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Nuclear Warships and Naval Nuclear Weapons 1990: A Complete Inventory

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Abbreviations

(for ship class abbreviations see Appendix H)

ACNO	U.S. Assistant Chief of Naval Operations
ASW	Anti-Submarine Warfare
CEA	Commissariat a L' Energie Atomique
CNO	U.S. Chief of Naval Operations
COMPHIBGRUEASTPAC	Commander, Amphibious Group Eastern Pacific
DCN	Direction des Construction Navales
DCNO	Deputy Chief of Naval Operations
DIA	U.S. Defense Intelligence Agency
DNA	U.S. Defense Nuclear Agency
DOD	U.S. Department of Defense
Encl.	Enclosure
EWDA	U.S. Congress, Energy and Water Development Appropriations
FBIS	U.S. Foreign Broadcast Information Service
FOIA	U.S. Freedom of Information Act
FY	U.S. federal Fiscal Year (1 October to 30 September)
GAO	U.S. Congress, General Accounting Office
HAC	U.S. Congress, House Appropriations Committee
HASC	U.S. Congress, House Armed Services Committee
HMSO	Her Majesty's Stationary Office
HOC	U.K. House of Commons
IISS	International Institute for Strategic Studies
IOC	Initial Operational Capability
JCS	U.S. Joint Chiefs of Staff
JPRS	U.S. Joint Publication Research Service
Milcon	U.S. Congress, Military Construction Appropriations
NASBARPTINST	Naval Air Station Barbers Point Instruction
Neptune 2	Joshua Handler and William M. Arkin, Neptune Papers No. 2, Nuclear Warships and Naval Nuclear Weapons: A Complete Inventory, (Greenpeace/Institute for Policy Studies) May 1988)
NWEF	Commanding Officer, U.S. Navy, Naval Weapons Evaluation Facility
NWP	U.S. Navy, Naval Warfare Publication
OPNAVINST	U.S. Chief of Naval Operations Instruction
PDASD(ISP)	Principal Deputy Assistant Secretary of Defense (International Security Policy)
RADM	Rear Admiral
RDT&E	Research, Development, Testing & Evaluation
Rev.	Revision
SAC	U.S. Congress, Senate Appropriations Committee
SASC	U.S. Congress, Senate Armed Services Committee
(S/FRD)	Secret/Foreign Restricted Data
SIPRI	Stockholm International Peace Research Institute
SIRPA	Service d'Information et de Relations Publiques Armees
SLCM	Sea-Launched Cruise Missile
SMP	U.S. Department of Defense, Soviet Military Power
(U)	unclassified
UNOOB	U.S. Defense Intelligence Agency, Unclassified Naval Order of Battle - Soviet Union and Communist Eastern Europe (DDB-1200-124-89) June 1989; released under the FOIA
USMC	U.S. Marine Corps
USN	U.S. Navy
USNI	U.S. Naval Institute
VADM	Vice Admiral

I. Recent Trends in Nuclearization of the Oceans — Spontaneous Disarmament[1]

Despite steadfast opposition by the U.S. government to any form of naval arms control, and the continuing failure of the Soviet Union to engage the west in a naval arms control process, naval forces are far from static.

Superpower navies are declining in size, and plans for future expansion are being abandoned. Naval nuclear weapons are being reduced and controlled. Research and development of new nuclear capabilities is at an all time low. The future for naval nuclear power looks increasingly bleak.

This condition, chiefly driven by the technological obsolescence of Cold War generation equipment, internal changes in military doctrines and strategy, and reductions in defense spending, could be characterized as having nothing to do with a "disarmament" process. Each side accuses the other of improving its combat capabilities. The Soviet Union eliminates hundreds of vessels and draws back its operations and is accused of trying to repair its economy, and of refocusing its military effort from quantity to quality. The United States unilaterally retires virtually all of its nuclear weapons earmarked for open ocean combat, and it is accused of building up its conventional capabilities and shifting its energies to attacking the Soviet Union directly.

There is a bit of truth in both arguments. But what is being ignored in the posturing on both sides is a process of spontaneous disarmament which is occurring at a time of declining superpower tensions and threat, when the public mandate is for reductions in the resources devoted to the military, and when pressure is building in the arms control community to find a forum to deal with naval matters.

Spontaneous disarmament has already begun to have an effect in the late 1980s:

* Between 1988-1990, nuclear-capable ships and submarines in the U.S. Navy declined by 167 units, from 292 to 136. During the same time period, Soviet nuclear-capable ships and submarines declined by 68 units, from 633 to 565.

* The number of U.S. and Soviet naval nuclear weapons declined from 15,429 to 13,934 between 1988-1990. U.S. non-strategic nuclear weapons declined from 3,645 to 2,500, with the elimination of the ASROC, SUBROC, and Terrier nuclear systems. Soviet non-strategic weapons declined from 2,705 to 2,608. Now the Soviets have declared that nuclear weapons will be withdrawn from the Baltic Fleet.

* Construction of new naval platforms shows signs of slowing,[2] and both navies have begun to experience cuts in naval research and development.[3]

* The START agreement will result in future constraints on strategic and non-strategic naval warheads.[4] Submarine-launched ballistic missiles will be constrained to around 3,000 warheads for the United States and 2,000 for the Soviet Union. Nuclear armed long-range sea-launched cruise missiles will be limited to 880. These limits will result in reductions of 1,000 warheads in the U.S. force and 2,000 from the Soviet force, and will likely be followed by even greater numerical constraints in subsequent agreements.

Perhaps most significant factor contributing to spontaneous disarmament is the changing pace of naval nuclear modernization during the 1980s. It may be true that the counterforce nuclear missiles — the Trident II D5 and the SS-N-23 — are being deployed, but they are being introduced in far smaller numbers than were projected in the early 1980s. Both sides are deploying long-range, accurate sea-launched cruise missiles. But a few hundred warheads will ultimately replace thousands of theater strike weapons (e.g., SS-20, SS-4, Yankee) which existed less than a decade ago. In the distorted arithmetic of nuclear warfare, this is significant progress.

But most important, the trends portend major quantitative reductions in nuclear capabilities. Eight U.S. naval nuclear weapons under development since the mid-1970s — vertical launch ASROC with a nuclear warhead, Standard Missile 2 (Nuclear), nuclear Harpoon, nuclear Phoenix, Sea Lance, the anti-submarine warfare standoff weapon, insertable nuclear components, a naval nuclear artillery projectile — were cancelled for one reason or another. The U.S. Navy has only one nuclear weapon under development, the B90 nuclear depth/strike bomb, and its future has recently been put in jeopardy.[5] With the deployment of the Trident II, the U.S. Navy does not have a new strategic missile under development for the first time since the early 1950s. Tomahawk missile follow-ons are widely reported as being examined only with conventional warheads.

It is unknown whether future nuclear programs have been abandoned in the Soviet Navy, but the rate of nuclear testing continues to be extremely low (the Soviets had not conducted a nuclear test at least between October 1989 and July 1990), and spending on nuclear weapons has been reported as being massively cut. Development of the new SS-NX-24 supersonic sea-launched cruise missile appears to be essentially halted, and Backfire bomber deployment has slowed or stopped. The Soviets are also moving in the direction of greater reliance on conventional weaponry.

1. Naval Nuclear Weapons in 1990

The two superpowers have deployed nuclear weapons at sea for over 30 years, and the other three nuclear weapons states — France, Britain, and China — have joined them with their own naval nuclear systems. Approximately 14,600 nuclear weapons are earmarked for use by the five navies, about 30 percent of the world's total nuclear arsenal. In 1990, about 750 ships and submarines, and 2,800 aircraft and helicopters can fire naval nuclear weapons.

[1] A version of this introduction was presented at the "Naval Arms Limitations and Maritime Security Conference," sponsored by the Center for Foreign Policy Studies, Dalhousie University, Halifax, Canada, 26-29 June 1990.

All five nuclear navies deploy long-range submarine-launched ballistic missiles (SLBMs) on nuclear-powered ballistic missile submarines (SSBNs). These constitute 64 percent of all sea-based nuclear weapons, an all time high. Fourteen types of ballistic missile submarines carry 14 different types of missiles. There are currently 1,682 SLBMs armed with some 9,364 nuclear warheads, making up approximately 50 percent of the world total of land- and sea-based strategic nuclear warheads.

An estimated 5,200 nuclear warheads are for the use of tactical naval forces. Anti-submarine warfare (ASW) nuclear weapons are the largest category, numbering 2,150, or 15 percent of all nuclear warheads with naval roles. These weapons are deployed on surface ships, submarines, and maritime patrol aircraft and helicopters — 1,677 platforms in total.[6]

The third largest category of naval nuclear weapons are air-delivered: bombs and air-to-surface missiles intended for attacks on surface ships and shore targets. In 1990, there are almost 1,700 aircraft (bombers, attack planes and fighters) with about 1,900 nuclear weapons. Twelve different types of aircraft with naval missions can deliver at least six types of nuclear bombs and five types of nuclear air-to-surface missiles.

Sea-launched cruise and anti-ship missiles are the fourth largest, and fastest growing, category of naval nuclear weapons. The U.S. and Soviet navies currently have about 900 nuclear sea-launched cruise missiles, of eight different types. Nuclear-armed sea-launched cruise missiles (SLCMs) are currently deployed on 107 surface ships and 118 submarines (225 total platforms).

Table 1: Naval Nuclear Weapons (1990)

	United States	Soviet Union	United Kingdom	France	China	Total
Strategic						
Missile Warheads	5,024	3,802	96	416	26	9,364
Non-strategic						
Sea-Launched Cruise missiles	325	570	0	0	0	895
Anti-submarine weapons	825	1,300	25	0	0	2,150
Anti-air weapons	0	188	0	0	0	188
Aircraft delivered weapons (not ASW)[7]	1,350	450	25	36[8]	-	1,861
Coastal missiles	0	100	0	0	0	100
Subtotal	**2,500**	**2,608**	**50**	**36**	**0**	**5,194**
Total	**7,524**	**6,410**	**146**	**452**	**26**	**14,558**

Table 2: Nuclear-Capable Naval Aircraft (1990)

	United States	Soviet Union	United Kingdom	France	China	Total
Attack	995	395	82	36	150[9]	1,658
Anti-submarine[10]	595	330	178	0	0	1,103
Total	**1,590**	**725**	**260**	**36**	**150**	**2,761**

Table 3: Nuclear-Capable Ships and Submarines (1990)

	United States	Soviet Union	United Kingdom	France	China	Total
Submarines						
Ballistic missile	32[11]	61	4	6	2[12]	105
Cruise missile	0	60	0	0	0	60
Attack	50	178	0	0	0	228
Subtotal	**82**	**299**	**4**	**6**	**2**	**393**
Surface Ships						
Aircraft carriers	18[13]	4	3	2	0	27
Battleships	4	0	0	0	0	4
Cruisers	16	33	0	0	0	49
Destroyers	16	37	12	0	0	65
Frigates	0	118	15	0	0	133
Patrol combatants	0	74	0	0	0	74
Subtotal	**54**	**266**	**30**	**2**	**0**	**352**
Total Ships	**136**	**565**	**34**	**8**	**2**	**745**
Support ships[14]	96[15]	47	4	0	0	147

2. Strategic Forces

The U.S. ballistic missile submarine (SSBN) force has declined steadily since 1980. Forty-one boats were maintained from 1967, when the last Polaris submarine joined the fleet, to 1980, when the first Polaris boats were withdrawn from strategic patrols. During the 1980s, ten Polaris boats were retired or converted to attack submarines, and an additional eight Poseidon boats were decommissioned. This reduction was only partially offset by the deployment of ten new Ohio class submarines, and thus by 1990, the force had shrunk to 33 submarines.[16] The number of submarines will continue to decrease as all 11 of the remaining Poseidon submarines are retired by the mid-1990s.[17]

The number of strategic ballistic missiles and nuclear warheads aboard submarines has also fallen. In 1990, U.S. ballistic missile submarines carry 584 ballistic missiles with 5,024 nuclear warheads, a decrease from a peak of 648 missiles and 5,760 warheads in 1985.

While the size of the submarine force has been declining, the nuclear capacity and targeting capability of the force has increased. The current submarine force is made up of a larger number of more accurate and capable Trident I missiles, as well as the new Trident II D5. The Trident II became operational on 29 March 1990 when the ninth Ohio-class submarine, the USS Tennessee (SSBN-734), went to sea for its first patrol.[18]

At the end of the century, a planned 21 boat Ohio class fleet will have the capacity of carrying 4,032 warheads, all atop accurate Trident II D5 missiles.[19] Nonetheless, the START Treaty restricts U.S. SLBM warheads to about the 3,000 level, which will result in a constraint of some 1,000 warheads.

The Soviet ballistic missile submarine force currently consists of 61 boats, a decline of 28 submarines since the peak in

1978.[20] Since 1988 alone, the force has suffered a net loss of 16 submarines. Twenty-one boats were retired or denuclearized — including 15 diesel-powered Golf II, Golf III, Golf V submarines and six nuclear-powered Yankee I boats — but only five nuclear-powered submarines of the Typhoon and Delta IV classes joined the fleet during the same period.

While the number of operational Soviet SLBMs has declined to 914 from a peak of 1,038 in 1981, the number of nuclear warheads has steadily increased to the current level of 3,802. This growth reflects continued deployment of MIRVed SS-N-20 and SS-N-23 missiles on Typhoon and Delta IV class submarines. These missiles are replacing older missiles with single or double warhead capabilities.

The sixth and last unit of the Typhoon class was deployed in 1989. The sixth Delta IV submarine was also added to the strategic force in 1989, and while the Delta VI class continues in production,[21] START constraints will force the Soviet to reduce the level of all their strategic warheads at sea from the current 3,800 to some 2,000 by the late-1990s.

In 1987, U.S. intelligence reported that a new class of ballistic missile submarine, a follow-on to the Delta IV class, was under construction at Severodvinsk.[22] The report, however, now appears to be premature. In February 1990, the U.S. Director of Naval Intelligence reported that "a new class of SSBN could replace the older Deltas," but did not mention a new submarine actually in construction.[23] In addition, the U.S. government reported in 1987 that two new Soviet SLBMs were under development, one a follow-on and improvement of the SS-N-20, and the other a new missile.[24] It now appears that the new missile has been cancelled or slowed in development.[25]

3. Cruise Missile and Attack Submarine Forces

Budget constraints and a declining threat began to seriously affect the U.S. nuclear-powered attack submarine (SSN) force during 1989-1990. The U.S. Navy's 100 SSN force goal was abandoned de facto along with the 600-ship Navy. Since 1988, the SSN force has had a total loss of six submarines, dropping from 98 to 92 boats. Further reductions are likely to follow; reportedly the total SSN force is likely to decline to some 70-80 SSNs by FY 2000,[26] with the retirement of older classes of submarines outnumbering the introduction of new boats.

The 1980s plan for a total of 68-69 Los Angeles class submarines was revised in the FY 1990 budget, as the Navy decided to end the program at 62 submarines in order to shift resources to the new Seawolf (SSN-21) class program. In addition, during the formulation of the FY 1991 budget, the Navy decided to retire the entire fleet of 37 Sturgeon class submarines rather than overhaul them.[27] Previous programs called for the boats to have their useful life extended to the year 2000.[28] The Navy plans to ultimately procure 29-30 Seawolf submarines by early in the next century, but a continuing trend of tightening fiscal limits and improved superpower relations will likely constrain this $36-40 billion program.

The number of nuclear-capable SSNs has also decreased, albeit temporarily. Mainly because of the retirement of the SUBROC nuclear depth bomb, the number of SSNs carrying nuclear weapons declined from a mid-1980s peak of about 70 submarines carrying either SUBROCs or Tomahawk SLCMs, to 50 Tomahawk-certified submarines in 1990. The number of Tomahawk certified submarines will continue to increase in the short run. But the looming reductions in the total SSN force make current Navy plans for 86 SSNs to be Tomahawk-armed by FY 2000 problematic.

Throughout the 1990s, five classes of Soviet cruise missile and attack submarines will likely continue in production — Akula, Kilo, Oscar II, Sierra and Victor III. Their production will result in the deployment of four or five new submarines per year in the early 1990s, and could accelerate in the late 1990s (if the second production line for the Akula class significantly accelerates introduction of this class).[29] Production of new submarines, however, will be more than offset numerically by the retirement of older submarines, 120 of which at least will be retired in the 1990s.[30]

A significant number of diesel submarines were already retired in the 1980s,[31] and U.S. intelligence predicts that well over 100 will be scrapped by 1995. "Clearly," Rear Admiral Thomas A. Brooks, Director of Naval Intelligence, stated in February 1990, "the Soviets have made the decision to give up their traditional large diesel submarine force in favor of quality vs. quantity."[32]

In addition to the retirement of large numbers of diesel submarines, the reactor accident aboard an Echo II submarine on 26 June 1989[33] resulted in a Soviet decision to accelerate the retirement of the Echo boats, as well as that of older first generation nuclear-powered submarines, including Hotels, Novembers, and a single Papa class.[34] Many may already have been taken out of operational service, including the submarine involved in the initial accident.[35] By 1995, U.S. intelligence predicts that some of the newer Mod Echo IIs and Charlies may also be retired.[36] In addition, one of six Alfa class submarines was withdrawn and scrapped in 1988,[37] and two Juliett class submarines were transferred from the Northern Fleet to the Baltic Sea in November 1989, possibly on their way to being scrapped.

The number of SLCMs and nuclear warheads on cruise missile submarines remained fairly constant in the 1980s. The retirement of older SS-N-3 and SS-N-7 SLCMs was balanced by the deployment of roughly the same number of new SS-N-9, SS-N-12, and SS-N-19 missiles. In the attack submarine force, the major new capability is the deployment of the SS-N-21 SLCM, 136 of which are estimated to be deployed in 1990.

4. Long-range Sea-launched Cruise Missiles

Long-range sea-launched cruise missile (SLCM) programs in the U.S. and Soviet Union have been slowed or scaled back.

The number of U.S. ships able to fire the Tomahawk SLCM is increasing slower than planned. In the mid-1980s, the Navy wished to have 126 Tomahawk capable vessels in FY 1990,[38] some 40 more than the 86 that are currently available. This is mostly due to delays in conversions in Sturgeon (SSN-637) class submarines to carry Tomahawks; slower backfits of

Spruance (DD-963) class destroyers with vertical launching systems; problems with achieving an operational capability with the vertical launch system fitted on Los Angeles (SSN-688) class submarines, and postponements in deliveries of new Los Angeles class submarines. Also, instead of building-up to 37 Tomahawk-armed Sturgeon class submarines through the year 2000, Sturgeon conversions are now expected to peak in 1994 at 26 boats, and then start to decline.

The projected total number of Tomahawk-armed combatant vessels has also declined, from 198 to 191.[39] This number will undoubtedly decrease further in revised projections as it assumes the United States will maintain a 100 boat SSN force, and keep all four battleships. As noted the SSN force is likely to fall to 70-80 boats and, in addition, two battleships are up for retirement in the FY 1991 budget, with the other two expected to follow later in the 1990s.

The final number of nuclear Tomahawk missiles (TLAM/N) that will be procured will almost certainly be less than the 880 SLCMs permitted by the May 1990 U.S-Soviet SLCM limit agreement made in conjunction with the START negotiations. It also will likely fall below the U.S. Navy's original 758 missile inventory objective. The Navy's 1980s plan was to have achieved the 758 nuclear Tomahawk goal by FY 1991, of which 90 percent (678) were to be procured by FY 1990.[40] But as of FY 1990, the Navy had only procured 367 nuclear missiles or 50 percent of its original goal. The FY 1991 budget request included 75 more nuclear Tomahawks, with the remaining 316 left to be requested in FY 1992, the currently scheduled final year of procurement.[41]

There is a push in the Navy to extend the production run of the Tomahawk beyond FY 1992. This would obviously help to avoid such an unusual final year purchase of nuclear missiles (the largest purchase of almost a 100 was in FY 1986). Nonetheless, the shift from the original plan has implied that the Navy will purchase less than 758 nuclear Tomahawks. A declining number of planned SLCM platforms, and the Navy's budgetary constraints may have served to limit the nuclear program. In addition, the problems in the U.S. nuclear weapons production complex may have affected the priority of Tomahawk in comparison with other warhead programs. It is not thought that the slowdown in the Tomahawk program was caused by any reassessment of nuclear strategy, however, the Navy may be anticipating some reductions in targets in Eastern Europe and/or the Soviet Union. Also, reportedly, the Navy may have slowed purchases to avoid having excess missiles dismantled due to an arms control agreement.[42] At any rate, reports persist that the Navy may elect to produce less than the 758 nuclear SLCMs it originally desired.[43]

At the end of the 1980s, there was a significant slowdown in Soviet long-range cruise missile programs, with the SS-N-21 Sampson evidently running into technical problems, and the SS-NX-24 development program being slowed considerably.

The larger supersonic SS-NX-24 SLCM, which the Pentagon predicted "to be operational in the next few years" in 1987,[44] may have been cancelled. Test activity has been at a slow pace,[45] and the U.S. Navy's director of naval intelligence observed in early 1990 that the missile "possibly remains under development."[46] In addition to the possible cancellation of the SS-NX-24, the SS-N-21 may also have run into technical problems.[47] Nonetheless, some 136 SS-N-21 Sampson SLCMs, first operational in late 1987, are estimated to be deployed on 30 Akula, Sierra, Victor III, and Yankee Notch class attack submarines.

5. Aircraft Carrier and Surface Forces

Fifteen aircraft carriers are active in the U.S. Navy in 1990, but the deployable force is 12 ships, rather than the usual 14 through the late 1980s. This is because three carriers, instead of the usual one, are in extended overhauls.[48] A 15-carrier deployable force by 1990 was the centerpiece goal of the 600-ship Navy, but now it even looks doubtful that the Navy will sustain a 13 carrier force.

The USS Coral Sea (CV-42) was decommissioned in April 1990, and the USS Midway (CV-41) is slated for retirement during 1991-1992. Three other carriers — the USS Ranger (CV-61), the USS America (CV-66), and the USS John F. Kennedy (CV-67) — are slated for service life extensions in the 1990s, but fiscal constraints will likely result in the cancellation of one or more of these planned overhauls. The USS Ranger and the USS Saratoga (CV-60) are already being considered for retirement.[49] The deployment of three new Nimitz class carriers in the 1990s will not prevent the decline in aircraft carrier numbers.

The number of nuclear weapons on aircraft carriers also shrunk slightly in the late 1980s, and is planned to continue to shrink in the 1990s under current plans. Each individual aircraft carrier will carry fewer nuclear weapons if the B90 nuclear depth/strike bomb is deployed. According to the Department of Defense, anti-submarine warfare and land-attack "...commonality will allow smaller aircraft carrier bomb loadouts than would otherwise be possible with separate tactical strike and depth bombs, thereby reducing overall stockpile numbers of fleet strike and depth bombs."[50]

With the abandonment of 15 carrier battle groups, so goes the four battleship battle groups, created by recommissioning World War II era Missouri class ships in the 1980s. The four battleship force was a short lived and expensive achievement. The FY 1991 budget calls for retiring the USS Iowa (BB-61), and the USS New Jersey (BB-62). The remaining two battleships will also be likely retired later in the 1990s.

The retirement of the nuclear ASROC rocket thrown depth charge and the Terrier nuclear surface-to-air missile during 1988-1989 has had a major impact on the nuclear capabilities of U.S. surface forces. Despite an increase in the size of the cruiser force from 36 to 43 ships between 1988-1990, the number of nuclear-armed cruisers declined by 20, from 36 to 16 ships.[51] The number of nuclear weapons aboard cruisers decreased by over two-thirds from an assortment of over 300 ASROCs, Terriers, and Tomahawks in the late 1980s, to 76 Tomahawks.

During 1988-1990, the destroyer force shrunk by nine ships from 68 to 59 ships, and the nuclear armed destroyer force shrank by 48 ships, from 64 to 16.[52] The number of Tomahawk outfitted destroyers, however, increased from nine to 16. The number of nuclear weapons aboard destroyers overall de-

creased by about two-thirds from an assortment of about 300 ASROCs, Terriers, and Tomahawks in the late 1980s to about 110 Tomahawks.

A new destroyer class — the Arleigh Burke (DDG-51) — was scheduled to be delivered in October 1989, but production problems have delayed the delivery date to February 1991. The Navy plans to construct at least 33 Burke class ships at a total cost of $27 billion, although the program has run into Congressional criticism and could be scaled back.

The retirement of ASROC has resulted in the denuclearization of the frigate force, which shrank form 65 nuclear ships to zero. Overall the frigate force has declined from 115 to 100 ships due to the fiscally accelerated retirement of older classes.

The Soviets have four smaller aircraft carriers, but have three full deck aircraft carriers in construction. The deployment of these three ships in the 1990s will significantly improve the ability of the Soviet Navy to take aircraft to sea.

While preparation of the first Soviet large deck aircraft carrier continues, all commentators have neglected to report that the Soviets claim the Tbilisi, the first of these new ships, will not carry nuclear weapons.[53] In addition, while western naval publications have speculated about a 60-aircraft wing aboard the ship, the commander of the Black Sea Fleet claimed that the Tbilisi will only carry ten aircraft.[54]

Claims of reduced nuclear capability for the Tbilisi seems to follow a pattern set by the last aircraft carrier deployed by the Soviet Navy: the fourth and last ship of the Kiev class, the Baku. This ship's weapons configuration deleted the nuclear-only FRAS-1 anti-submarine rockets present on earlier Kiev class ships, deleted nuclear torpedoes, and deleted SA-N-3 nuclear capable surface-to-air missiles.

Larger surface warship production in the Soviet Navy has been modest, slightly lower than U.S. and NATO production, and is declining. Between 1988-1990, the nuclear-capable cruiser force was reduced by eight ships, and the destroyer force was reduced by 31 ships. The last of the Sverdlov class cruisers, and Skoryy, Kotlin, SAM Kotlin, MOD Kildin, Kildin, and Kanin class destroyers were retired in the late 1980s. The number of nuclear weapons in the cruiser and destroyer force declined, particularly the number of nuclear SAMs and torpedoes.

Three major surface combatant types continued in production in 1990: the fourth and last Kirov class cruiser (to be deployed in 1992),[55] and destroyers of the Udaloy and Sovremennyy classes.[56] Budget cutbacks have led to discontinuance of construction of the fifth unit of the Kirov class.[57] Slava class construction ended with the fourth ship. A new cruiser, smaller than the Kirov class, but larger than the Slava, is believed to be under construction at the Baltic Yard, Leningrad.[58] The initial two units of a Krivak class frigate follow-on, designated BAL-COM 8, are also under construction in the Baltic and could commence sea trials in 1990.[59]

Most reference books credit Soviet surface combatants with the ability to carry nuclear armed surface-to-air missiles and nuclear torpedoes. Soviet naval officers, however, have denied that the SA-N-6 missiles are nuclear capable, or that surface ships carry nuclear torpedoes on a regular basis.

6. Naval Aviation

As the number of U.S. aircraft carriers declines, so will the size of the naval aircraft force. A 14th carrier air wing was activated in 1987 to equip the anticipated 15-carrier force, but due to fiscal constraints it was deactivated in FY 1989.[60] In order to standardize naval aviation operations, and due to attack aircraft shortfalls in the late 1980s, variously configured air wings on different aircraft carriers are being reorganized into standard air wings.[61] This plan is necessitating the transfer of Marine Corps A-6s to the Navy. Transitioning to the new air wing configuration will obviously be facilitated much easier if aircraft carriers are retired, freeing up aircraft to be assigned to remaining wings.

The stealth A-12 Avenger Advanced Tactical Aircraft (ATA) remains under development, although the Defense Department decided in April 1990 to cut the planned program from 858 to 620 aircraft.[62] This reduction follows the budget-saving decision taken in FY 1989 to terminate an improved A-6F variant of the A-6, and to instead extend the A-6's service life. The Navy states that 448 A-12s are needed to replace the A-6E,[63] the remainder being earmarked for electronic warfare and surveillance roles. Given the high expense of the aircraft (620 will reportedly cost $52 billion),[64] the program is likely to be reduced further.

Ironically, even as U.S. aircraft carriers start to be cut back, Soviet Naval Aviation (SNA) is becoming an increasingly important part of the long-range strike capabilities of the Soviet Navy. Although the traditionally large maritime bomber force is declining in size as Backfire bombers replace Badger and Blinder bombers on a less than one-for-one basis (SNA bombers are at their lowest level in a decade), additional new aircraft are being assigned maritime missions from the Soviet Air Forces, or are being directly put under the command of SNA. In the last half of the 1980s, this includes assignment of maritime missions to Bear G bombers assigned to Strategic Aviation, and resubordination of Air Forces Su-24 Fencer (and possibly MiG-27 Flogger J) fighter-bombers to SNA.

7. U.K. and French Naval Nuclear Forces

Spontaneous disarmament is beginning to affect U.K. and French naval forces as well. The recently released results of the British government's "Options for Change" study calls for a reduction of the frigate/destroyer force to some 40 ships. The diesel- and nuclear-powered attack submarine force will shrink by almost a half to around 16 submarines, including the retirement of some five older nuclear-powered boats. In addition, the Nimrod maritime patrol force will also be reduced, and the Buccaneer maritime strike aircraft will be replaced by Tornado aircraft reconfigured for the maritime role.[65]

While the trend overall is clearly downward for U.K. naval forces, it is more mixed for U.K. naval nuclear weapons. Tactical nuclear weapons seem to be on the decline. A decision about a replacement for the WE-177C nuclear depth bomb has been put off, with even some U.K. analysts saying it may be delayed indefinitely. The Trident strategic program,

however, is still proceeding towards deploying four new SSBNs with new Trident II missiles by the late 1990s. Depending on warhead production and the number of SSBNs kept at sea, this could lead to at least a trebling of the number of strategic nuclear warheads in the U.K. arsenal.

French military forces are also undergoing reexamination, and facing pressures to cut expenditures. It is unclear how the overall size of the fleet will be affected, but major new programs, such as construction of the new generation SSBNs and Charles de Gaulle aircraft carriers have been delayed, due to budgetary constraints. French land-based prestrategic weapons are coming under increasing criticism for only being able to strike targets in eastern Europe, portending criticisms of French carrier based nuclear weapons with a similar capability. But, currently new naval nuclear weapons programs do not seem to be in doubt, although the total number of naval Super Etendard carrier aircraft converted to carry the new ASMP nuclear missile has been reduced, and there has been some delay in the development of the new 12-warhead M5 missile, with its fleet introduction pushed back from 1999 to the beginning of the next century.[66]

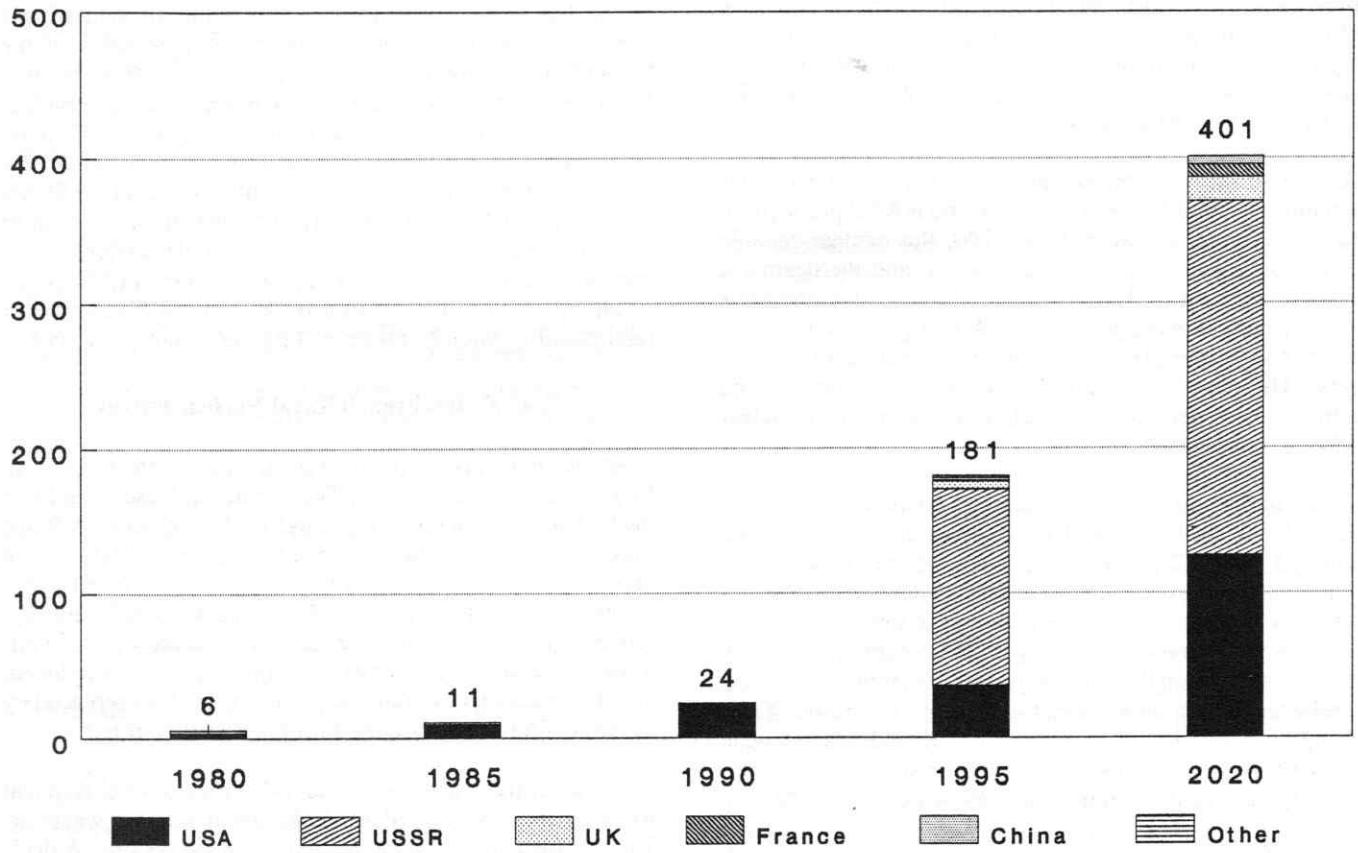
These trends do not promise a change in the role of naval nuclear weapons comparable to the metamorphosis occurring to the superpowers' forces. British and French forces have always stressed long-range strategic attack, and the completion of both countries' SSBN and SLBM modernization will underscore this emphasis. But as the process of spontaneous disarmament unfolds, planned British and French nuclear modernization will not escape criticism. There is a particular nationalistic/psychological origin of support which keeps the status British and French nuclear forces independent from the state of the superpowers' arsenals. Nonetheless, the roots of these "independent" forces are in the dated Cold War justification that the United States would not attack Moscow to save London or Paris. As the Cold War continues to wind down, the British and French naval nuclear forces will increasingly appear outmoded.

8. Nuclear Propulsion

One of the most intriguing aspects of the current and projected cutbacks in naval forces is the coming decline in the number of nuclear reactors at sea. Approximately 579 nuclear power reactors are currently located at sea, but this number is not likely to go much higher before it declines quite noticeably during 1991-1992. First-generation nuclear-powered submarines or surface ships in all countries are facing block obsolescence or retirements, and will leaving the nuclear fleets faster than the introduction of new submarines.

The Soviet Union uses 380 reactors to run its fleet of nuclear-powered submarines, cruisers and ice-breakers.[67] Most submarines have two reactors each (a few have just one), and the cruisers and ice-breakers have two each. The United States

Naval Reactors Requiring Disposal 1980-2020



To 1990 is the actual number of reactors to be disposed. 1990-1995 is estimated disposals of Soviet first generation nuclear-powered submarines, and additional older U.S., U.K., and French SSNs and SSBNs. 1995-2020 represents the 30-year life-span retirements of remaining ships and submarines. Other category includes 3 commercial and 2 Indian SSGNs.

has 162 nuclear reactors in its nuclear-powered submarines, aircraft carriers, cruisers and a single submersible research vessel. All the U.S. submarines have one reactor each, while the cruisers have two. Four aircraft carriers have two each and one aircraft carrier has eight reactors. The United Kingdom has one reactor on each of its 21 nuclear-powered submarines. Similarly France's 10 nuclear-powered submarines, and China's six nuclear-powered submarines each have one reactor.

From a peak of 169 reactors aboard U.S. vessels in 1988, the number in the United States is now declining at a steady rate. Between 1990-1995, the U.S. will likely retire some 34 nuclear-powered vessels, while only commissioning about 17 new ones.[68] The number of Soviet nuclear-powered vessels is just about at a maximum and will decline sharply after 1991-1992 as Soviet first generation nuclear-powered boats are retired. In the early 1990s, the Soviet Navy will likely retire some 45 nuclear-powered submarines, a rate that will far exceed new commissionings, and the number will then decline. In addition, some six older U.K. and French nuclear-powered submarines are up for retirement in the same period.

The declining number of nuclear-powered vessels is already having effects which will likely work to reduce further the number of nuclear reactors at sea, mainly by constraining the production of new nuclear-powered vessels. Increasing public concern, even including citizen activism in the Soviet Union, is being expressed about the disposal of decommissioned nuclear reactors. Concerns about safe disposal of reactors in turn is prompting a reexamination of the total cost of nuclear power at sea. At the same time, the up-front costs of nuclear-powered submarines are leading military professionals and elected officials to question the value of nuclear power given its share of the cost of building new submarines. This has resulted in slower building rates or lower projected class totals for new ships. And, as the number of nuclear powered vessels under construction declines, the unit-cost of each submarine increases, further underscoring the prohibitive cost of building nuclear-powered warships.

Nuclear Reactors on Naval Vessels (1990)

Nuclear Powered Ship Types	United States	Soviet Union	United Kingdom	France	China	Total
Ballistic Missile Submarines	33	122	4	6	2	167
Cruise Missile Submarines	0	78	0	0	0	78
Attack Submarines	92	149	17	4	4	266
Aircraft Carriers	18	0	0	0	0	18
Cruisers	18	6	0	0	0	24
Other[69]	1	25	0	0	0	26
Total	162	380	21	10	6	**579**

9. Conclusion

As naval arms control is talked about more, the assumption grows that some solutions or compromises must be found. It is unclear what role traditional "arms control" fora have in this, as the process of spontaneous disarmament has occurred without the intervention of the arms control community.

The U.S. and Soviet Navies are experiencing similar transformations as the contract to post-Cold War transition forces. The U.S. surface fleet, with the retirement of ASROC and Terrier and deployment of the Tomahawk cruise missile, is being altered from a multidimensional nuclear force, with anti-air, anti-submarine, and land attack capabilities, to a largely one dimensional force, with solely long-range nuclear attack capabilities.

Similarly, the Soviet Navy is increasing its long-range strike capabilities. Former Yankee class strategic submarines and new land attack SLCMs launched from converted Yankees and other naval platforms provide new theater targeting capabilities in Europe and Asia, and could threaten North America. In addition, land-based Backfire and Bear-G bombers, together with newly assigned Fencer and/or Flogger air force fighter-bombers, provide a farther ranging maritime force to protect the Soviet homeland and threaten U.S. aircraft carriers and surface platforms.

Tactical nuclear war at sea seems to be a declining threat, as nuclear weapons assigned to naval forces take on strategic roles in threatening or defending the homeland. As non-strategic naval forces evolve into more offensively capable one-dimensional nuclear forces, they must be reckoned with as being part of strategic capabilities, even if they have traditionally been regarded as solely of naval interest.

As nuclear weapons assigned for purely "naval" missions are eliminated, the remaining nuclear weapons — long-range SLCMs, land-based attack aviation, and aircraft carrier aviation — are shown to be integral to theater, and increasingly strategic, arsenals. This inherent and growing strategic role of seemingly non-strategic naval nuclear forces has provoked a move by many western naval arms control advocates to suggest the elimination of non-strategic nuclear weapons. In the late 1989, the Soviets also began to shift some of their attention specifically to naval nuclear weapons, in addition to their various calls for confidence building measures and operational controls.

Spontaneous disarmament, however, is mainly affecting fleet sizes and future ship and aircraft building rates. It can probably only go so far in relation to nuclear weapons. Elimination of long-range non-strategic naval nuclear weapons — sea- and land-based, particularly aboard aircraft carriers — will require an act of will on the part of national leaders to transform the nature of their naval forces. The navies of the United States and the Soviet Union do not themselves seem predisposed towards volunteering to give up their non-strategic nuclear capabilities, even in a changing world. The challenge is whether prolonged naval arms control discussions will ever provoke higher level decisions to do so.

II. Naval Nuclear Weapons

1. Submarine-launched Ballistic Missiles (SLBMs)

United States

The United States has three different types of submarine-launched ballistic missiles (SLBMs) on 32 ballistic missile submarines.[70] The 584 missiles are armed with 5,024 nuclear warheads, broken down as follows:

Missiles		Warheads
176	Poseidon C3	1,760
384	Trident I C4	3,072
24	Trident II D5	192
584	**Total**	**5,024**

The **Poseidon C3** missile (UGM-73A) is a two-stage, solid propellent missile. It replaced Polaris A2/A3 SLBMs on converted Poseidon submarines and first became operational on the USS James Madison (SSBN-627) in March 1971. The last submarine with Polaris missiles was converted to the Poseidon C3 in 1977. Since 1988, the number of submarines carrying Poseidon missiles decreased from 16 to 11 as five Lafayette (SSBN-619) class boats were deactivated. Currently the missile is deployed on three Lafayette (SSBN-619) class, two James Madison (SSBN-627) class, and six Benjamin Franklin (SSBN-640) class submarines. The number of Poseidons will decrease further as these classes are retired. The last Poseidon will likely be retired in the mid-1990s.

Each Poseidon missile can be armed with six to fourteen W68/Mk3 warheads/multiple independently-targetable reentry vehicles (MIRVs). Generally, however, each missile carries ten warheads. The W68 warhead was first produced in 1970, and in 1990, some 1,800 are in the U.S. nuclear stockpile.[71] The warheads have the explosive power of 40 kilotons each.

Poseidon missiles are inertially guided and have an accuracy (circular error of probability) of 0.25-0.3 nautical miles (0.46-0.72 kilometers).[72] Their explosive power, targeting ability, and accuracy make it useful for attacking mostly "soft" targets such as military airfields, bases, and command and communications installations. They have a range of 2,400-2,800 nautical miles (4,500-5,200 kilometers) with ten reentry vehicles or 2,200 nautical miles (4,000 kilometers) with 14 reentry vehicles.

The **Trident I C4** missile (UGM-96A) is a three-stage, solid propellent missile. It is deployed on 12 converted Poseidon ballistic missile submarines and eight new Ohio class boats. The first Trident I C4 became operational in 1979, the last in 1983.[73] Twelve James Madison (SSBN-627) class and Benjamin Franklin (SSBN-640) class ballistic missile submarines were converted. The missile is also deployed on eight Ohio (SSBN-726) submarines.

Each Trident I C4 missile can be armed with eight W76/Mk4 warheads/MIRVs. First produced in 1978, 3,175 W76 warheads are in the U.S. nuclear stockpile in 1990, and each has an explosive power of 100 kilotons.[74]

Trident I missiles have stellar-aided inertial digital computer guidance, and their accuracy (circular error of probability) is 0.125-0.27 nautical miles (0.23-0.50 kilometers). They have little hard target capability, but can attack "moderately hard" targets such as bomber bases or heavy industry. The missiles' range is 4,200 nautical miles (7,800 kilometers) at full payload and is greater with fewer reentry vehicles.[75] The longer range of the Trident I missile over Polaris and Poseidon meant that submarines carrying the missile did not have to be based overseas to be within range of their targets for a reasonable amount of time during their patrols.

The numbers of submarines carrying the Trident I will decline as the James Madison and Benjamin Franklin submarines retire, and the eight Ohio class submarines with Trident I are modified to carry the Trident II. Approximately half of the existing W76 warheads will be "transferred" for use on Trident II missiles starting in the mid-1990s.

The **Trident II D5** is a three-stage, solid propellent missile. The U.S. Navy's newest SLBM, the D5 became operational on 29 March 1990 when the ninth Ohio-class submarine, the USS Tennessee (SSBN-734), went to sea for its first patrol.[76] The Trident II D5 will be deployed on subsequent Ohio class submarines and backfitted on the first eight submarines (replacing their Trident I C4 missiles) during their overhauls, with conversions starting in FY 1993. By FY 2001 all of the 20-21 Trident submarines scheduled to be in the U.S. fleet will carry the Trident II D5.

The Trident II D5 missile can carry either the W88/Mk5 or the W76/Mk4 warhead/MIRVs. The W88 is a new high-yield warhead with an explosive power of 475 kilotons, while the W76 is the same 100 kiloton yield warhead currently used on the Trident I. The W88 commenced production in September 1988 and some 200 are in the U.S. nuclear stockpile as of mid-1990.[77] Although the missile is designed to carry up to 14 of the lighter W76 warheads, under the START negotiations the U.S. and Soviet Union have agreed that the Trident II missile will be counted as carrying eight warheads.[78]

The Navy has primarily justified the D5 missile for its ability to "engage the full spectrum of targets," including "those ... which the Soviets value most," referring to command and control sites and underground missile silos.[79] When armed with the W88 warhead, the Trident II "will have the capability to destroy hardened targets, earlier thought to be vulnerable only to high-yield bombs or to the most modern U.S. [land-based] intercontinental ballistic missiles (ICBMs)."[80]

Production of the W88 warhead may be affected by the closure of the U.S. Department of Energy's Rocky Flats, Colorado, plutonium processing plant where the cores of nuclear warheads are fabricated. Environmental and safety problems led to the suspension of operations at Rocky Flats in December 1989. According to the U.S. Navy, enough W88 cores were produced prior to the shutdown to arm the USS Tennessee (SSBN-734) and the USS Pennsylvania (SSBN-735).[81] But U.S. officials claim if the Rocky Flats plant is not reopened by Fall 1990, the third submarine to be armed with the W88, the USS West Virginia (SSBN-736), may have to be equipped with older W76 warheads removed from Trident I missiles.[82]

Trident II missiles are equipped with stellar-aided inertial digital computer guidance. Prior to underwater testing, the Trident II D5 was predicted to be more than twice as accurate as the Trident I C4,[83] with a circular error of probability estimated to be 0.07-0.10 nautical miles (0.13-0.19 kilometers). Testing has reportedly confirmed the doubling of accuracy. During the January 1990 underwater test launches, RADM Kenneth Malley, Program Manager of the Trident II, noted that the missile exceeded the "highest expectations" he had held, and added that "at 4,000 nautical miles we have an accuracy that's better than the length of the submarine [560 feet]."[84]

Admiral Malley also provided new details about the range of the Trident II. He said that with the heavier W88 warheads, the Trident II missile will have a range "hundreds of miles" greater than the 4,000 nautical mile (7,400 kilometers) Trident I missiles. With the lighter W76 warheads, the missile will have range "thousands" of miles greater,[85] estimated to be some 6,000 nautical miles (11,100 kilometers).

The U.S. Department of Defense reports the Trident II missile program cost is $37 billion for development and procurement of 899 missiles, including test and spare missiles.[86] In addition, the estimated warhead cost is $5 billion.[87] Total life-cycle costs for the development, acquisition, and operational support for the Trident II D5 missiles and related strategic weapons systems equipment (excluding the submarines and warheads) through the year 2032 is approximately $99.3 billion in escalated dollars.[88]

The Soviet Union

The Soviet Union has six different types of submarine-launched ballistic missiles on 61 ballistic missile submarines. The 914 missiles are thought to be armed with 3,802 nuclear warheads, broken down as follows:

Missiles		Warheads
176	SS-N-6	352
286	SS-N-8	286
12	SS-N-17	12
224	SS-N-18	1,568
120	SS-N-20	1,200
96	SS-N-23	384
914	**Total**	**3,802**

The **SS-N-6 Serb** is a single stage, liquid fuel missile. As of mid-1990, it is deployed on 11 Yankee I class SSBNs. The current modification of the missile (Mod 3) carries two warheads on multiple reentry vehicles (not independently targetable) and became operational in 1973. The missile has a range of 1,600 nautical miles (3,000 kilometers), and its two warheads have the explosive power of 375-1,000 kilotons each. The missile is inertially guided and has an accuracy (circular error of probability) of about one nautical mile.

The **SS-N-8 Sawfly** is a single stage, liquid fuel single warhead missile. It is deployed on 23 submarines: one Hotel III class, 18 Delta I class, and four Delta II class.[89] The SS-N-8 first became operational in 1973. Each missile carries a single warhead with the explosive power of 1,000-1,500 kilotons. The missile has a range of 4,900 nautical miles (9,100 kilometers), is inertially guided, and has an accuracy (circular error of probability) of about 0.8 nautical miles.

The solid fuel **SS-N-17 Snipe** is deployed on a single Yankee II class SSBN which was converted from a Yankee I in 1977. The missile itself may not have reached operational status until 1980. Each missile carries a single 500-1,000 kiloton warhead and has a range of 2,100 nautical miles (3,900 kilometers). The missile is inertially guided and has an accuracy (circular error of probability) of 0.75-0.8 nautical miles.

The **SS-N-18 Stingray** is a two stage, liquid propellent multi-warhead missile, and was the first Soviet submarine-launched missile with MIRVs. It is currently deployed on 14 Delta III class SSBNs. The SS-N-18 first became operational during 1977-1978, and is deployed in three modifications: Mod 1 with three warheads, Mod 2 with a single warhead, and Mod 3 with up to seven warheads. The average loading of SS-N-18 missiles is assumed to be seven warheads under agreed U.S. and Soviet counting rules for START negotiations.

The SS-N-18 Mod 1 and 3 missiles carry warheads that each have an explosive power of 200-500 kilotons. The Mod 2 missiles carry a larger warhead with an explosive power of 450-1,000 kilotons. The SS-N-18 Mods 1 and 3 missiles with multiple reentry vehicles have a range of 3,500 nautical miles (6,500 kilometers). The single warhead Mod 2 has an extended range of 4,300 nautical miles (8,000 kilometers). The missile is inertially guided and has an accuracy (circular error of probability) of 0.5-0.76 nautical miles.

The **SS-N-20 Sturgeon** is a three stage, solid fuel multiple warhead missile that is deployed on six operational Typhoon class SSBNs.[90] First operational in 1983, the missile is still in limited production. Each missile is counted as carrying ten 100-200 kiloton warheads under agreed U.S. and Soviet counting rules for START negotiations. The SS-N-20 missile is inertially guided and has an accuracy (circular error of probability) of about 0.3 nautical miles. It has a range of 4,500 nautical miles (8,300 kilometers). A modified version of the SS-N-20 is also thought to be in flight testing and the early stages of production.[91]

The **SS-N-23 Skiff** is the newest Soviet SLBM, a three stage, liquid fuel multiple warhead missile. It is deployed on six Delta IV SSBNs and is still in production. The SS-N-23 first became operational in early 1986.[92] Each missile is counted as carrying four 100 kiloton warheads under agreed U.S. and Soviet counting rules for START negotiations.

The inertially guided missile reportedly has a greater accuracy than the SS-N-18. However, it has suffered some reliability problems in the past. In March 1988, the Director of Naval Intelligence testified before Congress that:

> Four DELTA IVs [submarines which carry the SS-N-23] are assessed to be operational, although none has gone on patrol. The SS-N-23, a highly sophisticated missile that probably pushes Soviet state of the art, apparently has suffered reliability problems. The missile is assessed to be operational, however, and work to improve its reliability continues.[93]

In 1989, Soviet Military Power reported that the Soviets had deployed a modified version of the SS-N-23 missile in 1988.[94] It is assumed that this modified version corrected the problems encountered in the earlier missile. The SS-N-23 may be backfitted into Delta III class submarines in place of older SS-N-18s.[95]

In 1988, the U.S. Department of Defense reported that new Soviet SLBMs were under development, and predicted that they "should be well into developmental flight testing before 1990."[96] One these missiles is the modified version of the SS-N-20. The other, a completely new SLBM, continued to be reported in development in 1989, but in 1990 nothing was mentioned of it and it is assumed to have remained in the research stage or to have been cancelled.[97]

The United Kingdom

The United Kingdom deploys the Polaris A3TK SLBM on four ballistic missile submarines, and plans to replace this missile with the U.S. manufactured Trident II D5.

The **Polaris A3TK** is a two stage, guided missile containing two "Chevaline" multiple reentry vehicles.[98] The Chevaline modernization program began in 1974, and became operational in 1982 on HMS Renown (S26), replacing older Polaris A3 reentry vehicles. All four submarines were equipped with the new front-ends by 1987. The missile has a range of 2,500 nautical miles (4,700 kilometers) and each warhead has an estimated yield of 40 kilotons. Some 96 warheads for the missiles are estimated to be in the British stockpile.[99]

In 1987 new engines for the Polaris missiles were installed at a total cost of £437 million, allowing them to function until the Royal Navy converts to the Trident II. A refurbishment of the Chevaline reentry vehicles started in January 1988. The work was to extend "over a number of years," and be the last major work done to the Polaris A3TK missile before they were replaced by Trident.[100]

In the early 1980s, Britain decided to replace the aging Polaris missiles with the U.S. **Trident II D5** missile. Trident missiles will be purchased from the United States, but be armed with British designed and built warheads, and carried on British built nuclear-powered ballistic missile submarines.[101] The first U.K.-produced warheads are due to be delivered at the end of 1992, and the first Royal Navy Trident submarine, the HMS Vanguard, is scheduled to become operational in the mid-1990s.[102]

The Trident program is officially estimated to cost some £9.38 billion (approximately $15 billion), some 32 percent of which will be spent in the United States.[103] It is thought that the U.K. Trident missiles nominally will carry at most eight MIRVs, although missiles could carry up to 14 warheads.[104] Deployment of the Trident missile will increase the number of warheads per submarine from the present 32 to at least 128 per boat.

