphibious assault of Vietnam War
	1050	14 Apr	Korea: U.S. Navy EC-121 plane shot down by North Koreans; TF 71 demonstrates 20–26 Apr 1969
	1970	29 Apr	Vietnam: U.S. and South Vietnamese forces invade Cambodia MSTS renormed Military Sealift Command (MSC)
	1979	1 Aug 6 May	Vietnam: Mining campaign against North Vietnam ports. <i>Objection Packet Maney</i>
	1973	27 Ian	Vietnam: U.S.–North Vietnam cease fire goes into effect: POWs released
		27 Feb	Vietnam: U.S. begins minesweeping operations off Haiphong
		15 Aug	Vietnam: U.S. offensive operations in South East Asia end
		6 Oct	War between Syria and Egypt and Israel: Yom Kippur War
	1974	22 Jul	U.S. and British evacuate civilians from Cyprus: Turks land on Cyprus
Evac of Cambodia	1975	12 Apr 91 Apr	Vietnam: Operation Eagle Pull—evacuation of U.S. personnel from Cambodia
Evac of Vietnam		21 Api 99–30 Apr	Vietnam: Obstation Frequent Wind—evacuation of 1 500 U.S. personnel from Saigon: 26 000 refugees reach
Livite of Victualit		22 00 mpi	the Philippines, also numerous ships of South Vietnam Navy
Mayaguez Op.		12 May	Vietnam: U.S. merchant ship <i>Mayaguez</i> seized by Cambodian gunboat, ship and crew recovered by U.S.
			forces on 15 May (41 killed)
		30 Jun	Reclassification of DLG to cruisers, DE to frigates
Beirut Evac	1976	20 Jun–27 Jul	Lebanon: Beirut evacuation—263 Americans
	1979	10 Jan 91 Feb	Southwest Asia: Revolution in Iran overthrows government of the Shan who nees
		8 Mar	Southwest Asia: Navy helps evacuate people from manual ports
		23 Jul	Vietnam : Navy starts rescuing Vietnamese "boat people"
		30 Sep	Panama Canal Zone turned over to the Republic of Panama
		4 Nov	Southwest Asia: Iranian militants seize U.S. embassy in Teheran, take hostages (released 20 Jan 1981)
	1000	27 Dec	Soviet forces invade Afghanistan
	1980	24 Apr	Southwest Asia: Operation to rescue hostages in Teheran fails— <i>Operation Eagle Claw</i>
Liberia 1980	1080	5 Aug	Southwest Asia : Tanker escording operations 1980 Liberia (Obstation Sharp Edge) (to 21 Feb 1001)
Liberta 1500	1980	19 Aug	Libva: Libvan fighters engage U.S. planes—two Libvan fighters shot down Gulf of Sidra
	1982	2 Apr	Argentine forces land in Falkland Islands
		6 Jun	Lebanon: Israeli forces occupy southern Lebanon
Lebanon 1982		23 Jun	Lebanon: Evacuation of Beirut embassy
		25 Aug	Lebanon: Marines land in Lebanon to provide security for evacuation of PLO
	1009	20 Sep	Lebanon: Marines land in Lebanon again following assassination of president Gemayel
	1983	1 Feb 18 Apr	Counter-insurgency operations in Honduras
		1 Sep	Soviet fighters shoot down Korean airliner off Kamchatka
		23 Oct	Lebanon : Terrorists destroy Marine barracks in Beirut, 241 killed
Grenada		23 Oct	Invasion of Grenada (Operation Urgent Fury)
	1984	21 Feb	Lebanon: Marines evacuate Lebanon
Libya/El Dorado	1986	20 Jan	Libya: Operations in Gulf of Sidra to demonstrate freedom of the seas to Libya
		24 Mar	Libya: Libyan aircraft attack U.S. forces
	1087	12–17 Apr 17 May	LIDya: U.S. carrier aircrait Domb Libya (<i>Operation Eldorado Canyon</i>)
	1907	17 May 25 May	Southwest Asia: Fligate Stark damaged by Haqi missiles in Persian Guir Southwest Asia: U.S. Navy starts escorting reflagged Kuwaiti tankers in Persian Gulf (Oberation Farmest
			Will)
	1000	19 Oct	Southwest Asia: Two Iranian oil platforms destroyed by U.S. surface warships
	1988	14 Apr 18 Apr	Southwest Asia: Frigate Samuel B. Roberts damaged by a mine in Persian Gulf
		18 Apr 3 Iul	Southwest Asia: Iranian migates <i>Sanand</i> and <i>Sabalan</i> attacked by U.S. ships in Gulf, one sunk
Panama	1989	20 Dec	Invasion of Panama (Operation Just Cause)
		-	