France

France has three different types of SLBMs on six ballistic missile submarines. The 96 missiles are thought to be armed with 416 nuclear warheads, broken down as follows:

Missiles	Warheads
32 M20	32
16 M4A	96
48 M4B	288
96 Total	**416**

The **M20** is a two stage, solid propellent, inertially guided 1,600 nautical mile (3,000 kilometer) range missile armed with a single 1,000 kiloton TN-61 nuclear warhead. The M20 was first deployed in 1977 as a replacement for the M2 missile which was retired. In 1990, the M20 is deployed on two submarines: Le Foudroyant (S610) and Le Redoutable (S611). Le Foudroyant will be upgraded to the M4B missile by 1993. Le Redoutable will be retired in 1991.[105] Since 1988, two of the other four submarines originally converted to carry the M20 have been further converted to carry the M4B missile. The number of M20/TN-61 warheads is thought to have fallen proportionately from 64 to 32.

The **M4A** is a three stage, solid propellant, inertially guided 2,200-2,700 nautical mile (4,000-5,000 kilometer) range missile armed with six MIRVs, each with a 150 kiloton TN-70 warhead. Sixteen missiles carrying some 96 warheads are presently deployed on the L'Inflexible (S615). Development of the M4A as a replacement for the M20 began in 1975, and it was first deployed in 1985 when L'Inflexible went to sea. L'Inflexible, however, is the only submarine with the M4A, since all subsequent replacements of the M20 missiles will be with the M4B.[106]

The **M4B** is a three stage, solid propellant, inertially guided 3,200 nautical mile (6,000 kilometer) range missile armed with one to six MIRVs with 150 kiloton TN-71 warheads.[107] It can achieve a greater range than the M4A by using the lighter TN-71 warhead and by mounting fewer than six warheads on the missile. The M4B was first deployed in 1987 on Le Tonnant (S614), which had undergone an extensive refit.[108] Since 1988, two more submarines have been converted from the M20 missile to the M4B: L'Indomptable (S613) and Le Terrible (S612). A fourth submarine, Le Foudroyant (S610), will be upgraded by 1993. Some 48 M4B missiles with 288 TN-71 warheads are deployed with the three converted submarines.

In 1986, development began on another version of the M4, the **M45**. This missile is an intermediate between the M4 missile and the under development M5 missile, combining some features of both. The M45 will carry six warheads, but will have improved penetrations aids and a new TN-75 warhead. It will be deployed on the first three new generation ballistic missile submarines, beginning with the first submarine, Le Triomphant, when it enters service in 1994.[109] The new 12-warhead **M5** missile is also under development. The M5 program has faced delays, however, and its fleet introduction has been pushed back from 1999 to the beginning of the next century. Thus it will arm the fourth new generation submarine, rather than the third as previously had been planned.[110]

China

China's only reported SLBM is the **Juilong 1 (CSS-N-3)**,[111] a two stage solid fuel missile with an estimated range of 1,800

nautical miles (3,300 kilometers).[112] It can carry a single warhead with an estimated yield of 200-1,000 kilotons. It was designed to be deployed on the Xia class ballistic missile submarines.[113] Under development for more than ten years, the missile's first underwater launch from a submarine took place in 1982, using the Golf class SSB.[114] Its first underwater launch from an Xia class submarine in 1985 seemingly was a failure. But a second underwater firing from the Xia submarine took place in 1988, and was a success. Some 26-38 warheads are estimated to be in the Chinese naval arsenal, enough to arm the missiles for the one or two Xia class submarines thought to be operational, as well as one Golf test submarine. Reportedly a new type of SLBM is also under development.[115]

2. Sea-launched Cruise Missiles

The United States

The U.S. has one nuclear-armed sea-launched cruise missile (SLCM) — the **Tomahawk** (BGM-109A) — a subsonic guided, submarine- or surface-ship launched, missile which comes in both conventional and nuclear versions. The nuclear version is commonly called TLAM/N, for Tomahawk Land-Attack/Nuclear.[116] It carries one W80-0 warhead with a selectable yield of 5-150 kilotons. About 325 W80-0 warheads are estimated to be in the U.S. nuclear stockpile in mid-1990.[117]

TLAM/Ns have an inertial and terrain matching guidance system (TERCOM) and an accuracy (circular error of probability) of about 30 meters. The missile is propelled by a solid booster for launch and a small turbofan engine during its cruise flight. The TLAM/N range is 1,350 nautical miles (2,500 kilometers).[118] A total of 3,630 Tomahawks of all variants are scheduled to be procured.[119] Tomahawk missiles can be launched from submarine torpedo tubes, armored box launchers (ABL) on surface ships, and vertical launching systems (VLS), both on submarines and surface ships.[120]

TLAM/N introduction has been moving forward slower than originally planned by the U.S. Navy. In the mid-1980s the Navy intended to buy its total inventory objective of 758 nuclear missiles by FY 1991, of which 90 percent (678) were to be procured by FY 1990.[121] As of FY 1990, the Navy had only procured 50 percent (367) of its original goal. The FY 1991 budget request includes 75 more nuclear Tomahawks, with the remaining 316 left to be requested in FY 1992, the currently scheduled final year of Tomahawk procurement.[122]

Since this would be an unusual final year purchase of nuclear missiles (the largest purchase of almost a 100 was in FY 1986), this has implied the Navy will ultimately build less than 758 nuclear Tomahawks. Nonetheless, the shift from the original plan remains unclear. Reportedly, the Navy may have slowed purchases to avoid having excess missiles dismantled due to an arms control agreement.[123] But also the number of planned SLCM platforms has declined slightly, and the Navy is suffering budgetary constraints. In addition, the problems in the U.S. nuclear weapons production complex may have affected the priority of Tomahawk in comparison with other warhead programs. It is not thought that the slowdown in the nuclear Tomahawk program was caused by any reassessment of nuclear strategy, although the Navy may be anticipating reductions in targets in Eastern Europe and/or the Soviet Union. Still, reports persist that the Navy may elect to produce less than the 758 nuclear SLCMs it originally desired.[124]

The nuclear Tomahawk was first deployed on ships and submarines in June 1984. In June 1990, there are 86 ships and submarines certified to launch and carry some, but not necessarily all, variants (see Table 5).[125]

Table 5: Tomahawk Certified Vessels (end 1985-1989 and June 1990)

	Submarines			Surface Ships					
	688	637	Sub-Total	BB	CGN	CG47	DD963	Sub-Total	Grand TOTAL
1985	-	-	15	2	2	0	4	8	23
1986	-	-	21	3	3	1	6	13	34
1987	25	6	31	3	4	3	7	17	48
1988	28	8	36	3	5	6	9	23	59
1989	30	13	43	4	5	8	12	29	72
1990	32	18	50	4	5	11	16	36	86

The number of vessels able to fire the Tomahawk missile is also increasing slower than earlier U.S. Navy plans. In the mid-1980s the Navy planned to have 126 Tomahawk-capable vessels by FY 1990,[126] 40 more than are currently available. The reduction is mostly due to delays in conversions in Sturgeon (SSN-637) class submarines to carry Tomahawks; slower backfits of Spruance (DD-963) class destroyers with vertical launching systems; problems with achieving an operational capability with the VLS fitted on Los Angeles (SSN-688) class submarines, and postponements in deliveries of new Los Angeles class submarines.

The total number of combatant vessels that will carry nuclear Tomahawks also will be slightly less than the Navy had originally envisioned. In the mid-1980s, the Navy wanted to have 198 surface ships and submarines equipped with Tomahawk missiles by the mid- to late-1990s.[127] Now the Navy estimates it will have 191 vessels by the late-1990s or early 2000s.[128] Even this goal probably will not be achieved as it does not account for the retirement of all four battleships, nor a possible submarine force of only some 70-80 boats.

The Navy is developing a follow-on to the Tomahawk, called the long-range conventional cruise missile (LRCCM), but current plans call for this missile only to be conventionally armed. The LRCCM program also has been referred to as "Excalibur," the Long Range Conventional Standoff Weapon (LRCSW), or the advanced sea-launched cruise missile (ASLCM).

The Soviet Union

The Soviet Navy deploys seven different types of nuclear-capable sea-launched cruise and anti-ship missiles: the SS-N-3 Shaddock/Sepal, the SS-N-7 Starbright, the SS-N-9 Siren,

the SS-N-12 Sandbox, the SS-N-19 Shipwreck, the SS-N-21 Sampson, and the SS-N-22 Sunburn. With the exception of the SS-N-21, all of these SLCMs are thought to be dual-capable, i.e., they can carry either a conventional or nuclear warhead. As of 1990, Soviet ships and submarines have 1,010 SLCM launchers (not counting the capacity of 30 attack submarines which can fire approximately 136 SS-N-21s from torpedo tubes), and it is estimated that the Soviet Navy possesses 570 nuclear versions (see Table 6).[129]

Table 6: Soviet Sea-Launched Cruise Missiles and Platforms

Type	Platform	Missiles	Warheads
SS-N-3c Shaddock	Juliett, Echo II	96	76
SS-N-3b Sepal	Kynda, Kresta I	48	14
SS-N-7 Starbright	Charlie I	64	32
SS-N-9 Siren	Charlie II, Papa, Nanuchka, Sarancha	248	92
SS-N-12 Sandbox	Kiev, Slava, Echo II	248	106
SS-N-19 Shipwreck	Kirov, Oscar I/II	180	72
SS-N-21 Sampson	Akula, Sierra, Victor III, Yankee Notch	136	136
SS-N-22 Sunburn	Sovremennyy, Tarantul III	126	42
Total		**1,146**	**570**

Soviet deployment of shorter range cruise and anti-ship missiles continued at a steady but reduced rate during the late 1980s.[130] According to U.S. naval intelligence, "several Soviet naval cruise missiles systems have recently undergone or are possibly undergoing upgrade.... Other naval anti-surface cruise missile systems are also being developed that may significantly enhance the ASUW capabilities of a number of units. A new small, subsonic missile system — designated the SS-NX-25 and believed to be very similar to the U.S. Harpoon — is under test and evaluation.[131] It is not known whether this last missile would be nuclear capable.

First deployed in 1960, the **SS-N-3** is the oldest SLCM in the Soviet fleet. The SS-N-3 is deployed in two versions: the submarine-launched SS-N-3c Shaddock, and the surface-launched SS-N-3b Sepal. With a range of 250 nautical miles (460 kilometers), it was the longest range cruise missile until the introduction of the SS-N-12 in 1976. It is estimated that there are a total of 144 SS-N-3 missiles deployed with 90 nuclear warheads. The SS-N-3c is deployed on Echo II and Juliett class cruise missile submarines, and the SS-N-3b is deployed on Kresta I and Kynda class cruisers. SS-N-3s on Echo II class submarines were being replaced by SS-N-12s in the 1980s, and only seven Echo IIs are thought to still be armed with the SS-N-3.

The SS-N-3 was once the most numerous Soviet SLCM deployed. The decision to phase out the Echo IIs, and the age or conversion of the other SS-N-3 platforms (a single Juliett class submarine reportedly has been converted to be a trials ship for the SS-N-12), however, means the remainder of the missiles probably will be retired by the mid-1990s.

The **SS-N-7 Starbright** was deployed in 1968 on Charlie I (and possibly Charlie II and Papa) cruise missile submarines. It was the first Soviet SLCM capable of submerged launch from a submarine. Some 64 of the 30 nautical mile (56 kilometer) range missiles and 32 nuclear warheads remain deployed on the Charlie I class. Charlie II and Papa class submarines are thought to have been converted to the SS-N-9. A nuclear version of the SS-N-7 missile may no longer be active, as Charlie I class submarines are being retired, and two have been leased to India with conventional versions of the missile. In any case, the missile is likely to be retired in the 1990s.

First deployed in 1969, the **SS-N-9 Siren** arms Charlie II and Papa class cruise missile submarines, Nanuchka I and III class patrol combatants, and Sarancha class patrol combatant hydrofoils. Some 248 missiles are operational with 92 nuclear warheads. The range of the SS-N-9 is 60 nautical miles (100 kilometers). The SS-N-9 is thought to be in production.

The **SS-N-12 Sandbox** is currently the most numerous SLCM deployed. It is a long range SLCM (300 nautical mile (550 kilometer) range), arming Kiev and Baku class aircraft carriers, Slava cruisers, modified Echo II class cruise missile submarines, and a single Juliett class cruise missile submarine. Some 248 of the missiles are deployed with 106 nuclear warheads. About 20 of 25 Echo II class submarines are thought to be converted from the SS-N-3 to launch the SS-N-12. The SS-N-12 is thought to be in production.

The **SS-N-19 Shipwreck**, which was deployed in 1980, has a range of 300 nautical miles (550 kilometers), and is thought to be the Soviets' second longest range SLCM. It is an improved SS-N-12 with a lower flight profile. It is fired from three of the Soviet Navy's most heavily armed ships — the Kirov class cruisers and Oscar I and II class cruise missile submarines. It is estimated that some 180 missiles and 72 nuclear warheads are deployed. The missile is in production.

The subsonic **SS-N-21 Sampson**, a 1,600 nautical mile (3,000 kilometer) range missile similar to the U.S. Tomahawk, was first deployed in late 1987.[132] It is fired from Akula, Sierra, Victor III, and converted Yankee Notch class SSNs.[133] It is estimated that some 30 submarines (four Akula, two Sierra, 23 Victor III, and one Yankee Notch) are capable of delivering the SS-N-21. These submarines carry an estimated 136 SS-N-21s.

The SS-N-21 despite being declared operational in late 1987, may still not be widely deployed.[134] In March 1990, the U.S. Navy described the "recent completion of a two year improvement program for the SS-N-21 land attack cruise missile, which probably focused on improving the SLCM's guidance/propulsion systems."[135] The missile is thought to be in full scale production.

The **SS-N-22 Sunburn**, deployed in 1981, arms the Sovremennyy class destroyers, Tarantul III class patrol combatants, and the Utka and Dergach class hydrofoils. The 60 nautical mile (100 kilometer) range missile is an improved derivative of the SS-N-9, and the first Soviet anti-ship missile having a sea skimming flight profile in the final phase of its attack trajectory. It uses the same radar and fire control systems as the SS-N-9. Some 126 missiles are deployed with a total of 42 nuclear warheads.[136] The missile is in production.

A large supersonic **SS-NX-24** SLCM is believed to be undergoing testing from a single converted Yankee class submarine (designated a cruise missile submarine, SSGN, rather than an attack submarine).[137] But development of the SS-NX-24 seemingly has been slowed, and perhaps even terminated. After years of declaring the missile imminently operational, Soviet Military Power 1989 stated that "Test activity for a sea-launched version [of the supersonic AS-X-19 air-launched cruise missile], the SS-NX-24, is continuing at a slow pace."[138] Rear Admiral Thomas Brooks, Director of U.S. Naval Intelligence, in his March 1990 testimony before the U.S. Congress only mentioned the SS-NX-24 once, and that was with this reticent passage: "The supersonic SS-NX-24 also possibly remains under development."[139]

3. Anti-submarine Warfare Nuclear Weapons

The United States

The retirement of the nuclear SUBROC submarine-launched and ASROC surface-ship launched rockets during 1989-1990, leaves the U.S. with one nuclear anti-submarine weapon: the B57 nuclear depth bomb.[140] In addition, the B90 nuclear depth/strike bomb is under development to replace the B57 in the mid-1990s. Experimental development of other anti-submarine nuclear weapons was halted in the 1980s. Warhead development for the Vertical Launch ASROC and Sea Lance anti-submarine warfare standoff weapon was cancelled in FY 1986 and FY 1988, respectively. Nuclear versions of neither are anticipated to be revived.[141] Paper studies for an unspecified new type of nuclear anti-submarine warfare (ASW) weapon continue, however.[142]

Despite retirement of virtually all ASW nuclear weapons in the U.S. inventory, and cancellation of anticipated replacements, the U.S. Navy still justifies the need for a new air-launched depth bomb. "The principal advantage provided by a nuclear depth bomb," according to the Navy, "is a credible deterrence against escalation to nuclear warfare at sea. Should deterrence...fail, a nuclear depth bomb improves our warfighting capability since it is invulnerable to countermeasures or false targets. Also, a nuclear depth bomb provides increased lethality against the modern, high speed deep diving double hulled Soviet submarines."[143]

The **B57** is a lightweight multi-purpose nuclear bomb that can be used as a nuclear depth bomb for ASW. Its yield is in the sub-kiloton to 20 kiloton range. Of the 1600 B57s in the U.S. arsenal in 1990, approximately 825 are anti-submarine versions for delivery by U.S. and NATO naval aircraft (Dutch NP-3 Orions, U.K. Nimrods, and Italian Atlantics).[144] It can be delivered by carrier-based S-3A/B Viking jets and SH-3D/H Sea King helicopters, A-6E and A-7E attack aircraft, as well as land-based P-3 Orion maritime patrol aircraft.[145]

Development of the **B90 nuclear depth/strike bomb (NDSB)** continued in 1988-90. It was scheduled to enter the inventory in FY 1993, but its status is now in doubt as its FY 1991 budget request is facing opposition in the U.S. Congress.[146] The B90 will be a multi-purpose bomb which will have "modern safety and security features" and will replace the almost 30-year-old B57 tactical strike bombs and B57 depth bombs.[147] According to the U.S. Department of Defense, "This commonality will allow smaller aircraft carrier bomb loadouts than would otherwise be possible with separate tactical strike and depth bombs, thereby reducing overall stockpile numbers of fleet strike and depth bombs."[148] The B90 will be deliverable by the P-3, the long-range replacement for the P-3, the S-3, and the SH-3, as well as allied maritime patrol planes. It is estimated that some 1,000 B90 bombs will be purchased between 1993-2000. Total program cost is estimated to run approximately $1 billion dollars, or $1 million dollars per warhead.

The Soviet Union

The Soviet Navy has a total of about 1,300 nuclear anti-submarine warfare warheads on five different types of weapons: nuclear torpedoes, a submarine rocket nuclear depth bomb, a submarine launched ASW missile, a ballistic rocket, and air delivered nuclear depth bombs.

The Soviet Navy deploys two different types of **nuclear torpedoes**: the Type 65 and ET-80. The Type 65 was introduced in the early 1960s, and the ET-80 was introduced in the early 1980s.[149] Today, 520 nuclear torpedoes are estimated to be deployed on submarines and surface ships.[150]

Three incidents involving Soviet attack submarines indicate that nuclear torpedoes are routinely deployed. The first reportedly occurred in December 1972, when a nuclear-powered submarine from the Northern Fleet had an accident while on patrol off the east coast of North America. The accident occurred in the forward section of the submarine and was caused, according to intelligence reports of the U.S. Central Intelligence Agency, by a radiation leak from a nuclear torpedo.[151] The second occurred in October 1981 when a Whiskey class attack submarine ran aground near the Karlskrona naval base in Sweden. Swedish Defence Ministry authorities detected the presence of Uranium-238, leading them to conclude that the submarine probably had "one or more nuclear weapons aboard."[152] The third occurred in April 1989, when the Mike class submarine sank in the Barents Sea and the Soviet government announced that the submarine was carrying two nuclear torpedoes.

Most western reference books credit all 21-inch nuclear torpedo launchers as capable of delivering nuclear torpedoes. Soviet officials, however, have denied that surface ships regularly carry nuclear torpedoes. There are 149 surface ships of nine classes — Riga, Grisha I/III/IV/V, Krivak I, and Krivak II class frigates as well as Turya class patrol combatants — that are only armed with one possible nuclear-capable launcher, i.e. 21-inch torpedo tubes. Since these ships are small frigates and patrol boats, it is thought that they may not be nuclear capable.

The Soviet Union also deploys three types of nuclear-armed missiles and rockets for anti-submarine missions: the FRAS-1 nuclear rocket, the SS-N-15 Starfish nuclear depth bomb, and the SS-N-16 Stallion dual-capable ASW missile.[153]

Twin SUW-N-1 launchers with **FRAS-1** (Free Rocket Anti-Submarine) rockets are deployed on three Kiev and two Moskva class surface ships. The missile is a nuclear-only variant of the Soviet Army's FROG-7 short-range rocket. It is

estimated that 25 missiles with nuclear warheads are deployed. The fourth ship of the Kiev class — the Baku — designated a separate class because of major weapons configuration changes, did not include the SUW-N-1 launcher.

The submarine-launched **SS-N-15 Starfish** rocket propelled nuclear depth bomb was deployed in 1973 and is similar to the U.S. Navy's retired SUBROC.[154] It is fired from either 21- or 25.6-inch torpedo tubes and is carried on Typhoon, Charlie I/II, Papa, Oscar I/II, Victor II, Alfa, Sierra, and Akula class submarines. Victor I and Tango class attack submarines also may be capable of firing the SS-N-15.

The **SS-N-16 Stallion** ASW missile has a longer range than the SS-N-15 (64 versus 20 nautical mile [120 versus 37 kilometers]), and is able to carry a nuclear or conventional torpedo. The nuclear version is designated the SS-N-16B. Larger than the SS-N-15, the SS-N-16 can only be fired from 25.6-inch (650mm) torpedo tubes.

First deployed in 1979, the SS-N-16 is thought to be deployed on the Typhoon, Oscar I/II, Victor III, Sierra, and Akula classes. Tango class attack submarines also may be capable of firing the SS-N-16. There are an estimated 400 nuclear warheads for SS-N-15s and SS-N-16s, with each submarine being allocated an average of four nuclear weapons.

The Soviet Navy also deploys **ASW nuclear depth bombs**, which are deliverable by three types of land-based fixed wing aircraft and two ship-based helicopters. Two types of ASW nuclear depth bombs exist, one older and one introduced in the early 1980s.[155] There are 330 nuclear capable ASW aircraft: 180 land-based aircraft, comprised of about 75 Be-12 Mail, 60 Tu-142 Bear F, and 45 Il-38 May patrol planes; and 150 Hormone A and Helix A helicopters. It is estimated there are 350 nuclear depth bombs, or about one per nuclear-capable airplane and helicopter. These aircraft also may be capable of delivering nuclear torpedoes and nuclear sea mines.

The United Kingdom

The United Kingdom possesses some 25 nuclear depth bombs versions of the WE-177 nuclear bomb, designated the **WE-177C**.[156] According to the U.K. Ministry of Defence, "British nuclear depth-bombs can be delivered by Royal Navy anti-submarine helicopters" (i.e. Sea King and Lynx ASW helicopters).[157] During 1988-1990, the United Kingdom has been considering replacing the WE-177. The main interest has been in a new air-launched strike weapon to succeed the RAF's WE-177A/Bs, but a follow-on for the WE-177C depth bomb has also received attention.[158] The government was to make a decision by mid-1990 on whether to proceed, but the decision was subsequently put off until late 1990.[159]

4. Anti-air Warfare Nuclear Weapons

The United States

The United States no longer deploys nuclear-armed surface-to-air missiles. The last nuclear **Terrier** (RIM-2F) was retired in September 1988.[160] In the early to mid-1980s, a nuclear-armed Standard-2 missile (SM-2(N)) was under development to replace the Terrier. The U.S. Congress, however, refused to fund the missile and the program was terminated in mid-1986.

The Soviet Union

The Soviet Navy has two types of surface-to-air missiles which are thought to be nuclear capable: the **SA-N-1 Goa** and the **SA-N-3 Goblet**.[161] It is estimated that a total of 188 nuclear versions exist, four per ship on three aircraft carriers, 27 cruisers, and 17 destroyers.

The 12 nautical mile (22 kilometer) range SA-N-1 Goa, is deployed on Kresta I, Kynda, and Kashin/Mod Kashin class cruisers and destroyers. The SA-N-1 also has limited surface-to-surface capability. As older ships are retired, the SA-N-1 is also thought to be undergoing retirement. This may also mean a diminished, and or, eliminated nuclear capability. The 20 nautical mile (37 kilometer) range SA-N-3 Goblet, is deployed on the Kiev class carriers, and the Moskva, Kresta II, and Kara class cruisers.[162]

5. Air-Delivered Nuclear Weapons

The United States

U.S. Naval and Marine Corps aircraft can deliver some 1,350 nuclear weapons in three types for attacks on surface targets.

The **B43-1** (B43 mod 1) "is a tactical thermonuclear bomb designed for high-speed, low or high-altitude delivery against surface targets" by A-4M, A-6E and A-7E attack aircraft.[163] The B43 has an estimated yield of 1,000 kilotons, and of the 350 B43s in the U.S. stockpile in 1990, 250 are estimated to be for Navy use.[164]

The **B57** is a lightweight "multipurpose, air-launched, nuclear fission bomb designed for special tactical situations and anti-submarine warfare. Selectable delivery options are free-fall airburst, retarded-fall airburst, retarded-fall ground burst (laydown), and retarded-fall underwater burst [for the ASW depth bomb version]."[165] Its yield is in the sub-kiloton to 20 kiloton range. For land-attack missions, it can be delivered by A-4M, A-6E, A-7E, and F/A-18 attack/fighter aircraft. Of the 1600 B57s in the U.S. arsenal in 1990, 475 are thought to be for strike/land-attack use by the Navy.[166]

The **B61** is a lightweight, multipurpose thermonuclear "modern tactical bomb" in seven current modifications (mods). Four mods are currently used by the Navy (mods 0, 1, 2, 5), the rest are used exclusively by Air Force and NATO aircraft.[167] The selectable yield bomb can be exploded from as low as one kiloton, to 100-345 kilotons. B61s can be delivered by A-4M, A-6E, A-7E and F/A-18 attack/fighter aircraft. Another four B61 mods are scheduled to enter the stockpile in the 1990s, with improved safety and command features, of which the B61 mod 6 (B61-6) is scheduled to achieve an initial operational capability with the Navy in early 1991.[168] The remaining mods are in preproduction phases. Of the 3,025 B61s in the U.S. stockpile in 1990, some 625 are estimated for Navy use.

The Soviet Union

The Soviet Union has four types of dual-capable air-to-surface nuclear missiles (ASMs), as well as nuclear gravity bombs for naval missions. The ASMs include: the AS-2 Kipper, the AS-4 Kitchen, the AS-5 Kelt, and the AS-6 Kingfish. It is estimated that some 450 nuclear versions are deployed, arming Tu-95 Bear G strategic bombers in Strategic Aviation, and naval Backfire and Badger bombers. Fitter C fighters and Su-24 Fencer C/D/E aircraft assigned to SNA can deliver nuclear bombs, and may also be converted to carry the newer anti-ship missiles. (The number of nuclear bombs deployed on naval aircraft is not precisely known.)

The 100-115 nautical mile (185-210 kilometer) range **AS-2 Kipper**, deployed on Badger bombers in 1961, is the oldest missile and is being phased out of service. The **AS-4 Kitchen**, introduced in 1967, is carried on the Backfire B/C naval bombers. This 150-300 nautical mile (280-560 kilometer) range missile is the primary anti-ship weapon of SNA Backfire bombers. The 100-120 nautical mile (180-220 kilometer) range **AS-5 Kelt** carried on the Badger C/G, first deployed in 1965, partially replaced the AS-2. The 150-250 nautical mile (280-460 kilometer) range **AS-6 Kingfish**, first deployed in 1970, is also carried on the Badger C/G. It also is reportedly carried by Backfire bombers, although this has not yet been confirmed visually.

In addition to the SNA bombers, the AS-4 Kitchen is carried on converted Bear G bombers which are assigned maritime missions. The **AS-15 Kent** long-range air-launched cruise missile, introduced in 1984 and deployed on Bear-H bombers of Strategic Aviation, could also be assigned maritime missions.

The United Kingdom

The Royal Navy has approximately 25 **WE-177A/B** nuclear bombs for non-strategic naval missions. The bombs have a variable yield of 200-400 kilotons and can be delivered by RAF Buccaneer maritime strike aircraft.[169] During 1988-1990, the United Kingdom began to consider replacing the WE-177A/B versions with a new nuclear-armed tactical air-to-surface missile (TASM).[170] Three foreign systems already under development are being examined: Boeing Aerospace's Short Range Attack Missile Tactical (SRAM-T); a missile based on Martin Marietta's Supersonic Low-Altitude Target (SLAT) missile; and a longer-range successor to the French ASMP (Air-Sol Moyenne Portee) missile, known as the ASLP (Air-Sol Longue Portee).

In early 1989, Britain signed a government-to-government pact with the United States, which sanctioned U.S. contractors to assist in the development of the U.K. missile. However, by late 1989, a decision on the missile was delayed a year to be able to reevaluate a new French design. In early 1990, Aerospatiale was awarded a $1 million contract by the U.K. Ministry of Defence for a pre-feasibility study for a 500 km stand-off missile. A decision on the missile airframe is expected in late 1990. The missile could be carried by Buccaneer and Sea Harrier aircraft by the end of the century.[171]

France

French naval aviation has one type of air-to-surface missile, and two types of nuclear gravity bombs. The gravity bombs on Clemenceau class aircraft carriers are delivered by Super Etendard fighter aircraft, and include the **AN-52**, reported to have an explosive yield of some 25 kilotons, as well as a 6-8 kiloton **lower-yield bomb** variant of the AN-52.[172]

The new supersonic air-to-surface missile, the **Air-Sol-Moyenne-Portée** (ASMP), became operational with French naval aviation in 1989.[173] It carries a TN-80 300 kiloton warhead and has a range of 30-130 nautical miles (60-250 kilometers).[174] An inertial navigation system guides the missile, but the missile has no terminal homing capability. The ASMP is a dual-service program also used by French Air Force aircraft and serves both non-strategic (préstratégic) or strategic purposes.

The missile is intended to replace AN-52 gravity bombs carried by only some Super Etendard aircraft. About 50-55 Super Etendards were scheduled to be outfitted to carry the ASMP, but due to budgetary constraints only 20 will be so configured.[175]

II. U.S. Nuclear-capable Ships and Aircraft

The U.S. Navy had 549 commissioned ships as of June 1990.[176] Some 40 percent (233) of these ships are nuclear-capable. About 343 ships are principal combatant warships, attack submarines and ballistic missile submarines. About 40 percent (131) of these ships do, or could, carry or deliver nuclear weapons (see Table 7). The remaining 205 or so ships consist of amphibious warfare ships for Marine Corps support, small patrol combatants, and various logistic support and service ships. Nuclear weapons could be transported or serviced by approximately 50 percent (102) of these ships.[177] The U.S. Navy also operates six types of nuclear-capable aircraft, five from ships and one from land, while the Marine Corps has one additional nuclear type. Together the Navy and Marine Corps possess almost 1,600 operational planes and helicopters which can deliver nuclear weapons, some 30 percent of their total operational aircraft inventory.

Table 7: U.S. Nuclear-Capable Warships and Submarines (June 1990)

Type	Number	Nuclear Weapons
Ballistic Missile Submarines	33	Poseidon, Trident I, Trident II
Attack Submarines	50	Tomahawk SLCMs
Aircraft Carriers	12	Bombs and Depth Bombs
Battleships	4	Tomahawk SLCMs
Cruisers	16	Tomahawk SLCMs
Destroyers	16	Tomahawk SLCMs
TOTAL	**131**[178]	

A. Fleet Organization, Homeports, and Naval Nuclear Weapons' Shore Locations

U.S. Navy ships belong to either the Atlantic or Pacific Fleet. Ships in the Atlantic Fleet are further operationally assigned to either the Second or Sixth Fleet, while ships in the Pacific Fleet are assigned to either the Third or Seventh Fleets. Ships are then subordinated to battlegroups and task forces which are part of the numbered fleets.[179] The Second Fleet is headquartered in Norfolk, Virginia, and its ships operate in the Atlantic Ocean and adjoining seas (except the Mediterranean area). The Sixth Fleet is headquartered in Gaeta, Italy, and its ships operate in the Mediterranean and Black Seas. The Third Fleet is headquartered in Pearl Harbor, Hawaii, and its ships operate in the northern and eastern Pacific. The Seventh Fleet is headquartered at Yokosuka, Japan, and its ships operate in the western Pacific and Indian Ocean. With the exception of the ships deployed overseas, ships and submarines generally are rotated between their homeports and assignments to forward deployed fleets (the Sixth and Seventh Fleets).

Ships in the Atlantic Fleet are homeported on the Atlantic coast of the United States, and in the U.K. and Italy. Pacific Fleet ships are homeported on the Pacific coast of the United States, Hawaii, Japan, and Guam.

In the United States the two largest homeports are in San Diego, California, and Norfolk, Virginia, areas. Each has some 100 ships at a number of different installations. Charleston, South Carolina, Pearl Harbor, Hawaii, and Long Beach, California, are the next largest homeports with approximately 60 in the Charleston area, and 40 ships each at the other two sites. Other ships are homeported in Bangor, Washington, near Seattle; in the San Francisco Bay area (at Alameda, Concord, and Vallejo); Mayport, Florida, near Jacksonville; King's Bay, Georgia; Earle, New Jersey, and in Groton and New London, Connecticut.

Overseas, the largest bases are at Yokosuka, Japan, where the USS Midway (CV-41) and accompanying ships are homeported, and Sasebo, Japan, which hosts several amphibious ships. In addition, one nuclear-capable submarine tender is virtually permanently based at Holy Loch, Scotland, La Maddalena, Sardinia, and Guam, and a cruiser is homeported in Gaeta, Italy.

U.S ships also make regular port calls to overseas naval facilities at Subic Bay, Philippines; Yokosuka and Sasebo, Japan; Holy Loch, Scotland; Rota, Spain; Augusta Bay, Sicily; Roosevelt Roads, Puerto Rico; and Guantanomo Bay, Cuba.

Throughout the 1980s the U.S. Navy pursued its "Strategic Homeporting Plan" which was scheduled to add Everett, Washington near Seattle; San Francisco, California; Staten Island in New York City; Corpus Christi, Texas; Mobile, Alabama; Pascagoula, Mississippi; and Pensacola, Florida to the list of nuclear-capable ship homeports. Battleships were programmed to be homeported in San Francisco, Staten Island, and Corpus Christi, while an aircraft carrier was to be homeported in Everett and Pensacola. Since 1988, however, the number of ports in the Strategic Homeporting Plan has been reduced due to budget constraints. The San Francisco homeport has been abandoned, and the rest of the plan has faced delays. Due to increased Congressional opposition and continued fiscal problems, most of the program may be forgone.[180]

The U.S. Navy has 18 principal nuclear weapons storage sites in the United States and overseas. Most are located near major naval stations for support of ships and aircraft.[181]

Nuclear weapons facilities in the Pacific include:

- Naval Air Station (NAS) Adak, Alaska, which stores B57 nuclear depth bombs for use by P-3 Orion anti-submarine aircraft.

- Strategic Weapons Facility Pacific, Silverdale, near Bangor, Washington, which stores W76 Trident I warheads for the Trident submarines homeported at Bangor.[182]

- Naval Weapons Station (NWS) Concord, near San Francisco, California, which supports six homeported ammunition ships of the Pacific Fleet as well as NAS Moffett Field and NAS Alameda. Weapons stored include nuclear Tomahawks, nuclear bombs for U.S. Navy and Marine Corps aircraft, artillery warheads for the Marines, and B57 nuclear depth bombs for NAS Moffett Field's P-3 Orions.[183]

- NAS Alameda which serves as a storage and transshipment point for the nuclear weapons aboard the aircraft carriers (bombs and depth bombs) and cruisers (Tomahawks) homeported at Alameda.[184]

- NAS North Island, Coronado near San Diego, California, stores bombs, nuclear depth bombs, and Tomahawks for the ships and submarines in the San Diego area. It is also the "logistics control center for all movements of Tomahawks needing air transportation," in the Pacific.[185]

- West Loch, Pearl Harbor, Oahu, Hawaii, is the main nuclear weapons storage site of Naval Magazine Lualualei and provides support for the ships, submarines, and Marines at Pearl Harbor. Naval Magazine Lualualei has facilities for supporting Tomahawks.[186]

- NAS Barbers Point, Oahu, Hawaii, stores B57 nuclear depth bombs for use by P-3 Orions, and serves as a main transshipment point for nuclear Tomahawks and nuclear weapons stored a Lualualei.[187]

- Naval Magazine Santa Rita, Guam, is the main nuclear weapons storage site in the western Pacific, supporting U.S. Navy and Marine Corps units in Japan and the Philippines, and storing artillery projectiles, bombs, and B57 nuclear depth bombs. It also has been upgraded to support Tomahawks.[188]

Facilities in the Atlantic include:

- NAS Brunswick, Maine, which stores B57 nuclear depth bombs for use by P-3 Orions.[189]

- NWS Earle (Colts Neck), New Jersey, supports five ammunition and fast combat support ships homeported there as well as Atlantic Fleet ships which call, and stores nuclear Tomahawks, nuclear bombs, and artillery warheads for the Marines.[190]

- NWS Yorktown near Norfolk, Virginia, stores nuclear weapons for naval units in the Norfolk area, including U.S. Navy and Marine Corps bombs, Tomahawks,[191] nuclear depth bombs, and Marine Corps artillery warheads.

- NAS Norfolk, Virginia, which is a major transshipment center for not only Navy nuclear weapons for ships and submarines at the Norfolk naval base, but for the nuclear weapons of other services as well.

- NWS Charleston, South Carolina, located on the west bank of the Cooper River about 25 miles outside of Charleston, services Poseidon and Trident I warheads for submarines in overhaul and storage. It also supports Tomahawk missiles.[192]

- Naval Submarine Support Base, Kings Bay, Georgia, stores Trident I ballistic missiles and warheads. In addition, a Strategic Weapons Facility, for Trident II missiles and warheads has been constructed.

- NAS Cecil Field, "Yellow Water," Florida (near NAS Jacksonville and Naval Station Mayport) stores Navy bombs and B57 nuclear depth bombs for use by Mayport ships and P-3 Orions.[193]

- NS Mayport, Florida, is a transshipment and storage point for nuclear weapons for the ships homeported at Mayport.[194]

Overseas land-based nuclear storage points include:

- NAS Sigonella, Sicily, Italy, which stores B57 nuclear depth bombs for use by U.S. P-3 Orions and Italian Atlantics, and serves as the major transhipment point for ships of the Sixth Fleet.[195]

- Naval Aviation Weapons Facility, St. Mawgan, United Kingdom,[196] which stores B57 nuclear depth bombs for use by U.S. and Dutch P-3 Orion, and U.K. Nimrod aircraft.[197]

The Tomahawk logistic infrastructure in the U.S. Navy has been steadily increasing as the missile is deployed. At the end of 1984, in the first year of deployment, four submarine tenders and two shore sites were fully capable of supporting Tomahawks.[198] By 1987, seven submarine tenders and five shore stations were Tomahawk-capable. Currently nine of twelve submarine tenders can support Tomahawks: six of the nine Atlantic Fleet tenders (all but the three devoted to ballistic missile submarine support) and all three Pacific Fleet tenders. Sixteen shore-based ordnance facilities can support Tomahawk, ten in the Pacific and six in the Atlantic Fleet.[199] As of 1990, nine of the Pacific and four of the Atlantic shore stations were fully capable of Tomahawk support, while the remainder had at least an initial capability to support horizontally launched Tomahawks. By FY 1992 all facilities should be able to support both horizontally- and vertically-launched Tomahawks.[200]

There are numerous other shore facilities that do not store nuclear weapons, but are part of the naval nuclear infrastructure. These facilities include test and training ranges for nuclear units, communications complexes used by nuclear units, and support headquarters. Some locations such as Holy Loch, Scotland, La Maddalena, Sardinia, Italy, and New London, Connecticut, routinely have submarine tenders and submarines with nuclear weapons docked in port and so become de facto storage locations, although no nuclear weapons are stored on land. Also Naval Supply Center (NSC) Oakland, California, and NSC Norfolk, Virginia, have important nuclear related roles. They stock nuclear weapon repair parts, maintain supplies of tritium for nuclear weapons, and keep track of nuclear logistics in their respective fleets.

B. Nuclear-capable Ships[201]

1. Ballistic Missile Submarines

In 1990, the ballistic missile submarine (SSBN) force consists of 33 submarines: 11 submarines with Poseidon missiles; 20 with Trident I missiles; one with Trident II missiles; and one awaiting loading with Trident II missiles.[202] Excluding the new submarine, which will probably become operational in late 1990, these vessels carry 584 ballistic missiles with 5,024 nuclear warheads.[203]

The numbers of SSBNs, missiles, and warheads will continue to decline as Poseidon submarines are retired faster than new Trident submarines are introduced. By FY 2001, Navy plans call for an all Trident II submarine force of 21 operational submarines loaded with 504 missiles and 4,032 warheads, with an additional two or three submarines in overhaul.[204]

Poseidon submarines each have 16 SLBM launch tubes.[205] The submarines were commissioned during 1963-1967, and displace 8,250 tons submerged. They originally were armed with Polaris missiles, but then were modified during 1969-1977 to carry the Poseidon C3. Twelve submarines were further converted during 1979-1983 to carry 16 Trident I C4 SLBMs. The 11 remaining Poseidon C4 submarines are all planned to be retired by 1996, and the 12 Trident I C4 submarines will be gone by 1999 (although they may be retired earlier for arms control, fiscal, or operational reasons).[206] The Poseidon submarines operate out of Charleston, South Carolina, and Holy Loch, Scotland. The converted Trident I C4 submarines operate out of King's Bay, Georgia.

The new and larger Ohio class submarines each have 24 launch tubes. The first eight carry the Trident I C4 missile, while the ninth and subsequent submarines will carry the Trident II D5 missile. Ohio class submarines are twice the size

of previous Poseidon boats, displacing 18,700 tons submerged. They are designed to be quieter and more reliable, spending about 66 percent of their life cycle at sea as opposed to 55 percent for the Poseidon submarines.[207] Ohio class submarines with Trident I missiles are stationed in Bangor, Washington. Ohio class submarines with the Trident II D5 missile are based at King's Bay, Georgia.

Construction of the Ohio class began in the mid-1970s and the first ship, the USS Ohio (SSBN-726) was commissioned in 1981. The ninth submarine of the class, and the first to be armed with Trident II D5, the USS Tennessee (SSBN-734), made its first operational deployment in March 1990. The tenth submarine, the USS Pennsylvania (SSBN-735), is scheduled to go to sea in late 1990,[208] and the eleventh, the USS West Virginia (SSBN-736), will make its first patrol in 1991. Six more are under construction, and the FY 1991 budget requests funding for procurement of the 18th, as well as advanced procurement for the 19th and 20th.

The total number of Trident submarines to be procured has been a matter of debate. Throughout the 1980s, the Navy avoided setting an upper limit on how many Trident submarines it planned to procure. But in 1990, the Navy finally stated that it has a goal of 21 operational submarines, with and additional 2-3 in overhaul.[209] Without "detubing" submarines and carrying fewer missiles than 24 per boat, or reducing the number of warheads on the missiles, START limits on ballistic missile warheads will limit the Navy to about 18 submarines, depending on the mix of land- and sea-based missiles. Congressional critics of a larger submarine force have noted that since each submarine costs approximately $1.3 billion, significant savings would accrue if the Trident program was limited to 18 submarines.

The first eight Ohio class submarines will be converted to carry the Trident II D5 missile during regular overhauls at a rate of one per year from FY 1993-2001.[210] The USS Ohio (SSBN-726), the first submarine to be backfitted, is scheduled to enter the Puget Sound Naval Shipyard, Washington, in December 1992, and finish its overhaul by about January 1995.[211]

U.S. ballistic missile submarines operate regularly in the Arctic, north Atlantic, and north Pacific Oceans and the Mediterranean Sea. About 30 percent of the force is "on station" in day-to-day alert while another 25-30 percent is in transit or on training missions. To maximize their time at sea, submarines are assigned two crews (a "blue" and "gold" crew) that alternate in manning the submarine. An average submarine patrol lasts about two months.[212] The submarine then returns to port for about 30 days to exchange crews, reprovision, and carry out repairs before returning to sea. By 1990 the entire ballistic missile submarine force had conducted more than 2,700 deterrent patrols since the USS George Washington (SSBN-598) first deployed in November 1960.[213]

2. Attack Submarines

As of mid-1990, the United States had 92 nuclear-powered attack submarines (SSN), six less than in 1988. The Navy's 100- submarine force goal has been abandoned de facto along with the 600-ship Navy. Depending on building rates, the numbers of SSNs are projected to decline to some 70-80 SSNs by the end of the 1990s.[214]

The retirement of the SUBROC anti-submarine rocket leaves the nuclear Tomahawk land-attack cruise missiles as the only nuclear weapon carried by U.S. SSNs.[215] Tomahawks are being deployed on newly commissioned Los Angeles class submarines as well as on older Los Angeles, Sturgeon and Narwhal class boats. They will also be deployed on the new Seawolf (SSN-21) class submarines. As of June 1990, 50 SSNs are capable of firing Tomahawks. Current plans call for 86 submarines to be Tomahawk certified by FY 2000 (see Table 8).[216]

Table 8: Projected Tomahawk Certified Attack Submarines September 1990-1999[a]

SSN Class	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99
SSN-637	21	24	24	25	26	25	22	21	21	21
SSN-688	26	30	31	31	31	31	31	31	31	31
SSN-688 (VLS)	8	14	18	22	25	30	31	31	31	31
SSN-21	0	0	0	0	0	0	0	1	1	3
Total	**55**	**68**	**73**	**78**	**82**	**86**	**84**	**84**	**84**	**86**

[a] U.S. Navy, Cruise Missile Project Office, "Tomahawk Certified SSNs, end of FY 1989-FY 1999," 25 April 1990.

Los Angeles (SSN-688) class submarines hull numbers 688-718, and Sturgeon (SSN-637) and Narwhal (SSN-671) class submarines can carry eight SLCMs internally, to be fired from 21-inch torpedo tubes. Los Angeles class submarines SSN-719 and after have a vertical launch system (VLS) installed in the bow that can carry 12 SLCMs.[217] The first submarine equipped with VLS Tomahawks deployed to the Mediterranean Sea in August 1988.[218]

The Sturgeon (SSN-637) class boats are the oldest nuclear-capable submarines. They were commissioned during 1967-1975, and displace some 4,600 tons submerged. As of June 1990, 18 of 37 Sturgeon class submarines are certified for some but not necessarily all variants of the Tomahawk. The Navy had planned to convert all 37 submarines plus the single Narwhal (SSN-671) class to carry Tomahawk. However, due to budget constraints the submarines are being retired early instead of undergoing overhauls and conversions.[219] The numbers of Tomahawk-armed Sturgeon submarines will increase to 26 vessels in FY 1994 and then decline to 21 boats by FY 2000.

The latest class of attack submarines, the Los Angeles (SSN-688) class, was developed in the late 1960s and early 1970s. The first ship was commissioned in 1976 and they displace some 6,900 tons submerged. By June 1990, 44 Los Angeles class were commissioned, with 18 additional authorized or under construction.[220] As of June 1990, 32 Los Angeles class boats are certified for some but not necessarily all variants of the Tomahawk. Ultimately all 62 will carry nuclear Tomahawks. In the mid-1980s, the Navy had wanted a total of 68-69 Los Angeles submarines. In the FY 1990 budget, however, the Navy decided to end the program with 62

submarines, and shifted resources to the Seawolf class submarine program.

An improved version of the SSN-688 has been entering the fleet since June 1988.[221] These improved submarines are quieter, have an improved combat control system (the AN/BSY-1), can operate more freely in Arctic waters, and have a vertical launching system for missiles. The first five of these submarines are not yet fully operational due to problems with the BSY-1 system, but when finally ready, according to the U.S. Navy, they will be able to destroy twice as many Soviet submarines as earlier versions of the Los Angeles class: 5-6 Soviet submarines eliminated for every improved Los Angeles class submarine lost.[222]

The Seawolf class (SSN-21) is being developed as a follow-on to the Los Angeles class. According to the U.S. Navy, this new submarine design is needed to counter Soviet submarine improvements and will be a "revolutionary improvement in submarine warfighting capability."[223] The first submarine was authorized in the FY 1989 budget, and the contract for the lead ship was awarded to Electric Boat, Groton, Connecticut, in January 1989. The Seawolf is scheduled to join the fleet in 1995. The second and third of the class are being requested in the FY 1991 budget. The Navy plans to buy some 29-30 submarines, 28 by the year 2000.[224]

The Seawolf submarines will be larger and even more capable than the improved Los Angeles class, displacing some 9,150 tons submerged.[225] They will be quieter, have a higher tactical speed, an advanced AN/BSY-2 combat system, and carry more weapons (including nuclear Tomahawk SLCMs). The Seawolf's maximum speed will be a little over 35 knots, and importantly, the acoustic speed will be in excess of 20 knots.[226] Eight 30-inch (760 mm) torpedo tubes amidships, will permit quieter launches of weapons.[227] Seawolf class submarines will "spend half the time in transit" compared to the Los Angeles class submarines, and will be able to achieve "twice the time on station" in forward areas.[228] Overall, the U.S. Navy maintains, it will have "three times the mission effectiveness of the improved [Los Angeles class] SSN-688."[229]

A new nuclear reactor is under development for the Seawolf submarine. The reactor is to provide significantly more power without commensurate weight and size penalties, and will do so more quietly than any previous reactor plant developed. According to the Navy's director of nuclear propulsion, "the Seawolf at its tactical speed will be as quiet as the [Los Angeles class] SSN-688 alongside the pier."[230] A prototype core is scheduled to be installed and operated in an existing land-based nuclear propulsion plant at the Knolls Atomic Power Laboratory, in West Milton, New York, (near Albany) prior to fleet introduction.[231]

Attack submarines are homeported at Pearl Harbor, Hawaii, and San Diego, California, and Vallejo, California, in the Pacific; and at Charleston, South Carolina, Norfolk, Virginia, and Groton, Connecticut, in the Atlantic. As of June 1990, 38 nuclear-powered submarines are assigned to the Pacific Fleet and 54 are assigned to the Atlantic. A typical submarine patrol lasts 75-80 days; however, they have been known to operate submerged for more than 100 days.[232] On average, 50 percent of their time is spent away from port.[233]

3. Aircraft Carriers

Although the Navy owns 15 front-line aircraft carriers (CV/CVN), only 12 are considered deployable in mid-1990. Since 1988, the deployable force shrunk from 14 to 12 ships, with the commissioning of one new Nimitz class being offset by the decommissioning of one Midway class ship, and three rather than one carrier being in extended overhaul. The 12 active carriers include one Midway (CV-41) class; four Forrestal (CV-59) class; one Kitty Hawk (CV-63) class; one John F. Kennedy (CV-67) class; and five Nimitz (CVN-68) class.[234]

The U.S. Navy's mid-1980s goal was to have 15 deployable aircraft carriers as the centerpiece of the 600-ship fleet by 1990. Now a deployable 15-carrier force has been abandoned, since carriers are being retired early due to budget constraints. The USS Coral Sea (CV-42) was decommissioned in April 1990. The USS Midway (CV-41) will be retired during 1991-1992. In addition, the USS Saratoga (CV-60) and the USS Ranger (CV-61) are being considered for early retirement. U.S. Department of Defense planning for the FY 1992 budget reportedly envisions a 12 carrier force by FY 1997, although it is unclear whether this number accounts for ships in overhaul.[235]

The latest Nimitz class carrier, the USS Abraham Lincoln (CVN-72), was commissioned in November 1989. Three more Nimitz class ships are under construction: the USS George Washington (CVN-73), USS John Stennis (CVN-74), and the USS United States (CVN-75). The George Washington was authorized in the FY 1983 budget (along with the newly-commissioned Abraham Lincoln) and is scheduled for delivery in 1992. CVN-74 and CVN-75 were authorized in the FY 1988 budget and will be delivered during 1995-1998.[236]

Depending on the size of the carrier and its air wing, aircraft carriers deploy with 66-86 aircraft on board.[237] These aircraft include F/A-18 Hornets for surface attack and air-to-air combat; F-14 Tomcats for air-to-air combat; A-6E Intruders and A-7E Corsairs for attack missions; S-3A/B Viking jets, SH-3D/H Sea King helicopters, and SH-60F Seahawk helicopters for anti-submarine warfare; EA-6B Prowlers for electronic warfare; KA-6D aerial refueling tankers; and E-2C Hawkeyes for airborne early warning and command and control. In addition, several logistic aircraft may be on board.

The F/A-18s, A-6s, A-7Es, S-3A/Bs, and SH-3D/Hs are all nuclear-capable.[238] The aircraft carrier "stores" B43, B57 and B61 nuclear bombs for surface attacks by the attack aircraft, and B57 nuclear depth bombs for the ASW aircraft. The "W Division" of the Weapons Department of each aircraft carrier is responsible for maintaining and preparing the nuclear weapons aboard. Security for the nuclear weapons is provided by a Marine Corps security detachment assigned to each aircraft carrier.[239] Aircraft carriers are thought routinely to carry about 100 nuclear weapons when forward deployed.[240]

As of mid-1990, seven aircraft carriers are located in the Atlantic and five are in the Pacific.[241] Pacific based aircraft carriers are homeported in Yokosuka, Japan (the USS Midway (CV-41)); Alameda (San Francisco) and North Island (San Diego), California; and Bremerton, Washington, (the Bremerton carrier will be shifted to Everett, Washington, as

part of the U.S. Navy's strategic homeporting plan). In the Atlantic carriers are stationed at Norfolk, Virginia and Mayport, Florida. (A non-nuclear capable training carrier, the USS Lexington (AVT-16) is located at Pensacola, Florida.)

Aircraft carriers operate world-wide and typically spend six months in forward deployment before being relieved.[242] Four aircraft carriers generally are forward deployed at any given time, divided among the Mediterranean Sea, Indian Ocean (although the Indian Ocean patrols are decreasing) and Western Pacific. The other carriers are either in overhaul or participating in exercises and training off the East and West coasts of the United States. When underway, carriers are accompanied by several escort ships, forming carrier battlegroups (CVBGs). The escort ships provide additional protection to the carrier from air, surface and submarine attacks, and in turn, the carrier's air wing gives similar protection to the escort ships. In peacetime, a carrier battlegroup usually consists of one carrier, 1-2 cruisers, 2-3 destroyers, 1-3 attack submarines plus support ships. In wartime 2-4 carriers would operate together along with proportionately more escort ships.[243]

4. Battleships

The U.S. Navy has four nuclear capable battleships (BB). Renovated and recommissioned during the Reagan Administration,[244] three battleships — the USS Iowa (BB-61), USS New Jersey (BB-62), and USS Missouri (BB-63) — were recommissioned during 1982-1986, and the fourth, the USS Wisconsin (BB-64), was recommissioned in October 1988. Despite the expense of recommissioning these ships, the second largest vessels in the U.S. Navy, the four battleship force will be short lived. The FY 1991 budget calls for retiring the USS Iowa and USS New Jersey in early 1991. The remaining two ships may also be retired later in the 1990s.

Battleships can fire Tomahawk land-attack SLCMs.[245] Each can be armed with 32 Tomahawks in eight armored box launchers of four missiles each. Reportedly, the mix of versions "is generally believed to be one-half anti-ship, one-quarter conventional land-attack, and one-quarter nuclear tipped."[246]

Currently the USS New Jersey and USS Missouri are homeported at Long Beach, California, while the USS Iowa and USS Wisconsin are based at Norfolk, Virginia.

5. Cruisers

As of June 1990, the U.S. Navy has 43 cruisers (CG/CGN),[247] of which 16 are nuclear-capable and nine are nuclear-powered.[248] The number of nuclear-capable cruisers has dropped from 36 to 16 since 1988, due to the retirement of the nuclear ASROC and Terrier weapons.[249] Now only capable of delivering nuclear Tomahawk SLCMs, the number of nuclear-armed cruisers will increase to 27 by the mid-1990s, as the last Tomahawk-armed Ticonderoga class cruisers enter the fleet.

Five nuclear-powered cruisers can launch Tomahawks from two four-celled armored box launchers. These include the USS Long Beach (CGN-9) and the four Virginia (CGN-38) class cruisers. Eleven Ticonderoga class cruisers are certified to carry Tomahawks. These are CG-52 and later ships outfitted with vertical launching systems (VLSs) that nominally carry 26 Tomahawks.[250] The eleven Ticonderoga ships that remain to be delivered will also carry Tomahawks, thus 22 Ticonderoga class cruisers will eventually be nuclear-armed.[251]

Nuclear-capable cruisers range in size from 9,500-17,100 tons at full load. The oldest classes were commissioned in 1961 (the USS Long Beach), and during 1976-1980 (the four Virginia class ships), while the latest Ticonderoga class ships are still entering the fleet. The FY 1991 budget begins the planning process for the retirement of two nuclear-powered cruisers: the USS Truxtun (CGN-35), to be decommissioned in FY 1992, and the USS Bainbridge (CGN-25), to be decommissioned in FY 1994. This is the first time the U.S. Navy will retire nuclear-powered surface warships.

6. Destroyers

As of June 1990, the U.S. Navy had 59 destroyers (DD/DDGs), 16 of which are nuclear-capable.[252] The nuclear-capable destroyers are all Spruance (DD-963) class ships, and were commissioned during 1975-1980 and displace 7,800 tons at full load.

Tomahawk SLCMs are the only nuclear weapon deployed on destroyers. The number of nuclear-capable destroyers has dropped from 64 to 16 since 1988, due to the retirement of the nuclear ASROC and Terrier weapons.[253] The number of nuclear-armed destroyers will, nevertheless, double by the mid-1990s as more Spruance class ships are converted to carry Tomahawks and the new Tomahawk-armed Arleigh Burke class destroyers enter the fleet.

Sixteen Spruance class ships are currently certified to carry Tomahawks. Seven of these ships carry two four-celled Tomahawk SLCM armored box launchers on the forward deck, positioned on either side of the conventional ASROC anti-submarine rocket eight-cell box launcher. Nine other Spruance class ships have had the forward ASROC launcher removed and replaced by a 61 cell vertical launching system (VLS), allowing each to carry a nominal load of 45 Tomahawks.[254] Fifteen more Spruance class ships are scheduled to have the VLS installed, thus all 31 Spruance class destroyers will eventually be nuclear-armed.

A new Arleigh Burke (DDG-51) destroyer class is under construction. In July 1986 the keel of the first ship was laid down at Bath Iron Works, Maine, and it is scheduled to be delivered in February 1991.[255] The Navy plans to construct at least 33 Burke class ships at a total cost of $27 billion.[256] These ships will displace 8,300 tons at full load, and will be outfitted with an Aegis phased-array radar similar to the radar on the Ticonderoga class cruisers. Burke destroyers will be all steel to help limit the effects of electromagnetic pulse. The ships are also designed to withstand a nuclear blast overpressure of 7 pounds per square inch (psi) compared to 3 psi in most other Navy surface combatants.[257]

Burke class ships will be equipped with one 61 cell and one 29 cell VLSs, and will carry a nominal load of 28 Tomahawks.[258] Non-nuclear Vertical Launch ASROC anti-submarine rockets, and Standard anti-air warfare and Harpoon anti-ship missiles will also be fired from the VLS.

Destroyers, like cruisers, are multi-mission ships that can perform anti-air, anti-surface, and anti-submarine warfare, as well as provide support to amphibious operations. As in the case of cruisers, the addition of Tomahawks land-attack missiles has given destroyers a significant long-range, nuclear and conventional, land-strike capability for the first time. Guided missile destroyers are optimized for anti-air warfare, while the Spruance (DD-963) class has a strong anti-submarine warfare capability. Destroyers operate as escort ships in carrier or battleship battlegroups, or independently in escorting convoys of logistic ships. They also can operate independently or with cruisers to form their own surface action groups.

7. Frigates

Sixty-five frigates were nuclear-capable prior to the retirement of nuclear ASROC anti-submarine rockets. No frigates in the U.S. fleet are currently capable of delivering nuclear weapons.

8. Amphibious Warfare Ships

As of June 1990, the U.S. Navy operates 64 major active and reserve amphibious warfare ships, all of which have a contingent wartime ability to transport nuclear weapons. Only 20 ships of these ships, however, may actually be certified to carry nuclear weapons during peacetime. According to the Navy's authoritative doctrinal manual concerned with nuclear warfare operations, "Selected amphibious ships can store and transport a variety of air-delivered nuclear weapons as well as all ground tactical nuclear weapons for which the USMC [U.S. Marine Corps] has a capability."[259]

The eight types of amphibious ships capable of transporting nuclear weapons for the Marine Corps include: general purpose amphibious assault ships (LHD[260] and LHA), helicopter amphibious assault ships (LPH), amphibious transport docks (LPD),[261] amphibious cargo ships (LKA), dock landing ships (LSD), tank landing ships (LST), and amphibious command and control ships (LCC).

Currently, only helicopter amphibious assault ships (LPH) and amphibious transport docks (LPD) regularly train for handling nuclear weapons during peacetime. The other amphibious ship types probably are not nuclear-certified (certainly not tank landing ships (LST) and command and control ships (LCC)), and do not regularly embark nuclear weapons during peacetime.

Amphibious assault ships carry troops, materiel, or smaller landing craft for conveying troops and materiel ashore. The larger ships (LHDs, LHAs, and LPHs) are equipped with a complement of transport, attack helicopters, or AV-8B Harrier II attack vertical take-off and landing jets. They can carry nuclear bombs for nuclear-capable Marine aviation units (which operate from shore), or nuclear projectiles for use ashore by Marine Corps 155mm and 8-inch (203mm) artillery. The nuclear weapons can be transported ashore by smaller tracked landing vehicles or helicopters, with helicopters being the preferred mode of transportation.[262]

9. Support and Logistic Ships

The U.S. Navy has 38 support and logistic ships which can transport, maintain, and service nuclear warheads and their delivery systems. These include submarine and possibly destroyer tenders, as well as ammunition ships, fast combat support ships, replenishment oilers, and ballistic missile cargo supply ships.[263]

As of June 1990, there are 12 active submarine tenders (AS) divided among six classes. They were commissioned during 1941-1981, and range in size from 16,230 to 23,000 tons at full load. Typically, submarine tenders are docked in a port and service submarines moored along side. Three submarine tenders support ballistic missile submarines' weapons, and nine support attack submarines' weapons. All tenders, however, can provide generic support to all nuclear-powered submarines, including various degrees of maintenance to nuclear reactor plants.

Tenders assigned duty with ballistic missile submarine have facilities for servicing SLBMs, reentry vehicles and warheads.[264] One is based at Holy Loch, Scotland, to support the forward deployed Poseidon ballistic missile submarines.[265] The other ballistic missile submarine tenders are homeported in Charleston, South Carolina, and King's Bay, Georgia.

All nine of the attack submarine tenders have been converted to support Tomahawk SLCMs.[266] Six attack submarine tenders are located in the Atlantic and three in the Pacific. They are homeported at: New London, Connecticut; Norfolk, Virginia; Charleston, South Carolina; La Maddalena, Italy; San Diego, California; and Guam.

As of June 1990, there are nine active destroyer tenders (AD) in the fleet. Traditionally, the primary nuclear-weapons function of destroyer tenders was to support the nuclear capable ASROC and Terrier missiles aboard surface ships. With the retirement of these weapons, the nuclear weapons related activity of destroyers tenders is now unclear. Unlike submarine tenders, destroyer tenders have not yet been outfitted for Tomahawk support. But destroyer tenders retain a nuclear-related role since they continue to provide support for surface ship nuclear power plants.

The nuclear-capable logistics ships consist of 13 ammunition ships (AE), four fast combat support ships (AOE), and seven replenishment oilers (AOR). According to an authoritative U.S. Navy nuclear warfare operations publication, "Ammunition ships and most fast combat support ships are capable of transporting, storing, and providing underway replenishment for all Navy weapons except Polaris and Poseidon." Replenishment oilers, however, are not regularly certified to carry nuclear weapons in peacetime, and only have "an emergency capability for transporting and providing underway replenishment for all Navy weapons except Polaris and Poseidon."[267] These logistic ships, in addition, "may be ordered to load Marine Corps," nuclear weapons, "for transport to amphibious forces."[268]

The multi-product fast combat support ships and replenishment oilers have the speed to operate at sea as an integral

part of a carrier battlegroup. Ammunition ships, as well as non-nuclear stores ships (AFS) operate in escorted underway replenishment groups to shuttle fuel, ammunition, and stores to and from advanced logistic bases or consolidation points at sea. These shuttle ships in turn are supplied by merchant tanker and cargo ship deliveries from the United States. AOEs are the primary station ships which accompany a battlegroup. If an AOE is not available for a carrier battlegroup, an AOR and an AE may be used to replace it.[269]

Underway transfer of nuclear weapons may occur either through connected replenishment (CONREP), where supply ships are joined to the ship to be supplied by cables, and slings are used for transferring weapons, or by vertical replenishment (VERTREP), where CH-46 or CH-53 helicopters convey nuclear weapons from ship to ship.[270] If the operational situation demands, small craft also can be used to transfer nuclear weapons, but this is the least desirable and the most hazardous method of transfer.[271]

Transfers of nuclear weapons are "generally made between support ships and combatants, but an exchange or consolidation could be ordered between ships of the same type," for example, from aircraft carrier to aircraft carrier using the underway replenishment ships as a conveyor.[272]

The U.S. Navy warns that, "The transfer of nuclear weapons at sea presents one of the most hazardous of all shipboard operations. It contains all the dangers found in conventional ammunition transfer plus the grave consequences of accidental loss or contamination."[273]

Separate from the logistic ships which support battlegroups, there are two Military Sealift Command cargo ships (TAK) converted to carry ballistic missiles and other submarine equipment. TAKs supply submarine tenders in the continental United States, and are the primary logistic link to the forward deployed submarine tender in Holy Loch, Scotland.[274]

C. U.S. Nuclear-capable Naval and Marine Corps Aircraft

The U.S. Navy and Marine Corps possess nearly 1,600 operational nuclear-capable aircraft and helicopters that can deliver nuclear weapons.[275] Nuclear-capable naval aircraft include: A-6E Intruders and A-7E Corsair attack jets for bomb or missile strikes on surface targets on land or at sea; F/A-18 Hornet fighter-attack jets used for either air-to-air combat or surface strikes; S-3A/B Viking jets; SH-3D/H Sea King helicopters; and P-3A/B/C Orion turboprops, whose primary mission is anti-submarine warfare. The A-6s, A-7s, F/A-18s, S-3s, and SH-3s are known as "sea-based air" or "carrier air" because they would perform their missions while embarked on an aircraft carrier as part of the carrier's air wing. The P-3 Orions are land-based naval aviation, conducting ocean anti-submarine warfare patrols from bases around the world.

These aircraft are divided among the active and reserve U.S. Navy and Marine Corps forces. Marine Corps aircraft are land-based but regularly deploy on aircraft carriers to supplement carrier air wings.

1. Carrier Air

Nuclear-capable carrier aviation is composed of some 1,175 aircraft in five types, including: 420 A-6 and A-7 attack aircraft; 500 F/A-18 fighter-attack aircraft and; 255 S-3 and SH-3 anti-submarine aircraft. These aircraft can be armed with 1,400 nuclear weapons, consisting of approximately 1,350 B43, B57, and B61 nuclear gravity bombs, and 50 B57 nuclear depth bombs.

The A-6E Intruder is a twin-engine, turbojet, medium attack aircraft. It has an integrated attack/navigation computer system to locate targets while at a low altitude and is able to destroy sea or land targets with conventional or nuclear weapons under day and night, all-weather conditions without a visual reference to the target. The first flight of an A-6E was in 1970 and it first deployed in squadrons in 1972. It can carry up to 18,000 lbs of weapons and deliver the B43, B57 or B61 nuclear bombs.[276] It has a 900 nautical mile (1,700 kilometers) combat radius that can be extended to 2,818 nautical miles (5,300 kilometers) with external fuel pods.[277] One or two squadrons are assigned to a carrier air wing. Approximately 280 A-6Es are in the operational inventory in 1990. An improved A-6F variant was under development, but the Department of Defense terminated the program in its FY 1989 budget. A limited number of A-6Es are being upgraded to allow the A-6E to remain state of the art until the advanced tactical aircraft (ATA) "completely replaces it in the next century."[278]

The A-7E Corsair is an all-weather, single-engine, turbofan, light attack aircraft. First deliveries of the A-7E began in 1969 and the last of 596 A-7Es were delivered to the U.S. Navy in 1981. The A-7E can carry up to 15,000 lbs of weapons and can deliver B43, B57 or B61 nuclear bombs.[279] It has a combat radius of 430 nautical miles (800 kilometers) or 550 nautical miles (1,000 kilometers) with external fuel pods.[280] Two squadrons of 12 aircraft each are in carrier air wings which have not been upgraded to the F/A-18. Approximately 140 aircraft are in the operational inventory in 1990, but the total number of aircraft and squadrons continues to decline as they are replaced by the F/A-18s.

The F/A-18 Hornet is a twin engine, dual-mission jet fighter and attack aircraft used by the Navy and Marine Corps.[281] The first production aircraft was delivered in 1980 and the first U.S. Navy combat squadron became operational in 1983. It can carry up to 16,000 lbs of ordnance and deliver the B57 and B61 nuclear bombs.[282] It has a 460 nautical mile (860 kilometer) fighter combat radius and a 662 nautical mile (1,230 kilometer) attack combat radius.[283] Increased capability aircraft purchased after FY 1986 are designated F/A-18C/D. Navy "D" versions are two-seat trainers, while Marine "D" versions are for reconnaissance and close-air-support.[284] The U.S. Navy and Marine Corps operational F/A-18A/B/C/D inventory is about 500 aircraft in 1990. Ultimately the Navy wishes to have some 800 F/A-18s to equip 52 Navy and Marine Corps active and reserve squadrons.[285] F/A-18s are replacing A-4s and A-6Es in the Marine Corps, and A-7s in the Navy.

The S-3A Viking is an all-weather, high-endurance, carrier-based, long-range, twin-engine, jet aircraft. It replaced the

nuclear-capable S-2 Tracker in the mid to late 1970s as the aircraft carrier fixed-wing ASW aircraft.[286] S-3As can remain aloft for seven hours and remain on station for three hours 300 nautical miles (560 kilometers) from the aircraft carrier. They generally patrol several hundred miles from aircraft carriers providing an outer ASW screen. The S-3 uses sonobuoys, forward-looking infrared sensors, and a magnetic anomaly detector to locate and identify submarines. It can be armed with B57 nuclear depth bombs or light-weight torpedoes as well as other missiles, conventional bombs, or mines.[287] The planes are no longer in production, but a planned Weapons System Improvement Program (WSIP) is converting 160 S-3As to S-3Bs.[288] This will be completed by 1996.[289] Currently, some 100 S-3As and 35 S-3Bs are in the operational inventory. Due to further possible reductions in squadron size, reopening the production line has been considered.[290]

The SH-3D/H Sea King is a twin-engine, all-weather, ASW helicopter.[291] The helicopter provides inner zone (about 40 nautical miles/75 kilometers) ASW protection for aircraft carriers. Equipped with a variable-depth active dipping sonar, sonobuoys, and a magnetic anomaly detector, SH-3D/Hs have a 280 nautical mile (520 kilometer) radius at 120 knots.[292] SH-3D/Hs can be armed with one B57 nuclear depth bomb, or two conventional light-weight torpedoes or depth-bombs. Although they are no longer in production, approximately 120 operational aircraft remain in the inventory. The SH-3s will be replaced by SH-60Fs over a period of five to six years in the early 1990s. The SH-60F is a carrier version of the SH-60B, which is deployed on surface ships. The first SH-60Fs are scheduled to deploy aboard the USS Nimitz (CVN-68) in July 1990. The Navy wishes to purchase 175.[293] It is not believed that the SH-60F has a nuclear capability.

U.S. Navy aircraft are organized in squadrons of similar aircraft. Several squadrons of different "sea-based" aircraft are combined to deploy as part of a carrier air wing (designated CVW). As of June 1990, there are 13 active and two reserve carrier air wings.[294]

A typical carrier air wing includes squadrons of the nuclear-capable sea-based aircraft listed above. It also contains squadrons of non-nuclear-capable F-14 fighter/interceptors, EA-6 electronic warfare jets, and E-2C airborne early warning planes. Several configurations of carrier airwings are currently used in the fleet (See Table 9).

Table 9: Carrier Air Wing (CVW) Types[a]

	Conventional	Coral Sea	Kennedy	Transitional	Roosevelt
F-14	24	-	24	20	20
F/A-18	24[b]	36	-	20	20
A-6	10	16	24	16	20
KA-6	4	-	4	-	-
EA-6	4	4	4	5	5
E-2	4	4	4	5	5
S-3	10	-	10	8	10
SH-3/SH-60	6	6	6	6	6
Total	**86**	**66**	**76**	**80**	**86**

[a] Sources: Bruce Powers, "Carrier Air Wings in Transition," Naval Aviation News, November-December 1989, p. 8; HAC, FY 1990 DOD, Part 6, p. 432.
[b] Some conventional wings will operate A-7s until they are retired.

The oldest and most widespread version is known as the **Conventional** air wing, and has two F-14, one A-6, and two F/A-18 or A-7 squadrons. The **Coral Sea** air wing is only used for the oldest aircraft carrier, the USS Midway (CV-41). Three squadrons of F/A-18s and two squadrons of A-6s are in the Coral Sea air wing, while there are no F-14s and S-3s. The **Kennedy** air wing is an experimental configuration, and only the USS Ranger (CV-61) carries it. It has two larger 12-plane A-6 squadrons and no A-7 squadrons. When the Ranger is modified to operate F/A-18s in FY 1993, the Kennedy air wing will be eliminated. The **Transitional** air wing is a stepping-stone arrangement towards the Navy's goal of having an all **Roosevelt** air wing force in the late 1990s.

The smaller **Transitional** air wing was necessitated by aircraft shortfalls, particularly for attack aircraft, which will occur in the early to mid-1990s. Some three air wings currently are converting to the Transitional version, but all the remaining airwings are programmed for this configuration in the early 1990s. A-6 aircraft are scheduled to be transferred from the Marine Corps to the Navy allowing more Roosevelt air wings to be added to the fleet in the mid-1990s.[295] The all Roosevelt carrier air wing goal may be achieved if aircraft carriers are retired early, alleviating the need for 15 complete wings.

There are approximately 24 active attack squadrons (designated VA), each consisting of 8-16 A-6E or 12 A-7E aircraft.[296] These are supplemented by three reserve squadrons, two equipped with A-7 aircraft and one with A-6E aircraft.[297] The number of A-7 squadrons is declining as F/A-18 squadrons replace them. Some eight active A-7 squadrons remain, but are scheduled to be phased-out during FY 1991-1992.[298] When ashore, active A-6 squadrons are based at NAS Oceana, Virginia, and NAS Whidbey Island, Washington. The two A-6E squadrons assigned to the aircraft carrier USS Midway (CV-41) are stationed at NAF Atsugi, Japan. A-7s are at NAS Cecil Field, Florida, and at NAS Lemoore, California. Reserve attack squadrons are at: NAS New Orleans, Louisiana; NAS Atlanta, Georgia; and, NAS Alameda, California.

There are approximately 18 fighter-attack squadrons (designated VFA) consisting of 10-12 F/A-18s each. Active F/A-18 squadrons are based at NAS Cecil Field, Florida, and NAS Lemoore, California. The three squadrons assigned to the USS Midway (CV-41) are stationed at NAF Atsugi, Japan. There are also three reserve and two fleet readiness and training squadrons. NAS Cecil Field and NAS Lemoore each host one reserve and training squadron, and the third reserve squadron is at NAS Point Mugu, California. The number of F/A-18 squadrons will continue to increase. For a 13 active, two reserve air wing force, the U.S. Navy plans to have 26 active and two reserve F/A-18 squadrons of 10 aircraft each by the mid-1990s.[299]

There are 12 carrier-based jet anti-submarine squadrons (designated VS) consisting of 8-10 S-3A/Bs each (Transitional air wings have squadrons with eight planes). In addition, there is one fleet readiness squadron, which also trains crews for the transition to the S-3B. S-3s are based at NAS Cecil Field, Florida, and NAS North Island, California. By the mid-1990s, the Navy is scheduled to have 13 active S-3 squadrons of eight aircraft each.[300]

There are 13 carrier-based helicopter anti-submarine warfare squadrons (designated HS). Twelve squadrons are composed of nuclear-capable SH-3D/Hs helicopters, and the thirteenth is made up of the new non-nuclear SH-60F helicopter. Six helicopters are in each squadron. There are also two reserve squadrons and two fleet readiness squadrons. The active squadrons are stationed at NAS Jacksonville, Florida, and NAS North Island, California. The one squadron assigned to the USS Midway (CV-41) is stationed at NAF Atsugi, Japan. Reserve squadrons are at NAS Jacksonville, Florida, and NAS Alameda, California.

The Navy has one nuclear-capable attack aircraft under development. The A-12 Avenger Advanced Tactical Aircraft (ATA) is a two-seat, medium-range, deep-interdiction, jet for deployment in the 1990s. The plane incorporates stealth technology and is being developed largely in secret. The A-12 will supplement and then replace the A-6E Intruder as the long-range attack aircraft aboard aircraft carriers. The first Navy A-12 aircraft will be based on the West Coast, possibly in California.[301]

A U.S. Department of Defense "Major Aircraft Review" released in April 1990 reduced the total buy of A-12s from 858 to 620 aircraft.[302] According to the Navy, approximately 448 are needed to replace the A-6E.[303] The remaining aircraft may be used for an Advanced Tactical Surveillance role, to replace or supplement the EA-6 and E-2C electronic warfare or surveillance aircraft on carriers.[304] In April 1989, the Bush Administration planned to procure some 150 aircraft at cost of $11.2 billion during FY 1990-1994, with production starting in FY 1990 with six aircraft, and peaking with 78 aircraft in FY 1994.[305] The new April 1990 plan calls for peak production of 36 aircraft a year in FY 1994.[306] This means about 100 aircraft are to be bought at a cost of some $10 billion in the same five-year period. Overall, reportedly, 620 aircraft will cost $52 billion of which $5.1 billion has already been spent.[307]

2. Land-based Maritime Patrol

The P-3 Orion is an all-weather, twelve-crew, four-engine, turboprop, long-range, maritime patrol aircraft. Its primary mission is anti-submarine warfare, and its secondary missions include surface surveillance, mining and logistics support. The P-3 Orion can deliver the B57 nuclear depth bomb, and during peacetime serves as a transportation platform for the movement of naval nuclear weapons.

The P-3 was developed from the commercial Lockheed "Electra" design in the 1950s to replace the nuclear capable P-2 Neptune maritime patrol plane. It is deployed in three versions: P-3A, P-3B and P-3C.[308] The P-3Cs, also, have had several improvements known as Updates. Update III entered fleet service in May 1984 and Update IV is under development to enter the fleet in the 1990s.[309] Most of the 24 active squadrons fly P-3Cs (the rest fly P-3Bs), while the 13 reserve squadrons mainly fly P-3As and P-3Bs. Due to fiscal constraints, the Navy decided in the FY 1990 budget to retire 73 older P-3A/B aircraft. In addition, the squadron size will be reduced from nine to eight aircraft until new P-7 aircraft enter the fleet in the 1990s.[310] About 340 P-3A/B/C aircraft are in the operational inventory. P-3s can spend 10-14 hours flying 1,300 to 1,500 nautical miles (2,400 to 2,800 kilometers) on patrol where they use sonobuoys, radar, forward-looking infrared sensors and magnetic anomaly detectors to locate and identify submarines. The last P-3 Orion is scheduled to be delivered in late 1991, after which a new Long-Range Air ASW Capability Aircraft (LRAACA) is planned to enter production.[311]

There are 24 active and 13 reserve land-based patrol squadrons (designated VP). In addition, there are two fleet readiness (training) squadrons that each have about 20 aircraft. The active P-3 squadrons are based at NAS Brunswick, Maine; NAS Jacksonville, Florida; NAS Moffett Field near San Francisco, California; and NAS Barber's Point, Oahu, Hawaii. Reserve squadrons are based at: NAS Glenview, Illinois; NAS Jacksonville, Florida; NAS Willow Grove, Pennsylvania; NAS Point Mugu, California; NAS Millington, Tennessee; NAF Washington, D.C. (Andrews AFB, Maryland); NAS Whidbey Island, Washington; NAS Moffett Field, California; NAS South Weymouth, Massachusetts; NAF Mt. Clemens, Michigan; and NAS New Orleans, Louisiana. P-3 squadrons regularly deploy overseas in squadron strength for four to six month periods. Forward operating bases are in Bermuda, the Azores (Lajes Field), Puerto Rico (NAS Roosevelt Roads), Ascension Island, Spain (NAS Rota), Italy (NAS Sigonella), Iceland (NAS Keflavik), Diego Garcia, the Philippines (NAS Cubi Point), Japan (Kadena AB), Alaska (NAS Adak), and Guam (NAS Agana). Aircraft occasionally operate from other countries as well, such as Oman and Pakistan.

A P-7A aircraft was scheduled to replace the P-3 Orions in the 1990s.[312] Some 125 were to be produced. The new plane was originally scheduled to enter full scale production in FY 1992, but then problems encountered in engineering design resulted in delaying the production date to at least 1994.[313] Due to these problems, the Navy cancelled the program in mid-1990, and began to explore alternatives.

3. Marine Corps Aviation

Although the Marine Corps is part of the U.S. Navy it possesses its own aircraft, of which three types — the A-4M Skyhawk, A-6E Intruder, and F/A-18 Hornet — are nuclear capable. The Marine Corps, like the U.S. Navy, also has aircraft for logistical transport of nuclear weapons.

The A-4M Skyhawk is an all-weather, day-night, single-engine, dual-capable light attack aircraft.[314] The Skyhawk series originated in 1953 and the latest version is the A-4M. The A-4M is used for surface strikes in support of amphibious warfare operations and operates as part of a Marine Aircraft Wing. It has a combat radius of 1,700 nautical miles (3,200 kilometers) with external fuel tanks and it can carry up to 10,000 lbs of weapons and deliver the B43, B57 or B61 nuclear bomb.[315] Approximately 75 A-4Ms remain in the Marine Corps operational inventory. The aircraft are being replaced by non-nuclear AV-8B Harrier IIs.

The A-4M equips five reserve Marine Corps attack squadrons (designated VMA). One squadron of 12 aircraft each is located at NAS Memphis, Tennessee; NAS Willow Grove, Pennsylvania; NAS Alameda, California; NAS Cecil Field, Florida; and NAS South Weymouth, Massachusetts.

Four active Marine Corps all-weather attack squadrons (designated VMAAW) fly ten A-6E aircraft each. Two squadrons are based at MCAS Cherry Point, North Carolina; and two are at MCAS El Toro, California. These squadrons are scheduled to transition to all-weather F/A-18D Hornets, to allow A-6Es to be transferred to the Navy to alleviate their A-6 aircraft shortfalls.[316]

Marine Corps F/A-18A/Cs equip 12 active fighter-attack squadrons (designated VMFA) of 12 aircraft each. In addition, one reserve VMFA has recently converted to F/A-18As from non-nuclear capable F-4S Phantoms, and one all-weather attack squadron (VMFAAW) has two-seat F/A-18Ds. There is also a fleet replenishment (training) squadron of some 30 aircraft. F/A-18s will continue to replace reserve F-4S aircraft as well as active VMAAW A-6E squadrons. Six squadrons are based at MCAS Beaufort, South Carolina; five at MCAS El Toro, California; three at NAS Barbers Point, Hawaii; and one at MCAS Yuma, Arizona.

4. Non-U.S NATO Nuclear-capable Naval Aircraft

Three NATO countries — the Netherlands, Italy, and the United Kingdom — deploy anti-submarine warfare planes which are certified to carry U.S. B57 depth bombs. (U.K. helicopters deliver U.K. depth bombs, see U.K. section below).

The Netherlands

The Royal Netherlands Navy (RNLN) operates 13 NP-3C Orion aircraft, which are certified to deliver B57 nuclear depth bombs. The training for nuclear capability began in November 1981 at NAS Jacksonville, Florida, when the RNLN received its first NP-3C Update II aircraft.[317] In 1982, the nuclear certification plan for the NP-3C aircraft were drafted.[318] In September 1983, U.S. personnel conducted certification tests for special equipment necessary to deliver B57 nuclear-depth bombs at the planes' base at Valkenburg, Netherlands.[319] In 1984, the nuclear Preoperational Safety Study (held just prior to achieving a nuclear capability) of the NP-3C was conducted and the U.S. Joint Chiefs of Staff issued safety rules for "Non-US NATO Royal Netherlands Navy" P-3 aircraft.[320] The nuclear Operational Review (held shortly after a nuclear capability is attained to review operational procedures) of the NP-3Cs was conducted in the Fall 1985, with the aircraft undergoing a nuclear certification inspection in November 1985.[321] Further nuclear certifications followed in October 1986 and September 1987.[322] Nuclear weapons are stored in the United Kingdom at St. Mawgan for use by the Dutch NP-3s.

Italy

The Italian Air Force (IAF) operates nine Breguet Br 1150 Atlantic Mk.1 maritime patrol aircraft certified to deliver the B57 nuclear depth bomb. The Atlantics are 12-crew, twin-engine turboprop aircraft produced by Dassault-Breguet, a French company. Atlantics have a range of 600 nautical miles (1100) with eight hours on station, or 1000 nautical miles (1900 km) with five hours on station.[323]

The first Atlantic prototype flew in October 1961 and some 40 were produced for the French Navy. The Netherlands, West Germany, and Italy also acquired Mk.1 aircraft. The Mk.1 version is no longer in production, but improved Atlantic Mk.2s are being manufactured for the French Navy. The Italian planes, however, are also being modernized, and the upgrade is to be completed by late-1992. One nuclear-capable squadron of nine aircraft is based at Catania/Fontanerossa, Sicily, adjacent to NAS Sigonella where U.S. B57 nuclear depth bombs are stored.[324]

The Atlantics took over the anti-submarine nuclear delivery role from Italian S-2F Tracker aircraft in the late 1970s.[325] Preparations for receiving a nuclear capability were well advanced when the Initial Safety Study of the Atlantic with the B57 nuclear depth bomb was conducted in June 1979. Forty IAF personnel and two aircraft came to the United States to conduct certification flight tests of the aircraft with the B57.[326] In February 1981, certification tests for special equipment necessary for delivering the B57. In addition, in the first half of 1981, a logistic support system for the Atlantic program of cooperation was established.[327] A nuclear Safety Study of the Atlantics was conducted at NAS Sigonella by U.S. personnel in 1982.[328] In March 1983, the first four aircraft were finally certified for the use of the B57.[329] On 2 February 1984, another important milestone was passed when the U.S. Joint Chief of Staff (JCS) issued "Safety Rules for the Non-US Italian Atlantic (Breguet 1150) Aircraft" with the B57.[330] And, during 1984, the remaining aircraft of the squadron underwent nuclear certification tests.[331] The first nuclear Operational Safety Review for the Atlantic with the B57 took place in 1985.[332] This insured the planes were meeting the expected safety standards finalized in the initial safety study and JCS rules. The Atlantics underwent a U.S. Navy nuclear certification inspection in October 1986 in Italy.[333] A year later, in September 1987, another non-U.S. NATO nuclear certification of the planes took place.[334] A second Atlantic/B57 nuclear Operational Safety Review occurred in April 1988.[335] Atlantics were also under consideration for the new B90 Nuclear Depth/Strike Bomb (NDSB). As early as February 1986, work was done to include the Atlantics in the NDSB [B90 nuclear depth/strike bomb] nuclear stockpile-to-target sequence.[336]

The United Kingdom

The Nimrod MR Mk.2 is a Royal Air Force (RAF) all-weather, four-engine, turbofan, dual-capable, maritime patrol aircraft. The first flight of the Nimrod Mk.1 prototype was in 1967, and the first Mk.2 was delivered to the RAF in 1979.[337] Royal Air Force Nimrod maritime patrol aircraft can deliver United States B57 nuclear depth bombs and are certified by the U.S. for nuclear missions.[338]

Nimrods have a range of 5,000 nautical miles (9,265 kilometers), with an endurance of about 12 hours. Some 33 Nimrod Mk.2s belong to RAF Group Number 18 and are spread among four squadrons and one Operational Conversion Unit (OCU). Each squadron has about six aircraft available with several more undergoing maintenance. Three squadrons — 120 Squadron, 201 Squadron, and 206 Squadron — with about 22 aircraft are based at RAF Kinloss, Grampian, Scotland. 42 Squadron and the 236 Operational Conversion Unit are located at St. Mawgan, Cornwall, with approximately 11

aircraft (the OCU would become 38 Squadron during mobilization).[339] Sixteen Nimrods were fitted with aerial refueling probes and are designated MR Mk.2Ps.[340]

Preparations for outfitting Nimrod aircraft with U.S. nuclear weapons capability were well underway when a nuclear Pre-operational Safety study of the Mk.2 version with the B57 was held in February 1981.[341] In 1982 and 1983, several aircraft underwent tests of special electronic mechanisms for arming and launching the B57, and as the aircraft finally achieved a nuclear capability, a nuclear Operational Safety Review was held in May 1983.[342] U.S. personnel held a U.S. Navy nuclear certification inspection for the Nimrod Mk.2 in the United Kingdom in October 1986.[343] Another nuclear inspection, this time a non-U.S. NATO Nuclear Technical Proficiency Inspection was held in September 1987.[344]

A new patrol aircraft to replace the Nimrods in the late 1990s is under consideration. The U.S. P-7 patrol plane is a contender, but other European designed aircraft are also being examined.[345]

III. Soviet Nuclear-capable Ships and Aircraft

The Soviet Navy consists of a total of 2,600 ships and submarines as of early 1990.[346] About 645 of these ships and submarines are principal combat ships, while the remainder are minor patrol vessels and support ships. Almost 90 percent of the major ships — 266 surface warships (including 74 patrol combatants) and 299 submarines — are nuclear-capable (see Table 10).[347]

Like U.S. naval nuclear forces, Soviet forces are split between strategic and non-strategic forces. There are 61 ballistic missile submarines in the strategic force. The non-strategic nuclear force consists of 266 surface warships and 238 attack and cruise missiles submarines, as well as 725 bomber, anti-submarine warfare, and fighter aircraft. Non-strategic forces are armed with antiship and cruise missiles, anti-air missiles, anti-submarine missiles and rockets, torpedoes, gravity bombs, and nuclear depth bombs.[348]

Table 10: Soviet Nuclear-Capable Warships and Submarines (1990)

Type	Number	Nuclear Weapons
Ballistic Missile Submarines	61	SS-N-6, 8, 17, 18, 20, 23, SS-N-15/16, torpedoes
Cruise Missile Submarines	60	SS-N-3, 7, 9, 12, 19, SS-N-15/16, torpedoes
Attack Submarines	178	SS-N-15/16, SS-N-21, torpedoes
Aircraft Carriers	4	FRAS-1, SS-N-12, ASW helicopters, SA-N-3, torpedoes
Cruisers	33	SS-N-3, 12, 19, SA-N-1, SA-N-3, torpedoes, ASW helicopters
Destroyers	37	SS-N-22, SA-N-1, torpedoes, ASW helicopters
Frigates	118	torpedoes
Patrol Combatants	74	SS-N-9, 22, torpedoes
TOTAL	**565**[349]	

A. Fleet Organization, Missions, and Homeports

The Soviet Navy is organized into four Fleets: Northern (Atlantic Ocean) (NORFLT), Pacific Ocean (PACFLT), Baltic and Black Sea.

The Pacific Ocean Fleet is numerically the largest of the four fleets with about 700 ships in mid-1989, composed of two aircraft carriers, 76 principal surface combatants, 80 patrol combatants, 19 amphibious warfare ships, 27 mine warfare ships, 95 seagoing auxiliaries, and 118 submarines (including 22 ballistic missile submarines). About 547 nuclear and non-nuclear aircraft are assigned to naval aviation in the Pacific, including 165 bombers and fighters, and 165 anti-submarine warfare aircraft.

Ships in the Pacific Ocean Fleet are homeported on the Kamchatka peninsula and at Far East coastal bases near Vladivostok and around the Sea of Okhotsk. Vladivostok is the Fleet headquarters. The Fleet is concentrated in three areas: Vladivostok, and the nearby Dunay/Strelok/Abrek complex, together with bases at Nakhodka and Petrovka; Pertropavlovsk on the Kamchatka peninsula; and Sovetskaya Gavan (together with the nearby Alekseyevka naval airfield). Minor bases are also located at Magadan and Nikolayevsk on the Sea of Okhotsk; Vladimir in the northern Sea of Japan; Korsakov on Sakhalin Island; Shakotan and Simushir on the Kuriles; and at inland bases at Khabarovsk and Komsomolsk.[350]

The Northern Fleet is the second largest fleet, with about 600 ships, composed of two aircraft carriers, 73 principal surface combatants, 12 amphibious warfare ships, 96 seagoing auxiliaries and 173 submarines (including 39 ballistic missile submarines). About 433 nuclear and non-nuclear aircraft are assigned to naval aviation in the Northern Fleet, including 95 bombers and fighters, and 145 anti-submarine warfare aircraft.

Headquarters for the Northern Fleet is at Severomorsk, near Murmansk. The Northern Fleet is also concentrated mostly around Severomorsk and Murmansk on the Kola Inlet. Bases on the Kola Inlet include Murmansk, Severomorsk, Polyarnyy, Olen' ya Guba, and Sayda Guba. Bases further west on fjords on the Kola peninsula include Pechenga, Litsa Guba, and Ura Guba; and Gremikha to the east. Two bases in the White Sea include Severodvinsk and Arkangel'sk.[351]

The Baltic Fleet is composed of 575 ships, including 49 principal surface combatants, 50 auxiliaries, and 46 submarines. Naval aviation in the Baltic Fleet is assigned some 270 nuclear and non-nuclear aircraft, and 105 bombers and fighters and 45 anti-submarine aircraft. Headquarters for the Baltic Fleet is Kaliningrad. Baltic naval bases are located at: Baltiysk, near Kaliningrad; Klaipeda in Lithuania; Liepaja and Riga in Latvia; Paldiski and Tallinn in Estonia and; Lomonsov, Kronshtadt, and Vysotsk in the Leningrad area. The Leningrad Naval Base is an independent headquarters, reporting direct to Moscow.[352]

The Black Sea Fleet/Caspian Flotilla is composed of 475 ships, including 70 principal surface combatants, 53 auxiliaries, and 27 attack submarines.[353] Some 468 nuclear and non-

nuclear aircraft are assigned to the Black Sea Fleet, including 80 bombers and fighters, and 105 anti-submarine aircraft. Headquarters for the Black Sea Fleet is Sevastopol. Naval bases of the Black Sea Fleet include Izmail on the Romania border; Odessa and Ochakov; Chernomorskoya, Donuzlav, Sevastopol, Balaklava, Feodosiya and Kerch on the Crimean peninsula; and Novorosslysk, Ochamchira, Poti, and Batumi in the eastern Black Sea.[354]

During wartime, the Fleet commanders would become naval component commanders of Soviet joint commands, and naval operations would fall under one of five "theaters of military operations" (known as TVDs). TVDs currently consist of Northwestern, Western, Southern, Southwestern, and Far Eastern commands, or three "oceanic" TVDs: Arctic, Atlantic, and Pacific commands. Arctic and north Atlantic operations would fall under the Northwestern TVD; central Atlantic and Baltic operations against NATO would fall under the Western TVD; Black Sea and Mediterranean Sea operations would fall under the Southern TVD; Indian Ocean and Middle Eastern operations under the Southwestern TVD; and Pacific Ocean operations would fall under the Far Eastern TVD. According to U.S. Naval intelligence, "the bulk of the SSBNs would probably be preserved as a significant component of the Soviet Supreme High Command's strategic nuclear reserve," and would not be assigned directly to the TVDs.[355]

B. Nuclear-capable Ships

1. Ballistic Missile Submarines

The present Soviet ballistic missile submarine force consists of 61 submarines of eight different classes. The oldest class entered service in 1967 and the Delta IV class is still in production. Ballistic missile submarines range in size from 2,700 to 25,000 tons submerged. Depending on the class, they can carry from six to 20 missiles. Together, the submarines are loaded with 914 submarine-launched ballistic missiles (SLBMs) and can fire approximately 3,802 nuclear warheads. All of the submarines have 21-inch torpedo tubes and also are capable of firing nuclear torpedoes. The Typhoon class can also fire anti-submarine missiles.

The Soviet Navy has retired or denuclearized all three of the remaining classes of diesel powered submarines — Golf II, Golf III, and Golf V.[356] Golf II class boats formerly carried the SS-N-5 SLBM, but their nuclear warheads were removed in 1987, and they are undergoing retirement (as of late 1989, six in the Baltic had been reduced to four, and seven in the Pacific had been reduced to two).[357] The single Golf III was a test and training platform for the SS-N-8 SLBM and the single Golf V was a test and training submarine for the SS-N-20 SLBM.

The remaining ballistic missile submarines are all nuclear-powered and are often referred to as "modern" strategic submarines. They are all homeported in the Northern or Pacific Fleets, and are distributed 39 in the Northern and 22 in the Pacific (see Table 11).

Table 11: Soviet Ballistic Missile Submarine Basing (1990)

	Northern Fleet	Pacific Fleet
Hotel III	1	0
Yankee I	6	5
Yankee II	1	0
Delta I	9	9
Delta II	4	0
Delta III	6	8
Delta IV	6	0
Typhoon	6	0
Total	**39**	**22**

Two of the eight classes, both deployed in the Northern Fleet, are unique types: One Hotel III which is the test platform for the SS-N-8 missile, and one Yankee II which is a test platform for the SS-N-17 solid-propellent ballistic missile. The Hotel III boat will probably be decommissioned in 1990 or soon thereafter as part of a program to retire first generation nuclear boats.[358]

Thirty-four Yankee class submarines were built during 1967-1974, but only 12 remain in service as of mid-1990. The Soviet Navy has been retiring older Yankee class submarines at an average rate of one each year, and just eleven Yankee I class SSBNs are still operational, each carrying 16 SS-N-6 missiles with two multiple reentry vehicles (MRVs), giving a total of 352 warheads. Also, an additional Yankee I class boat was upgraded to a Yankee II class to carry the SS-N-17 missile and continues in service.[359]

Yankee submarine patrols off the U.S. coasts ceased in late 1987, intermittent patrols in the central Atlantic resumed in June 1988, and then all patrols outside of European waters and home waters ended by mid-1989.[360] Although some speculated that the shift in patrols was related to new Eurasian targeting missions to compensate for reduced SS-20 target coverage after the INF Treaty, the U.S. Navy stated in June 1988 that the reduction could be attributed primarily to "deployment patterns as units of that class, and their older missile systems, reach the end of their active operational lives."[361]

There are 42 Delta submarines made up of four types. Eighteen Delta I submarines carry 12 SS-N-8 missiles each, for a total of 216 warheads. Four Delta II submarines carry 16 SS-N-8 missiles, with a total of 64 warheads. Fourteen Delta IIIs carry 16 multiple warhead SS-N-18 missiles, giving a total of 1,568 warheads.[362]

Six Delta IV submarines, first deployed in 1985, carry 16 multiple warhead SS-N-23 missiles, for a total of 384 warheads. The Delta IV class continues in production, and there are rumors that the submarines could be transferred from the Northern Fleet to the Pacific Fleet.[363]

In 1988, there were reports that none of the Delta IV boats had yet gone on patrol, but despite that, the system was still considered to be operational.[364] The problem apparently was the SS-N-23 missile, which had reliability problems. No mention was made of Delta IV patrols in 1989 reports of the U.S. Department of Defense, but a modified version of the SS-N-23 was deployed. The SS-N-23, which became operational

in 1986, has a greater range and accuracy than the SS-N-18 deployed on Delta III class submarines. The missile is likely to be backfitted into some Delta IIIs.[365]

An even larger submarine than the Delta, the Typhoon class (25,000 tons submerged), began deployment in 1983. Six were built during 1983-1989, and are stationed in the Litsa fiord, about 40 km from the Norwegian border. The Typhoons carry 20 SS-N-20s, the first Soviet solid-fuel SLBM equipped with multiple independently targetable reentry vehicles (MIRVs). Together, the six Typhoons carry 120 multiple warhead SS-N-20 missiles, for a total of 1200 warheads. In addition, 25.6-inch tubes in the pressure hull are capable of firing the SS-N-15 nuclear depth bomb or the SS-N-16 ASW missile.

The rate of introduction of new Soviet ballistic missile submarines will likely fall below one per year with the deployment of the last Typhoon class, although Delta IV construction rates could increase. There was no official word in 1988 or 1989 about a new class of ballistic missile submarine reported to be under construction in 1987.[366] But in late 1989, one report stated that a new ballistic missile submarine, supposedly a follow-on to the Delta IV class, began construction in 1987 in Severodvinsk.[367] And in February 1990, U.S. intelligence officials stated that "a new class of SSBN could replace the older Deltas."[368]

2. Cruise Missile Submarines

The Soviet Navy currently has 60 cruise missile submarines (SSGs/SSGNs) in eight different classes, capable of carrying 502 nuclear-capable SLCMs of six different types. Cruise missile submarines range in size from 3,750 to 14,500 tons submerged. All classes of Soviet cruise missile submarines are nuclear-powered, except for the diesel/electric-powered Juliett class.

The oldest class of cruise missile submarine entered service in 1961 and the newest Oscar II class is in production. Until the mid-1980s, only one or two of the first generation submarines had been retired. However, on 26 June 1989, a reactor accident occurred aboard an Echo II submarine, while operating 65 miles off the north coast of Norway, and this started a process which will lead to the retirement of the early cruise missile boats. The accident, coming on the heals of the sinking of the Mike nuclear-powered attack submarine in April, provoked a thorough review of Soviet submarine safety and operations. According to U.S. intelligence, "The Echo II casualty brought to the forefront Soviet concerns about the reliability of their older first generation submarines and resulted in a Soviet decision to retire them."[369] These first generation nuclear boats to be discarded — Hotels, Echos, Novembers, the single Papa — may already have been taken out of operational service, although it is unclear how the Soviets will dispose of them.[370] By 1995, the U.S. predicts that all of the unmodified Echo IIs will be gone, as well as some of the Mod Echo IIs and Charlies.[371] With the deployment of the tube-launched SS-N-21 missile, cruise missile submarines may be declining in importance, particularly with the current retirement program.

All of the newer cruise missile submarines are assigned to the Northern Fleet. Some older Charlie I, Echo II and Juliett class submarines are allocated to the Pacific Fleet.[372] Juliett class submarines are also deployed with the Baltic and Black Sea Fleets.

All of the cruise missile submarines are capable of firing nuclear torpedoes from their standard 21-inch torpedo tubes, as well as launching cruise missiles from dedicated launchers. Charlie I, Papa, and Charlie II class submarines also can fire the SS-N-15 nuclear depth bomb. The Oscar I and II classes can fire both the SS-N-15 nuclear depth bomb and the SS-N-16 ASW missile.

The Juliett is the oldest of the dedicated cruise missile submarines, introduced in 1961. The submarine carries four of the older SS-N-3a/c cruise missiles. Sixteen Juliett class submarines were commissioned; one was decommissioned in 1984-1985. Two Juliett class submarines sailed from the Northern Fleet bases to the Baltic Sea in November 1989, and it is thought that they were on the way to being retired and scrapped. The remaining 13 will likely be decommissioned in the early 1990s.

The oldest Soviet nuclear-powered cruise missile submarine is the Echo II, first introduced in 1962. Five Echo II class submarines carry eight SS-N-3a/c missiles; 20 were modified to carry eight SS-N-12s in place of the SS-N-3s.[373] Twenty-nine Echo II class submarines were built; at least one was converted for special operations in the early 1980s The Echo II class submarine which had an accident on 26 June 1989 is thought to be non-operational. Some 25 Echo II class submarines are thought to remain in the force; they will likely be retired in the early 1990s.

A single Papa class submarine, introduced in 1973, was converted in the late 1980s to carry ten SS-N-9 missiles. The submarine will likely be retired in the early 1980s. The Charlie I class submarines, introduced in 1968, are the last to carry the SS-N-7 missile. Eleven Charlie I class submarines were built. One sank in June 1983 east of the tip of the Kamchatka peninsula, and although it was raised, it did not reenter service. Two other Charlie Is (with non-nuclear SS-N-7 missiles) have been leased to India. Six submarines of the Charlie II class, introduced starting in 1974, have been converted to carry eight SS-N-9 missiles each.

Four operational Oscar I class submarines are capable of firing 24 SS-N-19 long-range cruise missiles and are the most capable and heavily armed Soviet anti-ship platform. A new Oscar cruise missile submarine, launched in 1988, and designated Oscar II, was observed in March 1989 in the Norwegian Sea. The new Oscar II improves some of the operating characteristics of the Oscar I, but continues to carry the SS-N-19 missile. In early design and development, it may have been earmarked to carry the SS-NX-24 cruise missile, but the delay in the SS-NX-24's development probably led to the submarine carrying the SS-N-19. Oscar II submarines continue in construction.[374]

A single converted Yankee ballistic missile submarine has been designated a cruise missile submarine and is the test platform for the SS-NX-24 long-range SLCM.[375] The Yankee is likely to carry 12 SS-NX-24 missiles, if the missile becomes operational. A new nuclear-powered submarine also is ex-

pected to be deployed as a launch platform for the SS-NX-24, and may be under construction at Severodvinsk.[376]

3. Attack Submarines

The Soviet Navy currently operates 230 attack submarines of various types, 178 of which are nuclear capable. These nuclear capable boats include 77 nuclear-powered and 101 diesel-powered attack submarines. The nuclear capable submarines are of 15 different types, and can carry about 606 nuclear weapons.

The oldest attack submarine class still active entered service in 1951, and several classes are still in production. They range in size from 1,350 to 9,700 tons submerged. All of these attack submarines have 21-inch torpedo tubes and therefore can fire the standard nuclear torpedo. In addition, Tango, Victor I/II/III, Alfa, Sierra, and Akula class submarines carry either the SS-N-15 nuclear depth bomb or the SS-N-16 dual-capable ASW missile. Victor III, Sierra, Akula and the single Yankee Notch class submarines all deliver the SS-N-21 SLCM.[377]

Four attack submarine classes are in production: Akula, Sierra, Victor III and Kilo. Additional retired Yankee class ballistic missile submarines may be converted to attack or cruise missile submarine configuration.