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Liberia 1990	1990	5 Aug	U.S. forces evacuate civilians from civil war in Liberia (thru Nov 1990) (<i>Operation Sharp Edge</i>); 1,700 are evacuated from Monrovia
	1990	2 Aug	Southwest Asia : Iraqi troops invade Kuwait; U.S. moves to protect Saudi Arabia with massive movement of troops and supplies by ship (<i>Operation Desert Shield</i>)
Desert Storm/SW Asia	1991	17 Jan	Southwest Asia: Operation Desert Storm; coalition forces attack on Iraq and Kuwait, ground war starts on 23 Feb, cease fire ordered 28 Feb
	1991	4 Jan	U.S. starts evacuating civilians from Somalia
		30 Dec	Soviet Union defunct, cold war ends
	1992	Jan	Southwest Asia : Operation Northern Watch/Southern Watch—Maritime intercept operations and enforcement of no fly zone in Irza & Arabian Culf (to Mar 2003)
Somalia 1009-05	1009	5 Dec	O highly 2016 in half & Alabian food (10 Mar 2003) Observation Restors Hoke to deliver food and restore security in Somalia (to 31 Mar 1005)
50mana 1 <i>55</i> 2–55	1002	17 Jan	Southwast Asia: Attack on Iragi installations
	1994	Aug	US Naw operations to halt Cuban refugees coming to U.S. (Observation Able Vigit)
Haiti 1994	1994	16 Sen	Hairi (Oberation Libbold Democracy)—blockade of Haiti (to 31 Mar 1995)
11atu 1551	1995	30 Aug	Striles on Rosnig also 5 Sen & 10 Sen (Obstriction Deliberate Force)
	1555	1 Dec	Southwest Asia: Iraa (Observation Maritine Interaction Constraints and Constr
	1996	May	Taiwan Strains, and Coperation International Materials, missile tests Chinese naval exercises in Taiwan area
	1550	3–4 Sep	Southwest Asia: Attacks on Iraoi targets
		20 Dec	Operations in Kosovo (Oberation Joint Guard) (to 20 Jun 1998)
	1998	20 Dec 91 Jun	Bosnia (Oberation Diote Force)
	1550	21 Jun	Bosnia (operation Solid Page) Kosovo (Operation Noble Anvil)
		Aug	Terrorist bombings of U.S. embassies in Kenya and Tanzania
		Aug	Attacks on Al Qaeda Afghan camps & Sudan
Desert Fox		16–22 Dec	Southwest Asia: U.S. forces launch cruise missile attacks against military targets in Iraq (Operation Desert Fox)
	2001	11 Sep	Terrorist attacks on New York and Washington
Afghanistan 2001		7 Oct	U.S. forces commence combat action in Afghanistan against Al Qaeda terrorists and their Taliban supporters (<i>Operation Enduring Freedom</i>)
	2003	25 Feb	Coast Guard transferred to Department of Homeland Security
Iraq War 2003	2003	20 Mar	Southwest Asia: United States-led coalition including Britain invades Iraq with the stated goal of eliminating
1			Iraqi weapons of mass destruction; by 1 May 2003, President Bush declares "mission accomplished";
			occupation of Iraq by foreign military forces continues through 2008 (Operation Iraqi Freedom)
Tsunami relief	2004	26 Dec	Earthquake and tsunami devastate Sumatra and neighboring countries killing about 230,000 people
	2006	17–19 Jul	Lebanon: Evacuation of Beirut