Submarine production levels diminished in the mid 1980s, but increased at the end of the decade.[378] Between 1979-1988, the Soviets produced 75 submarines, including ballistic missile submarines.[379] In 1987 and 1988, the Soviet Navy launched eight attack submarines and in 1989 launched nine.[380] Each year, the Soviets produced four Kilo submarines, including three intended for export. Three different classes of nuclear powered attack submarines are in production in the late 1980s — Akula, Sierra and Victor III.[381]

New production of submarines, however, has been offset numerically by retirement of a significant number of diesel submarines during the 1980s.[382] In 1989 alone, 35 submarines, mostly of the older Whiskey class, were withdrawn from the active force.[383] In 1989, 33 submarines were sent to foreign yards to be scrapped (three of which sank on the way), although they are all thought to have come out of older reserve and retired submarines.[384] U.S. intelligence predicts that well over 100 diesel submarines will be scrapped by 1995, including all of the remaining Whiskey class boats. "Clearly," Rear Admiral Thomas A. Brooks, Director of Naval Intelligence, said in February 1990, "the Soviets have made the decision to give up their traditional large diesel submarine force in favor of quality vs. quantity."[385]

As already noted, the Soviets have decided to retire first generation nuclear-powered submarines as a consequence of the Echo II accident in July 1989. Hotel II and November classes have been taken out of operational service, or will soon be, and Echo I attack submarines probably will be retired in 1990. A number of nuclear submarines are already awaiting disposal.[386]

The only diesel-powered submarine remaining in construction in the Soviet Union is the Kilo class, first deployed in 1980. In 1987 and 1988, the Soviet Navy launched four Kilo class submarines each year (six of which were intended for export), and the Kilo remains in production at three shipyards.[387] The 12th Kilo for the Soviet Navy was launched in 1988, and will probably become operational in 1991.

Five of the experimental Alfa class nuclear-powered submarines remain in the Northern Fleet.[388] The Alfa was designed to demonstrate high speed capability and exceeded 40 knots some 20 years ago. But because of its noise levels when traveling at high speeds, it was never widely adapted.[389] An experimental follow-on to the Alfa, the Mike class, also with a titanium hull and high speed and deep diving characteristics, sank in April 1989 after an electrical short and fire.

The Victor III class nuclear-powered submarine, first deployed in 1979, is now the mainstay of the Soviet nuclear-powered attack submarine force. In 1987, the Soviet Navy launched the 22nd Victor III, in 1988 it launched the 23rd, and in 1989, launched its 24th.[390] Introduction is expected to continue at the pace of one per year throughout the 1990s.[391] The Victor III, with 21- and 25.6-inch torpedo tubes, carries nuclear torpedoes and the SS-N-16 ASW missile. A modified Victor III, operating in the Northern Fleet, was the test platform for the SS-NX-21 SLCM during development. All of the Victor III class boats are assessed as being capable of firing the SS-N-21 SLCM.

A single Yankee class SSN, converted from a ballistic missile submarine in 1983, is operational. With updated fire control and sonar systems, it can "launch a wider variety of weapons."[392] Another converted Yankee class ballistic missile submarine, designated the Yankee Notch class, became operational in 1988. It is a test platform for flight testing of the SS-N-21 SLCM,[393] and can probably carry a considerable number in the "notch waisted" central section added with the removal of the ballistic missile section.[394]

The nuclear-powered Sierra class became operational in 1986 and two are operational in the Northern Fleet. The submarine carries the SS-N-21 SLCM, and can fire the SS-N-15 nuclear depth bomb as well as the SS-N-16 ASW missile. Six 21- and 25.6-inch torpedo tubes can also be used to fire nuclear torpedoes. The Sierra class, a follow-on to the Victor III, is now in low level series production at the Krasnoye Sormovo Shipyard (Gor'kiy).[395]

The nuclear-powered Akula class was first operational in 1988, and four are operational.[396] The submarine carries the SS-N-21 SLCM, and can fire the SS-N-15 nuclear depth bomb as well as the SS-N-16 ASW missile. Six 21- and 25.6-inch torpedo tubes can also be used to fire nuclear torpedoes.

The first three Akulas were assigned to the Pacific Fleet, and specialized in the anti-SSBN patrol mission.[397] The Akula was originally under construction at the Komsomolsk Shipyard in the Pacific,[398] but Soviet Military Power 1989 reported that a second production line for the Akula class submarine had opened at Severodvinsk in the Northern Fleet.[399] The fourth Akula was subsequently spotted in the Barents Sea in mid-1989 for the first time.[400] The Akula submarine, however, may not be fully operational. Akula hull 1, first launched in 1984, was still undergoing sea trials in early 1988.[401]

4. Aircraft Carriers

The Soviet Navy has four operational aircraft carriers, and three under construction. Three Kiev class, and one Baku class guided missile V/STOL aircraft carriers (CVHGs), are operational as of 1990. These ships are much smaller than U.S. front line aircraft carriers, and can only embark short take-off and landing aircraft, as well as helicopters.

The Kiev class ships were initially deployed in 1975. Two (the Minsk and the Novorossiysk) are deployed in the Pacific Fleet, while the Kiev is assigned to the Northern Fleet. The Kiev class ships carry a number of nuclear weapons: eight SS-N-12 SLCMs (with reload missiles), one twin SUW-N-1 with FRAS-1 nuclear-only ballistic rockets, 72 SA-N-3 surface-to-air missiles, and ten 21-inch torpedo tubes.

The Kiev class ships, with their angled flight deck also can embark about 30 aircraft: 12 Yak-38 Forger short take-off and landing (STOL) fighters, and up to 24 Ka-25 Hormone A/B or Ka-27 Helix A helicopters. These aircraft are capable of delivering nuclear bombs and depth bombs.

The fourth and last ship of the Kiev class aircraft carriers, the Baku, was deployed in 1988. Baku is equipped with a four faced phased array radar, extensive electronic warfare installations, and a command and control suite much improved over the other ships of the Kiev class. It is therefore designated a separate class.[402] Notable changes in the configuration of the ship are the addition of four SS-N-12 SLCM launchers over the Kiev class (for a total of 12), the absence of the SUW-N-1 launchers for nuclear armed FRAS-1 anti-ship/anti-submarine ballistic rockets, and deletion of the SA-N-3 surface-to-air missile, and 10 21-inch torpedo tubes. The Baku, which spent much of its first cruise at anchorage north of Tunisia in the Mediterranean Sea, is assigned to the Northern Fleet.[403]

The Soviets have three large-deck (65,000-75,000 ton) aircraft carriers under construction at the Nikolayev South Shipyard in the Black Sea.[404] Two are of the Tbilisi class, and the third, of a different class, is called the Ul'yanovsk. The keel of the first aircraft carrier, the Tbilisi, was laid in January 1983, and the ship commenced sea trials in 1989. The second ship of the class, the Riga was laid in December 1985, was launched in November 1988, and is expected to commence sea trials by 1992.[405] The third carrier, the Ul'yanovsk, is a new class displacing about 75,000 tons, 10,000 tons more than the Tbilisi. It was laid in November 1988 and is expected to commence sea trials by 1996.[406]

The Tbilisi (formerly designated Leonid Brezhnev and Kremlin) "could become operational later this year and conduct its first operational deployment in 1991."[407] The 65,000 ton ship has an overall length of 1,000 ft, and can attain a top speed of 32 knots. The island superstructure is similar to, but shorter than the Baku, the fourth of the Kiev class. The Soviets have consistently stated that the new class of aircraft carriers will conduct air cover for surface ships involved in missile strikes against U.S. ships approaching Soviet shores.

The Soviet government has explicitly stated that the Tbilisi will not carry nuclear weapons.[408] There has been some speculation, nonetheless, that the Tbilisi could mount a SS-N-19 SLCM in vertical launchers for anti-surface strikes, but photographs released to date do not show missile installations or any fire control radar associated with anti-ship missiles.[409]

The Tbilisi class have inclined ramps at the bow in lieu of steam catapults. Tbilisi can accommodate both conventional and vertical take-off and landing aircraft, and will ultimately be able to accommodate some 60 aircraft and helicopters. The first specially configured Su-25UT Frogfoot B, Su-27 Flanker and MiG-29 Fulcrum conventional jets landed on the deck of the Tbilisi in November 1989, aided by arresting gear.[410] U.S. intelligence believes, that with the use of experienced Air Force pilots in the first air wing, the initial operational capability with fixed wing conventional jets could be as early as 1991.[411]

Initially, though, it is thought that the ship will be restricted to short take-off and landing fighters and helicopters. The commander of the Black Sea Fleet claimed that the Tbilisi would only carry ten aircraft.[412] And in the words of one naval expert:

> it has taken U.S. naval aviation over 50 years to evolve to the point that Americans can routinely launch from and recover high performance jet aircraft on pitching decks at sea. The arrested landing on and ski jump takeoffs from Tbilisi on a calm day in the Black Sea performed by three highly accomplished test pilots do not equate to regular Soviet pilots routinely launching from and recovering onto a pitching deck at sea. For the Soviets to make this a routine practice even a decade after they start practicing would be phenomenal and probably very costly in terms of lives and equipment.[413]

This evaluation is backed up by observations by U.S. analysts of problems of integrating and perfecting the catapult and arresting gear system for use by conventional take-off and landing (CTOL) aircraft.[414]

Explaining the early demonstration of the Tbilisi's aircraft carrying capability, U.S. intelligence stated that "The fact that flight operations were conducted so early in Tbilisi's sea trials suggests the Soviet Navy felt the need to convince policymakers of the carrier's importance and viability during last fall's budget debate."[415]

Initially, the Tbilisi, and its sister ship the Riga, will likely carry the Yak-38 Forger V/STOL. It will also likely carry the Ka-27 Helix D search-and-rescue helicopter, the Ka-29 Helix B troop transport helicopter, and the An-74 Madcap AEW aircraft. The supersonic Forger follow-on, the Yak-41, has entered its flight test program, and is expected to replace the Yak-38 on the four Kiev class ships.[416]

5. Cruisers

The Soviet Navy operates 33 nuclear capable cruisers of seven different classes.[417] One class, the Kirov, is nuclear-powered, while the rest are conventionally-powered. The cruisers can deliver SLCMs, nuclear torpedoes, and surface-

to-air missiles, as well as embark anti-submarine warfare helicopters that can deliver nuclear depth bombs.

There are five older cruiser classes that are no longer in production — Kara, Kresta I, Kresta II, Kynda, and Moskva — and two newer classes — Slava and Kirov — that are at the end of their construction phase. Three ships each of the Slava and Kirov classes are deployed and a fourth (the last of each class) is finishing construction. Budget cuts have led to discontinuing the construction of the fifth unit of the Kirov class.[418] A new cruiser class, smaller than the Kirov class, but larger than the Slava, is believed to be under construction at the Baltic Yard, Leningrad.[419]

Four Kynda class cruisers, deployed during 1962-1965, can launch 16 SS-N-3b SLCMs, 24 SA-N-1 surface-to-air missiles, and also have six 21-inch torpedo tubes. Four Kresta I class cruisers became operational during 1967-1969, and can launch four SS-N-3b SLCMs and 44 SA-N-1 surface-to-air missiles, and have ten 21-inch torpedo tubes. A single Ka-25 Hormone B is carried for targeting the cruise missile, and mid-course corrections. Ten Kresta II cruisers entered service during 1969-1978, and have ten 21-inch torpedo tubes and 72 SA-N-3 surface-to-air missiles. The Kresta II carries a single nuclear-capable Ka-25 Hormone A helicopter, which can probably deliver nuclear depth bombs. Seven Kara class cruisers were deployed during 1973-1980, and mount 72 SA-N-3 surface-to-air missiles and ten 21-inch torpedo tubes. They also carry a single Ka-25 Hormone A that can probably deliver nuclear depth bombs.

The two Moskva class ships were introduced in 1967 and are homeported in the Black Sea. They are not capable of launching cruise missiles or carrying fixed wing aircraft, but carry one twin SUW-N-1 with FRAS-1 nuclear-only ballistic rockets and 44 SA-N-3 surface-to-air missiles. In addition, the Moskva class ships embark about 14 Ka-25 Hormone A anti-submarine helicopters. These helicopters are capable of delivering nuclear depth bombs.

The first Slava class cruiser became operational in 1981. Three are currently in the fleet, with the third beginning sea trials in August 1989. A fourth unit is expected to be launched in 1990.[420] The Slava can fire 16 SS-N-12 SLCMs.

Most reference books credit the Slava with the ability to carry nuclear armed SA-N-6 surface-to-air missiles, and 21-inch nuclear torpedoes, in addition to the SS-N-12 SLCM. Soviet officers, however, have denied that the SA-N-6 missiles on the ship has ever carried a nuclear warhead, or that the missile was even nuclear capable. They also stated that the crane aboard the ship was used for handling boats, and not for loading or reloading SA-N-6 missiles, a procedure accomplished only at portside. In addition, they explained that the ship never carried nuclear torpedoes.

The newest cruiser is the Kirov class. Three cruisers are operational, and a fourth is fitting out in the Baltic. It was launched in April 1989, and is to be commissioned in 1991, with sea trials by 1992.[421] The Kirov was the first surface combatant to deploy the SS-N-19 long-range SLCM. The ships carry 20 SS-N-19s in vertical launchers and are outfitted with eight 21-inch torpedo tubes. The Kirov also is capable of carrying up to three Ka-25 Hormone or Ka-27 Helix helicopters, which can probably deliver nuclear depth bombs. Although the ship carries 96 SA-N-6 surface-to-air missiles, the missile is no longer thought to be nuclear capable.

6. Destroyers

The Soviet Navy has 37 nuclear-capable destroyers of four classes. The destroyers all carry 21-inch torpedo tubes and some of the older ships carry surface-to-air missiles. Ships of the Sovremennyy class carry cruise missiles. The newest Udaloy class can carry two Ka-27 Helix A anti-submarine helicopters. The Sovremennyy and Udaloy classes, both first deployed in 1981, currently remain in construction.

A number of destroyer classes have been retired in the late 1980s. The Kanin, Kildin, and Skoryy/Mod Skoryy classes have been retired, and the Mod Kashin, Mod Kildin, SAM Kotlin, and Kotlin/Mod Kotlin classes are undergoing or awaiting retirement.[422]

Ten Sovremennyy ships are active, two were launched in 1989 and construction continues on a number of others.[423] The Sovremennyy boats carry eight SS-N-22 SLCMs and four 21-inch torpedo tubes.

Ten Udaloy class ships are active, and construction of two more continues. The second ship under construction could represent a design follow-on.[424] The Udaloy class carries eight "long-range cruise missile-delivered ASW weapons," presumed to be non-nuclear SS-N-14 torpedoes,[425] and eight 21-inch torpedo tubes.

7. Frigates and Patrol Combatants

One-hundred and eighteen frigates and 74 patrol combatants of the Soviet Navy are nuclear-capable. The 118 frigates of four classes and the 31 guided missile patrol combatants of the Turya class only carry 21-inch torpedo tubes. They are nominally nuclear capable, but it is doubted whether they carry nuclear torpedoes on a regular basis.[426]

The initial two units of a Krivak class frigate follow-on, designated BAL-COM 8, are under construction in the Baltic and could commence sea trials in 1990.[427]

Thirty-one Nanuchka I class and Nanuchka III class guided missile patrol combatants each carry six SS-N-9 SLCMs. Ten Tarantul III class patrol combatants each carry four SS-N-22 SLCMs, and a single Sarancha class guided missile patrol combatant (hydrofoil) carries four SS-N-9 SLCMs.

Two nuclear-capable advanced marine vehicles continue under development and are conducting sea trials. The Utka class wing-in-ground effect vehicle — a turbofan-powered, aircraft/ hovercraft — carries the SS-N-22 antiship missile in the coastal defense nuclear role.[428] Another marine vehicle, the Dergach class surface effect ship, the world's largest surface effect ship, will also be armed with the SS-N-22 antiship missile.[429]

8. Support Ships

The Soviet Union has 29 auxiliary naval ships that are capable of nuclear weapons support, i.e. either transportation, maintenance, or supply.[430] Sixteen ships are missile tenders (AEM) that transport ballistic and cruise missiles to Soviet bases, ships, and submarines. A single large replenishment oiler (Berezina class) can provide underway weapons support to submarines. Twelve submarine tenders (AS) also provide underway and moored transport and supply for attack submarines. These Ugra and Don class submarine tenders can support as many as 12 submarines at sea with supplies, fuel, water, and spare torpedoes. No Soviet amphibious ships or landing craft are thought to be capable of transporting nuclear weapons, and there are no ground-launched nuclear weapons assigned to Naval Infantry.

C. Soviet Nuclear-capable Aircraft

Soviet Naval Aviation (SNA) is a significant element of the nuclear capability of the Soviet Navy, comprising 725 nuclear-capable aircraft. The SNA land-based bomber force "possesses a significant portion of the cruise missile combat power in the Soviet inventory,"[431] and the maritime patrol and shipboard force constitutes approximately 25 percent of the anti-submarine nuclear capability. According to U.S. intelligence, "Soviet Naval Aviation experienced dramatic expansion and modernization during 1989. Perhaps the most significant change to the force has been the resurgence of fighter/fighter-bomber tactical airpower, both ashore and at sea."[432] The growth of tactical airpower includes introduction of the non-nuclear Su-25 Frogfoot close air support aircraft into SNA, an increasing number of Su-17 Fitters, and the transfer of Mig-27 Floggers and/or Su-24 Fencers from the Soviet Air Force (particularly those withdrawn from Eastern Europe) to SNA.

The increase of fighters in SNA comes at a time when the number of SNA bombers is at the lowest level in a decade.[433] Nonetheless, the Backfire bomber is the most numerous nuclear aircraft in SNA. The Backfire A/B/C (Tu-26) is an all-weather, twin-engine, dual-capable medium range bomber. It was introduced in 1974, and is currently deployed in the Northern, Black Sea, Baltic, and Pacific Ocean Fleets. Older Badger bombers are being replaced on a less than one-for-one basis with the newest variant of the supersonic Backfire medium range bomber — the Backfire C — which became operational in SNA in 1986. The Backfire can be armed with nuclear bombs or dual-capable AS-4 air-to-surface missiles.

The Soviets assign Backfire bombers to both the Strategic Air Armies and Soviet Naval Aviation. Approximately 300 are deployed in the Soviet military, some 175 with Strategic Aviation and about 130 with SNA.[434]

Backfire bombers began replacing Badger bombers at Olenegorsk in the Northern Fleet in 1988, their first permanent deployment north of the Arctic Circle.[435] According to U.S. Navy Intelligence, "The Backfires introduced into the Northern Fleet late in 1988 provide a supersonic strike capability with improved weapons, fire control systems, and self protection capability when compared to the older Badgers they replaced."[436] In the Pacific Fleet, Backfire bombers are based at Alekseyevka, and new Backfire Cs were introduced in the Pacific in 1989.

About 125 strike-configured Badger bombers are deployed in SNA, although they are being rapidly retired. The Badger A/C/G (Tu-16) is a twin-engine, dual-capable medium range bomber. It was introduced into the SNA in 1955. The Badger can deliver nuclear bombs and fire the AS-2, AS-5 and AS-6 air-to-surface missiles. The Soviet Navy has some 310 Badgers, 125 of which are nuclear versions. Nuclear capable Badger C/Gs are deployed in the Pacific at Alekseyevka, Artem North (Vladivostok), and Khorol East (Ussuriysk).[437]

The Blinder A (Tu-22) is a twin-engine, dual-capable medium range bomber. It was first deployed in 1962, and is now being retired. About 185 Blinders of all types are deployed by the Soviet Union, 25 of which are with SNA. SNA Blinders do not carry missiles.[438]

The Fitter C (Su-20) is a swing wing, single seat, medium range fighter suited for the support of amphibious forces and "antiship attacks against fast and highly maneuverable small combatants."[439] Fitters are assigned to the Soviet Air Force and SNA. Approximately 70 Fitter C/Ks are assigned to SNA, although they are now being replaced by Su-24 Fencers. SNA has two Fitter C fighter bomber units, one in the Baltic Fleet and one in the Pacific Fleet.

The newest and most significant nuclear-capable plane to be assigned to SNA is the Su-24 Fencer long-range theater fighter bomber. The dual-seat, twin engine aircraft has nearly twice the range of the Fitter and could be fitted with nuclear-capable anti-ship missiles in SNA duty.[440] Fencer E reconnaissance variants have been assigned to SNA since 1986.[441] Su-24 Fencer C/D strike aircraft, however, were only introduced into SNA service in 1989.[442] In May 1990, Hungarian Radio announced that 39 Su-24s being withdrawn from Hungary would be restationed with the Soviet Navy near Murmansk.[443] Some 50 Su-24s are now estimated to be in SNA.[444] Other Air Force Fencers withdrawn from bases in East Germany and Poland are thought to have been assigned to SNA as well.

The Mail (Be-12/M-12) is a land-based maritime patrol and anti-submarine warfare aircraft. It was introduced in 1966 and about 75 remain active in service.[445]

The May (Il-38) is a land-based long-range maritime patrol and anti-submarine warfare aircraft. About 45 remain operationally deployed, assigned to the Northern and Pacific Fleets, operating occasionally from South Yemen, Libya, and Syria.

A new flying boat has recently been observed to replace the Be-12 Mail and the Il-38 May.[446] The A-40 Albatross twin-turbofan amphibian aircraft, designated TAG-D under development, was displayed at the Moscow Air Show in August 1989, and is undergoing testing at the Naval Aviation base at Taganrog, on the Sea of Azov.[447] It is the largest amphibious aircraft ever developed.

The Bear F (Tu-142) is a land-based long-range, turboprop maritime patrol and anti-submarine warfare aircraft. First introduced in 1970, and subsequently upgraded, some 60 are deployed in the Soviet Navy. The newest version, the Bear F

Mod 4 is currently entering the force.[448] The planes are assigned to the Northern and Pacific Fleets, and operate occasionally from Cuba, Angola, and Vietnam.

Soviet Naval Aviation also includes two ship-based anti-submarine warfare helicopters capable of delivering nuclear depth bombs: the Ka-25 Hormone A, introduced in 1967, and the Ka-27 Helix A, introduced in 1982.[449] Approximately 150 helicopters of both types are in service. According to the U.S. Navy, "all new major combatants are capable of carrying the Soviet's newest ASW helo — the Helix A."[450] Ka-27 helicopters "are rapidly replacing" the Ka-25 Hormone on board Soviet ships, and they will likely be retired in the 1990s.[451]

Aircraft assigned to the growing force of aircraft carriers include the Yak-38 Forger A, Su-27 Flanker, Su-25UT Frogfoot, MiG-29 Fulcrum, and Helix and Hormone helicopters. Su-27, MiG-29, and Su-25s aircraft have demonstrated take-off and landings from the new Tbilisi aircraft carriers. Some 75 Forgers are assigned to the four carriers of the Kiev/Baku class. The supersonic Forger follow-on, the Yak-41, has entered its flight test program, and is expected to replace the Yak-38 on the four ships. None of these aircraft are thought to be nuclear capable.

In addition to aircraft assigned directly to SNA, bombers assigned to Strategic Aviation have been given maritime roles. The Tu-95 Bear G strategic bomber, accountable under START and assigned to the Air Forces, have been reassigned to theater and maritime roles, rather than continuing their intercontinental bomber roles, in a move similar to the reassignment of U.S. B-52Gs to conventional missions.[452]

Older strategic Bear B/C bombers have now been retrofitted to the Bear G models to carry the dual capable, supersonic AS-4 Kitchen air-to-surface missile (ASM) rather than the nuclear only AS-3 Kangaroo subsonic ASM. Some 60 Bear Gs are operational in 1990. The bombers are assigned to the Irkutsk Air Army.[453] According to one U.S. naval intelligence officer, the new Blackjack bomber may also have a maritime role.[454]

IV. United Kingdom Nuclear-capable Ships and Aircraft

The Royal Navy (RN) has some 175 warships, including 84 major warships, 34 of which are nuclear-capable.[455] The percentage of major combatants that are nuclear-capable has increased since 1988 with the introduction of seven new nuclear-capable frigates (raising the percentage to approximately 40 percent, compared to 32 percent in 1988). Nuclear ships in 1990 include four Polaris ballistic missile submarines and three aircraft carriers, as well as 12 destroyers and 15 frigates.[456] The Royal Navy and Royal Air Force also operate about 260 nuclear-capable aircraft with naval missions.[457]

The single largest category of U.K. naval nuclear weapons is the stockpile of 96 warheads for the Polaris SLBMs. The approximately 50 U.K. WE-177 nuclear depth bombs and free-fall bombs assigned for maritime missions make up the remainder of the naval nuclear stockpile.[458]

A. Fleet Organization, Homeports, and Naval Nuclear Weapons' Shore Locations

The RN is organized into three flotillas and two commands, each made up of several squadrons. The First and Second Flotillas are composed of squadrons of destroyers and frigates, whose primary task is to escort aircraft carriers or convoys. The Third Flotilla is made up of the ASW carriers and amphibious assault ships. The Submarine Command is composed of four squadrons: 1 Squadron of patrol submarines at Gosport, 2 Squadron of nuclear-powered attack submarines at Devonport, 3 Squadron of nuclear-powered attack and diesel-powered patrol submarines at Faslane, and 10 Squadron of Polaris submarines at Faslane. The Mine Countermeasures Command is in charge of minesweepers and smaller coastal patrol vessels.

The RN remains under U.K. command and operational plans, except when control is transferred to NATO's Supreme Allied Commander Atlantic (SACLANT).[459] The senior U.K. naval officer, Commander-in-Chief Fleet (CINCFLEET) in Northwood, near London, is also NATO commander of naval, submarine and maritime air forces in the Eastern Atlantic (CINCEASTLANT) area, as well as the NATO Commander-in-Chief of the English Channel area command (CINCHAN).

The RN's prime role is to meet national and allied maritime requirements in the NATO area, but forces are also frequently deployed around the world in support of lingering interests in the Caribbean, South Atlantic, Indian Ocean, and the Far East. Forces remain in Hong Kong, Diego Garcia in the Indian Ocean, the Falkland Islands, Belize, and Brunei. This residual presence is supplemented with overseas deployments of task forces. In February 1990, for example, nuclear-capable task forces were in the West Indies, near Spain, and proceeding towards the Persian Gulf to relieve the ships on the Armilla Patrol.[460]

Nuclear-capable Nimrod anti-submarine aircraft and various helicopters also conduct anti-submarine warfare training at the U.S. Atlantic Undersea Test and Evaluation Center (AUTEC) in the Bahamas, and Nimrod aircraft deploy periodically to Kindley NAS (Bermuda), Keflavik (Iceland), Oman, Gibraltar and Australia.

The RN's ASW capability is its main contribution to NATO naval forces. Former U.S. Secretary of the Navy John Lehman stated that the United States counts on the Royal Navy "to provide 70 percent of the ready NATO forces for protection of shipping against the Soviet threat" in the eastern Atlantic.[461] The three RN Invincible class aircraft carriers, and destroyer and frigate escorts, provide specialized ASW task groups and, along with other allied ASW forces, form NATO's Anti-submarine Striking Force Atlantic.

These ASW forces coordinate with U.S. Navy carrier battlegroups to constitute NATO's offensive force, the Striking Fleet Atlantic (STRKFLTLANT). The ASW task forces seek and destroy Soviet attack submarines with Sea King and Lynx helicopters launched from carriers, Type 42 destroyers, and Type 22 and Type 23 frigates, and could employ nuclear depth bombs. The nuclear-capable RAF Nimrod anti-submarine warfare aircraft also could support the task forces, delivering U.S. nuclear depth bombs.

The RN's nuclear- and diesel-powered submarines also contribute to NATO's anti-submarine warfare force. The U.K. provides the only European nuclear-powered submarine fleet assigned to NATO. It currently is comprised of 17 submarines and by 1991 will expand to 18 submarines.[462] NATO plans call for allied submarines, particularly diesel-powered submarines, to help defend the Greenland-Iceland-United Kingdom (GIUK) gap and coastal areas, thus freeing U.S. and U.K. nuclear-powered attack submarines to go forward into Soviet waters.[463] Although U.K. attack submarines play an important role in NATO's strategy, they are not nuclear-capable.

There are numerous facilities in the nuclear infrastructure that support the United Kingdom's naval nuclear weapons, including command, control and communication, research, testing, training and war planning facilities.

Four homeports support nuclear-capable ships. The Royal Navy's four Polaris submarines are homeported in Faslane, Gareloch, Strathclyde, Scotland. The three aircraft carriers as well as eight Type 42 destroyers are homeported at Portsmouth. The four other Type 42 destroyers are at Rosyth and the Type 22 and 23 frigates are at Devonport.

Nuclear-capable aircraft are located at seven bases. Royal Navy Sea Harriers are at RNAS Yeovilton, Ilchester, Somerset; Lynx helicopters are at RNAS Portland; and Sea King helicopters are at RNAS Culdrose, Helston, Cornwall, and Prestwick, Strathclyde, Scotland (for anti-submarine protection of the submarine bases). Royal Air Force Buccaneers are based at RAF Lossiemouth, Grampian, Scotland, and Nimrods are at RAF Kinloss, Grampian and St. Mawgan, Cornwall.

Nuclear warheads for U.K. naval forces are located in several locations from Scotland to Cornwall. Polaris missiles and their warheads are stored at Coulport, Loch Long, Strathclyde, and maintained and overhauled at Burghfield, Berkshire, where other Royal Navy warheads are serviced as well. Nuclear weapons probably are stored in the Royal Navy Armament Depots at Bull Point and Ernesettle, both near Plymouth, Devon, for the ships at Devonport, with Bull Point reportedly being the more active site. Also, the depot at Frater, Gosport, is thought to store nuclear weapons for the ships at Portsmouth. The depot at Dean Hill, Salisbury, Wiltshire, also serves as a storage point, particularly, it is believed, as an overnight stopping point for nuclear weapons convoys. RAF Kinloss, Scotland, is a possible wartime nuclear weapons storage base. (And, as noted, St. Mawgan stores U.S. B57 depth bombs for the U.K. Nimrods, while Machrihanish is in inactive status.)

Outside the United Kingdom, the Royal Navy still retains several bases used by nuclear-capable naval forces. Gibraltar is a dockyard and temporary homeport for Royal Navy ships, some of which are nuclear-capable, on rotational assignment to NATO forces in the Mediterranean Sea. Port Stanley in the Falklands has hosted nuclear-capable navy Sea Kings. Nuclear-capable Nimrods deploy periodically to Ascension Island in the Atlantic, to the U.K. air base in Akrotiri, Cyprus, and to Oman and Australia for anti-submarine warfare training.

B. Nuclear-capable Ships

1. Ballistic Missile Submarines

The four U.K. Polaris ballistic missile submarines — HMS Resolution (S22), HMS Repulse (S23), HMS Renown (S26), and HMS Revenge (S27) — were commissioned between 1967-1969. They originally were armed with U.S. Polaris A-3 missiles, each carrying three U.K. nuclear warheads. Now each carries sixteen Polaris A3TK (Chevaline) missiles with two multiple reentry vehicles (MRVs). The 10 Squadron of the Submarine Command is responsible for three of the submarines that are operational at any given time. Of these three submarines, only one or two are on active patrol (often only one), while the third is involved in training and resupply at Faslane. A fourth submarine is usually out of service undergoing maintenance at the Rosyth shipyard.

The U.K. is currently constructing a new Vanguard class of four submarines to replace the existing Resolution class.[464] The first was ordered in 1986, and will enter service in 1994.[465] These submarines are expected to be about twice the size of the current Resolution class (displacing 15,500 vs. 8,400 tons submerged) and carry 16 Trident II missiles.

The Resolution class submarines are based at Faslane on the Clyde Estuary in Scotland. The submarines each have two crews that rotate on twelve-week cycles, four weeks of trials and maintenance and eight weeks on patrol. They are routinely under the control of NATO, although U.K. independent targeting plans also exist. Submarines patrols in the northern Atlantic are coordinated with U.S. submarine commands.[466] If the Royal Navy's SSBN is ordered to transfer to another patrol area, other NATO and French submarines will be warned of its intended course, and will clear a lane about four nautical miles (eight kilometers) each side of its path.[467]

2. Aircraft Carriers

The RN has three nuclear-capable aircraft carriers — HMS Invincible (R05), HMS Illustrious (R06) and HMS Ark Royal (R07) — all homeported at Portsmouth. These ships displace some 16,250-20,000 tons and were commissioned between 1980-1985. Only two ships are kept operational, the third is either kept in a stand-by condition or is undergoing refit.[468] The Invincible class can carry up to 21 aircraft including a squadron of 8-12 Sea Harrier vertical/short take-off and landing (V/STOL) jets, one squadron of 5-9 Sea King anti-submarine warfare helicopters, and three airborne early warning Sea King helicopters.[469]

These aircraft carriers are certified to carry nuclear weapons in peacetime as well as in wartime. They carry WE-177A/B nuclear bombs for delivery by the Sea Harrier attack aircraft and the anti-submarine WE-177C variant for use by the Sea King anti-submarine warfare helicopters. It is believed that each vessel is allocated all together about five to six nuclear bombs and depth bombs.

Although the Sea Harriers provide the carriers with some anti-air and surface strike capability, the carriers and their escorts are mainly optimized for anti-submarine warfare. As

such, in a war with the Soviet Union they are expected to fulfill the NATO requirement of protecting carrier battlegroups against Soviet submarines and supporting control of the Norwegian Sea.

3. Destroyers

Twelve of the RN's 13 destroyers are nuclear-capable.[470] They are the Type 42 destroyers and are divided into three "batches," with each batch containing progressively more modernized capabilities. The eight ships in Batch 1 and Batch 2 were commissioned between 1976-1983, and displace 4,100 tons at full load. (Two more of these ships, HMS Sheffield and HMS Coventry, were lost during the Falklands War.) The four Batch 3 ships are about 52 feet (16 meters) longer than the other eight ships, and displace 4,775 tons at full load. They were commissioned from 1982-1985.[471] Four of the Type 42s are homeported at Rosyth and the others are at Portsmouth.

These ships are certified for nuclear weapons carriage in wartime, but reportedly not in peacetime. Batch 1 and 2 vessels embark one nuclear-capable Lynx anti-submarine helicopter, while Batch 3 ships deploy two. All can carry WE-177 nuclear depth bombs.

4. Frigates

Fifteen of 36 frigates in the RN are nuclear-capable.[472] These 15 ships belong to the Type 22 frigate and Type 23 classes. The Type 22 class consists of four Batch 1 ships commissioned between 1979-1982, displacing 4,400 tons full load; six Batch 2 ships commissioned between 1984-1988, displacing 4,800 tons full load; and four Batch 3 ships commissioned in 1988-1990, displacing 4,900 tons full load.[473]

The Type 22 "Broadsword" frigates are reportedly certified to carry nuclear weapons in both wartime and peacetime. The four Batch 1 ships can carry two Lynx anti-submarine helicopters, but usually embark one. HMS Brave (F94) and subsequent Batch 2 and 3 ships can carry either two Lynx or one Sea King helicopter.[474] Each ship is believed to be allocated one to two nuclear depth-bombs for use by the anti-submarine helicopters.

A new class of nuclear-capable frigate, the Type 23 "Duke" class, is under construction. The first ship, the HMS Norfolk (F230), entered the fleet in late 1989 and displaces 3,850 tons at full load. Some nine more are currently on order, with more than half to enter the fleet in the next few years. About twenty in all are expected to be constructed. The Type 23s can carry two Lynx helicopters or one EH-101.[475]

5. Support Ships

Several types of RN support ships have a nuclear capability. Four Royal Fleet Auxiliary (RFA) ships — RFA Fort Grange (A385), RFA Fort Austin (A386), RFA Resource (A480), and RFA Regent (A486) — are used for at sea replenishments and are understood to be nuclear certified for peacetime operations. The two Fort class ships were commissioned in 1978-1979, displace some 24,000 tons at full load, and can carry four anti-submarine Sea King helicopters. The Resource class ships were both commissioned in 1967, and displace 22,900 tons at full load.[476]

Three smaller logistic ships — RMAS Kinterbury (A378), RMAS Throsk (A379), and RMAS Arrochar (A382) (ex-St. George) — reportedly have been used to ferry nuclear weapons between or within ports in the United Kingdom. These Royal Maritime Auxiliary Service armament stores ships displace some 2,200 tons full load, can carry armaments in two holds, and have spare bunks for Royal Marine guards. They were commissioned between 1977 and 1981.[477]

C. United Kingdom Nuclear-capable Aircraft

The Buccaneer S.2B is a RAF two-engine, turbofan, dual-capable, maritime strike aircraft. The first flight of a Buccaneer prototype took place in 1958, the Buccaneer Mk.1 entered the force in 1962, and the first production Buccaneer S.2Bs flew in 1964.[478] The Buccaneer S.2B can carry conventional arms as well as WE-177A/B nuclear bombs in the internal bomb bay for anti-shipping and land attacks.[479] It has a tactical radius of some 520 nautical miles (965 kilometers). Forty-two Buccaneers have recently received a major avionics and weapons upgrade and are based at RAF Lossiemouth, Grampian, Scotland with the 12 and 208 Squadrons. Another eight or so are in the 237 Operational Conversion Unit (OCU) also based at Lossiemouth. The OCU aircraft have the wartime role of providing laser designations for bomb strikes in Central Europe. In addition, about 13 Buccaneers are held in storage.[480]

The Sea Harrier FRS.1 is a RN single-engine, light attack carrier based jet used for air-intercept and strike warfare. The first RAF prototype flew in 1966 and the naval version was delivered in 1977.[481] It can carry a variety of conventional weapons for air-to-air or air-to-surface attack as well as the WE-177 nuclear bomb. The Sea Harrier's trademark characteristic is its vertical/short take-off and landing capability (V/STOL), and it has a range of 760 nautical miles (1,400 kilometers). Some 40 are operational and are with two deployed squadrons — 800 Squadron on the HMS Invincible, and 801 Squadron assigned to the Ark Royal — and one additional undeployed squadron (899 Squadron). A program to modernize some 29 FRS.1s to an FRS.2 version with improved avionics is currently underway. In addition, ten new construction FRS.2s are on order to replace lost planes and compensate for the FRS.1 planes undergoing conversion.[482] When not at sea these squadrons are located at RNAS Yeovilton, Ilchester, Somerset.

The Lynx HAS.2/3 is a RN dual-engine, light ship-based helicopter. It has both anti-submarine and antiship missions. The first Lynx flew in 1971 and currently about 83 helicopters are deployed with three squadrons. 702 Squadron has Lynx HAS.2/3s and does air crew training. 815 and 829 Squadrons have about 30-35 Lynx HAS.2/3s each. The Lynx can carry one nuclear depth bomb, as well as conventional torpedoes and anti-ship missiles. It has a range of 340 nautical miles (630 kilometers) and is deployed on Type 42 destroyers, and Type 22 and Type 23 frigates. Each ship usually carries one Lynx helicopter in peacetime. However the Batch 3 Type 42 destroyers and all the Type 22 and Type 23 frigates could carry two Lynx helicopters each in wartime. When not at sea Lynx helicopters are located at RNAS Portland.

The Sea King HAS.5/6 is a RN dual-engine, medium ship-based helicopter primarily used for anti-submarine warfare. It is a U.K. produced version of the U.S. Navy's Sea King helicopter. The first U.K. version flew in 1969. It can carry nuclear depth bombs as well as conventional torpedoes and depth bombs and has a range of 660 nautical miles (1,230 kilometers). Sixty-two ASW HAS.5/6 helicopters are deployed with six squadrons. Some 46 of these helicopters are operational in the ASW role, while 16 are used for ASW training. The aircraft carriers usually embark one squadron of nine aircraft, while the Type 22 frigates Batches 2 and 3 could embark one Sea King helicopter each. Five Sea King squadrons are based at RNAS Culdrose, Helston, Cornwall and one (819 Squadron) is at Prestwick, Strahclyde, Scotland. Three non-nuclear-capable variants exist: the HC.4s, which are used for the delivery of commandos; the AEW.2s, which are Sea King HAS.2s that have been converted to airborne early warning helicopters; and, some HAS.5s which are used for search and rescue.

V. French Nuclear-capable Ships and Aircraft

The French Navy has some 155 warships, eight of which are nuclear-capable: six ballistic missile submarines and two aircraft carriers.[483] Nuclear-capable French naval aviation consists of 36 Super Etendard aircraft.[484] France's other land-based aircraft with naval missions and sea-based anti-submarine warfare helicopters are not believed to have a nuclear capability.[485] The major changes in France's naval nuclear capability since 1988 are: a greater number of strategic submarine-launched ballistic missile warheads, due to the continued deployment of the M4B, and the introduction of nuclear-armed ASMP missile on Super Etendard aircraft aboard the aircraft carrier Foch (R99).

A. Fleet Organization and Missions, Homeports, and Naval Nuclear Weapons' Shore Locations

The Marine Nationale is divided into five major commands: La Force Océanique Strategic (FOST), Mediterranean Forces, Atlantic Forces, Naval Forces Pacific Ocean, and Naval Forces Indian Ocean. FOST controls the SSBN fleet that operates out of Ile Longue, Brest and is independent of the other naval commands. The Mediterranean fleet is based at Toulon and includes the two nuclear-capable aircraft carriers as well as sundry other non-nuclear-capable surface ships, minor combatants, nuclear-powered attack submarines, and naval air forces. A similar assortment of non-nuclear ships, submarines and aircraft is controlled by the commander of the Atlantic Fleet, and operates out of Brest, Landivisiau, and Hyeres. The commander of the Pacific forces is based in Papeete, French Polynesia. He commands a dozen or more smaller non-nuclear combatants and auxiliary ships and protects the French Nuclear Test Center in the Pacific. Finally, the Indian Ocean forces' commander is based on board a fleet tanker and controls about a dozen smaller non-nuclear combatants and support ships, as well as contingency deployments such as those ships currently in the Gulf of Oman protecting French shipping in the Persian Gulf. Only the FOST and Mediterranean Fleet regularly are assigned the nuclear-capable ships, although the aircraft carriers can be deployed into other sea areas.

Like the United Kingdom, France has territories and interests outside of the main European area of operations. In pursuit of these interests, French nuclear-capable aircraft carriers range worldwide. For example, a carrier task group, centered on the aircraft carrier Foch, operated off Lebanon in 1983, was activated after the U.S. attacks on Libya, and both carriers have deployed to the Persian Gulf. Carriers also have deployed in the Gulf of Guinea off the west coast of Africa, and near Ethiopia and South Yemen.[486]

As with the other nuclear powers, there is a relatively extensive command and control, research and development, and maintenance infrastructure that directs and supports French naval nuclear weapons. Yet only two ports and two naval air stations host French nuclear-capable ships and aircraft. The ballistic missile submarines operate out of Ile Longue (Brest, Finistère) which also has storage facilities for missiles and nuclear warheads, and the two aircraft carriers are homeported in Toulon. Naval aviation has two squadrons of Super Etendards, the 11F and 14F, based at Landivisiau NAS, Finistère, and the third, the 17F, is at Hyeres NAS, Var, near Toulon. Nuclear weapons for these aircraft are stored at two air bases of the tactical air force (FATAC): Istres (Air Base 125), Bouches-du-Rhone and; Luxeuil (Air Base 116), Haute-Saone (and also on the aircraft carriers).

B. Nuclear-capable Ships

1. Ballistic Missile Submarines

France has six nuclear-powered ballistic missile submarines, each displacing about 8,900 tons submerged, and carrying 16 SLBMs. They are divided into two classes. The five boats of the Le Redoutable class entered active service between 1971-1980, and carry M20 or M4B SLBMs. The newest class consists of the single submarine L'Inflexible, which became operational in 1985, and carries the M4A SLBM.

French sea-based strategic nuclear forces are undergoing a significant expansion (see Table 12). Four Le Redoutable class submarines are being converted to carry the six-warhead M4B SLBM in lieu of the older single-warhead M20 SLBM. Le Tonnant (S614), the first submarine to undergo conversion, reentered service in 1987 with the M4B missile. L'Indomptable (S614) and Le Terrible (S612) also were upgraded, returning to service in 1989 and 1990, respectively. The fourth submarine to be converted, Le Foudroyant (S610) still carries the M20 SLBM, but it will soon start a refit which is scheduled to finish in 1993. The Le Redoutable, which carries the M20, is to be decommissioned in 1991.[487]

A new class of French ballistic missile submarines is under production. The first boat of the class, Le Triomphant (S616), began construction in 1989, and it is scheduled to enter service in late 1994. Six of these "New Generation" ballistic missile submarines are planned, the last to enter service in 2008. They will displace 14,300 tons submerged, have a length of 455 feet (138 meters), and carry 16 missiles. The first three submarines will carry the six-warhead M45 missile, while the latter three will be armed with 12-warhead M5 missile.[488]

Table 12: French SLBM Warheads 1980-1995

Year	M20 SLBMs		M4 SLBMs		**Total**	
	Subs	Warheads	Subs	Warheads	**Subs**	**Warheads**
1980	5	80	0	0	**5**	**80**
1985	5	80	1	96	**6**	**176**
1990	2	32	4	384	**6**	**416**
1995	0	0	6	576	**6**	**576**

French ballistic missile submarines, like their U.S. and U.K. counterparts, each have two crews to maximize time on patrol.[489] Significant naval activity takes place around Brest to protect the submarines as they come and go. The French Navy has noted that the three operational French submarines patrol in the North Atlantic, the Mediterranean, and the Norwegian Sea.[490] The submarines equipped with shorter-range M20 missiles reportedly move into the Norwegian Sea to be able to strike targets in the Soviet Union, but the submarines armed with the longer-range M4 missiles are able to reach their targets while patrolling in waters nearer to France.[491]

2. Aircraft Carriers

The French aircraft carriers, the Clemenceau (R98) and the Foch (R99) are the French Navy's only nuclear-capable surface warships.[492] The Clemenceau became operational in 1961, and was outfitted to carry nuclear weapons in 1978 when the nuclear-capable Super Etendard fighter-bomber was deployed.[493] The Foch, entered service in 1963, and was similarly modified to carry nuclear bombs in 1981. The Foch underwent another upgrade in 1987-1988 to provide facilities for handling and storing the Air-Sol-Moyenne-Portée (ASMP) nuclear missile.[494]

Although the Clemenceau carriers will retire in the 1990s, France intends to retain an aircraft carrier capability into the next century. In 1980 the French Defense Council approved the construction of two replacement nuclear-powered aircraft carriers,[495] although just one is on order as of 1990. These Charles-de-Gaulle class carriers will displace 36,000 tons at full load and be powered by two nuclear reactors.[496] They will carry approximately 40 aircraft and store ASMP nuclear missiles for aircraft delivery.[497] Construction on the first carrier began in 1989. It was scheduled to enter service in 1996, but due to fiscal constraints its delivery has been delayed until 1998.[498] A second carrier has not been ordered.

C. French Nuclear-capable Aircraft

The sea-based tactical bomber force (aviation embarquée) is the most recently formed contingent of French tactical nuclear forces. It consists of the Super Etendard, which is a single-engine, all-weather, attack/fighter aircraft, first deployed in 1978.[499] The Super Etendard was the first French aircraft designed with inertial navigation capability from its inception.[500] The plane has a top speed of over Mach 1 in high level flight and a 920 nautical mile (1680 kilometer) range.[501] Eighty-five aircraft were manufactured and 56 are currently operational. Theoretically all are nuclear-capable, although only 36 are formally declared to be so. They can carry one AN-52 or a smaller-yield nuclear bomb. Twenty of these nuclear-capable aircraft have been modified to carry the ASMP nuclear air-to-surface missile.[502]

Of the 56 aircraft deployed, some 36 are active and the rest are in reserve.[503] They are organized into three squadrons of about 15 aircraft each.[504] The 11F and 14F squadrons operate out of Landivisiau while 17F Squadron is based at Hyeres. Operational control of the embarked aviation is vested in ALPA (Commandant l'Aviation Embarquee et le groupe des Porte-Avions), who is based at Toulon. At sea, ALPA flies his flag on one of the two aircraft carriers.[505]

VI. Chinese Nuclear-capable Ships and Aircraft

The Chinese Navy (People's Liberation Army Navy (PLAN)) consists of some 1,300 ships, but only some three are nuclear capable: one or two Xia class nuclear-powered SSBNs, and a single Golf class test/training diesel-powered SSB.[506] Additionally, 150 land-based aircraft potentially could have nuclear weapons missions. Five or six of some 90 submarines are nuclear-powered, including the one or two Xia class submarines, and four Han class attack submarines.[507]

A. Fleet Organization and Missions

The Chinese Navy, headquartered in Beijing, is organized into three fleets: the North Sea Fleet at Qingdao, the East Sea Fleet at Shanghai, and the South Sea Fleet at Zhanjiang.[508] The Chinese navy is primarily a coastal defense fleet. The North Sea fleet is responsible for defending Beijing and the northeast coast against seaward attacks from the Yellow Sea. It confronts the fleets of the two Koreas and Japan, as well as the home waters of the Soviet fleet in the western Pacific. The East Sea fleet protects the Shanghai region and is responsible for waters adjacent to Taiwan. The South Sea fleet is responsible for defending Hainan island and the southern coast, and faces the Gulf of Tonkin.[509]

B. Nuclear-capable Ships

The Xia class SSBNs were under development for fifteen years. (The development of a reliable nuclear power plant was a significant technical problem to be solved in its construction.) The submarines reportedly displace 8,000 tons at full load and carry 12 CSS-N-3 SLBMs. At least one, and possibly two, Xia class submarines are operational.[510]

The Golf class submarine was constructed from Soviet parts in 1964 and has served as a test and training ship for ballistic missile and submarine crews. It can carry two missiles and could possibly be used in a crisis as an operational launcher.[511]

Chinese ballistic missile submarines would be vulnerable to Soviet (or U.S.) ASW forces if they patrolled too far away from Chinese waters. It is therefore more likely that the ballistic missile submarines will deploy near the Chinese coast in the Bohai Gulf where they can be protected by other Chinese forces, including land-based naval aircraft.[512]

C. Chinese Nuclear-Capable Naval Aviation

The status of Chinese naval aviation's nuclear mission remains uncertain. The total naval aviation force consists of about 890 aircraft, 710 of which are fighters, helicopters and transports, with no known nuclear mission or capability. The remaining 180 aircraft are mostly H-6/Tu-16 Badgers (some 50), and H-5/Il-28 Beagles (approximately 130).[513] The Chinese Air Force also deploys H-5 and H-6 bombers and trains with nuclear gravity bombs. The naval H-5s and H-6s also may have a nuclear mission because the nuclear gravity bombs that are available for the Air Force bombers are theoretically available for the Navy planes.[514] However, there is still no evidence to suggest the Chinese train for naval nuclear missions. Naval aviation seemingly does not give nuclear bombing a high priority, as the aircraft mainly have an air defense mission, with anti-ship torpedo and bombing tasks as secondary missions. For the anti-ship mission, the Chinese put more emphasis on torpedoes, anti-ship cruise missiles and conventional gravity bombs, than on naval nuclear bombing.

Footnotes

[1] A version of this introduction was presented at the "Naval Arms Limitations and Maritime Security Conference," sponsored by the Center for Foreign Policy Studies, Dalhousie University, Halifax, Canada, 26-29 June 1990.

[2] For the Soviet Union, this includes ships and submarines that would have been started under Gorbachev, as opposed to before him. Production of long-range sea-launched cruise missiles, ships and submarines has declined; DOD, *Soviet Military Power 1989*, p. 34 (hereafter *SMP 19XX*).

[3] Statement of RADM Thomas A. Brooks, Director of Naval Intelligence, before the Seapower, Strategic, and Critical Materials Subcommittee of the HASC on Intelligence Issues, 14 March 1990, p. 18 (hereafter RADM Thomas A. Brooks, 14 March 1990).

[4] This follows a pattern established in earlier arms control agreements. On 10 June 1985, the Reagan Administration announced that the USS Sam Rayburn, a Poseidon submarine, would be dismantled in order to remain within the SALT II Treaty ceiling on MIRVed missiles.

[5] In early July 1990, the Senate Armed Services Committee terminated the program in its version of the Department of Defense FY 1991 budget request. Paper studies for an unspecified new type of nuclear anti-submarine warfare weapon continue, however; HAC, FY 1991 EWDA, Part 6, p. 799.

[6] Two non-nuclear countries, the Netherlands and Italy, together operate 22 anti-submarine warfare aircraft which are certified to deliver U.S. B57 nuclear depth bombs. These planes are included in this total.

[7] Includes air-launched anti-ship missiles.

[8] In addition to nuclear bombs, France is deploying the ASMP surface-to-air missile.

[9] Chinese naval aviation may be assigned nuclear bombs.

[10] Italy and the Netherlands operate an additional 22 nuclear-capable anti-submarine warfare aircraft, not included in this total.

[11] This does not include the one U.S. SSBN in commission, but not yet loaded with missiles.

[12] China has one Golf class SSB used for testing and training, not included in this total, that also could be nuclear capable.

[13] Includes 12 aircraft carriers and the six largest amphibious assault ships (LHAs).

[14] Include ships used in the transport, maintenance, or storage of nuclear weapons and components.

[15] In addition to support ships, this number includes amphibious warfare ships other than the amphibious assault ships (LHAs and LHDs).

[16] The force consists of 11 submarines with Poseidon missiles, 20 with Trident I missiles, one with Trident II missiles, and one awaiting loading with Trident II missiles.

[17] Since 1988, the number of submarines carrying Poseidons has decreased from 16 to 11 as five Lafayette (SSBN-619) class boats have been deactivated. See *Neptune 2* for 1988 figures.

[18] U.S. Navy, *News Release*, 29 March 1990.

[19] The Trident II D5 will be backfitted on the first eight submarines (replacing their Trident I C4 missiles) during their overhauls, with conversions starting in FY 1993. In addition, approximately half of the existing 100 kiloton W76 warheads on the Trident I C4 missiles will be "transferred" for use on Trident II D5 missiles starting in the mid-1990s, rather than arming all of the Trident IIs with the new 475 kiloton W88.

[20] Thomas B. Cochran, et. al., *Nuclear Weapons Databook: Volume IV, Soviet Nuclear Weapons* (New York: Harper & Row/Ballinger Publishing Co. 1989), p. 107.

[21] RADM Thomas A. Brooks, 14 March 1990, p. 23.

[22] *SMP 1987*, pp. 27 and 34; "Soviet sub construction seeks to maintain 300-ship force," *Navy News & Undersea Technology*, 25 September 1989.

[23] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990.

[24] *SMP 1988*, p. 40; DOD, *1989 Joint Military Net Assessment*, p. 3-2.

[25] *SMP 1988* (p. 48) states that the Soviets "may begin at-sea flight test of a modified version of the SS-N-20 missile sometime this year." *SMP 1989* (p. 47) makes no mention of a new SLBM.

[26] Robert Holzer, "Navy's 100-sub Fleet Unrealistic, Admiral Says," *Defense News*, 12 March 1990; Eric Rosenberg, "Navy Attack Submarine Stockpile To Take a Dive," *Defense Week*, 12 March 1990, p. 6.

[27] The Navy, however, may "buy back" these submarines if funds permit.

[28] HASC, FY 1987 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 110.

[29] Statement of RADM Thomas A. Brooks, Director of Naval Intelligence, before the Seapower, Strategic, and Critical Materials Subcommittee of the HASC on Intelligence Issues, 22 February 1989, p. 10 (hereafter RADM Thomas A. Brooks, 22 February 1989); Statement of RADM William O. Studeman, Director of Naval Intelligence, before the HASC, 1 March 1988, pp. 32 and 34; *SMP 1989*, p. 3. Production of the Victor III may also slow with closure of the Pacific production line after 1984. A second production line for the Akula class submarine opened in 1988; *SMP 1989*, Preface; *Jane's Fighting Ships 1990-91*, p. 591.

[30] This includes 40 Whiskey class SS, 35 Foxtrot class SS, 11 November class SSNs, four Hotel II class SSNs, three Echo I class SSNs, one Juliett class SSG, and one Papa SSGN. It is also estimated the seven older Echo II class SSGNs with SS-N-3c SLCMs, and four Charlie class SSGNs will be retired.

[31] *SMP 1988*, p. 129; "Soviet SSK reduction," *Jane's Defence Weekly*, 17 February 1990, p. 284; "'Whiskeys' at Esbjerg," *Jane's Defence Weekly*, 27 January 1990, p. 135.

[32] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990.

[33] "Danger! Soviet Subs at Work," *Time*, 10 July 1989, p. 35; Michael Dobbs, "Soviet Sub Limps Home After Nuclear Shutdown," *Washington Post*, 27 June 1989, p. A10; Bill Keller, "Crippled Soviet Nuclear Sub Will be Towed Home," *New York Times*, 27 June 1989, p. A7.

[34] RADM Thomas A. Brooks, 14 March 1990, p. 35.

[35] "Atomic Submarine Withdrawn from Northern Fleet," TASS International Service, 18 July 1990, in FBIS "Daily Report' Soviet Union, 19 July 1990.

[36] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990.

[37] "Open Letter From Former Komsomolets Crew Members," *JPRS Soviet Union Military Developments*, 13 April 1990, p. 62.

[38] HASC, FY 1985 DOD, Part 2, p. 361.

[39] In the mid-1980s, the Navy wanted to have 198 surface ships and submarines equipped with Tomahawk missiles by the mid- to late-1990s; HAC, FY 1987 DOD, Part 4, p. 164. Now the Navy estimates it will have 191 vessels carrying Tomahawks by the late-1990s or early 2000s; U.S. Navy, Cruise Missile Projects Office, "Total Planned Current Tomahawk Capable Platforms," 10 May 1990.

[40] HASC, FY 1985 DOD, Part 2, p. 363.

[41] U.S. Navy, Cruise Missile Project Office, "Tomahawk Missile Procurement Objective," 8 May 1990.

[42] David Bond, "Navy Mulls Nuclear Tomahawk Needs, Seeks to Extend Production Program," *Aviation Week and Space Technology*, 4 June 1990, p. 25.

[43] "Navy Plan to Reduce Tomahawk Buy Reflects Realization of Future Force Cuts," *Inside the Navy*, 21 May 1990, p. 6; "Navy Mulls Nuclear Tomahawk Needs, Seeks to Extend Production Program," *Aviation Week and Space Technology*, 4 June 1990, p. 25; Richard Fieldhouse, "Cruise Missile Compromise Surfacing," *Bulletin of the Atomic Scientists*, June 1990, pp. 21-24.

[44] *SMP 1988*, p. 53.

[45] *SMP 1989*, p. 47.

[46] RADM Thomas A. Brooks, 14 March 1990, p. 25.

[47] RADM Brooks described the "recent completion of a two year improvement program for the SS-N-21 land attack cruise missile which probably focused on improving the SLCM's guidance/propulsion systems;" RADM Thomas A. Brooks, 14 March 1990, p. 32.

[48] The USS Constellation (CV-64) entered a two-and-a-half year overhaul in April 1990, overlapping with the USS Kitty Hawk (CV-63), which is currently nondeployable and completing its service life extension. The USS Enterprise (CVN-65), in addition, is about to undergo a $1.9 billion two-year overhaul and has already been pulled out of service.

[49] "Navy Told to Retire Saratoga and Ranger Aircraft Carriers by FY-94," *Inside the Navy*, 11 December 1989.

[50] SASC, FY 1988/1989 DOD, Part 4, p. 2456.

[51] Retirement of the Terrier and ASROC denuclearized 27 ships, but the number of Tomahawk armed cruisers increased from 8 to 16 due to the commissioning of seven new Ticonderoga (CG-47) class ships and the conversion of the final Virginia (CGN-38) class armored box launchers.

[52] Thirty-three Adams and Farragut destroyers were denuclearized by the ASROC and Terrier retirements (nine of these ships have been retired as well). An additional 15 Spruance class destroyers have temporarily lost their nuclear capability until they receive Tomahawk VLSs.

[53] TASS, "Aircraft Take Off From New Soviet Tbilisi Carrier," Moscow, 22 November 1989.

[54] "Tbilisi to carry only 10 aircraft?" *Jane's Defence Weekly*, 15 July 1989.

[55] RADM Thomas A. Brooks, 14 March 1990, p. 28.

[56] Two Sovremenyy class DDGs were launched in 1989 and construction continues on a number of others; RADM Thomas A. Brooks, 14 March 1990, p. 28; Brian C. Cranshow, "From Sovremenny (sic) to Gremyashchy: The Sovremenny (sic) Class Destroyers," *Jane's Soviet Intelligence Review*, September 1989, pp. 414-422. Construction of two Udaloys continues, the second of which could represent a design follow-on; RADM Thomas A. Brooks, 14 March 1990, p. 28.

[57] RADM Thomas A. Brooks, 14 March 1990, p. 18.

[58] Barbara Starr, "Soviet building new cruiser," *Jane's Defence Weekly*, 15 July 1989, p. 57; *SMP 1989*, p. 35.

[59] RADM Thomas A. Brooks, 14 March 1990, p. 28.

[60] Secretary of Defense Frank Carlucci, *Annual Report to Congress FY 1989*, p. 207.

[61] Bruce Powers, "Carrier Air Wings in Transition," *Naval Aviation News*, November-December 1989.

[62] DOD, "Cheney Cuts Major Pentagon Aircraft Buys," News Release No. 203-90, 26 April 1990.

[63] HAC, FY 1990 DOD, Part 6, p. 434.

[64] Glenn W. Goodman, Jr., "Cheney Cuts Production Plans for Six New Aircraft by $35 Billion," *Armed Force Journal International*, June 1990, p. 16.

[65] Ian Kemp, "UK Forces Face 18% Reduction," *Jane's Defence Weekly*, 4 August 1990, pp. 152-153.

[66] Alexandra Schwartzbrod, "Ebbing Eastern Threat Gnaws at France's `Independent Defense' Stance," *Armed Forces Journal International*, June 1990, p. 30; "Confidence and Perseverance," an interview with the French Defense Minster, Jean-Pierre Chevenement," *Military Technology*, May 1990, pp. 32-33; Eric Grove, "European Navies Contributing to Stability," *Naval Forces*, No. II, Vol., XI, 1990, p. 33; David Fouquet, "East's Peace Offensive Taking Toll in France," *Armed Forces Journal International*, February 1990, p. 36; "France Details $29.6 Billion FY90 Defence Budget," *Jane's Defence Weekly*, 28 October 1989, p. 895; Jacques Isnard, "Runaway Costs of French Defence Effort," *Jane's Defence Weekly*, 14 October 1989, pp. 754-755.

[67] The Soviet Union has leased two of its Charlie class SSGNs to India. Indian naval personnel also have been reported as undergoing nuclear-powered submarine training in the Soviet Union since 1984; *Jane's Defence Weekly*, "Indian SSN Departs Vladivostock Submarine Base," 23 January 1988, p. 116. In addition to the Indian government, the Japanese, Canadian, Brazilian and Argentinean governments have expressed an interest in building or acquiring SSNs; *Jane's Defence Weekly*, "India and Brazil Take First Steps in Acquiring SSNs," 19 December 1987, p. 1399; Paul Beaver and Cpt. Richard Sharpe, "New Members for SSN Club," *Jane's Defence Weekly*, 9 January 1988, p. 11; William M. Arkin, *Neptune Papers No. 1: The Nuclear Arms Race At Sea*, October 1987, p. 16.

[68] The FY 1991 budget calls for the retirement of two nuclear-powered cruisers: the USS Truxtun (CGN-35), to be decommissioned in FY 1992, and the USS Bainbridge (CGN-25), to be decommissioned in FY 1994. This is the first time the U.S. Navy will retire nuclear-powered surface warships.

[69] Includes Ice-breakers, naval research vessels, and nuclear-powered submarines in non-weapons status. Does not include 28 additional reactors on submarines awaiting disposal.

[70] A "33rd" submarine is in commission in mid-1990, the USS Pennsylvania (SSBN-735), and will be loaded with new Trident II D-5 missiles and become operational in late 1990.

[71] "Nuclear Notebook: U.S. Nuclear Weapons Stockpile (June 1990)," *Bulletin of the Atomic Scientists*, June 1990, p. 48. Six hundred and nineteen operational missiles were procured, together with some 5,220 nuclear warheads; Thomas B. Cochran et al., *Nuclear Weapons Databook: Volume II, U.S. Nuclear Warhead Production*, (Cambridge: Ballinger 1987), p. 11.

[72] Circular error of probability (also sometimes referred to as "circular error probable") is a measure of the accuracy of a weapon system. It is the radius of a circle around a target of such size that a weapon aimed at the center of the target has a 50% probability of falling within the circle.

[73] The last of 474 missiles was delivered to the U.S. Navy in 1986; *Armed Force Journal International*, July 1986, p. 30.

[74] "Nuclear Notebook: U.S. Nuclear Weapons Stockpile (June 1990)," *Bulletin of the Atomic Scientists*, June 1990, p. 48.

[75] Thomas B. Cochran, et. al., *Nuclear Weapons Databook: Volume I, U.S. Nuclear Forces and Capabilities* (Cambridge: Ballinger Publishing Co. 1984), pp. 142-143.

[76] U.S. Navy, *News Release*, 29 March 1990.

Problems with the missile were encountered during the submerged launch portion of the test program, delaying the planned operational debut of the missile from December 1989 to March 1990. The first of nine underwater test launches of the missile (from the USS Tennessee) on 21 March 1989 ended in a spectacular failure when the missile pinwheeled and exploded just above the surface of the water. This resulted in delays in the testing program, and the operational deployment of the missile was deferred to March 1990. The second test in early August seemingly was successful, but in the third test in mid-August the missile again malfunctioned and was destroyed. This prompted the U.S. Congress to restrict Trident II procurement funding until the Navy had three successful test launches. Navy analyses showed that a larger than expected "water jet" followed the missile out of the sea and damaged the steering and nozzle mechanisms at the bottom of the missile as the first stage was igniting. With modifications incorporated to protect and strengthen the missile's steering and nozzle mechanisms, testing resumed in on 4 December 1989. The six test launches conducted between December 1989 and February 1990 were declared successful, paving the way for deployment of the missile in March 1990.

[77] "Nuclear Notebook: U.S. Nuclear Weapons Stockpile (June 1990)," *Bulletin of the Atomic Scientists*, June 1990, p. 48.

[78] Though each missile can carry only one type of warhead, theoretically each submarine could carry a mixture of missiles with different warheads. Unofficial U.S. Navy comments suggest, however, that the missiles will not be mixed aboard submarines. The majority of Trident submarines based in the Atlantic, moreover, will carry only missiles with the heavier W88 warhead, while the majority of the submarines in the Pacific will carry only missiles with the lighter W76 warhead.

[79] VADM D. L. Cooper, ACNO (Undersea Warfare), statement before the HASC, 7 March 1990; HAC, FY 1986 EWDA, Part 7, p. 414.

In the face of the changes in East-West relations, an additional use for the missile has been voiced. In January 1990, VADM Roger F. Bacon, Commander of Submarine Force, U.S. Atlantic Fleet, stated that as well as serving as a strategic deterrent, Tridents can be "a defense against terrorism, drug trading and other global conflicts;" as quoted in "Kings Bay Elevated to Full Navy Base Status," *Times-Union* (Jacksonville, Florida), 20 January 1990.

[80] Admiral Carlisle Trost, CNO, report to Congress on *Posture and Fiscal Year 1991 Budget of the United States Navy*, appendix, p. 8.

[81] VADM D. L. Cooper, ACNO (Undersea Warfare), "The Trident Submarine Program," statement before the SASC, 9 May 1990, p. 6.

[82] VADM D. L. Cooper, ACNO (Undersea Warfare), "The Trident Submarine Program," statement before the SASC, 9 May 1990, pp. 6-7; Beth Frerking, "Military Pushing Flats Restart, Lawmakers Say," *The Denver Post*, 22 March 1990; Thomas W. Lippman and R. Jeffrey Smith, "Energy Dept. Faces Hill, Environmental Hurdles to Reopening Nuclear Plants," *Washington Post*, 24 March 1990.

[83] Dr. Lawrence Woodruff, *Statement on Nuclear Force Modernization*, before HASC, March 10, 1987, p. 14.

[84] DOD Press Conference on the resumed testing of the Trident II missile, 18 January 1990; See also Admiral Carlisle Trost, CNO, report to Congress on *Posture and Fiscal Year 1991 Budget of the United States Navy*, appendix, p. 8.

[85] DOD Press Conference on the resumed testing of the Trident II missile, 18 January 1990.

[86] DOD, "Selected Acquisition Reports (SARs)," 31 December 1989, p. 11.

[87] Robert S. Norris, "Counterforce at Sea," *Arms Control Today*, September 1985, pp. 5-10.

[88] U.S. Congress, General Accounting Office, *Navy Strategic Forces: Trident II Proceeding Toward Deployment* (NSIAD-89-40), November 1988, p. 31; HAC, FY 1990 DOD, Part 6, p. 544.

[89] The Hotel III submarine was not SALT accountable, but the six launchers on the submarine were SALT accountable. A single Golf III class submarine with SS-N-8 missiles was retired during 1988-1989.

[90] The single Golf V class test submarine with a SS-N-20 missile was retired during 1988-1989; DIA, *Unclassified Naval Order of Battle - Soviet Union and Communist Eastern Europe* (DDB-1200-124-89) (hereafter *UNOOB*), June 1989, p. 2.

[91] *SMP 1988* (p. 48) stated that the Soviets "may begin at-sea flight testing of a modified version of the SS-N-20 missile sometime this year." According to the DOD, *1989 Joint Military Net Assessment* (p. 3-2) the Soviet Navy is "expected to continue to deploy" the SS-N-20 and SS-N-20 Follow-on; *SMP 1989* (p. 47) states that "a modified version of the Typhoon's SS-N-20 missile may begin testing soon."

[92] HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 9.

[93] Statement of RADM William O. Studeman, Director of Naval Intelligence, before the HASC, 1 March 1988, p. 33.

[94] *SMP 1989*, p. 44.

[95] *Jane's Fighting Ships 1990-91*, p. 581, states that the SS-N-23 missile "has probably been retrofitted in some of this class" already.

[96] *SMP 1988*, p. 40.

[97] DOD, *1989 Joint Military Net Assessment* (p. 3-2) mentions the Soviets' plan to deploy a new SLBM, along with the SS-N-20, SS-N-20 Follow-on and the SS-N-23. But *SMP 1989* (p. 47) makes no mention of the new SLBM.

[98] These two reentry vehicles, referred to as multiple reentry vehicles (MRVs), are not independently targetable.

[99] It is now thought Britain produced only enough warheads for three SSBNs with 48 missiles (British SSBNs carry 16 missiles each). Thus the number of strategic SLBM warheads has been revised downward from 128 to 96; Robert S. Norris, Thomas B. Cochran, Richard W. Fieldhouse, Andrew S. Burrows, William M. Arkin, "Nuclear Weapons," Chapter 1 in Stockholm International Peace Research Institute (SIPRI), *1990 Yearbook: World Armaments and Disarmaments* (Oxford University Press, 1990), p. 20 (hereafter referred to *SIPRI Yearbook*).

[100] Mark Daly, "Chevaline Refurbishment to Begin This Month," *Jane's Defence Weekly*, 16 January 1988, p. 54.

[101] Facilities at Coulport, Scotland, are being expanded for the new submarines but not the missiles; David Fairhall, "British Nuclear Subs to Carry 'Rented' U.S. Missiles," *The Guardian*, (U.K.), 22 October 1987.

Some development and production expenditures for the warheads, however, will be in the United States; "U.K. National Audit Office, *Ministry of Defence and Property Service Agency: Control and Management of the Trident Program*, HMSO, London, 14 July 1987, p. 18; *SIPRI 1988 Yearbook*, p. 48.

[102] U.K. officials claim that despite staff and construction pr reported in 1989 at Britain's nuclear production facility, A Weapons Establishment Aldermaston, the Trident progra schedule and within budget; Tony Robinson, "RN Trident 'S Schedule'," *Jane's Defence Weekly*, 31 March 1990, p. 582; Trident Faces Delay," *Jane's Defence Weekly*, 20 May 1989, p. Production problems and delays have been affecting the T warhead production schedule since at least 1987; *SIPRI 198 book*, p. 47.

[103] U.K. Ministry of Defence, *British Defence Policy 1990-91*, Apri p. 10; *SIPRI 1990 Yearbook*, p. 38.

[104] *SIPRI 1988 Yearbook*, p. 47. This is in keeping with offici Ministry of Defence statements and the START limits which U.S. Trident missiles.

[105] *SIPRI 1990 Yearbook*, pp. 20 and 41-42. French ballistic m submarines carry 16 missiles each.

[106] *SIPRI 1990 Yearbook*, pp. 20 and 41-42. L'Inflexible was als posed to received the TN-71 warhead if budgets and dockyard s permitted. The constraints on the French defence budget may preclude this upgrade.

The then commander of France's ballistic submarine force, VA Michel Merveilleux de Vignaux, revealed in 1988 that the M MIRVed warhead strikes can be concentrated on a single targe distributed over several targets over an area of 20,000 square kil ters; Jacques Isnard, "France Claims SSBN Advantage," *Ja Defence Weekly*, 1 October 1988, p. 746.

[107] *SIPRI 1990 Yearbook*, pp. 20 and 41-42.

The TN-71 is said to compare with the better U.S. ballistic miss in terms of survival and penetration capability, (CEA, *Rapport An 1985*, pp. 77-79) whereas the older TN-70 is comparable in term the weight/yield ratio; CEA, 'Informations non classifiées l'armement nucléaire Francais', 26 June 1986 and, CEA, 'Regard l'avenir du CEA', *Notes d'Information*, January-February 1986, p

[108] "Tonnant Recommissioned After M4 Missile Fit," *Jane's Defe Weekly*, 28 November 1987, p. 1257.

[109] "French Looking at Land-Based M-4," *Jane's Defence Weekly* October 1988, p. 1050; *SIPRI 1990 Yearbook*, p. 42.

[110] *SIPRI 1990 Yearbook*, pp. 42-43; "French cut ASMP Mirages to 4 *Jane's Defence Weekly*, 17 June 1989, p. 1209; "France Opens N Shipyard for Next-Generation SSBNs," *Jane's Defence Weekly* November 1987, p. 1024.

[111] 'CSS-N' stands for Chinese surface-to-surface, naval missile.

[112] Estimates on its maximum range vary because the missile has ne been fired at full range. Though the range of the missile technica makes it an intermediate range missile, it serves a "strategic" functi

[113] The missile can also be fired from a single testing and training G class diesel-powered ballistic missile submarine (SSB); Richa Fieldhouse, "Chinese Nuclear Weapons: an Overview," Chapter 5 *SIPRI 1986 Yearbook*, p. 109.

[114] Prior land and surface launches of the missile as part of the test a development program may have occurred.

[115] *SIPRI 1990 Yearbook*, pp. 22 and 34-35.

[116] BGM-109A-1 is the surface ship launched nuclear variant, wh BGM-109A-2 is the submarine launched nuclear variant.

[117] "Nuclear Notebook: U.S. Nuclear Weapons Stockpile (June 1990 *Bulletin of the Atomic Scientists*, June 1990, p. 48.

[118] The U.S. SLCM comes in three basic versions: a conventiona armed anti-ship (TASM); a conventionally-armed land-attack (TLA C); and the nuclear-armed land-attack (TLAM/N). The TASM h passive and active radar search for target guidance to attack surfa ships. The TLAM/C can have a high-explosive warhead or su munitions dispenser (the latter is also known as the TALM/D) wh the TASM has a high-explosive warhead. The TASM's range is 25 nautical miles and the TLAM/C's range is 600+ nautical miles; U.S Navy, Office of Information, *Navy Fact File, 9th Ed.*, (NAVSO P 3002), October 1989, p. V-2.

[119] This is 400 fewer production missiles than was planned prior to F 1990; Information provided by U.S. Navy Cruise Missile Office, 2 May 1990. Also see: DOD, *Selected Acquisition Reports*, 31 D cember 1989, p. 11.

[120] **Armored box launchers** contain four Tomahawks each and are used to fire Tomahawks from the battleships, nuclear-powered cruisers, and seven Spruance (DD-963) class destroyers.

Vertical launch systems (VLS) are modular units containing rectangular arrangements of 64 cells (8x8), 61 of which are for missiles and three of which are taken up by a support crane. The top is fitted flush with the deck of surface ships, with the rest of the VLS and its missiles extending vertically into ship. In addition to the standard 64 cell VLS, a "half-size" VLS of 32 cells (29 for missiles) will be deployed on the Arleigh Burke (DDG-51) class destroyers under construction. The Navy is outfitting 24 Spruance class destroyers, 22 Ticonderoga class cruisers (hull numbers 52 and after), and all Burke class destroyers with VLS. They can also fire non-nuclear Standard SM-2 surface-to-air missiles and vertical launch ASROCs.

Los Angeles class submarines, hull numbers 719 and later, have a 12-cell vertical launch system (known as the Mk 45 **capsule launch system**) installed forward of the pressure hull. Tomahawks are carried in a canister which then can be loaded directly into the launching system. The Tomahawk/canister combination are known as "all-up-rounds" (AURs).

Surface ships with ABLs or VLSs have a special weapons control system which is necessary for the command and control of the TLAM/N. Certification of this system aboard a surface ship is a costly and rigorous process, since "the system is nuclear capable, which requires Independent Software Nuclear Safety Analyses," to validate the computer software associated with the weapons control system; HAC, FY 1990 DOD, Part 6, pp. 575-576.

[121] HASC, FY 1985 DOD, Part 2, p. 363.

[122] U.S. Navy, Cruise Missile Project Office, "Tomahawk Missile Procurement Objective," 8 May 1990. At this rate, if 758 nuclear Tomahawks are procured, they will be able to be deployed by the mid-1990s. Cruise missiles are delivered to the Navy approximately 18 months after they are purchased.

[123] David Bond, "Navy Mulls Nuclear Tomahawk Needs, Seeks to Extend Production Program," *Aviation Week and Space Technology*, 4 June 1990, p. 25.

[124] According to one report, as of February 1990, 442 nuclear Tomahawks was to be the final total; Richard Fieldhouse, "Cruise Missile Compromise Surfacing," *Bulletin of the Atomic Scientists*, June 1990, pp. 21-24. A later story reported the Navy planned to buy a final 238 TLAM/Ns in FY 1992. The new total for nuclear Tomahawks was to be 680; David Bond, "Navy Mulls Nuclear Tomahawk Needs, Seeks to Extend Production Program," *Aviation Week and Space Technology*, 4 June 1990, p. 25. Also see: "Navy Plan to Reduce Tomahawk Buy Reflects Realization of Future Force Cuts," *Inside the Navy*, 21 May 1990, p. 6.

Although the latter reports also note there is an effort within the Navy to extend Tomahawk production beyond FY 1992 and restore the overall cut of 400 missiles to the total Tomahawk inventory objective. This would leave open the possibility of additional nuclear Tomahawk procurement after FY 1992.

The inventory objective of 758 nuclear Tomahawks was finalized in the early 1980s [Navy memo, "Point Paper: TLAM/N Inventory Objectives (S/FRD)," 11 September 1980; partially released under the FOIA by the Navy on 27 February 1988]. In response to classified Congressional questions submitted in the mid-1980s about how the 758 nuclear Tomahawk number was arrived at the Navy responded, "This number is currently deemed to be sufficient. Changing threat levels over time or changes in the target base will cause a reevaluation of TLAM/N requirements;" [partially declassified Navy response released on date cited above].

Limits on long-range nuclear SLCMs has been contentious issue in the ongoing START talks, with the Soviet Union generally seeking to constrain the numbers of U.S. SLCMs. But ironically, in May 1990 at the foreign ministers meeting in Moscow, the Soviet Union agreed to allow the United States to have 880 nuclear SLCMs, 122 more than the United States planned to produce. The original Soviet May proposal was to limit nuclear SLCMs to 760 on each side. This was crafted to take into account the U.S. SLCM program. But the U.S. negotiators, anticipating a lower Soviet offer, had suggested a limit of 1,000 on each side. The negotiators then agreed to split the difference between 760 and 1,000.

[125] U.S. Navy, Cruise Missile Project Office, "Numbers of SLCM Certified Ships," 8 May 1990 and 12 June 1990; HAC, FY 1987 DOD, Part 4, p. 132.

Along with increasing worldwide deployments, Tomahawk missiles are also increasingly finding their way into U.S. unified command and NATO nuclear war plans. In early 1985, U.S. General Bernard Rogers, Supreme Allied Commander Europe (SACEUR), told the U.S. Congress that, "presently there are no TLAM/N committed to SACEUR," but that, "various options are being studied for the employment of TLAM/N;" HASC, FY 1986 DOD, Part 3, p. 1452. But by Spring 1989, Admiral Carlisle Trost, CNO, told Congress in secret testimony that "Recently the NATO Ministers of Defense have approved a Memorandum of Agreement (MOA) that implements the planning process for TLAM/N in support of the alliance;" SASC, FY 1990/1991 DOD, Part 1, p. 225. This testimony was made public in 1990. In response to the resulting controversy, Trost further clarified that the agreement "was executed to implement a planning process by which TLAM/N might complement NATO's land-based nuclear deterrence." He underscored however that TLAM/Ns have not been directly assigned to NATO, though of course they could be used in the European theater; Admiral Carlisle A. H. Trost, "NATO Won't Control U.S. Nuclear Missiles," letter to the *Washington Times*, 26 June 1990.

[126] HASC, FY 1985 DOD, Part 2, p. 361.

[127] This total included: four Iowa (BB-61) class battleships; one Long Beach (CGN-9) and four Virginia (CGN-38) class nuclear-powered cruisers; 22 Ticonderoga (CG-47) class cruisers (hulls CG-52 and later); 31 Spruance (DD-963) class destroyers; 29 Arleigh Burke (DDG-51) class destroyers; and 68 Los Angeles (SSN-688) and 39 Sturgeon (SSN-637) class nuclear-powered submarines; HAC, FY 1987 DOD, Part 4, p. 164; U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev. E)*, September 1985, p. 3-19; partially released under the FOIA. The 39 Sturgeon submarine total includes the two single-ship class Narwhal and Lipscomb class SSNs. This total did not include the Seawolf (SSN-21) class submarines that are scheduled to begin to enter the fleet in 1995.

[128] This consists of 91 surface ships (including all four battleships) and approximately 100 nuclear-powered attack submarines; U.S. Navy, Cruise Missile Project Office, "Total Planned/Current Tomahawk Capable Platforms," 10 May 1990.

[129] This is calculated based upon the following: an average of two nuclear-armed SLCMs per nuclear-capable surface ship except for the larger Kiev and Kirov classes, which are assumed to be armed with four nuclear missiles; and an average of four nuclear-armed SLCMs per nuclear-capable cruise missile submarine, except for the Oscar I and II classes, which are armed with 12. Nuclear attack submarines which carry the SS-N-21 are assumed to carry four nuclear missiles, except for the single Yankee Notch, which is thought to carry 20 missiles.

The number of nuclear-armed SLCMs at sea may be higher or lower depending on operational missions. This estimate for all Soviet SLCM capable ships and submarines is to determine the approximate total size of the Soviet stockpile. Since the SLCMs are large and all of the ships and submarines fire them from special launchers, it is assumed that there are no operational reloads.

[130] *SMP 1989*, p. 34.

[131] RADM Thomas A. Brooks, 14 March 1990, p. 33.

[132] HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 10.

[133] RADM Thomas A. Brooks, 14 March 1990, p. 25.

[134] *SMP 1989* (p. 34) reports that an annual average of 200 long-range SLCMs were produced in 1986-1988. But although *SMP 1989* gives impressive production statistics for the missile, it generally downplays the missile's deployment (p. 47 and p. 76).

[135] RADM Thomas A. Brooks, 14 March 1990, p. 32.

[136] Since the SS-N-22 is only deployed on smaller vessels, patrol combatants, and destroyers, there is a possibility that it is not primarily a nuclear-capable missile.

[137] RADM Thomas A. Brooks, 22 February 1989, p. 11.

[138] *SMP 1989*, p. 47. In 1988, the missile was "expected to be operational in the next few years;" *SMP 1988*, p. 53. Banning of two ground-launched missiles under development in the INF Treaty, the subsonic SSC-X-4 and the supersonic SSC-X-5, undoubtedly affected the cost of their air- and sea-launched counterparts, the AS-X-19 and the SS-NX-24. It is interesting to note that since the Soviet Union did not include any SSC-X-5 missiles or support equipment in the INF Treaty data exchange for verification, most likely no prototypes of the missile had yet been produced as of November 1987.

[139] RADM Thomas A. Brooks, 14 March 1990, p. 25.

[140] In August 1988 the Navy approved the accelerated retirement of the ASROC rocket thrown depth charge aboard surface ships; see two memos signed by Admiral Carlisle Trost, CNO: "Memorandum for the Chairman, Joint Chiefs of Staff, Subject: ASROC Rocket Thrown Depth Charge (RTDC) (U)," (S/FRD), Ser 00/8S500371, 16 August 1988, and "Memorandum for the Secretary of the Navy, Subject: ASROC Rocket Thrown Depth Charge (RTDC) (U)," (S/FRD), Ser 00/8S500370, 16 August 1988; both partially released under the FOIA on 10 March 1989. Conventional ASROCs are still retained aboard U.S. surface ships, and a new conventional vertical launch ASROC (VLA) is being procured for use in VLS equipped ships.

A similar decision in regards to the SUBROC anti-submarine rocket carried by attack submarines was made in December 1988; see memo signed by VADM C. R. Larson, DCNO (Plans, Policy and Operations), "Memorandum for the CNO, Subject: SUBROC (U)," (S/FRD), Ser 653E/8S620317, 18 December 1988; partially released under the FOIA on 15 May 1989. The Navy had planned to at least replace the SUBROC with at least a conventional version of the Sea Lance anti-submarine standoff weapon. But due to development problems and costs the Sea Lance development program was cancelled by the Department of Defense in its FY 1991 budget request.

The W44 warhead for the ASROC finished retirement in September 1989 and the completion of retirement of the W55 warhead for the SUBROC is scheduled for September 1990; U.S. Department of Energy correspondence to Greenpeace, 30 November 1989.

[141] HAC, FY 1991 EWDA, Part 6, p. 800. But some 300 conventionally armed vertical launch ASROCs will be procured.

[142] HAC, FY 1991 EWDA, Part 6, p. 799.

[143] HAC, FY 1987 DOD, Part 5, p. 561.

[144] "Nuclear Notebook: U.S. Nuclear Weapons Stockpile (June 1990)," *Bulletin of the Atomic Scientists*, June 1990, p. 48.

[145] U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev. E)*, September 1985, p. 3-8; partially released under the FOIA.

[146] HAC, FY 1990 EWDA, Part 6, p. 673. In early July 1990 the Senate Armed Service Committee deleted all the FY 1991 funds ($13.7 million) requested by Department of Energy for the weapon. The SASC justified halting the B90's development for three reasons: the Navy is de-emphasizing nuclear anti-submarine warfare; other nuclear strike bombs in the Navy's inventory make the B90 redundant and; the weapon's cost. See: SASC, National Defense Authorization Act for FY 1991, Report 101-384, 10 July 1990, pp. 308-309.

[147] HAC, FY 1989 EWDA, Part 6, pp. 978-979. See also: HAC, FY 1987 DOD, Part 5, pp. 560-61; HAC, FY 1990 EWDA, Part 6, p. 673.

[148] SASC, FY 1988/1989 DOD, Part 4, p. 2456.

[149] JCS, *United States Military Posture FY 1989*, p. 54. The first nuclear weapons deployed by the Soviet Navy was a nuclear torpedo, which armed diesel attack submarines beginning in 1957-1958.

[150] This estimate is based upon an average of one nuclear torpedo per ship and submarine capable of carrying 21-inch torpedoes. The number of nuclear torpedoes actually loaded in the platforms that are at sea at any time could be higher.

[151] U.S. Central Intelligence Agency, Intelligence Report, "Soviet Submarine Accidents (DOI: 1971-1973)", n.d., p. 2; partially released under the FOIA.

[152] Frank J. Prial, "Sweden to Release Soviet Sub: Finds Signs of Nuc Arms," *New York Times*, 6 November 1981, p. 1; Leonard Dow Jr., "Soviet Sub `probably' Has A-Arms, Sweden Says," *Washing Post*, 6 November 1981, p. 1.

[153] Some reports credit the SS-N-14 Silex anti-submarine and anti- missile (once called the SS-N-10) with a nuclear depth cha payload. The weapon, however, is not believed to be nuclear-arm

[154] The Soviets reportedly benefitted by copying the design of SUBROC; DOD, *Soviet Acquisition of Militarily Significant We Technology: An Overview*, September 1985, p. 31.

[155] *SMP 1987*, p. 43.

[156] *SIPRI 1990 Yearbook*, p. 20. These are believed to be a lower y variants (5-10 kilotons) of the Royal Air Force's (RAF) WE-17 B nuclear gravity bombs.

[157] U.K. Ministry of Defence, *British Defence Policy 1990-91*, April 19 p. 11. U.K. Nimrod aircraft would deliver U.S. nuclear depth bom not British ones.

The W-177C also can be used as a free-fall bomb by varying casing and fuzing options. It may also have a variable yield; *SIPRI 19 Yearbook*, p. 20; Mark Urban, "Navy Wants to Replace Nucle Bomb," *The Independent* (U.K.), 23 June 1989; "Staff Short Threaten To Delay U.K. Nuclear Bomb Replacement," *Jane's D fence Weekly*, 27 May 1989, p. 985.

[158] Replacing the WE-177Cs reportedly is slightly less pressing as the are relatively new weapons. The WE-177s were manufactured b tween 1967 and 1982, and the naval C variants were made towards t end of this period; Mark Urban "Navy Wants to Replace Nucle Depth Bomb," *Independent* (U.K.), 23 June 1989.

[159] Some Parliamentary criticism has been directed at the need for a ne nuclear depth bomb. The Commons all-party Defence Commit noted in a 1989 report that improved conventional weapons ma obviate the need for nuclear depth charges. In addition, according the MPs, the use of nuclear depth bombs, aside from crossing t nuclear threshold, would also damage friendly sensors and impe operations; David Farnhall, "MPs Doubt Navy's Need for Nucle Depth Charge," *Guardian* (U.K.), 23 June 1989; Mark Urban, "Na Wants to Replace Nuclear Bomb," *The Independent* (U.K.), 23 Ju 1989.

The government has also admitted nuclear depth bombs may b unnecessary. Permanent Under Secretary of State for Defence, S Michael Quinlan, noted to Parliament that the development of 'smar homing torpedoes might eliminate the need for nuclear depth bomb "Staff Shortages Threaten To Delay U.K. Nuclear Bomb Replac ment," *Jane's Defence Weekly*, 27 May 1989, p. 985.

In addition, the same problems with the nuclear warhead produ tion facilities at Aldermaston that may affect the U.K. Trident warhead program could perhaps delay a replacement for the WE-17 *Jane's Defence Weekly*, 27 May 1989; Mark Fletcher, "Lack of Staf May Delay New Bomb," *London Times*, 23 June 1989.

[160] The decision to accelerate the Terrier's retirement was finalized i January 1988; see memo signed by VADM H. C. Mustin, DCN (Plans, Policy and Operations): "Memorandum for the Chief of Naval Operations, Subject: Nuclear Terrier (BTN) (U)," (S/FRD), Se 653E/8S620011, 19 January 1988. The W45 warhead for the Terr finished retirement in September 1988; U.S. Department of Energ correspondence with Greenpeace, 30 November 1989.

[161] According to U.S. Naval Intelligence, "a wide variety of naval weapons ... have nuclear capability, including ... certain anti-aircra weapons;" SASC, FY 1984 DOD, Part 6, pp. 2971-2972.

The 35 nautical mile (65 kilometer) range SA-N-6 Grumble, wa previously thought to be nuclear capable. The missile is a derivativ of the land-based SA-10 surface-to-air missile. It is deployed on on ship of the Kara class, and newer Kirov and Slava class cruisers. Mos western reference books credit the Slava with the ability to carry nuclear armed SA-N-6 Grumble surface-to-air missile. Soviet offi cials, however, have denied that the SA-N-6 missiles carry a nuclea warhead.

The SA-N-2 Guideline and the SA-N-7 Gadfly could be nuclear capable.

[162] This missile is credited with being nuclear-capable, even though it is derived from the non-nuclear land-based SA-6 Gainful.

[163] U.S. Navy, *Navy Nuclear Weapons (U) NWP 28-1*, (S) March 1983 p. 1-1; partially released under the FOIA.

[164] "Nuclear Notebook: U.S. Nuclear Weapons Stockpile (June 1990)," *Bulletin of the Atomic Scientists*, June 1990, p. 48.

[165] U.S. Navy, *Navy Nuclear Weapons (U) NWP 28-1*, (S) March 1983 pp. 1-1 and 1-5; partially released under the FOIA.

[166] "Nuclear Notebook: U.S. Nuclear Weapons Stockpile (June 1990)," *Bulletin of the Atomic Scientists*, June 1990, p. 48.

[167] U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev. E)*, September 1985, p. 3-19; partially released under the FOIA.

[168] U.S. Navy, *FY 1990/1991 Biennial RDT&E Descriptive Summary*, "Tactical Nuclear Weapons Development, Program Element," p. 400; partially released under the FOIA.

[169] "The total stockpile of WE-177 tactical nuclear bombs is estimated to be 180-200, of which 155-175 are A and B versions. All three weapons [A, B, and C versions] use the same basic `physics package,' and the yield is varied by using different amounts of tritium;" *SIPRI 1990 Yearbook*, p. 20.

[170] The Atomic Weapons Establishment Aldermaston is currently designing the warhead; Christy Campbell and Michael Prescott, "Bush Clears the Way for Anglo-French Missile," *The Sunday Correspondent*, (U.K.), 31 December 1989.

[171] "Staff Shortages Threaten To Delay U.K. Nuclear Bomb Replacement," *Jane's Defence Weekly*, 27 May 1989, p. 985; Nick Cook, "USA, UK Sign Nuclear Missile Deal," *Jane's Defence Weekly*, 24 June 1989, p. 1285; Douglas Barrie, "UK/France Revive Nuclear Dialogue," *Jane's Defence Weekly*, 23 September 1989, p. 541; Nick Cook and Jacques Isnard, "U.K. Stand-off Missile Choice Delay," *Jane's Defence Weekly*, 4 November 1989, p. 949; Christy Campbell and Michael Prescott, "Bush Clears the Way for Anglo-French Missile," *The Sunday Correspondent*, (U.K.), 31 December 1989; "Bomb Replacement," *Aviation Week and Space Technology*, 29 January 1990, p. 13; Nick Cook, "SRAM T `Natural' Choice for U.K.," *Jane's Defence Weekly*, 3 February 1990, p. 185; "Aerospatiale Wins Nuclear Study," *Naval Forces*, Vol. XI, No. II 1990, p. 117; *SIPRI 1990 Yearbook*, pp. 38-40.

The Nimrod patrol aircraft has also been mentioned as a possible platform; see *Jane's Defence Weekly*, 4 November 1989.

[172] *SIPRI 1990 Yearbook*, p. 21.

[173] After finishing operational testing in 1988, it became operational in the French fleet on the Super Etendards embarked on the aircraft carrier Foch (R99).

[174] The missile has three main flight profiles: high-altitude, high-speed (Mach 3); low-altitude, lower-speed (Mach 2); and low-altitude, sea-skimming trajectory. The range of the missiles varies with the type of flight. The first profile allows a maximum range of some 130 nautical miles; the second gives a range of about 40 nautical miles; and the third for attacks on ships yields a range of about 30 nautical miles; Ezio Bonsignore, "A New Element in France's Nuclear Deterrent: the ASMP Cruise Missile," *NATO's Sixteen Nations*, August 1987, p. 64.

[175] *SIPRI 1990 Yearbook*, pp. 21 and 45; *SIPRI 1989 Yearbook*, pp. 19 and 33. The Foch (R99) had been specially converted to handle and store the ASMP, returning to sea in June 1988 after undergoing a year-and-a-half overhaul. The other French carrier, the Clemenceau (R98), will not be so modified, but will remain equipped to handle AN-52s. The new nuclear-powered carrier, the Charles de Gaulle (R91), is scheduled to carry the ASMP when it enters the fleet in the late 1990s.

[176] In 1987, ships being built or authorized were to allow the Navy to achieve its Reagan-era goal of a 600-ship fleet by 1989; Admiral Carlisle Trost, CNO, report to Congress on *Posture and Fiscal Year 1988-1989 Budget of the United States Navy*, p. 31. Starting in 1988, fiscal constraints lead to earlier than planned ship retirements. But the 600-ship goal was not abandoned, just deferred to the early 1990s; Secretary of Defense Frank Carlucci, *Annual Report to Congress FY 1989*, p. 191. In 1989, it became increasingly apparent the goal of a 600 ship would never be reached. In fact by spring 1990, Department of Defense five year planning documents showed the fleet would shrink to 488 ships by the end of FY 1997; Michael Gordon, "Military Services Propose Slashes in Existing Forces," *The New York Times*, 12 May 1990.

[177] In 1988, some 70 percent of the U.S. fleet was nuclear-capable, including about 75 percent of the major combatants and almost 60 percent of the amphibious and support ships. The percentage of nuclear-capable ships declined due to the retirement of the nuclear ASROC, Terrier and SUBROC weapons.

[178] An additional 102 amphibious (64) and support ships (38) have nuclear-weapons transport and support roles.

[179] Operational control of ballistic missile submarines is an exception. They remain controlled by the fleet (Atlantic or Pacific) Commanders.

Administratively, ships are assigned to "type" organizations (i.e., surface, submarine, or naval air in the case of aircraft carriers), and then into subordinate groups and squadrons. The administrative organization permits the U.S. Navy more easily to service and supply like ships.

[180] Howard Kurtz, "Homeport's Fate Awash In Politics," *Washington Post*, 1 June 1990.

[181] Special procedures are followed when nuclear weapons are supplied to ships for loading from these storage facilities. The weapons are kept under armed guard and in the custody of a delivery courier. The weapons are delivered directly to the ships for loading at the naval weapons stations, naval air stations, or naval station piers, or are transported via lighter or helicopters to ships at explosive loading anchorages. When the weapons arrive, a dockside crane or floating crane, or in some instances the ship's booms are used to lift the weapons from the delivery vehicle to place them on the transfer deck; U.S. Navy, *Loading and Underway Replenishment of Nuclear Weapons (U) NWP 14-1 (Rev. D)*, July 1986, p. 2-1; released under the FOIA.

[182] DNA, "Annual Historical Report, Field Command, Defense Nuclear Agency, 1 October 1986 - 30 September 1987," p. 49; released under the FOIA.

[183] DNA, "Annual Historical Report, Field Command, Defense Nuclear Agency, 1 October 1985 - 30 September 1986," p. 57; released under the FOIA.

[184] DNA, "Annual Historical Report, Field Command, Defense Nuclear Agency, 1 October 1986 - 30 September 1987," p. 146; DNA, "Annual Historical Summary, Field Command, Defense Nuclear Agency, 1 October 1979 - 30 September 1980," p. 38; both released under the FOIA. released under the FOIA.

[185] HAC, FY 1988 Milcon, Part 2, p. 297; DNA, "Annual Historical Report, Field Command, Defense Nuclear Agency, 1 October 1985 - 30 September 1986," p. 57; released under the FOIA.

[186] HAC, FY 1987 Milcon, Part 2, p. 322; HAC, FY 1988 Milcon, Part 2, p. 287.

[187] DNA, "Annual Historical Report, Field Command, Defense Nuclear Agency, 1 October 1986 - 30 September 1987," p. 146; Naval Air Station Barbers Point, "Organization Manual," NASBARPTINST 5451.2L, 7 May 1990, p. 17-1; Commanding Officer, NAS Barbers Point, "Command History 1989," undated; all released under the FOIA. In addition to being nuclear-certified itself, NAS Barbers Point also supports nuclear certifications for the P-3 Orion squadrons based there.

[188] RADM Stephen Hostettler, Director Joint Cruise Missile Project Office, "Tomahawk Weapon System," Statement before the HAC, 11 March 1986, p. 9; HAC, FY 1991 Milcon, Part 2, p. 391; DNA, "Annual Historical Report, Field Command, Defense Nuclear Agency, 1 October 1986 - 30 September 1987," p. 146; released under the FOIA.

[189] In addition to being nuclear-certified itself, NAS Brunswick also supports nuclear certifications for the P-3 Orion squadrons based there; Commanding Officer, NAS Brunswick, "Command History 1986," 6 March 1987, pp. 29-30; released under the FOIA.

[190] HAC, FY 1987 Milcon, Part 2, p. 815; HAC, FY 1988 Milcon, Part 2, p. 512.

[191] By the end of 1984, NWS Yorktown's loadout station was able to provide "full support of Tomahawk capable submarines;" HASC, FY 1985 DOD, Part 2, p. 511.

[192] HAC, FY 1989 Milcon, Part 2, p. 664; HAC, FY 1991 Milcon, Part 2, p. 286.

[193] DNA, "Annual Historical Report, Field Command, Defense Nuclear Agency, 1 October 1985 - 30 September 1986," p. 53; released under the FOIA.

[194] DNA, "Annual Historical Report, Field Command, Defense Nuclear Agency, 1 October 1985 - 30 September 1986," p. 54; released under the FOIA.

[195] Commanding Officer, NAS Sigonella, "Command History 1988," 23 January 1990, Encl. 1, p. 9; Commanding Officer, NAS Sigonella, "Checklist of Effective Instructions," NASSIG Notice 5215, 2 April 1990; Commanding Officer, NAS Sigonella, "NAS Sigonella Organization Manual (Interim)," NASSIG Instruction 5400.3E, 19 May 1988, p. 41; all released under the FOIA.

[196] Under the control of U.S. Commander Eastern Atlantic.

[197] Machrihanish, United Kingdom, is a contingency nuclear weapons storage point to support U.S. and Dutch P-3 Orions, and possibly U.K. Nimrod operations. It is in inactive status; U.S. Navy, *Standard Navy Distribution List, Part 2 and Catalog of Naval Shore Activities*, ed. 71, OPNAV PO9B2-105(86), 1 September 1986, p. 201. Although it is seemingly is kept well prepared to perform its wartime missions, no nuclear weapons are thought to be stored there during peacetime.

[198] HASC, FY 1986 DOD, Part 2, p. 511.

[199] Requirements for support include waterfront facilities, storage magazines, security facilities, and facilities for intermediate maintenance.

[200] HAC, FY 1989 DOD, Part 6, p. 160; U.S. Navy, Cruise Missile Project Office, "Support Ships and Shore Stations, End of 1989, Capable of SLCM Support," 8 May 1990.

[201] Numbers of ships based on U.S. Navy, *U.S. Naval Ship Battle Forces 30 April 1990*, 1 May 1990.

[202] Since 1988, five older Poseidon boats have retired and two new Trident submarines have joined the fleet, shrinking the SSBN force from 36 to 33 submarines.

Not all these submarines are operational. Several are undergoing overhauls, repairs, and sea trials at any given time. From 1967 to 1980, the United States operated 41 SSBNs. The number then began to decline, as the older classes were retired faster than the new Ohio-class SSBNs entered the fleet.

[203] This is a decrease from the 1988 totals of 640 missiles and 5,632 warheads.

[204] Dr. J. D. Crouch, PDASD (ISP), "The Trident Submarine Program," statement before the SASC, 9 May 1990, p. 5; VADM D. L. Cooper, ACNO (Undersea Warfare), "The Trident Submarine Program," statement before the SASC, 9 May 1990, p. 4.

[205] Like any other naval ship, the name and hull number of the first ship in a class of ships identifies a submarine. Thus Poseidon submarines can be referred to as one of three classes: Lafayette (SSBN-619) class (3 of 9 submarines still in service), James Madison (SSBN-627) class (with 8 of 10 submarines still in service), and Benjamin Franklin (SSBN-640) class (with all 12 submarines still in service). Trident submarines also are known as Ohio (SSBN-726) class submarines after the first ship in their class.

[206] Dr. J. D. Crouch, PDASD (ISP), "The Trident Submarine Program," statement before the SASC, 9 May 1990, p. 5. No Poseidon submarines are scheduled to be retired in the FY 1991 budget.

[207] HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, pp. 264 and 302; HASC, FY 1984 DOD, Part 4, p. 227.

[208] Dr. J. D. Crouch, PDASD (ISP), "The Trident Submarine Program," statement before the SASC, 9 May 1990, p. 5; VADM D. L. Cooper, ACNO (Undersea Warfare), "The Trident Submarine Program," statement before the SASC, 9 May 1990, p. 6.

[209] VADM D. L. Cooper, ACNO (Undersea Warfare), "The Trident Submarine Program," statement before the SASC, 9 May 1990, p. 4. According to Cooper, the Soviets have agreed in principal to exempt some submarines in overhaul from accountability in START.

This potential 24 submarine force has not yet been endorsed by the Department of Defense, which seemingly favors an 18-boat operational Trident force with two to three additional submarines overhaul; Secretary of Defense Dick Cheney's testimony before HASC on 26 April 1990.

[210] Dr. J. D. Crouch, PDASD (ISP), "The Trident Submarine Program statement before the SASC, 9 May 1990, p. 5.

[211] HAC, FY 1990 DOD, Part 6, p. 545.

[212] SASC, FY 1986 DOD, Part 7, p. 3840. Trident submarines spend days on patrol, with a 25 day refit period before returning to VADM Bruce DeMars, *Seapower*, August 1987, p. 21.

[213] VADM D. L. Cooper, ACNO (Undersea Warfare), "Status of Submarine Force," statement before the HASC, 7 March 1990, p. 13. USS George Washington has been retired.

[214] Robert Holzer, "Navy's 100-sub Fleet Unrealistic, Admiral Says *Defense News*, 12 March 1990; Eric Rosenberg, "Navy Attack Stockpile To Take a Dive," *Defense Week*, 12 March 1990, p. 6.

[215] With deployment of the Tomahawk land-attack cruise missile, attack submarines can for the first time accurately attack shore targets from long ranges.

[216] Eight older submarines and two converted Polaris submarines are nuclear-capable. Most of these older submarines are scheduled for retirement in the pending FY 1991 budget, with the rest expected to follow soon after.

[217] These submarines could also carry up to eight internal Tomahawk HASC, FY 1987 DOD, Procurement of Aircraft, Missiles, p. 97. Both conventional and nuclear land attack cruise missiles can be fired from the VLS; VADM D. L. Cooper, ACNO (Undersea Warfare), "Status of Submarine Force," statement before the HASC, 7 March 1990, p. 18.

[218] HASC, FY 1990 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 285.

[219] Sturgeon submarines had been slated for modernization to extend their useful life to the year 2000; HASC, FY 1987 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 110. Two are now scheduled for decommissioning in FY 1991. According to VADM D. L. Cooper, ACNO (Undersea Warfare), in the final stages of formulating the FY 1991 budget, the Navy decided to retire all 7 of the Sturgeon class submarines rather than overhaul them. The Navy, however, may "buy back" these submarines if funds permit. Robert Holzer, "Navy's 100-Sub Fleet Unrealistic, Admiral Says *Defense News*, 12 March 1990.

[220] One submarine, the USS Memphis (SSN-691), was designated an interim research and development submarine in April 1988. It retains full combat capability, but is used for experimental trials; HASC, FY 1990 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 321.

[221] The USS San Juan (SSN-751) is the first improved or "SSN-688" class submarine; HASC, FY 1990 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 313.

[222] HASC, FY 1987 DOD, Seapower and Strategic and Critical Materials Subcommittee, pp. 80-82; Admiral Carlisle Trost, *FY 1988-89 Posture Statement*, p. 91.