PHASES OF THE KOREAN WAR

K-1	North Korean Aggression	27 Jun–2 Nov 1950
K-2	Communist China Aggression	3 Nov 1950–24 Jan 1951
K-3	Inchon Landing	13–17 Sep 1950
K-4	1st UN counteroffensive	25 Jan–21 Apr 1951
K-5	Communist China Spring	
	Offensive	22 Apr–8 Jul 1951
K-6	UN Summer Offensive	9 Jul–27 Nov 1951
K-7	2nd Korean Winter	28 Nov 1951–30 Apr 1952
K-8	Korean Defense	1 May-30 Nov 1952
K-9	3rd Korean Winter	1 Dec 1952–30 Apr 1953
K-10	Korea Summer-Fall 53	1 May–17 Jul 1953

PHASES OF THE VIETNAM WAR

Vietnam Advisory Campaign Vietnam Defense Campaign Vietnam Counter-offensive Vietnam Counter-offensive II Vietnam Counter-offensive III Tet Counter-offensive 15 Mar 1962–7 Mar 1965 8 Mar 1965–24 Dec 1965 25 Dec 1965–30 Jun 1966 1 Jul 1966–31 May 1967 1 Jun 1967–29 Jan 1968 30 Jan 1968–1 Apr 1968 Vietnam Counter-offensive IV Vietnam Counter-offensive V Vietnam Counter-offensive VI Tet 69 Counter-offensive Vietnam, Summer–Fall 1969 Vietnam, Winter–Spring 1970 Sanctuary Counter-offensive Vietnam Counter-offensive VII Consolidation I Consolidation II Vietnam Ceasefire Campaign 2 Apr 1968–30 Jun 1968 1 Jul 1968–1 Nov 1968 2 Nov 1968–22 Feb 1969 23 Feb 1969–8 Jun 1969 9 Jun 1969–31 Oct 1969 1 Nov 1969–30 Apr 1970 1 May 1970–30 Jun 1970 1 Jul 1970–30 Jun 1971 1 Jul 1971–30 Nov 1971 1 Dec 1971–29 Mar 1972 30 Mar 1972–28 Jan 1973

OPERATIONS DESERT SHIELD AND DESERT STORM (GULF WAR)

1. Defense of Saudi Arabia

 Liberation and Defense of Kuwait
 Southwest Asia Ceasefire Campaign 2 Aug 1990– Desert Shield 16 Jan 1991 17 Jan 1991– Desert Storm 11 Apr 1991 12 Apr 1991– 30 Nov 1995

1 AIRCRAFT CARRIERS

After World War II those aircraft carriers under construction were completed, so that by 1947 the Navy had on the list three large *Midway* Class carriers (designated CVB) twenty-four standard size *Essex* Class units (designated CV) and nine light carriers (designated CVL). Sixty-six escort carriers (CVE) were also retained, in reserve or employed as auxiliary units.

The introduction of jet aircraft soon showed that many of the smaller carriers were inadequate, the jets needing stronger decks and more room for flight operations than the CVEs and CVLs could provide. The *Essex* class units were large enough to warrant upgrading. In 1952 *Antietam* was fitted with an angled flight deck enabling both takeoffs and landings from different runways. Most of the existing *Essex* class, less *Boxer*, *Princeton*, *Valley Forge*, *Leyte*, and *Tarawa*, and all three of the *Midway* class carriers were subsequently fitted with angled flight decks, enclosed bows, and more powerful steam catapults to assist the heavier jets in their takeoffs. *Oriskany* was completed in 1949 with some of these modifications built right in. *Franklin*, heavily damaged in World War II, was repaired but never recommissioned. *Bunker Hill*, also damaged and repaired, saw only very limited post-war service.

The Navy's first attempt at building a "super-carrier" was aborted when Secretary of Defense Louis Johnson cancelled construction of *United States* immediately after it was laid down in 1949. Carriers larger than the *Midway* class were clearly needed, however, and by 1952 *Forrestal* was laid down, the first of eight near-sisters.