[223] Admiral Carlisle Trost, CNO, report to Congress on *Posture and Fiscal Year 1991 Budget of the United States Navy*, appendix p. 7.

[224] HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 49; "Construction of New Class of Submarines to Begin Next Fall, *Navy Times*, 23 January 1989.

[225] DOD, *Program Acquisition Costs by Weapon System for FY 1991*, 23 January 1990, p. 87; VADM D. L. Cooper, ACNO (Undersea Warfare), "Status of Submarine Force," statement before the HASC, 7 March 1990, pp. 21-23; VADM John W. Nyquist, ACNO (Surface Warfare), "Statement to the HAC on the FY 1991 Shipbuilding and Conversion, Navy Budget Request," 25 April 1990, p. 5.

[226] HAC, FY 1986 DOD, Part 2, pp. 919 and 926. The acoustic speed, or tactical speed, is the maximum speed a submarine can transit and search while keeping its own noise low and its ability to receive acoustic signals high. Reportedly, Navy officials have credited the Seawolf with a acoustic speed of 25 knots; "Seawolf's Maximum Silent Speed Revealed as 25 Knots," *Navy News and Undersea Technology*, 9 April 1990.

[227] HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 758; HASC, FY 1987 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 280.

[228] HAC, FY 1989 EWDA, Part 6, p. 1332.

[229] HASC, FY 1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 308.

[230] Admiral Bruce DeMars, Director Naval Nuclear Propulsion, "Statement before HASC," 7 March 1990, p. 7.

[231] During 1989, reactor plant components and main coolant pumps underwent testing for the first time. HASC, FY 1990 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 357; Admiral Bruce DeMars, Director Naval Nuclear Propulsion, "Statement before HASC," 7 March 1990, pp. 8-9; Matthew Wald, "Prototype of Submarine Reactor Prepared for Tests," *The New York Times*, 26 April 1990.

[232] HASC, FY 1984 DOD, Part 4, p. 222.

[233] HASC, FY 1984 DOD, Part 4, p. 227.

[234] A "13th" carrier, the USS Kitty Hawk (CV-63), will finish a two-and-a-half year extensive overhaul and modernization period (called a service life extension program (SLEP)) at the Philadelphia Naval Shipyard in February 1991. When the USS Kitty Hawk reenters the fleet in 1991, the deployable aircraft force will increase to 13 ships, unless the USS Midway (CV-41) is retired in the same period.

A "14th" carrier, the USS Constellation (CV-64), entered Philadelphia Naval Shipyard in April 1990 to prepare to replace the USS Kitty Hawk and commence its own SLEP.

Three other carriers had been programmed for SLEP in future years — USS Ranger (CV-61), USS America (CV-66), USS John F. Kennedy (CV-67) — but fiscal constraints may change this schedule.

A "15th" carrier, the USS Enterprise (CVN-65) is scheduled to start a $1.9 billion, two-year extensive overhaul and refueling period in 1991. It left its homeport of Alameda, California, in September 1989 and docked at Norfolk, Virginia, in March 1990. It is scheduled to move to Newport News, Virginia, for the overhaul in November 1990; Ted Bush, "Enterprise Ready for Overhaul," *Navy Times*, 9 April 1990. The Enterprise has eight reactors and was last refueled in 1970; Admiral Bruce DeMars, Director Naval Nuclear Propulsion, "Statement before the HASC," 7 March 1990, p. 12.

[235] "Navy Told to Retire Saratoga and Ranger Aircraft Carriers by FY-94," *Inside the Navy*, 11 December 1989; "Navy Spending Plan Calls for Fewer Carriers, Kill SLEPs," *Navy News and Undersea Technology*, 30 April 1990, pp. 1-2; Michael Gordon, "Military Services Propose Slashes in Existing Forces," *The New York Times*, 12 May 1990.

[236] HASC, FY 1990 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 179.

[237] Bruce Powers, "Carrier Air Wings in Transition," *Naval Aviation News*, November-December 1989, p. 8.

[238] Two versions of the A-6 — the A-6Es and the KA-6Ds — are nuclear-capable, but only the A-6E would be expected to be outfitted to deliver nuclear bombs.

[239] Major Charles E. Angersbach, Jr., USMC, "Marine Detachments: It's Time to Strip Away the Buttons," *Marine Corps Gazette*, February 1990, pp. 15-16; 1st Lieutenant Peter D. Cairney, USMC, "Soldiering at Sea," *Marine Corps Gazette*, February 1990, pp. 16-18.

[240] The number of nuclear weapons aboard aircraft carriers may decrease, however, with the deployment of the B90 depth/strike bomb. The DOD has stated that an aircraft carrier would reduce its complement of separate tactical strike and depth bombs with numerous different yields with a smaller number of dual-use B90s with selectable yields; SASC, FY 1988/1989 DOD, Part 4, p. 2456.

[241] The three carriers in extended overhauls — the USS Enterprise, USS Constellation, and USS Kitty Hawk— are also ported in the Atlantic. (The USS Enterprise, however, remains administratively assigned to the Pacific Fleet.) In addition, the USS Abraham Lincoln, currently in Norfolk, Virginia, is scheduled to shift its homeport to Alameda, California, in the Fall of 1990; Ted Bush, "Enterprise Ready for Overhaul," *Navy Times*, 9 April 1990; "First Repeater," *Seapower*, June 1990, p. 48. There have been rumors, however, of the USS Abraham Lincoln moving to Bremerton, Washington; Ed Offley, "Northwest Has Navy's Attention," *Seattle Post-Intelligencer*, 10 April 1989.

[242] HASC, FY 1984 DOD, Part 4, p. 222.

[243] SASC, FY 1985 DOD, Part 8, p. 3857.

[244] Originally commissioned at the end of World War II, the four ships were deactivated by the end of the 1950s (although the USS New Jersey was reactivated briefly for use in the Vietnam War). The Reagan Administration started a battleship reactivation program as a relatively quick, inexpensive way to add ships and firepower to the fleet. The Navy argued that the cost to reactivate the ships, about $320 million each, equaled the cost of a new frigate; Navy memorandum to correspondents, 24 July 1981.

[245] Other major conventional weapons on battleships include Harpoon anti-ship missiles for attacks on ships and targets ashore and their trademark 16-inch guns.

[246] Vincent P. Grimes, "The U.S.S. Wisconsin: Back on Line," *National Defense*, March 1989, p. 49.

[247] This is an increase of seven cruisers since 1988.

[248] The nine nuclear-powered cruisers (designated CGNs) have two nuclear reactors apiece.

[249] The retirement of ASROCs and Terriers means 27 cruisers — all 22 cruisers of the Leahy (CG-16), Belknap (CG-26), Bainbridge (CGN-25), Truxtun (CGN-35), California (CGN-36) classes, and the first five Ticonderoga class ships — are no longer nuclear-armed. The nine remaining ships plus the seven new nuclear-capable Ticonderoga class cruisers which have joined the fleet in the past two years means 16 ships are currently nuclear-capable.

[250] HASC, FY 1984 DOD, Part 2, p. 361. The VLS can also fire non-nuclear vertical launch ASROCs (VLA) and Standard anti-air warfare missiles.

The first five Ticonderoga class ships have twin-launcher rails for firing missiles rather than the VLSs.

[251] HASC, FY 1987 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 170.

As of June 1990, all the ships have been authorized, and 16 are in commission (including the first-five non-nuclear ships). The 27th and last ship, the Port Royal (CG-73), is scheduled to be completed in 1994. The last five ships were authorized in FY 1988; Gerald Cann, Assistant Secretary of the Navy (Research, Development and Acquisition), "Statement on Shipbuilding and Overhauls" before the HAC Subcommittee on Defense, 25 April 1990, p. 5.

[252] This is nine fewer ships than were in the force in 1988; see *Neptune 2*. These ships are divided among four classes: eight Farragut (DDG-37), 16 Charles F. Adams (DDG-2), 31 Spruance (DD-963) and four Kidd (DDG-993) class ships. Farragut and Adams class destroyers are being retired.

[253] The retirement of ASROCs and Terriers means 48 destroyers — all 33 destroyers of the Charles F. Adams and Farragut classes, and 15 of the unconverted Spruance class ships — are no longer nuclear-armed.

[254] HASC, FY 1985 DOD, Part 2, p. 361.

[255] The lead ship was to be delivered in October 1989, but production problems delayed the delivery date; H. Lawrence Garrett III, Secretary of the Navy, "Statement on the DDG-51 Arleigh Burke Class Aegis Destroyer," before the HASC, March 1990, p. 15.

[256] Martin M. Ferber, Director National Security and International Affairs Division, U.S. General Accounting Office, "Testimony on Navy Shipbuilding: Cost and Schedule Problems on the DDG-51 Aegis Destroyer Program," (GAO-T-NSIAD-90-14), 24 January 1990, p. 2.

[257] Norman Friedman, "The Arleigh Burke," *International Defense Review*, 3/1985, p. 328.

[258] HASC, FY 1985 DOD, Part 2, p. 361.

[259] U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev. D)*, November 1980, p. 4-9; partially released under the FOIA.

Another U.S. Navy instruction regarding the standards for loading nuclear weapons in amphibious ships adds that, "Transportation of nuclear weapons is authorized in amphibious type ships, generally as a `transhipment' capability," because most spaces "with few excep-

tions, have not been specifically designed for nuclear weapon or ammunition storage."

In particular this instruction notes, "Fleet Commanders in Chief may authorize transportation of nuclear weapons in commissioned amphibious ships," and moreover, "shall specify the numbers and types of weapons to be placed in such ships for any given exercise, operation or deployment."

Even so this publication allows that, "In emergency situations ships which are not currently nuclear weapons qualified may be used to transport nuclear weapons." Finally it cautions, "Nuclear weapons shall not normally be retained on board amphibious ships beyond the time actually required for exercise, operation, or deployment. Specifically, amphibious ships shall not be utilized as contingency storage facilities for nuclear weapons;" U.S. Navy, "Loading of Nuclear Weapons in Amphibious Shipping; Standards for (U)," OPNAV Instruction C8110.19, September 19, 1969, pp. 1-2; partially released under the FOIA. (Though the instruction was originally issued in 1969, it remains current as of 1989.)

[260] The Wasp (LHD-1) class ships are the newest amphibious assault ships. The first ship of the class, the USS Wasp, was commissioned in July 1989. Three more ships are authorized and the fifth ship is being requested in the FY 1991 budget. Additional ships are planned to replace the LPHs which are scheduled to be retired in the mid-1990s.

[261] A new class of LSDs, the Whidbey Island (LSD-41) class, is under construction. Five ships are in commission and three more are funded. A cargo variant of the Whidbey Island class LSD(CV) with increased cargo capacity, is also scheduled to be procured starting with the ninth ship; Gerald Cann, Assistant Secretary of the Navy (Research, Development and Acquisition), "Statement on Shipbuilding and Overhauls" before the HAC Subcommittee on Defense, 25 April 1990, p. 6.

[262] Commander, Amphibious Group Eastern Pacific, "Movement and Storage of Nuclear Weapons During Amphibious Operations (U)," COMPHIBGRUEASTPAC Instruction 3401.1, 24 June 1980, pp. 5-6; released under the FOIA.

[263] Two retired fleet oilers (AO) of the Ashtabula class, the USS Caloosahatchee (AO-98) and Canisteo (AO-99), were able to carry ammunition as well as petroleum products, and could transport nuclear weapons if needed; U.S. Navy, *Loading and Underway Replenishment of Nuclear Weapons (U) NWP 14-1 (Rev. D)*, July 1986, p. 4-2; released under the FOIA. These two ships have been retired, but five Cimarron class (AO-177) ships are scheduled to be modified to be able to carry ammunition, thus raising the possibility of a nuclear weapons mission at some future date. The first ship to be converted, the USS Merrimack (AO-179), is scheduled to be delivered in December 1990; HASC, FY 1990 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 185.

[264] U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev. D)*, November 1980, p. 4-8; partially released under the FOIA.

[265] Forward deployed strategic missile submarine tenders once were stationed in Guam and Rota, Spain, to support SSBN squadrons armed with Polaris and Poseidon missiles. When these missiles were replaced with Poseidon and Trident I missiles, the squadrons moved back to the United States with their strategic submarine tenders.

[266] U.S. Navy, Cruise Missile Project Office, "Support Ships and Shore Stations, End of 1989, Capable of SLCM Support," 8 May 1990.

[267] U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev. D)*, November 1980, p. 4-8; partially released under the FOIA.

[268] U.S. Navy, *Loading and Underway Replenishment of Nuclear Weapons (U) NWP 14-1 (Rev. D)*, July 1986, p. 2-29; released under the FOIA.

[269] VADM John W. Nyquist, ACNO (Surface Warfare), "Statement to the HAC on the FY 1991 Shipbuilding and Conversion, Navy Budget Request," 25 April 1990, p. 8.

[270] The CH-46 is the primary helicopter carried and used for VERTREP by logistic ships. It can carry nuclear weapons internally or externally. Helicopters can be also be used for ship-to-shore or shore-to-ship transport; U.S. Navy, *Loading and Underway Replenishm... Nuclear Weapons (U) NWP 14-1 (Rev. D)*, July 1986, pp. 3-1 ... 1; released under the FOIA.

[271] U.S. Navy, *Loading and Underway Replenishment of Nuclear W... ons (U) NWP 14-1 (Rev. D)*, July 1986, p. 4-4; released under FOIA.

[272] U.S. Navy, *Loading and Underway Replenishment of Nu... Weapons (U) NWP 14-1 (Rev. D)*, July 1986, p. 3-2; released ... the FOIA.

[273] U.S. Navy, *Loading and Underway Replenishment of Nu... Weapons (U) NWP 14-1 (Rev. D)*, July 1986, p. 3-1; released ... the FOIA.

[274] The need for this TAK service will disappear in the late 1990s w... the U.S. Navy achieves an all-Trident missile force based ... United States; SASC, FY 1985 DOD, Part 8, p. 4267.

[275] Number, location and status of planes and squadrons as of June 19... based on U.S. Navy, Office of the Comptroller, *Flying Hour Prog...* FY 1990 and FY 1991; U.S. Navy, *Standard Naval Distribution ... Part 1*, (OPNAV PO9B2-107 (89)), 1 July 1989; U.S. Navy, ... *lowances and Location of Naval Aircraft* (U), OPNAV Notice C3... 31 March 1988 (released under the FOIA); Judith A. Walters ... Gwendolyn Rich, "The Year in Review 1989," *Naval Aviation N...* July-August 1990, pp. 8-17; and authors' estimates.

[276] U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev...* September 1985, p. 3-19; partially released under the FOIA. Some ... 6E squadrons are also assigned four KA-6D aerial refueler tan... aircraft. KA-6Ds are being removed from the new Transitional ... Roosevelt airwings with the inflight refueling mission being ta... over by A-6Es and S-3Bs with "buddy store" tanks.

[277] U.S. Army War College, "Forces Capabilities Handbook, Vol ... Weapons Systems," 1 August 1986, p. 3-32; released under the FO...

[278] Secretary of Defense Frank Carlucci, *Annual Report to Congress ... 1989*, p. 209.

[279] U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev...* September 1985, p. 3-19; partially released under the FOIA.

[280] U.S. Army War College, "Forces Capabilities Handbook, Vol ... Weapons Systems," 1 August 1986, p. 3-31; released under the FO...

[281] The fighter and attack versions are identical except for interchan... able external equipment. Conversion from one mode to the other ta... less than one hour.

[282] U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev...* September 1985, p. 3-19; partially released under the FOIA.

[283] U.S. Army War College, "Forces Capabilities Handbook, Vol ... Weapons Systems," 1 August 1986, p. 3-30; released under the FO...

[284] Edward Walsh, "'Augmentation' Hornet Enters Corps Inventor... *Sea Power*, June 1990, p. 25; HAC, FY 1990 DOD, Part 6, p. 42...

[285] HAC, FY 1990 DOD, Part 6, p. 433.

[286] Surface surveillance and mining are secondary missions.

[287] U.S. Army War College, "Forces Capabilities Handbook, Vol ... Weapons Systems," 1 August 1986, p. 3-36; released under the FO... U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev...* September 1985, p. 3-8; partially released under the FOIA.

[288] HASC, FY 1987 DOD, Procurement of Aircraft, Missiles, p. 1056 ... total of approximately 180 planes are in the inventory, some 135 ... which are operational as S-3A/Bs. Moreover, the S-3 is be... considered for conversion to a new carrier based electronic reconna... sance plane, ES-3, to replace the EA-3B Skywarrior.

[289] VADM Richard M. Dunleavy, ACNO (Air Warfare), "Statem... before the SASC," 2 May 1990, p. 14.

[290] "Navy Planners Will Seriously Consider Re-Starting the S-3 Line ... FY-92," *Inside the Navy*, 25 September 1989, p. 12; "Navy FY-... Budget Plans Envision 25% Cut in S-3 Squadron Force Per Carrier ... *Inside the Navy*, 21 May 1990, p. 4.

[291] There are several non-nuclear versions of the Sea King: SH-3Gs, UH... 3As, HH-3As, VH-3A/Ds, which are used for utility and transpo... search and rescue, and executive transportation purposes. The Na... operates two more ASW helicopters from ships, both of which a... are *not* nuclear-capable. These are the SH-2F Sea Sprite LAMPS M...

I and the SH-60B Seahawk LAMPS Mk III helicopters (LAMPS stands for light-airborne-multi-purpose-system, which actually consists of the sensor, communication, processing systems on the host ship, as well as the helicopter itself). These helicopters can operate from some cruisers, destroyers and frigates. The Sea Sprite can carry torpedoes and the Seahawk can carry torpedoes and depth bombs.

[292] U.S. Army War College, "Forces Capabilities Handbook, Vol II: Weapons Systems," 1 August 1986, p. 3-37; released under the FOIA.

[293] David Steigman, "SH-60F Antisub Helo Joins Fleet," *Navy Times*, 16 April 1990.

[294] VADM Richard M. Dunleavy, ACNO (Air Warfare), "Statement before the SASC," 2 May 1990, p. 8. Commissioning of a fourteenth active carrier air wing (CVW-10) took place in 1987, but due to fiscal constraints, it was deactivated in FY 1989; Secretary of Defense Frank Carlucci, *Annual Report to Congress FY 1989*, p. 207.

[295] Bruce Powers, "Carrier Air Wings in Transition," *Naval Aviation News*, November-December 1989, pp. 7-9.

[296] Some A-6E squadrons also contain four KA-6D tankers. As noted, both are nuclear-capable, but only the A-6E has delivery of conventional or nuclear weapons as its primary mission; U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev. D)*, November 1980, p. 4-9; partially released under the FOIA.

[297] There are also three fleet "readiness" training squadrons whose aircraft could be rotated into active squadrons during wartime.

[298] HAC, FY 1990 DOD, Part 6, p. 433. In addition, there are two reserve and a fleet readiness squadrons.

[299] HAC, FY 1990 DOD, Part 6, p. 433.

[300] HAC, FY 1990 DOD, Part 6, p. 435.

[301] Ed Offley, "Navy Switch Could Cut Whidbey Role," *Seattle-Post Intelligencer*, 3 May 1990.

[302] DOD, "Cheney Cuts Major Pentagon Aircraft Buys," DOD News Release, No. 203-90, 26 April 1990.

[303] HAC, FY 1990 DOD, Part 6, p. 434.

[304] HAC, FY 1990 DOD, Part 6, p. 431.

[305] Estimated from "Revised President's Bush APN Budget Submission Apr. 28, 1989;" HAC, FY 1990 DOD, Part 6, p. 404.

[306] Adam Goodman, "Navy Has Big Plans for Its New A-12," *St. Louis Post-Dispatch*, 29 April 1990.

[307] Glenn W. Goodman, Jr., "Cheney Cuts Production Plans for Six New Aircraft by $35 Billion," *Armed Force Journal International*, June 1990, p. 16.

[308] P-3As became operational in 1961 and P-3Cs in 1969. There are non-nuclear-capable P-3 variants — EP-3A/B/Es, RP-3A/Ds, TP-3As and VP-3s — used for electronic reconnaissance, research and testing, training, and staff transport. Some P-3 A/Bs also are assigned to research, testing and development commands and are not part of ASW nuclear-capable squadrons.

[309] HAC, FY 1987 DOD, Part 4, p. 9.

[310] HAC, FY 1990 DOD, Part 6, p. 12. All of the approximately 25 remaining operational P-3As are to be retired by FY 1991.

[311] "P-3 Production Winds Down with Acturus," *Naval Aviation News*, November-December 1989, p. 5.

[312] The P-7 was to be able to carry larger payloads than the P-3 and have a radius of operation of 1,600 nautical miles (3,000 kilometers).Secretary of Defense Frank Carlucci, *Annual Report to Congress FY 1989*, p. 197.

[313] Rob Holzer, "Design, Delay Problems Plague Antisub Plane," *Navy Times*, 26 February 1990; Eric Rosenberg, "Two-Year Slip for Lockheed's P-7A," *Defense Week*, 23 April 1990, p. 5.

[314] The A-4 was also a U.S. Navy plane, but the last Navy squadron was disbanded in 1975.

[315] U.S. Navy, *Nuclear Warfare Operations (U) NWP 28 (Rev. E)*, September 1985, p. 3-19; partially released under the FOIA. U.S. Army War College, "Forces Capabilities Handbook, Vol II: Weapons Systems," 1 August 1986, p. 4-3; released under the FOIA.

[316] Lt. Gen. C. H. Pitman (USMC), "Aviation Posture Statement," *Marine Corps Gazette*, May 1990, p. 56.

[317] U.S. Navy, Navy Aviation Supply Office, "1981 Command History," p. 30; released under the FOIA.

[318] NWEF, "Command History for Calendar Year 1982," undated (U), Encl. 1, pp. 2 ff; released under the FOIA.

NP-3Cs with nuclear missions replaced Dutch nuclear capable NSP-2H NEPTUNE aircraft — A non-U.S. (NATO) Nuclear Weapons Operational Review was conducted on the Dutch NSP-2H for "continued assurance" with the B57 nuclear depth bomb in 1976; NWEF, "Command History for Calendar Year 1976," 15 August 1977 (U), Encl. 1, p. 6; released under the FOIA.

[319] NWEF, "Command History for Calendar Year 1983," undated (U), Encl. 1, p. 4; released under the FOIA.

[320] NWEF, "Command History for Calendar Year 1984," undated (U), Encl. 1, pp. 2 ff; JCS, *Register of JCS Papers for Calendar Year 1984*; both released under the FOIA.

[321] NWEF, "Command History for Calendar Year 1985," 28 February 1986 (U), Encl. 1, pp. 2 ff; released under the FOIA.

[322] NWEF, "Command History for Calendar Year 1986," 2 March 1987 (U), Encl. 1; NWEF, "Command History for Calendar Year 1987," 9 March 1988 (U), Encl. 1, pp. 11-12; released under the FOIA.

[323] John W. R. Taylor and Paul Jackson, "Gallery of West European Airpower," *Air Force Magazine*, October 1989, pp. 72-73; Jane's *All The World's Aircraft 1987-88*, pp. 77-78.

[324] A second squadron of nine aircraft is based at Cagliari/Elmes, Sardinia, and is not nuclear certified.

[325] Italian Trackers also were able to deliver U.S. nuclear depth bombs. For example, a non-U.S. (NATO) Nuclear Weapons Operational Review was conducted on the Italian IP-2F for "continued assurance" with the B57 nuclear depth bomb in 1976; NWEF, "Command History for Calendar Year 1976," 15 August 1977 (U), Encl. 1, p. 6; released under the FOIA.

[326] NWEF, "Command History for Calendar Year 1979," 18 March 1980 (U), Encl. 1, pp. 1 ff; released under the FOIA.

[327] NWEF, "Command History for Calendar Year 1981," undated (U), Encl. 1, p. 3; released under the FOIA.

[328] NWEF, "Command History for Calendar Year 1982," undated (U), Encl. 1, pp. 2 ff; released under the FOIA.

[329] NWEF, "Command History for Calendar Year 1983," undated (U), Encl. 1, p. 4; released under the FOIA.

[330] JCS, *Register of JCS Papers for Calendar Year 1984*; released under the FOIA.

[331] NWEF, "Command History for Calendar Year 1984," undated (U), Encl. 1, pp. 2 ff; released under the FOIA.

[332] NWEF, "Command History for Calendar Year 1985," 28 February 1986 (U), Encl. 1, pp. 2 ff; released under the FOIA.

[333] NWEF, "Command History for Calendar Year 1986," 2 March 1987 (U), Encl. 1; released under the FOIA.

[334] NWEF, "Command History for Calendar Year 1987," 9 March 1988 (U), Encl. 1, p. 13; released under the FOIA.

[335] DNA, "Annual Historical Report, Field Command, Defense Nuclear Agency, 1 October 1987 - 30 September 1988," p. 135; released under the FOIA.

[336] NWEF, "Command History for Calendar Year 1986," 2 March 1987 (U), Encl. 1; released under the FOIA.

[337] DIA, "Aircraft Handbook - Free World (U), Volume 2: Bombers, Transports, and Miscellaneous Support Aircraft (U)," DST-1300H-001-85-Vol 2-Chg 1, 2 October 1986, p. 108; partially released under the FOIA.

[338] U.K. Ministry of Defence, *British Defence Policy 1990-91*, April 1990, p. 11.

[339] John W. R. Taylor and Paul Jackson, "Gallery of West European Airpower," *Air Force Magazine*, October 1989, p. 73.

[340] "Nimrod Capabilities Enhanced," *Air International*, April 1983, p. 175.

[341] NWEF, "Command History for Calendar Year 1981," undated (U), Encl. 1, p. 3; released under the FOIA.

[342] NWEF, "Command History for Calendar Year 1982," undated (U), Encl. 1, pp. 3-4; NWEF, "Command History for Calendar Year 1983," undated (U), Encl. 1, pp. 4 and 13; both released under the FOIA.

[343] NWEF, "Command History for Calendar Year 1986," 2 March 1987 (U), Encl. 1; released under the FOIA.

[344] NWEF, "Command History for Calendar Year 1987," 9 March 1988 (U), Encl. 1, p. 13; released under the FOIA.

[345] Douglas Barrie "P-7 `Favorite' for RAF Need," *Jane's Defence Weekly*, 24 March 1990, p. 535.

[346] DIA, *UNOOB*, June 1989, p. 1.

[347] In 1987, the DOD estimated that, "Some 288 surface warships, 340 submarines, and about 30 other combatant ships carry at least one" nuclear weapons system; *SMP 1987*, p. 43

[348] JCS, *United States Military Posture FY 1989*, p. 54.

[349] An additional 47 support ships have nuclear-weapons or reactor related roles.

[350] DIA, *UNOOB*, June 1989, p. 16.

[351] DIA, *UNOOB*, June 1989, p. 13.

[352] DIA, *UNOOB*, June 1989, p. 14.

[353] The land-locked Caspian Flotilla is comprised of five principal surface combatants.

[354] DIA, *UNOOB*, June 1989, p. 15.

[355] HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 4.

[356] With one exception, all Soviet SSBN class names come from U.S.-NATO intelligence community letter designations. The letter designations, in turn, are usually replaced by words. For example, Golf for G, Hotel for H, November for N. The exception is the Typhoon class, whose designation is derived from "Tayfun", the Soviet's name for the boat.

[357] DIA, *UNOOB*, June 1989, p. 2. President Gorbachev promised in Helsinki, Finland in October 1989 that the submarines in the Baltic would be retired by the end of 1990; Bill Keller, "Gorbachev Plans to Destroy His A-Armed Subs in Baltic," *New York Times*, 27 October 1989.

[358] RADM Thomas A. Brooks, 14 March 1990, p. 35; Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990; Floyd D. Kennedy, Jr., "The Soviet Navy Under Gorbachev," *National Defense*, March 1990, p. 14.

[359] Of the remaining 22 submarines, a "13th" boat was converted to test platform for the SS-NX-24 SLCM, a "14th" was converted to a test platform for the SS-N-21 SLCM, a "15th" was converted to an attack submarine configuration, and a "16th" sank in 1986. Another 11 are operational with unknown non-strategic missions (and designated SSUNs), and seven more submarines are thought to be awaiting disposal.

[360] "Soviet `Yankees' resume US patrol," *Jane's Defence Weekly*, 30 July 1988, p. 154; Norman Black, "Soviet Nuclear Subs Resume Patrol Off U.S. East Coast," *Washington Post*, 8 August 1988, p. 13.

[361] U.S. Navy (Chief of Information), "Answer to Query by the *New York Times*," (n.d.) June 1988.

[362] *Jane's Fighting Ships 1990-91*, p. 581, states that the SS-N-23 "has probably been retrofitted in some of this class."

[363] RADM Thomas A. Brooks, 14 March 1990, p. 23.

[364] Statement of RADM William O. Studeman, Director of Naval Intelligence, before the HASC, 1 March 1988, p. 33.

[365] HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 9.

[366] *SMP 1987*, pp. 27, 34.

[367] "Soviet Sub Construction Seeks to Maintain 300-ship Force," *Navy News & Undersea Technology*, 25 September 1989.

[368] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990.

[369] RADM Thomas A. Brooks, 14 March 1990, p. 35.

[370] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990; Floyd D. Kennedy, Jr., "The Soviet Navy Under Gorbachev," *National Defense*, March 1990, p. 14.

[371] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990.

[372] Two Charlie class boats have been leased to India; "Nuclear Notebook," *Bulletin of the Atomic Scientists*, January-February 1990, p. 48.

[373] Modification results in a bulge on either side of the sail and a bulge at the forward ends of the missile tubes abreast of the sail.

[374] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990; RADM Thomas A. Brooks, 14 March 1990, p. 23.

[375] *SMP 1985*, p. 35.

[376] "Soviet Sub Construction Seeks to Maintain 300-ship Force," *Navy News & Undersea Technology*, 25 September 1989; Statement of Robert M. Gates, Chairman, National Intelligence Council, and Deputy Director for Intelligence, CIA, and Lawrence K. Gershin, National Intelligence Council, before a joint session of SASC and SAC, 26 June 1985, Chart II; HAC, FY 1986 DOD, Part 2, p. 908.

[377] The missile was first tested on a modified Victor III from the Northern Fleet and was fired from the submarine for the first time in 1987; HAC, FY 1986 DOD, Part 2, p. 914.

[378] RADM Thomas A. Brooks, 22 February 1989, p. 9. RADM Brooks further stated in the U.S. Naval Institute's *Proceedings* in November 1989 (p. 139) there were "apparently more nuclear submarines launched in 1989 than in any other year this decade."

[379] *SMP 1989*, p. 107.

[380] RADM Thomas A. Brooks, 22 February 1989. p. 10; Statement of RADM William O. Studeman, Director of Naval Intelligence, before the HASC, 1 March 1988, pp. 32 and 34; *SMP 1989*, p. 35.
In 1988, the Soviet Navy launched one Akula (the fourth), one Victor III (the 23rd), one Oscar II (the fourth Oscar and the first Oscar II), one Delta IV (the fifth), and four Kilo class submarines (three of which were for export). In 1987, the Soviet Navy launched one Victor III (the 22nd), one Akula (the third), one Oscar (the third), one Beluga experimental submarine, and four Kilo class submarines (three of which were also for export).

[381] RADM Thomas A. Brooks, 14 March 1990, p. 18; RADM Edward D. Sheafer, Jr., "An Intelligence Overview: The Threat Expands, Expands," *Wings of Gold*, Summer 1988, p. 18; *SMP 1988*, p. 38. Eleven of the 20 Kilo class submarines built through the middle of 1988 were in the Soviet fleet, the remainder had been exported to India, Poland, Romania, and Algeria.

[382] *SMP 1988*, p. 129.

[383] "Soviet SSK Reduction," *Jane's Defence Weekly*, 17 February 1990, p. 284. At least four Whiskey class submarines sank in the Baltic on the way to being scrapped in the West during 1988 and 1989; "`Whiskeys' at Esbjerg," *Jane's Defence Weekly*, 27 January 1990, p. 135.

[384] RADM Thomas A. Brooks, 14 March 1990, p. 19.

[385] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990.

[386] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990; Floyd D. Kennedy, Jr., "The Soviet Navy Under Gorbachev," *National Defense*, March 1990, p. 14.

[387] *SMP 1987*, p. 67; HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 10.

[388] The first boat was withdrawn and scrapped in 1988; "Open Letter From Former Komsomolets Crew Members," *JPRS Soviet Union Military Developments*, 13 April 1990, p. 62.

[389] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990.

[390] RADM Thomas A. Brooks, 22 February 1989. p. 10; Statement of RADM William O. Studeman, Director of Naval Intelligence, before the HASC, 1 March 1988, pp. 32 and 34; *SMP 1989*, p. 35.

[391] The Victor III is under construction at the Admiralty Shipyard in Leningrad; *Jane's Fighting Ships 1990-91*, p. 591. Through 1984, construction continued at Komsomolsk in the Pacific and at Admiralty Yard in Leningrad. After 1984, construction has only continued at Leningrad.

[392] *SMP 1988*, p. 85.

[393] DOD, *1989 Joint Military Net Assessment*, p. 3-5.

[394] *Jane's Fighting Ships 1990-91*, p. 593, says that three Yankee Notch class submarines are operational and five are in conversion. DIA, *UNOOB*, June 1989, says only one is operational.

[395] RADM Thomas A. Brooks, 14 March 1990, p. 23; "Soviet Sub Construction Seeks to Maintain 300-ship Force," *Navy News & Undersea Technology*, 25 September 1989.

[396] In 1987, the Soviet Navy launched the third Akula, and launched the fourth in 1988.

[397] Remarks by RADM Thomas A. Brooks, USN, to USNI ASW Seminar, 27 February 1990.

[398] "Soviet Sub Construction Seeks to Maintain 300-ship Force," *Navy News & Undersea Technology*, 25 September 1989.

[399] *SMP 1989*, Preface; *Jane's Fighting Ships 1990-91*, p. 589.

[400] "Akula SSN captured in Barents Sea," *Jane's Defence Weekly*, 7 October 1989.

[401] *SMP 1988*, Preface and p. 85.

[402] "Close-up on Baku's Defences," *Jane's Defence Weekly*, 21 January 1989.

[403] "Analysis of changes to the Baku," *Jane's Defence Weekly*, 6 August 1988, p. 225.

[404] The Soviets call these ships officially aircraft carrying cruisers.

[405] RADM Thomas A. Brooks, 14 March 1990, p. 27.

[406] RADM Thomas A. Brooks, 14 March 1990, p. 27.

[407] RADM Thomas A. Brooks, 14 March 1990, p. 27.

[408] TASS, "Aircraft Take Off From New Soviet Tbilisi Carrier," Moscow, 22 November 1989.

[409] Norman Polmar, "Longer Reach for Soviet Seapower," *Air Force Magazine*, June 1990, p. 48; *Jane's Fighting Ships 1990-91*, p. 598; "More details of new Soviet carrier," *Jane's Defence Weekly*, 17 June 1989; Guy de Bakker, "Tbilisi's punch," *International Defense Review*, 1/1990, p. 19.

[410] "Thunder on the Deck," *Wings of Gold*, Spring 1990, p. 59. See also "Sukhoi, Mikoyan Upgrade Carrier-Based Fighters," *Aviation Week & Space Technology*, 12 February 1990, p. 28. See photographs also in *Military Technology* (MILTECH), 2/90, p. 58, and *International Defense Review*, 1/1990, p. 19.

[411] RADM Thomas A. Brooks, 14 March 1990, p. 30.

[412] "Tbilisi to carry only 10 aircraft?" *Jane's Defence Weekly*, 15 July 1989.

[413] Floyd D. Kennedy, Jr., "The New Soviet Carrier: Offensive or Defensive?," *National Defense*, February 1990, p. 12.

[414] *SMP 1988*, Preface.

[415] RADM Thomas A. Brooks, 14 March 1990, p. 27.

[416] RADM Thomas A. Brooks, 14 March 1990, p. 31.

[417] Ten older Sverdlov class cruisers deployed from 1951 to 1955 were previously thought to have 12 nuclear-capable 152mm artillery guns, which are now assessed as being retired.

[418] RADM Thomas A. Brooks, 14 March 1990, p. 18.

[419] Barbara Starr, "Soviet Building New Cruiser," *Jane's Defence Weekly*, 15 July 1989, p. 57; *SMP 1989*, p. 35.

[420] RADM Thomas A. Brooks, 14 March 1990, p. 28.

[421] RADM Thomas A. Brooks, 14 March 1990, p. 28.

[422] The last Kanin class destroyers were reported decommissioned in 1988, and the last Skoryy class destroyers were decommissioned in 1990. One Mod Kashin DDG, three Kotlin DDG, and 10 Mod Kildin/Kotlin/Mod Kotlin/Skoryy class DDs were retired between 1986-1989.

[423] RADM Thomas A. Brooks, 14 March 1990, p. 28; Brian C. Cranshow, "From Sovremenny to Gremyashchy: The Sovremenny Class Destroyers," *Jane's Soviet Intelligence Review*, September 1989, pp. 414-422.

[424] RADM Thomas A. Brooks, 14 March 1990, p. 28.

[425] *SMP 1986*, p. 84.

[426] At any rate, the Riga frigate and Turya patrol combatant classes are being retired; RADM Thomas A. Brooks, 14 March 1990, p. 25.

[427] RADM Thomas A. Brooks, 14 March 1990, p. 28.

[428] RADM Thomas A. Brooks, 14 March 1990, p. 29; RADM Edward D. Sheafer, Jr., "An Intelligence Overview: The Threat Expands, Expands," *Wings of Gold*, Summer 1988, p. 18; *SMP 1988*, p. 134.

[429] RADM Thomas A. Brooks, 14 March 1990, pp. 17 and 29.

[430] An additional 14 ships are Special Liquids Tankers (AOS) capable of transporting radioactive waste and submarine-launched ballistic missile fuel, and four are repair ships (AR) that transport nuclear materials supporting nuclear reactors on ships and submarines.

[431] HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 13.

[432] RADM Thomas A. Brooks, 14 March 1990, p. 29. This activity in 1989 contrasts markedly with activity within SNA in 1988. That year, other than deployment of Backfire C bombers, "little SNA deployment activity occurred during the year. No new aircraft types were introduced..." *SMP 1989*, p. 77.

[433] *SMP 1988*, pp. 15, 79; see also Collins, pp. CRS-39, CRS-88.

[434] RADM Thomas A. Brooks, 22 February 1989, p. 15.

[435] RADM Thomas A. Brooks, 22 February 1989, p. 15.

[436] RADM Thomas A. Brooks, 14 March 1990, p. 31.

[437] G. Jacobs, "Soviet Pacific Fleet — Bases and Administration," *Jane's Soviet Intelligence Review*, February 1990, p. 71.

[438] Norman Polmar, *Guide to the Soviet Navy* (Annapolis, MD: Naval Institute Press, 1986), p. 420.

[439] *SMP 1987*, p. 88.

[440] HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 14.

[441] The Fencer E (Su-24) is a strike and reconnaissance version of the long-range Fencer fighter and was first introduced in the Baltic Fleet of SNA in 1986.

[442] G. Jacobs, "Soviet Pacific Fleet — Bases and Administration," *Jane's Soviet Intelligence Review*, February 1990, p. 71.

[443] "Soviet Air Regiment Heads for Murmansk Region," Budapest Domestic Service, 18 May 1990, FBIS, *Daily Report Soviet Union*, 22 May 1990, p. 33.

[444] Though this number may include some 10 Mig-23 Floggers; DIA, *UNOOB*, June 1989, p. 7.

[445] Piotr Butowski, "The Be-12 `Mail' — Beriev's Amphibian," *Jane's Soviet Intelligence Review*, February 1990, p. 60.

[446] RADM Thomas A. Brooks, 14 March 1990, p. 31.

[447] Norman Polmar, "Flying Boats Are Flying Again," *Proceedings*, September 1989, pp. 119-120.

[448] RADM Thomas A. Brooks, 14 March 1990, p. 31.

[449] The Ka-27PL Helix A, in service since 1982, has been replaced largely by the Ka-25BSh Hormone A; Piotr Butowski, "Kamov Shipborne Helicopters," *Jane's Soviet Intelligence Review*, May 1990, p. 200.

[450] "Current Naval Intelligence Issues by the Office of Naval Intelligence," March 1987, p. 8.

[451] RADM Edward D. Sheafer, Jr., "An Intelligence Overview: The Threat Expands, Expands," *Wings of Gold*, Summer 1988, p. 18.

[452] *SMP 1989*, p. 46; *SMP 1988*, pp. 51, 79.

[453] *SMP 1988*, pp. 51, 79.

[454] RADM Edward D. Sheafer, Jr., "An Intelligence Overview: The Threat Expands, Expands," *Wings of Gold*, Summer 1988, p. 18.

[455] The 84 major combatants include: four Polaris nuclear-powered ballistic missile submarines, 17 nuclear-powered attack submarines, 11 diesel-powered patrol submarines, and 52 surface warships. Recently announced plans call for reducing the submarine force to some 16 boats, and the destroyer/frigate force to about 40 ships in the mid-1990s; Ian Kemp, "UK Forces Face 18% Reduction," *Jane's Defence Weekly*, 4 August 1990, p. 152.

Each nuclear-powered submarine is powered by one reactor.

[456] Provided the Royal Navy retains a nuclear anti-submarine depth bomb, the fleet will progressively become more nuclearized as more nuclear-capable Type 23 frigates enter the fleet.

[457] Nuclear-capable aircraft with naval missions include some 40 RN Sea Harriers and 42 RAF Buccaneer attack aircraft for strikes against surface targets, and about 83 Lynx and 62 Sea King helicopters. In addition, 33 Nimrod anti-submarine patrol planes can deliver U.S. B57 nuclear depth bombs stored in the U.K. The helicopters and Sea Harriers can perform their missions from ships or shore bases. The Buccaneers and Nimrods are solely land-based. Only one-third, however, of the naval aviation aircraft may be assigned warheads. This is about the same number of nuclear-capable aircraft as two years ago. Reductions of one type of aircraft due to accidents, have been offset by new aircraft or conversions of other types of aircraft.

[458] U.K. nuclear forces are summarized by the U.K. Ministry of Defence as follows:

In addition to our strategic [Polaris] forces, the British free-fall nuclear bomb can be delivered by Royal Air Force Tornado GR1 and Buccaneer and Royal Navy Sea Harrier aircraft. British nuclear depth bombs can be delivered by Royal Navy anti-submarine helicopters; Royal Air Force Nimrod maritime patrol aircraft can deliver United States nuclear depth bombs.

U.K. Ministry of Defence, *British Defence Policy 1990-91*, April 1990, p. 11. Nuclear-capable Tornado aircraft do not have maritime roles, but are for a land-war in Europe.

[459] SACLANT is always a U.S. Admiral who also commands the U.S. Navy Atlantic Fleet (CINCLANT) headquartered at Norfolk Virginia. Under the NATO command structure the Royal Navy's main operational commander — CINCFLEET — is also the deputy to SACLANT.

[460] HOC Defence Committee, Sixth Report, Session 1987-88, "The Future Size and Role of the Royal Navy's Surface Fleet," 21 June 1988 (HC 309; HMSO, London, 1988), pp. vii-ix; Michael Evans, "Navy Lifts Secrecy to Reveal Its Global Role," *London Times*, 14 February 1990; U.K. Ministry of Defence, *British Defence Policy 1990-91*, April 1990, pp. 15-17.

[461] HASC, hearings on *The 600-Ship Navy and the Maritime Strategy*, June 24, September 5, 6 and 10, 1985, p. 279.

[462] The "18th" SSN, HMS Triumph (S93), is scheduled to enter the fleet in 1991; U.K. Ministry of Defence, *British Defence Policy 1990-91*, April 1990, p. 30. The 18-SSN force will be short lived since Britain's five older SSNs will be retired in the mid-1990s; Paul Beaver, "Axe Falls on SSK Force," *Jane's Defence Weekly*, 4 August 1990, p. 153.

[463] HAC, FY 1984 DOD, Part 2, pp. 641-642. In 1988 the British government officially announced that the wartime role of the RN was to support the U.S. maritime strategy. The British fleet would provide some 70 percent of the forces in the Northeast Atlantic at the outset of war and they would have to intercept and contain Soviet maritime forces until the NATO strike fleet was assembled; U.K. Ministry of Defence, *British Defence Policy 1990-91*, April 1990, p. 13; Norman Friedman, "West European and NATO Navies," *USNI Proceedings*, March 1989, p. 131.

[464] U.K. ballistic missile submarines have a service life of about 25 years, and therefore will be up for retirement in the mid-1990s.

[465] The second is on order, with the third to be ordered later in 1990, and the fourth is projected; U.K. Ministry of Defence, *British Defence Policy 1990-91*, April 1990, p. 30.

[466] This serves to coordinate the United States' and U.K. SSBN operations and patrol areas when the countries are acting in unison, and the "prevention of mutual interference" when they are acting apart. U.S. Atlantic Command, USCINCLANT/ CINCLANTFLT/ CINCWESTLANT/COMOCEANLANT, *Staff Organization and Regulations*, Staff Instruction 5200.1Q, 8 February 1985, p. 2-6-18; released under the FOIA.

[467] "'Designated Lanes' for NATO Submarines," *Jane's Defence Weekly*, 31 October 1987, p. 980.

[468] Currently the Illustrious in stand-by and is scheduled to enter a two-year refit starting in 1991; Simon Elliot, "RN Plans Seawolf Fit from 1991," *Jane's Defence Weekly*, 8 July 1989, p. 15.

[469] HOC Defence Committee, Sixth Report, Session 1987-88, "The Future Size and Role of the Royal Navy's Surface Fleet," 21 June 1988 (HC 309; HMSO, London, 1988), p. xlii.

[470] The one remaining non-nuclear-capable destroyer is the Type 82 HMS Bristol (D23). It is outfitted as a command ship.

[471] HOC Defence Committee, Sixth Report, Session 1987-88, "The Future Size and Role of the Royal Navy's Surface Fleet," 21 June 1988 (HC 309; HMSO, London, 1988), p. xliii.

[472] The non-nuclear frigates include: six Type 21 Amazon class and 15 Leander class ships.

[473] HOC Defence Committee, Sixth Report, Session 1987-88, "The Future Size and Role of the Royal Navy's Surface Fleet," 21 June 1988 (HC 309; HMSO, London, 1988), p. xliii; "News in Brief," *Naval Forces*, No. III, Vol. XI 1990, p. 76.

[474] These Batch 2 and 3 ships will also be able to operate the new nuclear-capable EH-101 ASW helicopter (IOC mid-1990s). The first Royal Navy frigate designed to operate the EH 101 is the HMS Brave, which was commissioned in 1986; HOC Defence Committee, Sixth Report, Session 1987-88, "The Future Size and Role of the Royal Navy's Surface Fleet," 21 June 1988 (HC 309; HMSO, London, 1988), p. xliii.

[475] U.K. Ministry of Defence, *British Defence Policy 1990-91*, April 1990, p. 30; HOC Defence Committee, Sixth Report, Session 1987-88, "The Future Size and Role of the Royal Navy's Surface Fleet," 21 June 1988 (HC 309; HMSO, London, 1988), p. xliii; "RN planning for 20 Type 23 frigates," *Jane's Defence Weekly*, 5 September 1987, p. 413.

[476] HOC Defence Committee, Sixth Report, Session 1987-88, "The Future Size and Role of the Royal Navy's Surface Fleet," 21 June 1988 (HC 309; HMSO, London, 1988), p. xlvi.

[477] There is a new class of support ships under construction. The RFA Fort Victoria (A387), the first of this class of fleet replenishment ships, is entering the fleet in 1990. It will displace 31,600 tons full load, and accommodate up to five Sea King helicopters. A second ship, the Fort George (A388) is on order; HOC Defence Committee, Sixth Report, Session 1987-88, "The Future Size and Role of the Royal Navy's Surface Fleet," 21 June 1988 (HC 309; HMSO, London, 1988), pp. xlvi-xlvi. The nuclear role, if any, of these ships is unknown.

[478] DIA, "Aircraft Handbook - Free World (U), Volume 1: Fighters, Ground Attack, and Miscellaneous Tactical Aircraft (U)," DST-1300H-001-85-Vol 1-Chg 1, 14 February 1986, p. 332; partially released under the FOIA.

[479] DIA, "Aircraft Handbook - Free World (U), Volume 1: Fighters, Ground Attack, and Miscellaneous Tactical Aircraft (U)," DST-1300H-001-85-Vol 1-Chg 1, 19 May 1985, p. 337; partially released under the FOIA.

[480] John W. R. Taylor and Paul Jackson, "Gallery of West European Airpower," *Air Force Magazine*, October 1989, p. 73. Reportedly, the Buccaneers will be phased out in the mid-1990s to be replaced with a nuclear-capable maritime version of the RAF Tornado aircraft; "Tornado Set for RAF Maritime Role," *Jane's Defence Weekly*, 11 March 1989, p. 382; Nick Cook, "Cuts, But No Role Change for RAF," *Jane's Defence Weekly*, 4 August 1990, p. 154.

[481] Martin Brice, *Royal Navy Handbook* (London: Ian Allen Ltd., 1985), p. 89.

[482] Nick Childs, "First Flight for Sea Harrier FRS2," *Jane's Defence Weekly*, 1 October 1988. p. 767; "UK FRS2 First Batch Buy Due in August," *Jane's Defence Weekly*, 17 June 1989, p. 1236; U.K. Ministry of Defence, *British Defence Policy 1990-91*, April 1990, p. 30.

[483] Some 62 of these ships are major combatants, including six nuclear-powered ballistic missile submarines, four nuclear-powered attack submarines, ten conventionally-powered (diesel/electric) attack submarines, two aircraft carriers, one cruiser, and 39 destroyer and frigate class ships. IISS, *The Military Balance: 1989-1990*, pp. 59-61; *Jane's Fighting Ships 1990-91*, p. 176 ff.

[484] *SIPRI 1990 Yearbook*, p. 21. The 36 Super Etendards are carrier-based aviation and are used for maritime strike and surface attacks. Another 20 are based ashore with similar roles, but are not thought to be nuclear-capable.

[485] Although *Jane's Fighting Ships 1989-90* (p. 187) credited France's ship-borne Alize and Lynx anti-submarine warfare helicopters with a nuclear depth bomb capability. But in the 1990-91 edition, only the Alize is still given a nuclear capability.

[486] John A. Burgess, "La Marine," *Proceedings*, March 1985, p. 94.

[487] *SIPRI 1989 Yearbook*, pp. 30-31; *SIPRI 1990 Yearbook*, p. 42.

[488] *Jane's Fighting Ships 1990-91*, p. 178; *SIPRI 1990 Yearbook*, p. 42.

[489] Even during the conversion to M4 missiles, four will be available for active patrols, allowing three to be kept at sea at all times.

[490] These details were revealed for the first time in September 1988, by the then commander of France's ballistic submarine force, VADM Michel Merveilleux de Vignaux; Jacques Isnard, "France Claims SSBN Advantage," *Jane's Defence Weekly*, 1 October 1988, p. 746.

[491] Captain John J. Hyland, USN, "France's Nuclear Reach," *Proceedings*, March 1987, p. 83.

[492] These ships are about half the size of and carry half as many aircraft as the largest U.S. Nimitz class aircraft carriers. At about 32,780 tons displacement at full load, the ships can embark 40 assorted aircraft, including one squadron of nuclear-capable Super Etendard strike aircraft, one squadron of F-8E Crusader interceptors, Alize anti-submarine warfare aircraft, and several helicopters for search, rescue and daytime transport.

[493] Reports state that completed work on the Clemenceau cost 170 million francs. Clemenceau was modified to allow operation of the Super Etendard, which also involved installing infrastructure for storage of the AN-52 nuclear bombs; "Work on the French Navy's Ships," *Aviation & Marine International*, February 1979, p. 19. Another naval analyst notes that the Clemenceau had her magazines modified to store tactical nuclear weapons in a 1977-78 refit; Floyd D. Kennedy, "French Naval Nuclear Capabilities," *National Defense*, October 1980, p. 28.

[494] *SIPRI 1990 Yearbook*, p. 33.

[495] Patricia Chilton, "French Nuclear Weapons," in Jolyon Howorth and Patricia Chilton (Eds.), *Defence and Dissent in Contemporary France* (London: Croom Helm, 1984) p. 151.

[496] DCN, "PAN: Porte Aeronefs Nucleaires," brochure, Paris, October 1984; Jacques Isnard, "SSBN Reactors Give de Gaulle Slow Speed," *Jane's Defence Weekly*, 23 September 1989, p. 548.

[497] DCN, "PAN: Porte Aeronefs Nucleaires," brochure, Paris, October 1984; *Jane's Fighting Ships 1990-91*, p. 181.

[498] *SIPRI 1990 Yearbook*, p. 45; Alexandra Schwartzbrod, "French Budget Saves Major Programs," *Armed Forces Journal International*, July 1989, p. 36.

[499] DIA, "Super Etendard Weapon System (U)," DST-1320S-712-85, 21 February 1985, pp. 1 and 11; partially released under the FOIA.

[500] DIA, "Aircraft Handbook - Free World (U), Volume 1: Fighters, Ground Attack, and Miscellaneous Tactical Aircraft (U)," DST-1300H-001-85-Vol 1-Chg 1, 14 February 1986, p. 6; partially released under the FOIA.

[501] SIRPA, "Marine Nationale: principaux materials en service," brochure, no date; *Jane's Fighting Ships 1990-91*, p. 193.

[502] *SIPRI 1990 Yearbook*, p. 21. Plans to convert some 50-55 Super Etendards to carry the ASMP were abandoned due to budgetary reasons.

[503] *SIPRI 1990 Yearbook*, p. 21.

[504] Tim Wrixon, "Super Etendard leads in technology," *Jane's Defence Weekly*, 5 January 1985, p. 19.

[505] Paul Beaver, "The Long Arm of the French Navy," *Jane's Defence Weekly*, 18 October 1986, pp. 899-901.

[506] The only major surface warships in the large Chinese fleet are some 56 destroyers and frigates. The Chinese Navy does not have any aircraft carriers, battleships or cruisers, and the vast majority of the Chinese fleet are minor combatants — patrol, amphibious warfare, and mine warfare ships, along with supply and service craft. None of these ships have any reported nuclear capability; DIA, *Unclassified Communist Naval Order of Battle*, (DDB-1200-124-86), April 1986, pp. 5, 11-12, and 20 (released under the FOIA); Kenneth G. Weiss, *Dragon at Sea: China's Navy in Strategy and Diplomacy*, Center for Naval Analysis, December 1985, p. A-1 (released under the FOIA); Richard Fieldhouse, "Chinese Nuclear Weapons: An Overview," *SIPRI 1986 Yearbook*, pp. 97-113; *SIPRI 1990 Yearbook*, p. 22.

[507] Chinese SSNs and SSBNs are powered by one nuclear reactor each.

[508] Kenneth G. Weiss, op. cit., p. 4.

[509] Harlan W. Jencks, *From Muskets to Missiles: Politics and Professionalism in the Chinese Army, 1945-1981* (Westview Press; Boulder, CO) p. 160.

[510] The first submarine was launched in 1981 and went on sea trials in 1983. By 1986 Chinese officials were suggesting it was operational; *SIPRI 1987 Yearbook*, p. 36.

The existence of a second Xia-class submarine is a matter of some uncertainty. In the mid-1980s, it was believed that several more Xia class submarine were under construction, and that a second submarine was launched in 1982, becoming operational in the mid-1980s; *Jane's Fighting Ships, 1989-90*, p. 101; *SIPRI 1986 Yearbook*, p. 109. *Jane's Fighting Ships, 1990-91* (p. 107) says, however, these reports may have been incorrect, and the second submarine may have been terminated. Seeking to err on the side of conservatism, the *Military Balance 1989-90* (p. 225) also estimates that only one Xia is operational. The *SIPRI 1990 Yearbook* (p. 44), however, counts two operational Xias. In addition, defense researchers from China insist, without providing specifics, that more than one Xia is operational, and reportedly photos of two separate submarines are available.

[511] *SIPRI 1990 Yearbook*, p. 22.

[512] Kenneth G. Weiss, op. cit., p. 11.

[513] IISS, *The Military Balance: 1989-1990*, p. 149. The bombers are organized into three shore-based divisions; *Unclassified Communist Naval Order of Battle*, op. cit., p. 20. In addition, a H-7 bomber is

Appendices

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Nuclear-powered[1] Ballistic Missile Submarines (SSBN)				
LAFAYETTE class	3[2]	1963		
Lafayette (SSBN 616)			Holy Loch, UK[3]	16 Poseidon C3 SLBM
Alexander Hamilton (SSBN 617)			Holy Loch, UK	16 Poseidon C3 SLBM
Woodrow Wilson (SSBN 624)			Charleston, SC	16 Poseidon C3 SLBM
JAMES MADISON class	8	1964		
James Madison (SSBN 627)			King's Bay, GA	16 Trident I C4 SLBM
Tecumseh (SSBN 628)			Charleston, SC	16 Poseidon C3 SLBM
Daniel Boone (SSBN 629)			King's Bay, GA	16 Trident I C4 SLBM
John C. Calhoun (SSBN 630)			King's Bay, GA	16 Trident I C4 SLBM
Ulysses S. Grant (SSBN 631)			Holy Loch, UK	16 Poseidon C3 SLBM
Von Steuben (SSBN 632)			King's Bay, GA	16 Trident I C4 SLBM
Casimir Pulaski (SSBN 633)			King's Bay, GA	16 Trident I C4 SLBM
Stonewall Jackson (SSBN 634)			King's Bay, GA	16 Trident I C4 SLBM
BENJAMIN FRANKLIN class	12	1965-67		
Benjamin Franklin (SSBN 640)			King's Bay, GA	16 Trident I C4 SLBM
Simon Bolivar (SSBN 641)			King's Bay, GA	16 Trident I C4 SLBM
Kamehameha (SSBN 642)			Holy Loch, UK	16 Poseidon C3 SLBM
George Bancroft (SSBN 643)			King's Bay, GA	16 Trident I C4 SLBM
Lewis and Clark (SSBN 644)			Charleston, SC	16 Poseidon C3 SLBM
James K. Polk (SSBN 645)			Charleston, SC	16 Poseidon C3 SLBM
George C. Marshall (SSBN 654)			Holy Loch, UK	16 Poseidon C3 SLBM
Henry L. Stimson (SSBN 655)			King's Bay, GA	16 Trident I C4 SLBM
George Washington Carver (SSBN 656)			Holy Loch, UK	16 Poseidon C3 SLBM
Francis Scott Key (SSBN 657)			King's Bay, GA	16 Trident I C4 SLBM
Mariano G. Vallejo (SSBN 658)			King's Bay, GA	16 Trident I C4 SLBM
Will Rogers (SSBN 659)			Holy Loch, UK	16 Poseidon C3 SLBM

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1 One reactor powers each SSBN.

2 Five Lafayette submarines -- the Andrew Jackson (SSBN 619), John Adams (SSBN 620), James Monroe (SSBN 622), Henry Clay (SSBN 625), and Daniel Webster (SSBN 626) -- have been deactivated or decommissioned since 1988.

3 Some seven Poseidon SSBNs are in Submarine Squadron 14 and operate out of Holy Loch, Scotland, although their crews are homeported in Groton, Connecticut. The other four operational Poseidon SSBNs not in Submarine Squadron 14 operate out of Charleston, South Carolina, under the administrative control of Submarine Squadron 18 (although some of these submarines may be in overhaul). All the Trident I SSBNs based on the East Coast, when operational, operate out of the submarine base at King's Bay, Georgia, but their crews are homeported at Charleston, South Carolina. East coast operational Trident I submarines are under the administrative control of Submarine Squadron 16 headquartered at King's Bay. Typically seven to eight of the total 12 Trident I East coast submarines are under Submarine Squadron 16. The other four to five may be undergoing repairs or extended overhauls under the administrative oversight of Submarine Group 6 in Charleston, SC, or the shipyard performing the overhaul.

Extended overhauls (approximately 20 to 30 months) of SSBNs are done at Portsmouth (New Hampshire), Norfolk (Virginia), Charleston (South Carolina), or Puget Sound (Bremerton, Washington) Naval Shipyards; HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 246.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
OHIO class	9(+8)[4]	1981-		
Ohio (SSBN 726)			Bangor, WA	24 Trident I C4 SLBM
Michigan (SSBN 727)			Bangor, WA	24 Trident I C4 SLBM
Florida (SSBN 728)			Bangor, WA	24 Trident I C4 SLBM
Georgia (SSBN 729)			Bangor, WA	24 Trident I C4 SLBM
Henry M. Jackson (SSBN 730)			Bangor, WA	24 Trident I C4 SLBM
Alabama (SSBN 731)			Bangor, WA	24 Trident I C4 SLBM
Alaska (SSBN 732)			Bangor, WA	24 Trident I C4 SLBM
Nevada (SSBN 733)			Bangor, WA	24 Trident I C4 SLBM
Tennessee (SSBN 734)			King's Bay, GA	24 Trident II D5 SLBM
(Pennsylvania (SSBN 735))			King's Bay, GA	(24 Trident II D5 SLBM)
(West Virginia (SSBN 736)[5]			(King's Bay, GA)	(24 Trident II D5 SLBM)
(Kentucky (SSBN 737)			(King's Bay, GA)	To be delivered in mid-1991.
(Maryland (SSBN 738)			(King's Bay, GA)	To be delivered in mid-1992.
(Nebraska (SSBN 739)			(King's Bay, GA)	To be delivered in early 1993.
(unnamed (SSBN 740)			(King's Bay, GA)	To be delivered in early 1994.
(unnamed (SSBN 741)			(King's Bay, GA)	To be delivered in late 1994.
(unnamed (SSBN 742)[6]			(King's Bay, GA)	To be delivered in late 1995.

Ballistic Missile Submarine Summary

Total Ballistic Missile Submarines: 32

Total Submarines with:[7]
Poseidon C3 SLBMs: 11
Trident I C4 SLBMs: 20
Trident II D5 SLBMs: 2

Total Ballistic Missiles: 584	Warheads: 5024
Poseidon C3 SLBM: 176	Warheads: 1760
Trident I C4 SLBM: 384	Warheads: 3072
Trident II D5 SLBM: 24	Warheads: 192

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4 Since 1988, the Tennessee and Pennsylvania have joined the fleet, with the Pennsylvania to become operational in late 1990. The Tennessee and subsequent submarines will be armed with the Trident II missile. The first eight submarines at Bangor, Washington, will be backfitted with the Trident II missile in the 1990s.

5 Scheduled to be commissioned in October 1990, and arrive in King's Bay, Georgia, in late 1990.

6 In addition to the seven Trident submarines still under construction, the Navy seeks funds for the 18th Trident submarine, and advanced procurement for the 19th and 20th in the FY 1991 budget.

7 Totals of SLBMs and warheads do not include the Pennsylvania as it is not scheduled to go to sea on its first operational patrol until late 1990.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Nuclear-capable Nuclear-powered[8] Attack Submarines (SSN)[9]				
STURGEON class[10]	18(+17)[11]	1967-75		
Sturgeon (SSN 637)			Charleston, SC	TT Tomahawk
Whale (SSN 638)			Groton, CT	TT Tomahawk[12]
Tautog (SSN 639)			Pearl Harbor, HI	TT Tomahawk
(Grayling (SSN 646))			(Charleston, SC)	(To be TT Tomahawk certified in 1990-91)
(Pogy (SSN 647))			(Bremerton, WA)	(TT Tomahawk)
Aspro (SSN 648)			Pearl Harbor, HI	TT Tomahawk
Sunfish (SSN 649)			Norfolk, VA	TT Tomahawk
Pargo (SSN 650)			Groton, CT	TT Tomahawk[13]
Puffer (SSN 652)			San Diego, CA	TT Tomahawk
Ray (SSN 653)			Charleston, SC	TT Tomahawk
(Sand Lance (SSN 660))			(Portsmouth, NH)	(TT Tomahawk)

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8 One reactor powers each SSN. The homeports of submarines known to be in overhaul are listed in parentheses.

9 **Sturgeon and Los Angeles class submarine Tomahawk Loadings**:
a) Sturgeon (SSN-637) and Los Angeles (SSN-688) class submarines without the vertical launching system (VLS) have a nominal load of eight Tomahawks; HASC, FY 1984 DOD, Part 2, p. 361. They are carried internally and launched through the torpedo tubes (TT). Two of the eight are nominally estimated to be nuclear-armed Tomahawks (TLAM/Ns).
b) Los Angeles class submarines with the VLS (SSN-719 and subsequent submarines) carry a nominal load of 20 Tomahawks, eight internally and 12 in the VLS; HASC, FY 1984 DOD, Part 2, p. 361. Five of the twenty nominally are estimated to be TLAM/Ns.
Sturgeon and Los Angeles class submarine Tomahawk Certifications:
a) All submarines not listed in parentheses are Tomahawk-certified as of June 1990.
b) Submarines which are scheduled to be converted to carry Tomahawks are enclosed with parentheses.
Sources: U.S. Navy, "Fiscal Year 1983 Fleet Modernization Program for Execution," OPNAVINST 4720.91, 16 June 1982; U.S. Navy, "Fiscal Year 1984 Fleet Modernization Program (FMP) for Execution," OPNAVINST 4720.92, 3 June 1983; U.S. Navy, "Fiscal Year 1985 Fleet Modernization Program for Execution," OPNAVINST 4720.94, 17 August 1984; U.S. Navy, "Fiscal Year 1986 Fleet Modernization Program (FMP) for Execution," OPNAVINST 4720.95, 15 August 1985; U.S. Navy, Submarine Group 6, Command Histories for 1986-1989 (partially released under the FOIA); U.S. Navy, Cruise Missile Project Office, "Tomahawk Certified SSNs, end of FY 1989 - FY 1999," 25 April 1990; U.S. Navy, Commander Submarine Force, Atlantic, "Index of Effective Instructions," COMSUBLANTNOTE 5215, 7 March 1989 (released under the FOIA); U.S. Navy, Commander Submarine Force, Pacific, "Checklist of Effective Tactical Publications," COMSUBPACNOTE 5215, 25 August 1989 (released under the FOIA); Jane's Fighting Ship's 1984-1985 and 1986-87; USNI Proceedings, "Naval Review 1984," May 1985, p. 290.

10 As of June 1990, 18 of 35 commissioned Sturgeon (SSN-637) class submarines listed here are certified to carry Tomahawks. Three more are scheduled to be certified by October 1990. An additional three are to be certified in FY 1991 (i.e., October 1990 - September 1991). The remaining submarines which are not decommissioned also will be converted to carry Tomahawks. The number of Tomahawk-certified SSN-637 class submarines is programmed to peak in FY 1994 with 26 submarines, but by the end of the decade the number will fall to 21; U.S. Navy, Cruise Missile Project Office, "Tomahawk Certified SSNs, End of FY 1989-FY 1999," 25 April 1990.

11 There are another two Sturgeon class submarines in commission -- the Queenfish (SSN-651) and Sea Devil (SSN-664) -- but they are scheduled for decommissioning and are listed in the non-nuclear nuclear-powered ships section below.

12 The Whale accidentally lost a Tomahawk test missile during a surface launch on 1 September 1988. The test missile rose to the surface and then sank in the waters of the underwater tracking range the United States maintains in St. Croix, the Virgin Islands; U.S. Navy Safety Center, "Material Damage Report, 5102.2," 10 April 1990; partially released under the FOIA.

13 The Pargo was the submarine (previously unknown) that conducted a submerged test firing of a Tomahawk TLAM/N on 26-28 February 1989 off the coast of Maine. The missile flew over the new Northern Maine cruise missile testing range and was recovered; DOD, Director Operational Test & Evaluation, Report FY '89, 7 February 1990, p. IV-86.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
(Lapon (SSN 661))			Norfolk, VA	(TT Tomahawk)[14]
Gurnard (SSN 662)			San Diego, CA	TT Tomahawk
Hammerhead (SSN 663)			Norfolk, VA	TT Tomahawk
Guitarro (SSN 665)			San Diego, CA	TT Tomahawk
(Hawkbill (SSN 666))			(Vallejo, CA)	(TT Tomahawk)[15]
Bergall (SSN 667)			Norfolk, VA	TT Tomahawk
Spadefish (SSN 668)			Norfolk, VA	TT Tomahawk
Seahorse (SSN 669)			Charleston, SC	TT Tomahawk
(Finback (SSN 670))			Norfolk, VA	(To be TT Tomahawk certified in 1990-91)
(Pintado (SSN 672))			(Vallejo, CA)	(TT Tomahawk)
Flying Fish (SSN 673)			Norfolk, VA	TT Tomahawk
(Trepang (SSN 674))			(Portsmouth, NH)	(TT Tomahawk)[16]
(Bluefish (SSN 675))			Charleston, SC	(To be TT Tomahawk certified in 1990-91)
(Billfish (SSN 676))			(Charleston, SC)	(TT Tomahawk)[17]
Drum (SSN 677)			San Diego, CA	TT Tomahawk
(Archerfish (SSN 678))			(Bremerton, WA)	(TT Tomahawk)[18]
Silversides (SSN 679)			Norfolk, VA	TT Tomahawk
(William H. Bates (SSN 680))			(Bremerton, WA)	(TT Tomahawk)[19]
(Batfish (SSN 681))			Charleston, SC	(TT Tomahawk)
(Tunny (SSN 682))			(Bremerton, WA)	(TT Tomahawk)
Parche (SSN 683)			Vallejo, CA	TT Tomahawk
(Cavalla (SSN 684))			Pearl Harbor, HI	(TT Tomahawk)
(L. Mendel Rivers (SSN 686))			Charleston, SC	(TT Tomahawk)
(Richard B. Russell (SSN 687))			Vallejo, CA	(TT Tomahawk)
NARWHAL class[20]	0(+1)	1969		
Narwhal (SSN 671)			Charleston, SC	(TT Tomahawk)

[14] Scheduled for its fourth major overhaul starting in late 1991; HASC, FY 1988/1989 DOD, Operation and Maintenance, p. 629. Because of the decision to retire Sturgeon class submarines early, the Lapon may be decommissioned in the upcoming FY 1992 budget rather than be overhauled.

[15] Due out of overhaul in mid-1991; HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials, p. 246.

[16] Due out of overhaul in mid-1990; HASC, FY 1988/1989 DOD, ibid.

[17] Due out of overhaul in mid-1990; HASC, FY 1988/1989 DOD, ibid.

[18] Due out of overhaul in early 1990; HASC, FY 1988/1989 DOD, ibid.

[19] Due out of overhaul in early 1990; HASC, FY 1988/1989 DOD, ibid.

[20] Scheduled to get Tomahawk capability if not decommissioned.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
LOS ANGELES class[21]	32(+30)[22]	1976-		
Los Angeles (SSN 688)			Pearl Harbor, HI	TT Tomahawk
Baton Rouge (SSN 689)			Norfolk, VA	TT Tomahawk
Philadelphia (SSN 690)			Groton, CT	TT Tomahawk
Memphis (SSN 691)			Norfolk, VA	TT Tomahawk[23]
Omaha (SSN 692)			Pearl Harbor, HI	TT Tomahawk
Cincinnati (SSN 693)			Norfolk, VA	TT Tomahawk
Groton (SSN 694)			Groton, CT	TT Tomahawk
Birmingham (SSN 695)			Pearl Harbor, HI	TT Tomahawk
New York City (SSN 696)			Pearl Harbor, HI	TT Tomahawk
(Indianapolis (SSN 697))			Pearl Harbor, HI	(To be TT Tomahawk certified in 1990-91)[24]
(Bremerton (SSN 698))			Pearl Harbor, HI	(TT Tomahawk)[25]
(Jacksonville (SSN 699))			Norfolk, VA	(TT Tomahawk)[26]
(Dallas (SSN 700))			Groton, CT	(TT Tomahawk)
La Jolla (SSN 701)			San Diego, CA	TT Tomahawk
(Phoenix (SSN 702))			Norfolk, VA	(TT Tomahawk)
Boston (SSN 703)			Groton, CT	TT Tomahawk
Baltimore (SSN 704)			Norfolk, VA	TT Tomahawk
City of Corpus Christi (SSN 705)			Groton, CT	TT Tomahawk
Albuquerque (SSN 706)			Groton, CT	TT Tomahawk
Portsmouth (SSN 707)			San Diego, CA	TT Tomahawk
Minneapolis-Saint Paul (SSN 708)			Norfolk, VA	TT Tomahawk
Hyman G. Rickover (SSN 709)			Norfolk, VA	TT Tomahawk
Augusta (SSN 710)			Groton, CT	TT Tomahawk
(San Francisco (SSN 711))			Pearl Harbor, HI	(To be TT Tomahawk certified in 1990-91)
Atlanta (SSN 712)			Norfolk, VA	TT Tomahawk
Houston (SSN 713)			San Diego, CA	TT Tomahawk
Norfolk (SSN 714)			Norfolk, VA	TT Tomahawk
Buffalo (SSN 715)			Pearl Harbor, HI	TT Tomahawk

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21 As of June 1990, 32 of the 44 commissioned Los Angeles (SSN-688) class submarines are Tomahawk certified. Two more are scheduled to be certified by October 1990, with the rest to follow in the 1990s.

Non-VLS submarines (i.e. SSNs 688-718): by October 1990, 26 of the 31 total non-VLS submarines will be Tomahawk certified for torpedo tube (TT) launches. Another four non-VLS submarines will be certified in FY 1991, and the last non-VLS submarine will be certified by the end of FY 1992.

Non-BSY-1 VLS submarines (i.e. SSNs 719-750): By October 1990, all eight of the non-BSY-1 VLS submarines will be both torpedo tube and VLS Tomahawk certified (some of these submarines have been Tomahawk certified, but only for torpedo tube launches).

BSY-1 VLS submarines (SSNs 751 and subsequent submarines): The first six are scheduled to be certified in FY 1991; U.S. Navy, Cruise Missile Project Office, "Tomahawk Certified SSNs, end of FY 1989 - FY 1999," 25 April 1990. Also see San Juan (SSN-751) below.

22 Since 1988, seven SSN-688 submarines have joined the fleet, and the final 62nd submarine has been authorized.

23 The Memphis was designated as an interim research and development submarine in mid-1988, but retains full warfighting capabilities.

24 Scheduled to have finished overhaul in early 1989; HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials, p. 246. Reportedly the submarine recently returned to Pearl Harbor after overhaul with an upgraded weapons system.

25 Scheduled to have finished overhaul in late 1989; HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials, p. 246. Probably will be Tomahawk certified in FY 1991.

26 Due to finish an overhaul in early 1990; HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials, p. 246.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Salt Lake City (SSN 716)			San Diego, CA	TT Tomahawk
Olympia (SSN 717)			Pearl Harbor, HI	TT Tomahawk
Honolulu (SSN 718)			Pearl Harbor, HI	TT Tomahawk
Providence (SSN 719)[27]			Groton, CT	VLS+TT Tomahawk
Pittsburgh (SSN 720)[28]			Groton, CT	VLS+TT Tomahawk
Chicago (SSN 721)			San Diego, CA	VLS+TT Tomahawk
Key West (SSN 722)			Norfolk, VA	VLS+TT Tomahawk
Oklahoma City (SSN 723)[29]			Norfolk, VA	VLS+TT Tomahawk
Louisville (SSN 724)			San Diego, CA	VLS+TT Tomahawk
Helena (SSN 725)			Pearl Harbor, HI	VLS+TT Tomahawk
(Newport News (SSN 750))[30]			Norfolk, VA	(To be VLS+TT Tomahawk certified in 1990-91)
(San Juan (SSN 751))[31]			Groton, CT	(VLS+TT Tomahawk)
(Pasadena (SSN 752))			Groton, CT	(VLS+TT Tomahawk)
(Albany (SSN 753))			Norfolk, VA	(VLS+TT Tomahawk)
(Topeka (SSN 754))			Groton, CT	(VLS+TT Tomahawk)
(Miami (SSN 755))			Groton, CT	(VLS+TT Tomahawk)
(Scranton (SSN 756))			–	To be delivered in early 1991.
(Alexandria (SSN 757))			–	To be delivered in mid-1991.
(Asheville (SSN 758))			–	To be delivered in mid-1991.
(Jefferson City (SSN 759))			–	To be delivered in early 1992.
(Annapolis (SSN 760))			–	To be delivered in early 1992.
(Springfield (SSN 761))			–	To be delivered in late 1992.
(Columbus (SSN 762))			–	To be delivered in early 1992.

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[27] The Providence and subsequent SSN-688 submarines are equipped with a 12-tube vertical launching system (VLS).
Full scale engineering development of the submarine VLS Tomahawk was conducted on the Providence; HAC, FY 1987 DOD, Part 4, p. 132. As part of the follow-on operational test and evaluation of the submarine VLS Tomahawk, the Providence test launched an unarmed TLAM/C on 7 August 1988 while submerged in the Gulf of Mexico; Air Force Magazine; October 1988, p. 26; DOD, Director Operational Test & Evaluation, Report FY '89, 7 February 1990, pp. IV-86-87.

[28] The submarine VLS started technical evaluation in 1986 on the Pittsburgh; HAC, FY 1989 DOD, Part 6, p. 158. The Pittsburgh also participated in the follow-on operational test and evaluation of the submarine VLS Tomahawk which was conducted from 5 September 1988 to 28 May 1989; DOD, Director Operational Test & Evaluation, Report FY '89, 7 February 1990, pp. IV-86-87.

[29] The Oklahoma City suffered a Tomahawk handling accident on 24 January 1990 when a missile was loaded too quickly in a torpedo room storage cradle; Charles H. Bogino and A. J. Plunkett, "Navy, Sub Personnel Scurry After Norfolk Missile, Snafu," Daily Press (Newport News-Hampton, VA), 25 January 1990.

[30] Hull numbers 726 to 749 reserved for Trident SSBNs, hence the gap between SSN 725 and SSN 750.

[31] The San Juan and subsequent SSN-688 submarines are equipped with an advanced integrated sonar/combat control system, known as the BSY-1 ("Busy 1"). As of June 1990, none of these submarines are Tomahawk certified. This is because the BSY-1 system is not yet fully operational. Design and production problems with the BSY-1 resulted in the first four BSY-1 submarines receiving only a preliminary baseline system. The preliminary system provides the submarines with a limited self-defense capability, but does not permit the submarine to conduct offensive or sustained operations at sea. The baseline BSY-1s are to be upgraded to fully capable systems during these four submarines' Post Shakedown Availabilities (PSAs are 9-10 month refit periods held after a submarine's initial post-commissioning shakedown cruise -- depending on circumstances, one or two years may pass between a vessel's commissioning, PSA, and its first operational deployment). So far only the San Juan has completed PSA (in November 1989, the PSAs for the three other commissioned BSY-1 submarines have been delayed). The San Juan with the first fully capable BSY-1 system, was scheduled for at sea technical testing in March 1990, and then operational testing in August 1990. These would be the first at sea tests of the full BSY-1 system, and if they are successful the San Juan will probably become Tomahawk certified in FY 1991; see GAO, Navy Acquisition: Cost, Schedule, and Performance of New Submarine Combat Systems, (GAO/NSIAD-90-72), January 1990, pp. 9-19; Glenn W. Goodman, "Submarine Combat Systems: the Navy's Front Line Against Quieter Soviet Subs," Armed Forces Journal International, July 1989, pp. 81-82.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
(Santa Fe (SSN 763))			–	To be delivered in early 1994.
(Boise (SSN 764))			–	To be delivered in mid-1992.
(Montpelier (SSN 765))			–	To be delivered in late 1992.
(Charlotte (SSN 766))			–	To be delivered in late 1993.
(Hampton (SSN 767))			–	To be delivered in early 1994.
(Hartford (SSN 768))			–	To be delivered in late 1994.
(Toledo (SSN 769))			–	To be delivered in late 1994.
(Tucson (SSN 770))			–	To be delivered in mid-1995.
(unnamed (SSN 771))			–	To be delivered in mid-1995.
(unnamed (SSN 772))			–	To be delivered in early 1996.
(unnamed (SSN 773))			–	
(SEAWOLF class)	(29+)	(1995-)		
(Seawolf (SSN 21))			–	(TT Tomahawk)
(more planned)				

Attack Submarine Summary

Total Nuclear-capable Attack Submarines: 50[32]
Total Torpedo Tube (TT) Tomahawk-capable Attack Submarines: 43
Total Vertical Launch System (VLS) Tomahawk-capable Attack Submarines: 7
Total Tomahawk TLAM/N SLCMs on Submarines: 121

Aircraft Carriers (CV)

MIDWAY class[33]	1	1945		
Midway (CV 41)			Yokosuka, JA	36 F/A-18, 10 A-6E, 6 SH-3; nuclear bombs, depth bombs
FORRESTAL class	4	1955-59		
Forrestal (CV 59)			Mayport, FL	24 A-7E, 10 A-6E, 10 S-3, 6 SH-3; nuclear bombs, depth bombs
Saratoga (CV 60)[34]			Mayport, FL	24 A-7E, 10 A-6E, 10 S-3, 6 SH-3; nuclear bombs, depth bombs
Ranger (CV 61)[35]			San Diego, CA	24 A-6E, 10 S-3, 6 SH-3;[36] nuclear bombs, depth bombs

[32] This is the number of Sturgeon (SSN-637) (18) and Los Angeles (SSN-688) (32) class submarines which are Tomahawk-certified submarines as of June 1990.

[33] The "second" Midway class carrier, the Coral Sea (CV-43), was decommissioned in April 1990. The Midway is scheduled to leave Yokosuka in 1991 and be decommissioned either in 1991 or 1992. The Independence is programmed to replace it in Japan.

[34] Possible candidate for early retirement during 1991-1994 instead of an overhaul in 1994 due to budgetary constraints.

[35] Possible candidate for early retirement during 1991-1993 instead of an overhaul in 1993-1995 due to budgetary constraints.

[36] Has "Kennedy" type air wing. The Kennedy had carried this air wing configuration (hence the name), but it was converted back to a "Conventional" air wing; Bruce Powers, "Carrier Air Wings in Transition," Naval Aviation News, November-December 1989, p. 9.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Independence (CV 62)[37]			San Diego, CA	24 F/A-18, 10 A-6E, 10 S-3, 6 SH-3; nuclear bombs, depth bombs
KITTY HAWK class	1(+2)	1961-65		
(Kitty Hawk (CV 63))[38]			(Philadelphia, PA)	Finishing SLEP in 1991
(Constellation (CV 64))			(Philadelphia, PA)	Starting SLEP in 1990
America (CV 66)[39]			Norfolk, VA	20 F/A-18, 16 A-6E, 8 S-3, 6 SH-3; nuclear bombs, depth bombs
JOHN F. KENNEDY class	1	1968		
John F. Kennedy (CV 67)[40]			Norfolk, VA	24 F/A-18, 10 A-6E, 10 S-3, 6 SH-3; nuclear bombs, depth bombs
Nuclear-powered Aircraft Carriers (CVN)[41]				
ENTERPRISE class	0(+1)	1961		
(Enterprise (CVN 65))[42]			Newport News, VA	Starting refueling and overhaul in 1990
NIMITZ class	5(+3)	1972-		
Nimitz (CVN 68)[43]			Bremerton, WA	20 F/A-18, 16 A-6E, 8 S-3, 6 SH-60F; nuclear bombs, depth bombs
Dwight D. Eisenhower (CVN 69)			Norfolk, VA	24 F/A-18, 10 A-6E, 10 S-3, 6 SH-3; nuclear bombs, depth bombs
Carl Vinson (CVN 70)			Alameda, CA	24 A-7E, 10 A-6E, 10 S-3, 6 SH-3; nuclear bombs, depth bombs

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37 Scheduled to replace the Midway in Yokosuka, Japan, in 1991.

38 Finishing a Service Life Extension Program (SLEP) in February 1991. The SLEP is an extensive multi-year overhaul designed to upgrade a carrier's capability and extend its service life beyond the normal 20 to 30 year service life of ships. The Constellation moved to Philadelphia Naval Ship Yard in April 1990 to prepare for a SLEP starting in mid-1990. Neither carrier's aircraft are included in the aircraft total as ships in SLEP are not deployable.

39 The America has a Transitional air wing configuration; David S. Steigman, "New Mix of Carrier Aircraft on Slower Course," Navy Times, 16 July 1990, p. 24.

40 After the Constellation, the Kennedy is the next aircraft carrier scheduled for SLEP (to start in FY 1993).

41 There are 18 nuclear reactors total on the CVNs. Eight reactors power the Enterprise. Two reactors power each Nimitz class CVN.

42 The Enterprise arrived in Norfolk, Virginia, in March 1990 from Alameda, California, via an around-the-world transit. It will move to Newport News, Virginia, in November 1990 for a three-year nuclear refueling and extensive overhaul. Its aircraft are not included in the totals as it will be undeployable during refueling and overhaul.

43 The Nimitz is the next nuclear-powered carrier scheduled for nuclear refueling and an extensive overhaul (in 1992 or 1993). It has a Transitional air wing configuration; David S. Steigman, "New Mix of Carrier Aircraft on Slower Course," Navy Times, 16 July 1990, p. 24.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Theodore Roosevelt (CVN 71)			Norfolk, VA	20 F/A-18, 20 A-6E, 10 S-3, 6 SH-3;[44] nuclear bombs, depth bombs
Abraham Lincoln (CVN 72)[45]			Norfolk, VA	20 F/A-18, 16 A-6E, 8 S-3, 6 SH-3; nuclear bombs, depth bombs
(George Washington (CVN 73))[46]				--To be delivered in mid-1992.
(John C. Stennis (CVN 74))				--To be delivered in 1995.
(United States (CVN 75))				--To be delivered in 1997.

Aircraft Carrier Summary

Number of Deployable Aircraft Carriers: 12[47]

Number of Nuclear-capable Aircraft in Deployable Carrier Air Wings: 592[48]
F/A-18 Hornets: 208
A-6E Intruders: 178, A-7E Corsairs: 72
S-3A/B Vikings: 112, SH-3H Sea Kings: 72
Each aircraft carrier carries approximately 100 nuclear weapons of all types[49]

Battleships (BB)

IOWA class[50]	4	1982-1988		
Iowa (BB 61)			Norfolk, VA	ABL Tomahawk
New Jersey (BB 62)			Long Beach, CA	ABL Tomahawk
Missouri (BB 63)			Long Beach, CA	ABL Tomahawk
Wisconsin (BB 64)			Norfolk, VA	ABL Tomahawk

Battleship Summary

Total Battleships with Tomahawk SLCMs: 4
Total Tomahawk TLAM/N SLCMs: 28-32

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[44] Has "Roosevelt" type air wing.

[45] The Lincoln is the newest carrier, commissioned in November 1989. It is still undergoing post-commissioning workups and availabilities, prior to achieving full operational capability. When fully operational, it is scheduled to move to Alameda, CA, or possibly Bremerton, WA. The Lincoln will probably receive a "Transitional" air wing configuration.

[46] Three new nuclear-powered aircraft carriers are authorized and under construction.

[47] The three carriers in various stages of extended overhaul are not included in this total.

[48] The Navy owns more of these aircraft types than are deployed in the carrier air wings. These additional aircraft include those in fleet readiness squadrons, in the maintenance pipeline, and those used for research and development.

[49] 5-10 of the 100 weapons are estimated to be B57 nuclear depth bombs, the remaining 90 some weapons are a mixture of B43, B57 and B61 nuclear gravity bombs.

[50] Eight four-celled armored box launchers (ABLs) hold 32 Tomahawks in the battleships. Nominal nuclear-armed Tomahawk (TLAM/N) loading is estimated to be 7-8 per ship.
The last battleship undergoing reactivation, the Wisconsin, was recommissioned in 1988. The Iowa and New Jersey are scheduled for decommissioning in the FY 1991 budget.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Cruisers (CG)				
LEAHY class[51]				
none				
BELKNAP class[52]				
none				
TICONDEROGA class	11(+11)[53]	1983-		
Bunker Hill (CG 52)			Yokosuka, JA	VLS Tomahawk
Mobile Bay (CG 53)			Yokosuka, JA	VLS Tomahawk
Antietam (CG 54)			Long Beach, CA	VLS Tomahawk
Leyte Gulf (CG 55)			Mayport, FL	VLS Tomahawk
San Jacinto (CG 56)			Norfolk, VA	VLS Tomahawk
Lake Champlain (CG 57)			San Diego, CA	VLS Tomahawk
Philippine Sea (CG 58)			Mayport, FL	VLS Tomahawk
Princeton (CG 59)			Long Beach, CA	VLS Tomahawk
Normandy (CG 60)			Norfolk, VA	VLS Tomahawk
Monterey (CG 61)			Mayport, FL	VLS Tomahawk
Chancellorsville (CG 62)			San Diego, CA	VLS Tomahawk
(Cowpens (CG 63))			–	To be delivered in mid-1990.
(Gettysburg (CG 64))			–	To be delivered in late 1990.
(Chosin (CG 65))			–	To be commissioned in Dec 1990.
(Hue City (CG 66))			–	To be delivered in late 1991.
(Shiloh (CG 67))			–	To be delivered in early 1992.
(Anzio (CG 68))			–	To be delivered in early 1992.
(Vicksburg (CG 69))			–	To be delivered in late 1993.
(Lake Erie (CG 70))			–	To be delivered in mid-1993.
(Cape St. George (CG 71))			–	To be delivered in early 1993.
(Vella Gulf (CG 72))			–	To be delivered in mid-1993.
(Port Royal (CG 73))			–	To be delivered in late 1993.
Nuclear-powered Cruisers (CGN)[54]				
LONG BEACH class	1	1961		
Long Beach (CGN 9)			San Diego, CA	ABL Tomahawk

[51] All nine Leahy (CG-16) class cruisers lost their nuclear capability when the nuclear ASROC and Terrier weapons were retired.

[52] All nine Belknap (CG-26) class cruisers lost their nuclear capability when the nuclear ASROC and Terrier weapons were retired.

[53] Since 1988, seven Ticonderoga class cruisers have joined the fleet. Sixteen of the 27 total authorized Ticonderoga class ships are commissioned. Ships authorized and under construction indicated by parentheses.

The first five ships -- the Ticonderoga (CG 47), Yorktown (CG 48), Vincennes (CG 49), Valley Forge (CG 50), and Thomas S. Gates (CG 51) -- only had twin-rail launchers for launching ASROCs, and could not fire Tomahawks: they are no longer nuclear capable.

CG-52 and later ships have two 61 cell vertical launching systems (VLSs), nominally loaded with 26 Tomahawks; HASC, FY 1985 DOD, Part 2, p. 361. Of these 26 Tomahawks, six TLAM/Ns are estimated to be the nominal load. The VLS ships are also able to fire non-nuclear vertical launch ASROCs and non-nuclear SM-2 surface-to-air missiles.

[54] Eight Tomahawks are carried in two four-celled armored box launchers (ABLs) on the five Tomahawk-equipped nuclear-powered cruisers. Of these eight, two TLAM/Ns are estimated to be the nominal load.

Two nuclear reactors power each CGN.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
VIRGINIA class	4	1976-80		
Virginia (CGN 38)			Norfolk, VA	ABL Tomahawk
Texas (CGN 39)			Alameda, CA	ABL Tomahawk
Mississippi (CGN 40)			Norfolk, VA	ABL Tomahawk
Arkansas (CGN 41)			Alameda, CA	ABL Tomahawk

Cruiser Summary

Total Nuclear-capable Cruisers: 16[55]
Total Cruisers with Tomahawk SLCMs: 16
Total ABL Tomahawk Cruisers: 5/Tomahawk TLAM/N SLCMs: 10
Total VLS Tomahawk Cruisers: 11/Tomahawk TLAM/N SLCMs: 66
Total Tomahawk TLAM/N SLCMs on Cruisers: 76

Destroyers (DD)

SPRUANCE class[56]	16(+15)	1975-83		
Spruance (DD 963)			Mayport, FL	VLS Tomahawk
Paul F. Foster (DD 964)			Long Beach, CA	VLS Tomahawk
(Kinkaid (DD 965))			San Diego, CA	(Tomahawk)
Hewitt (DD 966)			Yokosuka, JA	VLS Tomahawk
Elliot (DD 967)			San Diego, CA	VLS Tomahawk
Arthur W. Radford (DD 968)			Norfolk, VA	VLS Tomahawk
(Peterson (DD 969))			Norfolk, VA	(Tomahawk)
Caron (DD 970)			Norfolk, VA	VLS Tomahawk
David R. Ray (DD 971)			Long Beach, CA	VLS Tomahawk
(Oldendorf (DD 972))			Yokosuka, JA	(Tomahawk)
(John Young (DD 973))			Long Beach, CA	(Tomahawk)
Comte de Grasse (DD 974)			Norfolk, VA	ABL Tomahawk
O'Brien (DD 975)			San Diego, CA	VLS Tomahawk
Merrill (DD 976)			San Diego, CA	ABL Tomahawk
(Briscoe (DD 977))			Norfolk, VA	(Tomahawk)
(Stump (DD 978))			Norfolk, VA	(Tomahawk)
Conolly (DD 979)			Norfolk, VA	ABL Tomahawk
(Moosbrugger (DD 980))			Charleston, SC	(Tomahawk)
(John Hancock (DD 981))			(Pascagoula, MS)	(Tomahawk)[57]
(Nicholson (DD 982))			Charleston, SC	(Tomahawk)

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55 This is the number of Tomahawk-certified cruisers as of June 1990.

56 Due to the retirement of nuclear ASROCs, the only nuclear weapon on Spruance class destroyers is the Tomahawk TLAM/N SLCM. As of June 1990, 16 Spruance class ships are certified for some but not necessarily all variants of the Tomahawk. Ships with Tomahawks are indicated. Ships to be converted to carry Tomahawks are in parentheses.

ABL Ships: Seven ships carry eight Tomahawks in two four-celled armored box launchers (ABLs). Of these eight, two TLAM/Ns are estimated to be the nominal load.

VLS Ships: Nine destroyers were converted to carry one 61-cell VLS. Forty-five Tomahawks of all variants are the nominal load for Spruance class VLSs; HASC, FY 1985 DOD, Part 2, p. 361. Of these 45 Tomahawks, 10-11 Tomahawk TLAM/Ns are estimated to be the nominal load. The 15 remaining non-ABL ships will be fitted with VLSs during overhauls.

Tomahawk equipped Spruance class ships are easily identifiable. ABL-outfitted ships have the two rectangular ABLs (also called "coffins") positioned on the forward deck on either side of an eight-cell ASROC launcher. On the VLS-outfitted ships, the ASROC launcher has been removed and replaced with the VLS system, which appears as a square arrangement of hatches almost flush with the deck.

57 In overhaul and being converted to carry VLS.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
John Rodgers (DD 983)			Charleston, SC	ABL Tomahawk
Leftwich (DD 984)			Pearl Harbor, HI	ABL Tomahawk
(Cushing (DD 985))			San Diego, CA	(Tomahawk)
(Harry W. Hill (DD 986))			San Diego, CA	(Tomahawk)
(O'Bannon (DD 987))			Charleston, SC	(Tomahawk)
(Thorn (DD 988))			Charleston, SC	(Tomahawk)
Deyo (DD 989)			Charleston, SC	ABL Tomahawk
Ingersoll (DD 990)			Pearl Harbor, HI	ABL Tomahawk
Fife (DD 991)			Yokosuka, JA	VLS Tomahawk
(Fletcher (DD 992))			San Diego, CA	(Tomahawk)
(Hayler (DD 997))			Norfolk, VA	(Tomahawk)

Guided Missile Destroyers (DDG)

CHARLES F. ADAMS class
None[58]

FARRAGUT class
None[59]

(ARLEIGH BURKE class)[60]	(33+)[61]	(1991-)		(Tomahawks)
(Arleigh Burke (DDG 51))			–	To be delivered in early 1991.
(Barry (DDG 52))			–	To be delivered in late 1991.
(John Paul Jones (DDG 53))			–	To be delivered in early 1993.
(Curtis Wilbur (DDG 54))			–	To be delivered in mid-1993.
(Stout (DDG 55))			–	To be delivered in late 1993.
(John S. McCain (DDG 56))			–	To be delivered in early 1994.
(Mitscher (DDG 57))			–	To be delivered in early 1994.
(Laboon (DDG 58))			–	To be delivered in mid-1994.

Destroyer Summary

Total Nuclear-capable Destroyers: 16[62]
Total Destroyers with Tomahawk SLCMs: 16
Total ABL Tomahawk Destroyers: 7/Tomahawk TLAM/N SLCMs: 14
Total VLS Tomahawk Destroyers: 9/Tomahawk TLAM/N SLCMs: 90-99
Total Tomahawk TLAM/N SLCMs on Destroyers: 104-113

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58 All Charles F. Adams (DDG-2) class destroyers lost their nuclear capability when the nuclear ASROC weapons were retired. Adams class ships are being decommissioned.

59 All Farragut (DDG-37) class destroyers lost their nuclear capability when the nuclear ASROC and Terrier weapons were retired. Farragut class ships are being decommissioned.

60 Arleigh Burke class destroyers will be equipped with one 61 cell VLS and one "half-size" VLS of 29 cells. They will have a nominal Tomahawk loading of 28; HASC, FY 1985 DOD, Part 2, p. 361.

61 Eight Arleigh Burke destroyers are authorized and under construction. The Navy plans to have at least some 33 of these ships and is seeking funding for five more ships in the FY 1991 budget, and seeking to keep purchasing five a year.

62 This is the number of Tomahawk-certified destroyers as of June 1990.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Frigates (FF)				
None[63]				
Amphibious Warfare Ships[64]				
Amphibious Assault Ships				
(TARAWA (LHA 1) class)[65]	(5)	1976-80		Possible wartime nuclear weapons transport
IWO JIMA class[66]	7	1961-70		Possible peacetime transport of Marine Corps nuclear weapons
Iwo Jima (LPH 02)			Norfolk, VA	
Okinawa (LPH 03)			San Diego, CA	
Guadalcanal (LPH 07)			Norfolk, VA	
Guam (LPH 09)			Norfolk, VA	
Tripoli (LPH 10)			San Diego, CA	
New Orleans (LPH 11)			San Diego, CA	
Inchon (LPH 12)			Norfolk, VA	
(WASP class)[67]	(1)(+3)	1989-		
(Wasp (LHD 1))			Norfolk, VA	Possible wartime nuclear weapons transport
(Essex (LHD 2))			–	
(Kearsage (LHD 3))			–	
(Boxer (LHD 4))			–	
Amphibious Cargo Ships (LKA)[68]				
(CHARLESTON (LKA 113) class)	(5)	1968-70		Possible wartime nuclear weapons transport

63 Frigates are no longer nuclear-capable due to the retirement of nuclear ASROCs.

64 Amphibious warfare ships can be used to transport nuclear weapons and bombs for Marine Corps use ashore. Selected Marine Corps ships can be certified for nuclear weapons transport (possibly just the LPHs and LPDs during peacetime). The rest of the ships are nuclear-capable, but are not nuclear-weapons-certified and would be used to transport nuclear weapons on a contingent or emergency basis (See Section I for more discussion).

Ships that are nuclear-capable but that are not nuclear-certified during peacetime are indicated by parentheses.

65 Although able to carry nuclear weapons during wartime, LHAs are not nuclear certified during peacetime and so are not individually listed.

66 Some of these ships are nuclear-certified during peacetime depending on mission.

67 The nuclear status of LHDs during peacetime is unknown.

68 Although able to carry nuclear weapons during wartime, LKAs are not nuclear certified during peacetime and so are not individually listed.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Amphibious Transport Docks (LPD)[69]				
RALEIGH class	2	1962-63		
Raleigh (LPD 01)			Norfolk, VA	Possible peacetime transport of Marine Corps nuclear weapons
Vancouver (LPD 02)			San Diego, CA	
AUSTIN class	11	1965-71		Possible peacetime transport of Marine Corps nuclear weapons
Austin (LPD 04)			Norfolk, VA	
Ogden (LPD 05)			Long Beach, CA	
Duluth (LPD 06)			San Diego, CA	
Cleveland (LPD 07)			San Diego, CA	
Dubuque (LPD 08)			Sasebo, JA	
Denver (LPD 09)			San Diego, CA	
Juneau (LPD 10)			San Diego, CA	
Shreveport (LPD 12)			Norfolk, VA	
Nashville (LPD 13)			Norfolk, VA	
Trenton (LPD 14)			Norfolk, VA	
Ponce (LPD 15)			Norfolk, VA	
Dock Landing Ships (LSD)[70]				
(THOMASTON (LSD 28) class)[71]	(1)	1956		Possible wartime nuclear weapons transport
(ANCHORAGE (LSD 36) class)	(5)	1969-72		Possible wartime nuclear weapons transport
((WHIDBEY ISLAND (LSD 41) class))	(5)(+5)	1984-		Possible wartime nuclear weapons transport
Tank Landing Ships (LST)				
(NEWPORT (LST 1179) class)	(20)	1969-72		Possible wartime nuclear weapons transport
Amphibious Command Ships (LCC)				
(BLUE RIDGE (LCC 19) class)	(2)	1970-71		Possible wartime nuclear weapons transport

69 Some of these ships are nuclear-certified during peacetime depending on mission.

70 Although able to carry nuclear weapons during wartime, LSDs, LSTs, and LCCs are not nuclear certified during peacetime and so are not individually listed.

71 Thomaston class ships are being retired.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Amphibious Warfare Ship Summary

Total Nuclear-capable Amphibious Warfare Ships: 64[72]
Amphibious Command Ships: 2
Amphibious Assault Ships: 13
Amphibious Cargo Ships: 5
Amphibious Transport Docks: 133
Dock Landing Ships: 11
Tank Landing Ships: 20

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Support Ships[73]				
Ballistic Missile Cargo Supply Ships (TAK)[74]				
NORWALK class Marshfield (TAK 282)	1	1970	Atlantic Fleet[75]	Can carry 16 Poseidon missiles in hold and transport nuclear warheads
VEGA class Vega (TAK 286)	1	1983	Atlantic Fleet	Can carry 16 Trident I missiles in hold and transport nuclear warheads
Destroyer Tenders (AD)[76]				
(DIXIE (AD 14) class)	(3)	1940-44		
(SAMUEL GOMPERS (AD 37) class)	(2)	1966-68		
(YELLOWSTONE (AD 41) class)	(4)	1980-83		

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72 Although all 64 amphibious warfare ships can have wartime nuclear weapons transport missions, only the 20 ships of the amphibious assault Iwo Jima (LPH 2) class and the two amphibious transport dock (LPD) classes are certified during peacetime depending on the ship and mission to carry nuclear weapons.

73 Other non-nuclear-capable support ships include: Combat Store Ships (AFS) which can be part of underway replenishment groups, but only carry provisions, dry stores or refrigerated products; Military Sealift Command ships designated by a "T" before their ship class abbreviation, (e.g. TAO) except for the two ballistic missiles cargo supply ships (TAKs 282 and 286) and the Kilauea (TAE 26); and Fleet Oilers (AOs) of the Cimarron class.

74 These ships are the primary logistic link between the continental United States and the U.S. submarine tender at Holy Loch, Scotland.

75 Military Sealift Command ships are not assigned homeports, but operate as part of the Atlantic or Pacific Fleets.

76 Destroyer tenders did have the capability for storage, assembly, and issue of nuclear ASROCs and Terrier missiles; U.S. Navy, Nuclear Warfare Operations (U) NWP 28 (Rev. D), November 1980, p. 4-8; partially released under the FOIA. There is no indication yet that destroyer tenders are outfitted to support nuclear warheads for Tomahawk missiles for surface ships and so they are not individually listed. However, these ships are able to service the nuclear power plants aboard nuclear-powered surface ships, and may be capable of providing some maintenance and repair parts for TLAM/Ns.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Ammunition Ships (AE)[77]				
SURIBACHI class	2	1956-57		Helicopter landing area only
Suribachi (AE 21)			Earle, NJ	Transport/service of nuclear bombs, depth bombs, Tomahawks
Mauna Kea (AE 22)			Concord, CA	
NITRO class	3	1959		Helicopter landing area only
Nitro (AE 23)			Earle, NJ	Transport/service of nuclear bombs, depth bombs, Tomahawks
Pyro (AE 24)			Concord, CA	
Haleakala (AE 25)			Guam	
KILAUEA class	8	1968-72		2 CH-46 transport helicopters
Kilauea (TAE 26)			Pacific Fleet	Transport/service of nuclear bombs, depth bombs, Tomahawks
Butte (AE 27)			Earle, NJ	
Santa Barbara (AE 28)			Charleston, SC	
Mount Hood (AE 29)			Concord, CA	
Flint (AE 32)			Concord, CA	
Shasta (AE 33)			Concord, CA	
Mount Baker (AE 34)			Charleston, SC	
Kiska (AE 35)			Concord, CA	
Fast Combat Support Ships (AOE)				
SACRAMENTO class	4	1964-70		2 CH-46 transport helicopters
Sacramento (AOE 1)			Bremerton, WA	Transport/service of nuclear bombs, depth bombs, Tomahawks
Camden (AOE 2)			Bremerton, WA	
Seattle (AOE 3)			Earle, NJ	
Detroit (AOE 4)			Earle, NJ	
(SUPPLY class)	(3+)			
(Supply (AOE 6))			–	To be delivered in mid-1991.
(Paul Hamilton (AOE 7))			–	To be delivered in mid-1992.
(unnamed (AOE 8))				
Replenishment Oilers (AOR)[78]				
(WICHITA (AOR 1) class)	(7)	1969-70		

[77] "Ammunition ships and most fast combat support ships are capable of transporting, storing, and providing underway replenishment for all Navy weapons except Polaris and Poseidon," U.S. Navy, Nuclear Warfare Operations (U) NWP 28 (Rev. D), November 1980, p. 4-8; partially released under the FOIA.

[78] Replenishment oilers, "have an emergency capability for transporting and providing underway replenishment for all Navy weapons except Polaris and Poseidon;" U.S. Navy, Nuclear Warfare Operations (U) NWP 28 (Rev. D), November 1980, p. 4-8; partially released under the FOIA. These ships seemingly are not nuclear-certified during peacetime and so are not individually listed.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Submarine Tenders (AS)[79]				
FULTON class	2	1941-43		
Fulton (AS 11)			New London, CT	Provides Tomahawk support
Orion (AS 18)			La Maddalena, IT	Provides Tomahawk support
PROTEUS class	1	1944		
Proteus (AS 19)			Guam, MI	Provides Tomahawk support
HUNLEY class	2	1962-63		
Hunley (AS 31)			Norfolk, VA	Provides Tomahawk support[80]
Holland (AS 32)			Charleston, SC	Supports Poseidon missiles and warheads
SIMON LAKE class	2	1964-65		
Simon Lake (AS 33)			Holy Loch, UK	Supports Poseidon and Trident I missiles and warheads[81]
Canopus (AS 34)			King's Bay, GA	Supports Trident I missiles and warheads
L. Y. SPEAR class	2	1970-71		
L. Y. Spear (AS 36)			Norfolk, VA	Provides Tomahawk support
Dixon (AS 37)			San Diego, CA	Provides Tomahawk support
EMORY S. LAND class	3	1979-81		
Emory S. Land (AS 39)			Norfolk, VA	Provides Tomahawk support
Frank Cable (AS 40)			Charleston, SC	Provides Tomahawk support
McKee (AS 41)			San Diego, CA	Provides Tomahawk support

Support Ship Summary

Total Nuclear-capable Support Ships: 38[82]
Ballistic Missile Cargo Supply Ships: 2
Ammunition Ships: 13
Fast Combat Support Ships: 4
Replenishment Oilers: 7
Submarine Tenders: 121tx

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79 Ballistic missile submarine tenders have the capability for storage, assembly, and issue of Poseidon and Tridents to delivery ships; U.S. Navy, Nuclear Warfare Operations (U) NWP 28 (Rev. D), November 1980, p. 4-8; partially released under the FOIA. Additionally all nine of the attack submarine tenders are outfitted to support Tomahawks; U.S. Navy, Cruise Missile Project Office, "Support Ships and Shore Stations, End of 1989, Capable of SLCM Support," 8 May 1990.