The surviving smaller escort carriers, too small for the new planes, were used principally to transport aircraft, some remaining in service until the Vietnam war. Two, *Tinian* and *Palau*, completed after the war, were never commissioned. Two *Independence*-class light carriers were converted for anti-submarine warfare. By 1959 none of these remained in service, and the two *Saipan* class had been converted for other duties.

The first nuclear-powered carrier made its appearance in 1960. *Enterprise*, named after the most famous carrier of World War II,

was a very successful ship, and succeeding carriers, albeit of somewhat different design, have all been nuclear-powered. Ten similar units have been built, all at Newport News. The first ship, *Nimitz*, was completed in 1975 and the last of the class, *George H.W. Bush*, will commission in 2009. These nuclear powered carriers are the largest warships ever built and are able to remain at sea for long periods without refuelling.

Although the first carriers were named after historic naval vessels and battles, in recent years they have been named after historic persons, mostly presidents of the United States and a famous admiral. Politics has reared its ugly head with carriers named after a senator and a congressman, both of whom were helpful in legislating for the Navy.

All CV and CVB rec CVA, attack carriers, to reflect mission rather than size, a designation discontinued in 1975.



Figure 1.1: USS Hornet (CVS 12) prepares to recover the Apollo 12 command module following its splashdown southeast of Samoa in the South Pacific, 24 Nov 1969.



Figure 1.2: The aircraft carrier *Antietam* (CV 36) was the first to receive an angled flight deck. Here she is underway following the experimental conversion, 5 Jan 1953.



Figure 1.3: USS Hancock (CVA 19) at sea refuelling destroyers Maddox (DD 731) and Samuel N. Moore (DD 747), 12 Mar 1957. Notice the angled flight deck fitted in 1956 and new enclosed bow.

AIRCRAFT CARRIERS ON THE NAVY LIST, 1947

- CV 6 Enterprise Decomm 17 Feb 1947. Rec CVA 6, 1 Oct 1952. Rec CVS 6, 8 Aug 1953. Stricken 20 Oct 1956. Sold 2 Jul 1958, BU Kearny.
- CV 9 Essex Out of comm 9 Jan 1947–15 Jan 1951. Modernized (27A), Puget Sd NSYd Feb 1949–Jan 1951. Damaged by aircraft crash landing, off Korea, 16 Sep 1951 (8 killed). Rec CVA 9, 1 Oct 1952. Angled flight deck, 1955–56. Rec CVS 9, 8 Mar 1960. FRAM 1962.

Rammed in collision by submerged submarine *Nautilus* off North Carolina, 10 Nov 1966. Ran aground off Puerto Rico, 21 Jan 1967. Recovered space craft *Apollo* 7 and crew of three after a 10-day flight, south of Bermuda, 11 Oct 1968. Decomm 30 Jun 1969. Stricken 1 Jun 1973. Sold 14 May 1975, BU Kearny, NJ.

4★Korea K-6 K-7 K-8 K-9; ◆Lebanon Jul–Aug 1958, Taiwan Straits Sep 1958, Cuba Apr 1961, Jan 1962, Cuban missile crisis Oct–Nov 1962. *Yorktown* Out of comm 9 Jan 1947–20 Feb 1953.

 CV 10 Yorktown Out of comm 9 Jan 1947–20 Feb 1953.
 Modernized (27A), Puget Sd NSYd, Mar 1951–Feb 1953. Rec CVA 10, 1 Oct 1952. Angled flight deck, 1955. Rec CVS 10, 1 Sep 1957.
 Collided with destroyer Brush off San Diego, 23 Oct 1959. FRAM 1966.
 Recovery ship for spacecraft Apollo 8, in Pacific, 27 Dec 1968. Decomm 27 Jun 1970. Stricken 1 Jun 1973.

Later history: museum at Charleston, SC, 1975. 4★Vietnam Jan 1959, Mar–Jun 1960, May 1963, Feb–Apr 1965, Feb–Jul 1966, Mar–Jun 1968; ◆Taiwan Straits 31 Dec 1958, Quemoy-Matsu Jan 1959, Korea Jan–Mar 1968.

CV 11 Intrepid Out of comm 22 Mar 1947–9 Feb 1952.
Modernized (27C), Newport News, Apr 1952–Jun 1954. Rec CVA 11, 1 Oct 1952. Angled flight deck, 1956–57. Damaged by boiler explosion off Virginia, 25 Apr 1961. Rec CVS 11, 31 Mar 1962. Retrieved Scott Carpenter from space capsule Aurora 7, 24 May 1962. Recovery ship for Gemini space capsule (Virgil Grissom & John Young) in Atlantic, 23 Mar 1965. FRAM 1965. Ran aground off Jamestown, RI, 7 Sep 1969. Decomm 15 Mar 1974. Stricken 23 Feb 1982 and trfd to museum. Later history: Museum at New York, NY.

★Vietnam May–Oct 1966, Jun–Nov 1967, Jul–Aug, Oct–Dec 1968; ♦Cuba Jun 1961.

CV 12 Hornet Out of comm 15 Jan 1947–20 Mar 1951. Modernized (27A), New York NSYd, Jul 1951–Sep 1953. Rec CVA 12, 1 Oct 1952. Planes shot down two Chinese fighters in South China Sea, 25 Jul 1954. Angled flight deck 1956. Rec CVS 12, 27 Jun 1958. FRAM 1965. In collision with destroyer *Epperson* southeast of Tokyo Bay, 20 Sep 1965. Recovered unmanned Apollo spacecraft, 25 Aug 1966. Recovery ship for moon landing craft *Apollo 11* in South Pacific, 24 Jul 1969. Decomm 26 Jun 1970. Stricken 25 Jul 1989. Sold for BU 14 Apr 1993, but trfd to museum assn, 26 May 1998.
Later history: Museum at Alameda, Cal.

★Vietnam Oct–Nov 1965, Jan–Feb 1966, May–Oct 1967, Nov 1968–Apr 1969; ◆Quemoy-Matsu Jul 1959, Oct–Nov 1962, Korea Apr 1969.

- CV 13 Franklin Repaired. Decomm 17 Feb 1947. Rec CVA 13, 1 Oct 1952. Rec CVS 13, 8 Aug 1953. Rec AVT 8, 15 May 1959. Stricken 1 Oct 1964. Sold Jul 1966, BU Portsmouth, Va.
- CV 14 Ticonderoga Out of comm 9 Jan 1947–11 Sep 1954. Modernized (27C), New York NSYd, Apr 1952–Sep 1954. Angled flight deck, 1956–57. In collision with destroyer Picking in South China Sea, 15 Oct 1961. Rec CVA 14, 1 Oct 1952. Rec CVS 14, 21 Oct 1969. Recovery ship for fifth lunar landing craft Apollo 16, in Pacific, 27 Apr 1972, and for sixth and last lunar landing craft Apollo 17, 19 Dec 1972. Recovery vessel for the Skylab 2 space craft, in Pacific, 22 Jun 1973. Decomm and stricken 16 Nov 1973. Sold 15 Aug 1974, BU Portland, Ore. 12★Vietnam Sep–Oct 1961, Apr–May 1963, Aug–Nov 1964, Nov 1965–Apr 1966, Nov 1966–Apr 1967, Jan–Jul 1968, Mar–Jul 1969, Apr–May 1971, Jun 1972; ◆Taiwan Straits Nov–Dec 1958, Quemoy-Matsu Oct 1961, Korea Mar–Apr, Aug 1969.
- CV 15 Randolph Out of comm 25 Feb 1948–1 Jul 1953. Modernized (27C), Newport News, Jun 1951–Jul 1953. Rec CVA 15, 1 Oct 1952. Angled flight deck, 1955–56. Rec CVS 15, 31 Mar 1959. Damaged in collision with m/v Viscountess off Charleston, SC, 15 Oct 1961. FRAM 1961. Damaged by elevator accident at sea in Atlantic Ocean, 1 Apr 1964 (2 killed). Decomm 13 Feb 1969. Stricken 1 Jun 1973. Sold 14 May 1975, BU.

◆Lebanon Sep 1958, Cuba Apr–Jul 1961, Nov 1961–Feb 1962, Cuban missile crisis Oct–Nov 1962.