80 The Hunley had been stationed as a ballistic missile submarine tender in Holy Loch, Scotland, in the mid-1980s. Upon its return to the United States it was converted to an attack submarine tender with the ability to support Tomahawks.

81 HASC, FY 1984 DOD, Part 4, p. 208.

82 The 38 support ship total excludes destroyer tenders due to their uncertain status. Of the 38 nuclear-capable support ships, only 31 -- all except the seven AORs -- are regularly nuclear-certified during peacetime.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Non-Nuclear-capable Nuclear-powered Ships				
Attack Submarines (SSN)[83]				
PERMIT class[84]	8	1962-67		
Permit (SSN 594)			San Diego, CA	
Haddo (SSN 604)			San Diego, CA	
Tinosa (SSN 606)			New London, CT	
Guardfish (SSN 612)			San Diego, CA	
Flasher (SSN 613)			San Diego, CA	
Greenling (SSN 614)			New London, CT	
Gato (SSN 615)			New London, CT	
Haddock (SSN 621)			San Diego, CA	
ETHAN ALLEN class[85]	2	1959-60		
Sam Houston (SSN 609)			Pearl Harbor, HI	
John Marshall (SSN 611)			Norfolk, VA	
STURGEON class[86]	2	1966-69		
Queenfish (SSN 651)			Pearl Harbor, HI	
Sea Devil (SSN 664)			Charleston, SC	
Cruisers (CGN)[87]				
BAINBRIDGE class	1	1962		
Bainbridge (CGN 25)			Norfolk, VA	Decommissioning preparations to begin in FY 1991, for a decommissioning in FY 1994.
TRUXTUN class	1	1967		
Truxtun (CGN 35)			Bremerton, WA	Decommissioning preparations to begin in FY 1991, for a decommissioning in FY 1994.
CALIFORNIA class	2	1974-75		
California (CGN 36)			Bremerton, CA	
South Carolina (CGN 37)			Norfolk, VA	

[83] The non-nuclear-capable nuclear-powered attack submarines are not considered to be front line submarines. They will be up for retirement in the 1990s.

[84] Six of these submarines, all but the Haddo and Gato, are scheduled for decommissioning in FY 1991. The last two are expected to be decommissioned shortly thereafter.

[85] These submarines were formerly SSBNs, but have been converted to SSNs and outfitted to transport special operation forces.

[86] These two submarines are scheduled for decommissioning in the FY 1991 budget instead of undergoing overhaul, and thus will not be converted to carry Tomahawks.

[87] These ships became non-nuclear-capable due to the retirement of nuclear ASROCs and Terriers. They are each powered by two nuclear reactors.

APPENDIX A: U.S. Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Nuclear Weapon(s)/ Homeport	Remarks
Research Vessels				
NR-1 class submersible NR-1	1	1969	Groton, CT	

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Diesel-Powered Ballistic Missile Submarines (SSB)				
None[88]				
Nuclear-Powered Ballistic Missile Submarines (SSBN)[89]				
YANKEE I class (names unknown)	11[90]	1967-74	Northern Fleet Pacific Fleet	16 SS-N-6 SLBM 6 21-inch torpedo tubes
HOTEL III class (name unknown)	1	1969-701	Northern Fleet	6 SS-N-8 SLBM 6 21-inch torpedo tubes
DELTA I class (names unknown)	18	1972-779	Northern Fleet	12 SS-N-8 SLBM 9 Pacific Fleet6 21-inch torpedo tubes
DELTA II class (names unknown)	4	1974-75	4 Northern Fleet	16 SS-N-8 SLBM 6 21-inch torpedo tubes
DELTA III class (names unknown)	14	1975-82	7 Northern Fleet 7 Pacific Fleet	16 SS-N-18 SLBM 6 21-inch torpedo tubes
YANKEE II class (name unknown)	1	1977	Northern Fleet	12 SS-N-17 SLBM 6 21-inch torpedo tubes
TYPHOON class (names unknown)	6	1983-89[91]	Northern Fleet	20 SS-N-20 SLBM 4 25.6-inch torpedo tubes in pressure hull 2 21-inch torpedo tubes SS-N-15 NDB SS-N-16 ASW missile

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88 Golf II class submarines are no longer nuclear armed and are in the process of being retired. As of late 1989, the seven in the Sea of Japan had been reduced to two; and the six in the Baltic had been reduced to four. All had been denuclearized and President Gorbachev promised in Helsinki, Finland in October 1989 that the submarines in the Baltic would be retired by the end of 1990; Bill Keller, "Gorbachev Plans to Destroy His A-Armed Subs in Baltic," New York Times, 27 October 1989, p. A10. The single Golf III class submarine and the single Golf V class submarine, both missile test platforms, have been retired. DIA, UNOOB, June 1989, p. 2. Three Golf class SSA, which serve as communications platforms, remain active.

89 There are 122 nuclear reactors on the SSBNs. Two nuclear reactors power each SSBN.

90 Yankee I class SSBNs continue to be retired as Delta IV and Typhoon submarines are activated. Submarines will probably all be retired by the mid-1990s at current rates. Seven Yankee I class submarines were retired from 1988-1990. Three have been converted to cruise missile and attack configuration; other may be converted.

91 U.S. naval intelligence previously believed that seven or eight Typhoon submarines would be built, but the program ended with the sixth submarine; Office of Naval Intelligence, "Current Naval Intelligence Issues," March 1987, p. 4.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
DELTA IV class (names unknown) (under construction)	6	1985-	Northern Fleet[92]	16 SS-N-23 SLBM[93] 6 21-inch torpedo tubes

Ballistic Missile Submarine Summary

Total Ballistic Missile Submarines: 61

Total Ballistic Missiles: 914 Warheads: 3802
SS-N-6: 176 Warheads: 352
SS-N-8: 286 Warheads: 286
SS-N-17: 12 Warheads: 12
SS-N-18: 224 Warheads: 1568
SS-N-20: 120 Warheads: 1200
SS-N-23: 96 Warheads: 384

Total Submarines Carrying Nuclear-capable ASW Weapons: 6
Total Nuclear-capable ASW Weapons: 24
Total Submarines Carrying Nuclear-capable Torpedoes: 61
Nuclear Torpedoes: 61

Diesel-Powered Cruise Missile Attack Submarines (SSG)[94]

JULIETT class (names unknown)	15[95]	1961-69	Northern Fleet ~4 Pacific Fleet ~5 Baltic Fleet[97] Black Sea Fleet	4 SS-N-3c SLCM[96] 6 21-inch torpedo tubes

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92 A Delta IV submarine could be transferred to the Pacific Fleet.

93 The SS-N-23 missile did not become operational until 1986; HASC, FY 1988/1989 DOD, Seapower and Strategic and Critical Materials Subcommittee, p. 9.

94 Seven WHISKEY Long Bin and two WHISKEY Twin Cylinder class SSGs with SS-N-3 SLCM and nuclear capable torpedoes were retired in 1985.

95 DIA, UNOOB, June 1989, p. 2. One Juliett class SSG was decommissioned in 1984-1985.

96 One submarine in the Northern Fleet may have been upgraded to carry the SS-N-12. Plans may have existed to upgrade all of the submarines of the Juliett class to the SS-N-12, but these plans will be cancelled if the submarines are to be retired.

97 Two Juliett class submarines were observed transiting from the Northern Fleet to the Baltic Sea in November 1989, presumably to prepare for decommissioning. They could, however, be heading for upgrade to the SS-N-12 missile. Three Julietts were transferred from the Northern Fleet to the Baltic Fleet previously.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Nuclear-Powered Cruise Missile Attack Submarines (SSGN)[98]				
ECHO II class	25[99]	1962-68	Northern Fleet	8 SS-N-3c or SS-N-12 SLCM[100]
(names unknown)			Pacific Fleet	6 21-inch torpedo tubes
CHARLIE I class (names unknown)	8[101]	1968-73	Pacific Fleet	8 SS-N-7 SLCM SS-N-15 NDB 6 21-inch torpedo tubes
PAPA class (name unknown)	1	1973	Northern Fleet	10 SS-N-9 SLCM[102] SS-N-15 NDB 6 21-inch torpedo tubes
CHARLIE II class (names unknown)	6	1974-82[103]	Northern Fleet	8 SS-N-9 SLCM[104] SS-N-15 NDB 6 21-inch torpedo tubes
OSCAR I class (names unknown)	4[105]	1981-89	Northern Fleet	24 SS-N-19 SLCM 4 21-inch torpedo tubes 4 25.6-inch torpedo tubes SS-N-15 NDB SS-N-16 ASW missile
(YANKEE class) (name unknown) (under conversion)	(1)[106]	1984-	Northern Fleet	(12 SS-NX-24 SLCM)[107] (6 21-inch torpedo tubes)

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98 There are 78 nuclear reactors on the SSGNs. One nuclear reactor powers each CHARLIE I/II SSGN, two reactors power each of the remaining SSGNs.

99 DIA, UNOOB, June 1989, p. 2. One Echo II SSGN was modified in the mid-1980s for special operations; another had an accident in July 1989 and did not reenter service.

100 About 20 of the ECHO II class SSGNs are thought to have been refitted to fire the SS-N-12 SLCM.

101 DIA, UNOOB, June 1989, p. 2, reports 16 Charlie I and II class submarines, one less than most sources. This equals ten Charlie Is and six Charlie IIs. Two Charlie I class submarines have been leased to India, one on 1 May 1988, and one in 1989.

102 Formerly thought to carry the SS-N-7 SLCM.

103 DIA, Force Structure Summary, February 1989, p. 20.

104 The SS-N-7 SLCM is possibly deployed on some Charlie II class SSGNs.

105 Jane's Fighting Ships 1990-91, p. 586, states incorrectly that only the first two of the Oscar class SSGNs are Oscar Is. The first four are Oscar Is; all subsequent SSGNs are Oscar IIs.

106 This submarine is not yet fully operational with the SS-NX-24 SLCM, and is not nuclear armed or included in the nuclear-capable ship totals.

107 "The Yankee SSGN is the only unit capable of launching this missile at this time;" RADM Thomas A. Brooks, February 1989, p. 11.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
OSCAR II class (names unknown) (under construction)	1	1989-[108]	Northern Fleet	24 SS-N-19 SLCM 4 21-inch torpedo tubes 4 25.6-inch torpedo tubes SS-N-15 NDB SS-N-16 ASW missile

Cruise Missile Submarine Summary

Total Nuclear-capable Cruise Missile Submarines: 60
Total Diesel-Powered: 15
Total Nuclear-Powered: 45

Total Nuclear-capable Cruise Missiles: 502	Warheads: 280[109]
SS-N-3 Missiles: 96	Warheads: 76
SS-N-7 Missiles: 64	Warheads: 32
SS-N-9 Missiles: 58	Warheads: 28
SS-N-12 Missiles: 164	Warheads: 84
SS-N-19 Missiles: 120	Warheads: 60

Total Submarines Carrying Nuclear-capable ASW Weapons: 20
Total Nuclear-capable ASW Weapons: 80
Total Submarines Carrying Nuclear-capable Torpedoes: 60
Nuclear Torpedoes: 60

Diesel-Powered Attack Submarines (SS)[110]

WHISKEY class (names unknown) others unknown	40[111]	1951-57	Northern Fleet Baltic Fleet	4 21-inch torpedo tubes
FOXTROT class (names unknown)	35[112]	1958-67	Northern Fleet Pacific Fleet Baltic Fleet Black Sea Fleet	6-10 21-inch torpedo tubes

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108 The first Oscar II class submarine was launched in 1988; RADM Thomas A. Brooks, February 1989, p. 10.

109 SLCMs are calculated as four nuclear versions per ship, except the Oscar class, which are assumed to carry 12.

110 The last Zulu and Romeo class submarines were retired or made non-operational in 1984-1988; RADM Thomas A. Brooks, February 1989, p. 9; DIA, UNOOB, June 1989, p. 2. Four Bravo class target training submarines with 6 21-inch torpedo tubes could also be nuclear armed.

111 Of the 236 Whiskey class submarines originally produced, about 45 are believed to be nominally active, and another 60-70 are believed to be in inactive reserve. Four are designated SSA/SSQ. In 1988, Whiskey class submarines started to be sold for scrap overseas. By the end of 1989, 16 submarines had been disposed of. DIA, UNOOB, June 1989, p. 3; Jane's Fighting Ships 1990-91, p. 596. Between 1986-1989, five Whiskey submarines were deleted from the operational force; and another five are assumed to have been retired in 1989-1990. The number of operational Whiskey class submarines may be lower.

112 DIA, UNOOB, 1989, p. 3. DIA credits five submarines as being retired between 1986-1989. Another five are assumed to have been retired from 1989-1990. Additional Foxtrot submarines are part of the reserve.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
TANGO class (names unknown)	15[113]	1973-82	Northern Fleet Black Sea Fleet	8-10 21-inch torpedo tubes possible 25.6-inch torpedo tubes possible SS-N-15 NDB possible SS-N-16 ASW missile[114]
KILO class (names unknown) (under construction)	11[115]	1980-	Pacific Fleet Northern Fleet others unknown	6 21-inch torpedo tubes
Nuclear-Powered Attack Submarines (SSN)[116]				
NOVEMBER class (names unknown)	11[117]	1958-64	Northern Fleet others unknown	6 21-inch torpedo tubes
HOTEL II class names unknown)	4[118]	1959-62	unknown	6 21-inch torpedo tubes
VICTOR I class (names unknown)	16	1967-75	Northern Fleet Pacific Fleet	possible SS-N-15 NDB 6 21-inch torpedo tubes
ECHO I class (names unknown)	3[119]	1970-74[120]	Pacific Fleet	6 21-inch torpedo tubes
VICTOR II class (names unknown)	7	1972-78	Pacific Fleet others unknown	SS-N-15 NDB 6 21-inch torpedo tubes

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[113] DIA, UNOOB, June 1989, p. 3. DIA credits five submarines as being retired between 1986-1989.

[114] DIA, Force Structure Summary, February 1989, p. 20.

[115] DIA, UNOOB, June 1989, p. 3. The 12th Kilo class SS was launched for the Soviet Navy in 1988, and will probably become operational in 1991. Kilo submarines have also been built for India, Poland, Romania, and Algeria.

[116] There are 149 nuclear reactors on the SSNs. Two nuclear reactors power each SSN, except for the Alfa class which have one reactor each. The single Mike class SSN sank in April 1989.

[117] The operational status of these submarines is doubtful. The classes are to be retired in 1990; Jane's Fighting Ships 1990-91, p. 593.

[118] DIA, UNOOB, June 1989, p. 2. Four submarines were converted from ballistic missile configuration to attack submarines before a decision was made to retire the first generation nuclear-powered boats. DIA assumes that an additional SSBN was converted to an SSN between 1986-1989, but this is doubtful given the retirement program.

[119] DIA, UNOOB, June 1989, p. 2. Three Echo class SSGN were converted to SSNs; they will be retired in 1989-1991; Jane's Fighting Ships 1990-91, p. 579.

[120] These are converted from cruise missile submarines built 1960-1962.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
ALFA class (names unknown)	5[121]	1978-83	Northern Fleet	SS-N-15 NDB[122] 6 21-inch torpedo tubes
VICTOR III class (names unknown) (under construction)	23[123]	1979-86	Northern Fleet Pacific Fleet others unknown	SS-N-21 SLCM[124] SS-N-16 ASW missile[125] 2 21-inch torpedo tubes 4 25.6-inch torpedo tubes
YANKEE class (name unknown) (under conversion)	1[126]	1984-	unknown	6 21-inch torpedo tubes possible 25.6-inch torpedo tubes probable SS-N-15 NDB possible SS-N-16 ASW missile
YANKEE NOTCH class (name unknown) (under conversion)	1[127]	1988-	unknown	20+ SS-N-21 SLCM 6 21-inch torpedo tubes
SIERRA class (name unknown) (under construction)	2[128]	1986-	Northern Fleet	SS-N-21 SLCM SS-N-15 NDB SS-N-16 ASW missile 6 21- and 25.6-inch torpedo tubes
AKULA class (name unknown) (under construction)	4[129]	1987-	3 Pacific Fleet 1 Northern Fleet	SS-N-21 SLCM SS-N-15 NDB SS-N-16 ASW missile 6 21- and 25.6-inch torpedo tubes

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121 One Alfa class SSN was deactivated in 1986-1987.

122 DIA, Force Structure Summary, February 1989, p. 20. IISS, The Military Balance 1989-1990, states incorrectly that the Alfa class carries the SS-N-16 ASW missile.

123 The Soviet Navy launched its 23rd Victor III in 1988 and presumably the 24th in 1989; RADM Thomas A. Brooks, February 1989, p. 10. It is not known how many of these submarines are fully operational. DIA, UNOOB, June 1989, p. 2.

124 A modified VICTOR III in the Northern Fleet is being used as a test platform for the SS-NX-21.

125 Although IISS, The Military Balance 1989-1990, lists the Victor III as carrying the SS-N-15, DIA, Force Structure Summary, February 1989, p. 20, states that the submarine does not carry the weapon.

126 More are reportedly undergoing conversion; DOD, SMP 1987, p. 67.

127 DIA, UNOOB, June 1989, p. 3.

128 DIA, UNOOB, June 1989, p. 3.

129 DIA, UNOOB, June 1989, p. 3. At least five submarines are under construction.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Attack Submarine Summary

Total Attack Submarines: 178
Total Nuclear-Powered Attack Submarines: 77
Total Diesel-Powered Attack Submarines: 101[130]

Total Submarines Capable of Carrying SS-N-21 SLCMs: 30
Total Nuclear SS-N-21 SLCMs Deployed: 136[131]

Total Submarines Carrying Nuclear Capable ASW Weapons: 73
Total Nuclear Capable ASW Weapons: 292
Total Submarines Carrying Nuclear-capable Torpedoes: 178
Nuclear Torpedoes: 178

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Guided Missile VSTOL Aircraft Carriers (CVHG)				
KIEV class	3	1975-87		8 SS-N-12 SLCM (with 8 reloads)
Kiev			Northern Fleet	1 twin SUW-N-1/FRAS-1 ballistic rocket
Minsk			Pacific Fleet	
Novorossiysk			Pacific Fleet	72 SA-N-3 SAMs up to 24 Ka-25 Hormone A/B or Ka-27 Helix A; possible NDBs[132] 10 21-inch torpedo tubes
BAKU class[133]	1	1988		12 SS-N-12 SLCM (with reloads)
Baku			Northern Fleet	up to 24 helicopters: either Ka-25 Hormone A/Bs or Ka-27 Helix A; possible NDBs

130 DIA, Force Structure Summary, February 1989, p. 20, reported 115 diesel powered attack submarines as of February 1989.

131 Assumes that Sierra, Victor III, and Akula class SSNs carry four SS-N-21 SLCMs, and that the single Yankee Notch submarine carries 20 or more.

132 12 Yak-38 Forger STOL aircraft are carried on the Kiev and Baku classes. The aircraft, however, are not believed to be nuclear-capable.

133 The Baku, fourth ship of the Kiev class, has significantly different command and control and weapons configuration than the first three ships of the class. The Baku does not have FRAS-1 or SA-N-3 weapons. "Analysis of changes to the Baku," Jane's Defence Weekly, 6 August 1988.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Aircraft Carriers (CV)				
TBILISI class	(2)	1991-	Black Sea Fleet	Apparently no nuclear weapons;[134] possible SS-N-19 SLCM
Tbilisi				
Riga				
UL'YANOVSK class	(1)	1995-	Black Sea Fleet	unknown
Ul'yanovsk				

Aircraft Carrier Summary

Total Aircraft Carriers: 4
Total Aircraft Carriers with SLCMs: 4
Total SS-N-12 Cruise Missiles: 36 Warheads: 16

Total Aircraft Carriers with Nuclear ASW Weapons: 4
Total Ka-25/Ka-27 Anti-submarine Helicopters: 96
Total ASW NDBs: 96
Total Nuclear-capable FRAS-1 ASW Rockets: 6 Warheads: 25
Total Carriers Carrying Nuclear-capable Torpedoes: 3
Nuclear Torpedoes: 3

Total Aircraft Carriers with Nuclear-capable Surface-to-air Missiles: 3
Total nuclear capable SA-N-3 missiles: 216 Warheads: 12

Guided Missile Aviation Cruisers (CHG)				
MOSKVA class	2	1967-68		1 twin SUW-N-1/FRAS-1 ballistic rocket
Moskva			Black Sea Fleet	48 SA-N-3 SAMs
Leningrad			Black Sea Fleet	14 Ka-25 Hormone A/B helicopters; possible NDBs
Guided Missile Cruiser (CG)				
KYNDA class	4	1962-65		8 SS-N-3b SLCM[135]
Groznyy			1 Baltic Fleet	6 21-inch torpedo tubes
Admiral Fokin			2 Pacific Fleet	16 SA-N-1 SAMs
Admiral Golovko			1 Black Sea Fleet	
Varyag				
KRESTA I class	4	1967-69		4 SS-N-3b SLCM
Admiral Zozulya			1 Northern Fleet	32 SA-N-1 SAMs
Vladivostok			2 Pacific Fleet	10 21-inch torpedo tubes
Vitse Admiral Drozd			1 Baltic Fleet	1 Ka-25 Hormone B for targeting
Sevastopol				

[134] According to TASS (22 November 1989), the Tbilisi will not carry nuclear weapons. But, nonetheless, the first ship will be capable of carrying VSTOL aircraft and Ka-27/32 ASW helicopters, and could carry nuclear bombs or nuclear depth bombs. Subsequent ships could carry the Su-27 Flanker or MiG-29 Fulcrum aircraft, which could be nuclear capable.

[135] May includes eight reloads as well.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
KRESTA II class	10	1969-78		10 21-inch torpedo tubes
Kronshtadt			6 Northern Fleet	48 SA-N-3 SAMs
Admiral Isakov			1 Baltic Fleet	1 Ka-25 Hormone A;
Admiral Nakhimov			3 Pacific Fleet	possible NDBs
Admiral Makarov				
Marshal Voroshilov				
Admiral Oktyabrskiy				
Admiral Isachenkov				
Marshal Timoshenko				
Vasiliy Chapayev				
Admiral Yumashev				
KARA class	7	1973-80		72 SA-N-3 SAMs
Nikolayev			Black Sea Fleet	10 21-inch torpedo tubes
Ochakov			Black Sea Fleet	1 Ka-25 Hormone A; possible
Kerch			Black Sea Fleet	NDB
Azov[136]			Black Sea Fleet	
Petropavlovsk			Pacific Fleet	
Tashkent			Pacific Fleet	
Tallinn			Pacific Fleet	
SLAVA class[137]	3[138]	1981-		6 SS-N-12 SLCM[139]
Slava			Black Sea Fleet	8 21-inch torpedo tubes
Marshal Ustinov			Northern Fleet	1 Ka-25 Hormone A or
Chervona Ukraina				Ka-27 Helix A; possible NDB;[140]
Admiral Kuznetzov[141]				(64 SA-N-6 SAMs/VLS)[142]

Light Cruisers (CL)

None[143]

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136 Azov is a test ship for SAMs, has six SA-N-6 in vertical launchers, one SA-N-3 twin launcher, and four 21-inch torpedo tubes.

137 Originally referred to as KRASINA class.

138 Two additional SLAVA class cruisers under construction or fitting out; U.S. Navy, Office of Naval Intelligence, "Current Naval Intelligence Issues," March 1987, p. 4; DIA, UNOOB, June 1989, p. 3.

139 A single Ka-25 Hormone B is also embarked for over-the-horizon targeting.

140 Although western sources credit the Slava class with helicopters for missile-targeting only, during visits of the Marshal Ustinov to Norfolk in 1989, ships' personnel admitted that the helicopters had anti-submarine warfare capability; Norman Polmar, "A Perspective on Surface Combatants," Proceedings, November 1989, p. 134.

141 Jane's Fighting Ships 1990-91, p. 605.

142 The SA-N-6 is no longer thought to be nuclear capable.

143 The last Sverdlov class light cruisers with 152mm artillery guns were denuclearized in 1988-1989.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Nuclear-Powered Guided Missile Cruisers (CGN)[144]				
KIROV class	3[145]	1980-		20 SS-N-19 SLCM
Kirov			Northern Fleet	8-10 21-inch torpedo tubes
Frunze			Pacific Fleet	(96 SA-N-6 SAMs)[146]
Kalinin			Northern Fleet[147]	3 Ka-25 Hormone or Ka-27
Yuri Andropov[148]				Helix helicopters; possible NDBs

Cruiser Summary

Total Cruisers: 33

Total Cruisers with SLCMs: 14
Total Nuclear-capable Cruise Missiles: 156 Warheads: 32
Total SS-N-3 Cruise Missiles: 48 Warheads: 14
Total SS-N-12 Cruise Missiles: 48 Warheads: 6
Total SS-N-19 Cruise Missiles: 60 Warheads: 12

Total Ka-25/Ka-27 Anti-submarine Helicopters: 33
Total ASW NDBs: 33

Total Cruisers with Nuclear-capable Surface-to-air Missiles: 27
Total Nuclear-capable Surface-to-air Missiles: 1176 Warheads: 108

Total Cruisers Carrying Nuclear-capable Torpedoes: 31
Nuclear Torpedoes: 31

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144 There are six nuclear reactors on the CGNs. Two reactors power each ship.

145 The third Kirov class ship was operational in 1989. The fourth ship was launched in April 1989 and will be commissioned in 1991; RADM Thomas A. Brooks, February 1989, p. 12; DIA, UNOOB, June 1989, p. 3.

146 The SA-N-6 is no longer thought to be nuclear capable.

147 To go to the Baltic Fleet when completed; Jane's Fighting Ships 1990-91, p. 602.

148 A fourth vessel, laid down in April 1986, is due to be commissioned in 1992; "Kalinin latest addition to Northern Fleet," Jane's Defence Weekly, 14 January 1989.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Destroyers (DD)				
None[149]				
Guided Missile Destroyers (DDG)[150]				
KASHIN class	12	1962-72		5 21-inch torpedo tubes
Komsomolets Ukrainyy			1 Northern Fleet	32 SA-N-1 SAMs[151]
Soobrazitel'nyy			1 Baltic Fleet	
Obraztsovyy			8 Black Sea Fleet	
Odarennyy			2 Pacific Fleet	
Steregushichiy				
Krasnyy Kavkaz				
Reshitelnyy				
Strogiy				
Smetlivvy				
Krasnyy Krym				
Sposobnyy				
Skoryy				
MOD KASHIN class[152]	5[153]	1964-73		5 21-inch torpedo tubes
Sderzhanny			3 Northern Fleet	36 SA-N-1 SAMs
Slavny			1 Baltic Fleet	
Smyshlenny			1 Black Sea Fleet	

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149 DIA, UNOOB, June 1989, p. 4, list 10 Mod Kildin, Kotlin, Mod Kotlin, and Skoryy destroyers; one in the Northern Fleet, three in the Baltic Fleet, and six in the Black Sea Fleet. By 1990, it is assumed that all of the remaining ships of these classes had been retired.

Twenty Skoryy class destroyers were produced from 1949-1953. The two remaining Skoryy class assigned to the Northern Fleet were retired in 1989-1990. Skoryy class destroyers in the Pacific Fleet were reduced, 1984-1988; RADM Thomas A. Brooks, February 1989, p. 9.

The number of Kotlin class DDs, produced between 1955-1958, declined considerably from 1985-1990; about five remained by 1989. Kotlin class destroyers were reduced in the Pacific Fleet, 1984-1988. Jane's Fighting Ships 1990-91, p. 579, reports six Kotlin deleted in 1987-1988, and 11 Kotlin deleted in 1989-1990.

Jane's Fighting Ships 1990-91, p. 579, reports three Mod Kildin DDs deleted in 1989-1990.

150 Six Kanin class destroyers were retired from 1984-1989. The single Kildin class destroyer and the single Converted Kashin class destroyer were retired in the late 1980s. DIA, UNOOB, June 1989, p. 4; RADM Thomas A. Brooks, February 1989, p. 9.

DIA, UNOOB, June 1989, p. 9, reported four SAM Kotlin remaining in mid-1989. Jane's Fighting Ships 1990-91, p. 579, reports one SAM Kotlin deleted in 1987-1988, and seven deleted in 1989-1990.

151 The SA-N-1 could also be used in a surface-to-surface role. One additional non-nuclear ship (Prevornyy) has been converted as a test ship for the SA-N-7 SAM.

152 Modifications were made between 1973-1980.

153 DIA, Naval Order or Battle, June 1989, p. 4. Jane's Fighting Ships 1990-91, p. 579, reports two MOD Kashin deleted in 1989.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
SOVREMENNYY class	10[154]	1981-		8 SS-N-22 SLCM[155]
Sovremennyy			5 Northern Fleet	4 21-inch torpedo tubes
Otchayannyy			2 Baltic Fleet	1 Ka-25 Hormone A or
Otlichnyy			3 Pacific Fleet	Ka-27 Helix A; possible NDB[156]
Osmotritel'nyy				(SA-N-7 SAM)[157]
Bezuprechnyy				
Boyevoy				
Stoyky				
Okrylenny				
Burnyy				
Gremyashchy				
Bystry				
Rastoropny				
(under construction)[158]				
UDALOY class	10[159]	1981-		8 21-inch torpedo tubes[160]
Udaloy			3 Northern Fleet	2 Ka-27 Helix A
Vitze Admiral Kulakov			3 Baltic Fleet	helicopters; possible NDBs
Marshal Vasil'yevskiy			4 Pacific Fleet	(SA-N-9 SAM)[161]
Admiral Zakharov				
Admiral Spiridonov				
Admiral Tributs				
Marshall Shaposhnikov				
Simferopol				
Admiral Levchenko				
Admiral Vinogradov				
Admiral Kharlamov				
(under construction)[162]				

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154 DIA, UNOOB, June 1989, p. 4. Two Sovremennyy class destroyers are on sea trials, and at least six are under construction; Jane's Fighting Ships 1990-91, p. 610.

155 A single Ka-25 Hormone B is also embarked for over-the-horizon targeting.

156 Although western sources credit the Sovremennyy class with helicopters for missile-targeting only, during visits of the Otlichnyy to Norfolk in 1989, ships' personnel admitted that the helicopters had anti-submarine warfare capability; Norman Polmar, "A Perspective on Surface Combatants," Proceedings, November 1989, p. 134.

157 This SAM is not nuclear capable.

158 One more has been launched and six more are under construction at the Zhdanov Shipyard, Leningrad.

159 DIA, UNOOB, June 1989, p. 4. One Udaloy class DDG is on sea trials in 1990, and two are under construction; Jane's Fighting Ships 1990-1991, p. 611.

160 Eight "long-range cruise missile-delivered ASW weapons" are reported in DOD, SMP 1986, p. 84; They have been identified as the non-nuclear SS-N-14.

161 This SAM is not nuclear capable.

162 Two more are under construction.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Destroyer Summary

Total Guided Missile Destroyers: 37

Total Guided Missile Destroyers with SLCMs: 10
Total SS-N-22 Cruise Missiles: 80 Warheads: 20

Total Ka-25/Ka-27 Anti-submarine Helicopters: 30
Total ASW NDBs: 30

Total Guided Missile Destroyers with Nuclear-capable Surface-to-air Missiles: 17
Total Nuclear-capable Surface-to-air Missiles: 564 Warheads: 68

Total Guided Missile Destroyers Carrying Nuclear-capable Torpedoes: 37
Nuclear Torpedoes: 37

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Guided Missile Frigates (FFG)				
RIGA class Arkhangelsky Komsomolets Bars Barsuk Kuguar Kunitsa Leopard Rys Sovetsky Azerbaydzhan Sovetsky Dagestan Sovetsky Turkmenistan Tuman Volk Voron	25[163]	1955-1956	Northern Fleet Pacific Fleet Baltic Fleet Black Sea Fleet	2 or 3 21-inch torpedo tubes
GRISHA I/III/IV/V class[164] (15 Grisha I) (32 Grisha III) (1 Grisha IV) (14 Grisha V) (under construction)[166]	61[165]	1968-	unknown	4 21-inch torpedo tubes
KRIVAK I class Bditel'nyy Bodryy	21	1970-82	Northern Fleet Pacific Fleet Baltic Fleet	8 21-inch torpedo tubes

[163] DIA, UNOOB, June 1989, p. 4 says 30 Riga and Koni class frigates. The Riga class is being retired; Jane's Fighting Ships 1990-91, p. 579 states that seven Riga class frigates were deleted in 1987-1988 and 15 were deleted in 1989-1990.

[164] The Grisha II class ships are KGB ships.

[165] Jane's Fighting Ships 1990-91, p. 616.

[166] Grisha V class are under construction.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
			Black Sea Fleet	
Dostoynyy				
Svirepyy				
Doblestnyy				
Sil'nyy				
Storozhevoy				
Razumnyy				
Razyashchiy				
Deyatel'nyy				
Druzhnyy				
Retiyy				
Zharkyy				
Leningradskiy Komsomolets				
Letuchiy				
Bezzavetnyy				
Pylkiy				
Zadornyy				
Bezukoriznennyy				
Ladnyy				
Poryvistyy				
KRIVAK II class[167]	11	1975-82	Northern Fleet Pacific Fleet Baltic Fleet Black Sea Fleet	8 21-inch torpedo tubes
Rezvyy				
Rezkiy				
Grozyashchiy				
Razitel'nyy				
Bessmennyy				
Neukrotimyy				
Gordelivyy				
Gromkiy				
R'yanyy				
Revnostnyy				
Pytlivyy				
BALCOM-8 class (names unknown) (under construction)[169]	(2)	1990-	unknown	(SS-N-25 SLCM)[168] 1 Ka-27 Helix; possible NDBs unknown torpedo tubes

Frigate Summary

Total Frigates: 118

Total Frigates Carrying Nuclear-capable Torpedoes: 118
Nuclear Torpedoes: 118

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167 Five to eight Krivak III frigates also carry 21-inch torpedo tubes but are assigned to the KGB Maritime Border Troops and are not thought to be nuclear armed.

168 This new short-range SLCM is thought to be non-nuclear.

169 Two frigates are under construction in the Baltic Sea, and are designated BALCOM-8 in the west pending official naming. They are follow-ons to the Krivak II/III class ships.

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Guided Missile Patrol Combatant (PGG)[170]				
NANUCHKA I class Burun Grad Molniya Musson Raduga Shkval Shtorm Tayfun Tsiklon Zarnitsa Zub 5 unknown names)	16[171]	1969-76	unknown	6 SS-N-9 SLCM
NANUCHKA III class (names unknown) (under construction)	15[172]	1977-	Baltic Fleet	6 SS-N-9 SLCM
TARANTUL III class (name unknown) (under construction)	10	1981-	Baltic Fleet	4 SS-N-22 SLCM
TURYA class (names unknown)	31[173]	1972-78	unknown	4 21-inch torpedo tubes
Guided-Missile Patrol Combatant (Air Cushion) (PGGA)				
UTKA class (names unknown)	1	1986	Caspian Sea Flotilla[174]	6 SS-N-22 SLCM
(DERGACH class) (names unknown)	(1)	unknown	unknown	(SS-N-22 SLCM)[175]
Guided-Missile Patrol Combatant (Hydrofoil) (PGGH)				
SARANCHA class (name unknown)	1	1977		4 SS-N-9 SLCM

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170 DIA, UNOOB, June 1989, p. 4, states 60 Sarancha, Dergach/Utka, Nanuchka, and Tarantul. A single Nanuchka IV may be trials ship for the new non-nuclear SS-N-25 SLCM; Jane's Fighting Ships 1990-91, p. 621.

171 Jane's Fighting Ships 1990-91, pp. 579 and 621, states one Nanuchka I class PGG sent to the reserve in 1989.

172 Jane's Fighting Ships 1990-91, p. 621.

173 Jane's Fighting Ships 1990-91, p. 623.

174 Jane's Fighting Ships 1990-91, p. 621.

175 Not included in nuclear-capable ship totals.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Patrol Combatants Summary

Total Nuclear-capable Patrol Combatants: 74

Total Patrol Combatants with SLCMs: 43
Total Nuclear-capable Cruise Missiles: 236 Warheads: 86
Total SS-N-9 Cruise Missiles: 190 Warheads: 64
Total SS-N-22 Cruise Missiles: 46 Warheads: 22

Total Patrol Combatants Carrying Nuclear-capable Torpedoes: 31
Nuclear Torpedoes: 31

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Support Ships				
Missile Transport/Missile Tenders (AEM)[176]				
AMGA class Amgamissile Vetluga Daugava	3	1973-1981	unknown	SS-N-6, SS-N-8, SS-N-18 transport for submarines
LAMA class General Riyabakov Voronezh (PM-872) PM-44 PM-93 PM-131 PM-150 PB-625	7	1963-1979	unknown	Cruise missile transport and submarines
MOD ANDIZHAN class Venta (ex-Lakhta) Vilyuy (ex-Posyet)	2[177]	1958-1960	unknown	SS-N-9 SLCM and SA-N-3 SAM transport; helicopter landing deck
MELITOPOL class Indirka Fort Sheverenko	2	1950s	unknown	

[176] Two MP 6 class missile transporters, converted landing ships commissioned 1958-1960, and used as SS-N-5 ballistic missile transporters in the Baltic Fleet and Sea of Japan. Three other ships of the class are cargo ships and do not transport ballistic missiles.

[177] These ships are former merchant ships converted in the mid-1970s. Three others of the class are naval cargo boats and do not transport missiles.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Special Liquids Tankers (AOS)				
LUZA class Alambaifuel Aragvi Barguzin Don Kama Selenga	6	1960s	unknown	Transport of SLBM liquid
URAL class Ural	1	1969	Pacific Fleet	Nuclear waste transport
VALA class TNT-11 TNT-12 TNT-19 TNT-29 (others unknown)	7	1960s	unknown	Nuclear waste transport
Repair Ships (AR)				
MALINA class PM-63 PM-74	2	1984-1985	Pacific Fleet Northern Fleet	Nuclear materials transport supporting reactors on ships and submarines
PINEGA class Amur Pinega	2	1986-1987	 Northern Fleet Pacific Fleet	
Replenishment Oilers (AOR)				
BEREZINA class Berezina	1	1978	Black Sea Fleet	Submarine weapons support
Submarine Support Ship/Submarine Tenders (AS)				
BRYKIN class Alexander Brykin	1	1988-	Northern Fleet	Strategic FBM tender[178] 16 vertical storage holds for SS-N-20[179]

[178] DOD, SMP 1987, p. 95.

[179] Jane's Fighting Ships 1990-91, p. 637.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
UGRA class	7	1963-1972		Possible nuclear torpedo transport; landing decks for Ka-25 Hormone C transports[180]
Ivan Kolvshkin			Pacific Fleet	
Ivan Kucherenko			others unknown	
Ivan Vakhrameev				
Tobol				
Volga				
(other names unknown)				
DON class	6	1958-1961		Possible nuclear torpedo transport[181]
Dmitriy Galkin			Pacific Fleet	
Fyodor Vidyaev			others unknown	
Kamchatskiy Komsomolets				
Magadanskiy Komsomolets				
Magomed Gadziev				
Viktor Kotel'niko				

Non-Nuclear-capable Nuclear-powered Ships

Nuclear-Powered Submarines in Non-weapons Status

YANKEE class SSUN	11[182]			
ECHO class SSAN/SSQN	1[183]			
BELUGA class SSN	1[184]			
UNIFORM class SSAN	2	1982-1990	Northern Fleet Pacific Fleet	Special Operations
X-RAY class SSQN	1	1987		Oceanographic Research

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180 The Ivan Kolyshkin has a helicopter hanger; Jane's Fighting Ships 1990-91, p. 636.

181 Viktor Kotel'nikov and Magadansk have helicopter landing decks.

182 There are 14 Hotel and Yankee class SSUN; DIA, UNOOB, June 1989, p. 3. Thirty-four Yankee class submarines were constructed during 1967-1974, and 15 remain in active service, 11 Yankee Is, one Yankee II and three which have been converted to attack and cruise missile configurations. Of the 19 remaining submarines, one sank in October 1986, leaving 18 submarines in an uncertain non-weapons status or awaiting disposal.

183 DIA, UNOOB, June 1989, p. 3.

184 DIA, UNOOB, June 1989, p. 3.

APPENDIX B: Soviet Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Nuclear-Powered Submarines Awaiting Disposal				
HOTEL class SSUN	3[185]			
YANKEE class SS(B)N	7			
NOVEMBER class SSN	1[186]			
ALFA class SSN	1[187]			
Nuclear-Powered Icebreakers (AGBN)[188]				
TAYMYR class Taymyr Vaygach	2[189]	1988-1990	Northern Fleet	
ARKTIKA class Artika (ex-Leonid Brezhnev) Sibir' Rossiya Sovetskiy Soyuz Oktyabryskaya Revolutsiya	5	1975-1990	Northern Fleet (others unknown)	
Nuclear-Powered Auxiliaries (AGN)				
KAPUSTA class	1	1989	Pacific Fleet	Missile range control, intelligence collection, flagship
Nuclear-Powered Barge Carriers				
SEVMORPUT class	1	1989	Pacific Fleet	Civilian arctic resupply

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185 Eight Hotel I/II class submarines were built by 1968. One was subsequently converted to Hotel III class and is still active. Four others were converted to attack submarine configuration and are still active. The exact disposition of the remaining three is unknown, but they are thought to be awaiting disposal.

186 One submarine has been retired from the active force. Its status is unknown.

187 Although seven Alfa class were built, one was scrapped and dismantled in 1974. One was retired in 1987-1989. Five remain active.

188 There are 12 nuclear reactors on the Icebreakers. Two nuclear reactors power each Icebreaker.
The single ship of the Lenin class, commissioned in 1959 and serving in the Northern Fleet, was retired in 1990; Jane's Fighting Ships 1990-91, p. 579.

189 Constructed at the Wartsila Shipyard, Helsinki, Finland. The nuclear reactors were added at the Baltic Shipyard in Leningrad. The Vaygach was launched on sea trials in July 1990.

APPENDIX C: British Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Nuclear-powered Ballistic Missile Submarines (SSBN)[190]				
RESOLUTION Class	4	1967-69		
HMS Resolution (S22)			Faslane	16 Polaris A3-TK Chevaline SLBM
HMS Repulse (S23)			Faslane	16 Polaris A3-TK Chevaline SLBM
HMS Renown (S26)			Faslane	16 Polaris A3-TK Chevaline SLBM
HMS Revenge (S27)			Faslane	16 Polaris A3-TK Chevaline SLBM
VANGUARD class	(2+2)	mid-1990s		
(HMS Vanguard)			(Faslane)	(16 Trident II D5 SLBM)
(HMS Victorious)			(Faslane)	(16 Trident II D5 SLBM)
(HMS Vigilant)			(Faslane)	(16 Trident II D5 SLBM)
(one more planned)			(Faslane)	(16 Trident II D5 SLBM)

Ballistic Missile Summary

Total Ballistic Missile Submarines: 4
Total Ballistic Missiles: 64 Warheads: 96

Aircraft Carriers (CV)				
INVINCIBLE Class	3	1980-85		
HMS Invincible (R05)			Portsmouth	12 Sea Harriers, 5 ASW Sea Kings
HMS Illustrious (R06)[191]			Portsmouth	8 Sea Harriers, 9 ASW Sea Kings
HMS Ark Royal (R07)			Portsmouth	8 Sea Harriers, 9 ASW Sea Kings

Aircraft Carrier Summary

Total Aircraft Carriers: 3
Total Sea Harriers: 28
Total ASW helicopters: 23
Total Nuclear Depth and Strike Bombs: 15-18 (5-6 per carrier)

Destroyers (DD)				
TYPE 42 class	12			1-2 Lynx ASW helicopters;
Batch 1		1976-79		nuclear depth bombs
HMS Birmingham (D86)			Portsmouth	
HMS Newcastle (D87)			Portsmouth	
HMS Glasgow (D88)			Rosyth	
HMS Cardiff (D108)			Portsmouth	

[190] One nuclear reactor powers each SSBN.

[191] The Illustrious is the current carrier in a stand-by status.

APPENDIX C: British Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Batch 2		1980-82		
HMS Exeter (D89)			Portsmouth	
HMS Southampton (D90)			Portsmouth	
HMS Nottingham (D91)			Portsmouth	
HMS Liverpool (D92)			Rosyth	
Batch 3		1982-85		
HMS Manchester (D95)			Portsmouth	
HMS Gloucester (D96)			Portsmouth	
HMS Edinburgh (D97)			Rosyth	
HMS York (D98)			Rosyth	

Destroyer Summary

Total Nuclear-capable Destroyers: 12
Total Lynx Helicopters: 12-24

Frigates (FF)

TYPE 22 class	14			
Batch 1		1979-82		
HMS Broadsword (F88)			Devonport	1-2 Lynx ASW helicopters;
HMS Battleaxe (F89)			Devonport	nuclear depth bombs
HMS Brilliant (F90)			Devonport	
HMS Brazen (F91)			Devonport	
Batch 2		1983-88		
HMS Boxer (F92)			Devonport	
HMS Beaver (F93)			Devonport	
HMS Brave (F94)			Devonport	
HMS London (F95)			Devonport	
HMS Coventry (F98)			Devonport	
HMS Sheffield (F96)			Devonport	
Batch 3		1987-90		
HMS Cornwall (F99)			Devonport	1-2 Lynx or 1 Sea King ASW
HMS Cumberland (F85)			Devonport	helicopter; nuclear depth bombs
HMS Campbletown (F86)			Devonport	
HMS Chatham (F87)			Devonport	
TYPE 23 class	1(+9)	1989		1-2 Lynx or 1 Sea King ASW
HMS Norfolk (F230)			Devonport	helicopter; nuclear depth bombs
(HMS Argyll (F231))			--	To be delivered in 1991.
(HMS Lancaster (F232))			--	To be delivered in 1992.
(HMS Malborough (F233))			--	To be delivered in 1991.
(HMS Iron Duke (F234))			--	To be delivered in 1992.
(HMS Monmouth (F235))			--	To be delivered in 1992.
(HMS Montrose (F236))			--	To be delivered in 1993.
(HMS Westminster (F237))			--	To be delivered in 1994.
(HMS Northumberland (F238))			--	To be delivered in 1994.
(HMS Richmond (F239))			--	To be delivered in 1995.

Frigate Summary

Total Nuclear-capable Frigates: 15
Total Nuclear-capable ASW Helicopters: 15-30

APPENDIX C: British Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Support Ships				
Fleet Replenishment Ships[192]				
FORT class	2	1978-79		
RFA Fort Grange (A385)			n.a.	
RFA Fort Austin (A386)			n.a.	
RESOURCE class	2	1967		
RFA Resource (A480)			n.a.	
RFA Regent (A486)			n.a.	
Support Ship Summary				
Total Nuclear-capable Support Ships: 4				
Non-Nuclear-capable Nuclear-powered Ships				
Attack Submarines (SSN)[193]				
TRAFALGAR class	6(+1)	1983-		
Trafalgar (S107)			Devonport	
Turbulent (S87)			Devonport	
Tireless (S88)			Devonport	
Torbay (S90)			Devonport	
Trenchant (S91)			Devonport	
Talent (S92)			Devonport	Commissioned in May 1990.
(Triumph (S93))			–	To be delivered in 1991.
SWIFTSURE class	6	1973-81		
Swiftsure (S126)			Devonport	
Sovereign (S108)			Devonport	
Superb (S109)			Devonport	
Sceptre (S104)			Devonport	
Spartan (S105)			Devonport	
Splendid (S106)			Devonport	
CHURCHILL class	3	1970-71		
Churchill (S46)			Faslane	
Courageous (S50)			Faslane	
Conqueror (S48)			Faslane	
VALIANT class	2	1966-67		
Valiant (S102)			Faslane	
Warspite (S103)			Faslane	

192 These four ships are thought to be able to provide nuclear weapons logistical transport and/or support for ships at sea. In addition, reportedly three other smaller armament store carrier ships -- the RMAS Kinterbury (A378), RMAS Throsk (A379), and RMAS Arrochar (A382) -- serve as inter- and intra-U.K. harbor nuclear weapons transport ships.

193 Each SSN is powered by one nuclear reactor.
A new "W " class of nuclear-powered submarines has been designed with a planned order date in the mid-1990s; Jane's Fighting Ships 1990-91, p. 677.

APPENDIX D: French Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Nuclear-powered Ballistic Missile Submarines (SSBN)[194]				
REDOUTABLE class	5	1971-80		
Le Redoutable (S611)			Ile Longue	16 M20 SLBM
Le Terrible (S612)			Ile Longue	16 M4B SLBM
Le Foudroyant (S610)			Ile Longue	16 M20 SLBM
L'Indomptable (S613)			Ile Longue	16 M4B SLBM
Le Tonnant (S614)			Ile Longue	16 M4B SLBM
INFLEXIBLE class[195]	1	1985		
L'Inflexible (S615)			Ile Longue	16 M4A SLBM
LE TRIOMPHANT class[196]	(6)	1994-95		
(Le Triomphant (S616))			(Ile Longue)	(M45 SLBM)
(Le Temeraire (S617))			(Ile Longue)	(M45 SLBM)
(four more planned)				

Ballistic Missile Submarine Summary

Total Ballistic Missile Submarines: 6
Total Ballistic Missiles: 96 Warheads: 416[197]
Total M20 SLBMs: 32 Warheads: 32
Total M4A SLBMs: 16 Warheads: 96
Total M4B SLBMs: 48 Warheads: 288

Aircraft Carriers (CV)				
CLEMENCEAU class	2	1961-6330		Super Etendard aircraft.[198]
Clemenceau (R98)			Toulon	Carries AN-52 and lower-yield gravity
Foch (R99)			Toulon	bombs, and ASMP air-to-surface missiles
Nuclear-powered Aircraft Carriers (CVN)[199]				
CHARLES DE GAULLE class	(1+1)	1998-		
(Charles de Gaulle (R91))		–		(Super Etendards, and a new "avion de
(second ship unknown)		–		combat" marine aircraft)

194 Abbreviated as SNLE in French for "sous-marin nucléaire lanceur d'engins." One nuclear reactor powers each submarine.

195 Similar to Redoutable class, but considered an intermediate class between the Redoutable and the new generation SSBN.

196 Le Triomphant new generation class SSBNs (SNLE-NG) will replace the Redoutable class boats.

197 Since 1988, Le Terrible and L'Indomptable have converted to the M4B SLBM.

198 Based on two squadrons of 15 aircraft each. The number of Etendards on a carrier can vary depending on the carrier's mission, whether both carriers are deployed simultaneously, the availability of aircraft, and other reasons.

199 To be powered by two nuclear reactors each. Abbreviated as PAN in French for "porte-avions nucléaire".

APPENDIX D: French Nuclear-capable and Nuclear-powered Ships

Aircraft Carrier Summary

Total Aircraft Carriers: 2
Total Super Etendard aircraft: 30
Total Nuclear Bombs: 16-36

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Non-Nuclear-capable Nuclear-powered Ships				
Attack Submarines (SSN)[200]				
RUBIS class	4(+4)	1983-		
Rubis (S601)			Toulon	
Saphir (S602)			Toulon	
Casablanca (S603)			Toulon	
Emeraude (S604)			Toulon	
Amethyste (S605)			--	To be delivered in 1991.
Perle (S606)			--	To be delivered in 1993.
Turquoise (S607)			--	To be delivered in 1997.
Diamant (S608)			--	To be delivered in 1999.

APPENDIX E: Chinese Nuclear-capable and Nuclear-powered Ships

Ship Name and Hull Number	Number Deployed	Years Commissioned	Homeport	Nuclear Weapon(s)/ Remarks
Nuclear-powered Ballistic Missile Submarines (SSBN)[201]				
XIA class (names unknown)	2	1983-	East Sea Fleet	12 CSS-N-3 SLBM
Ballistic Missile Submarines (SSB)				
GOLF class[202] (name unknown)	1≈	1964	unknown	2 CSS-N-3 SLBM
Non-Nuclear-capable Nuclear-powered Attack Submarines (SSN)				
HAN class (names unknown)	4	1971-	North Sea Fleet	

[200] One nuclear reactor powers each submarine.

[201] Chinese nuclear-powered submarines are each powered by one nuclear reactor.

[202] The Golf class submarine is used for testing and training, but in a crisis could be armed with two SLBMs.

APPENDIX F: Alphabetical List of Nuclear Capable and Nuclear-powered Ships and Submarines

This alphabetical list of ships by name, noting each ship's nuclear capability, is provided for "quick reference." The text and Appendices A through E should be consulted for more detailed descriptions.

For the United States (US), the United Kingdom (UK) and France (FR) all nuclear-capable and nuclear-powered ships in commission are listed along with their type and hull number. In addition, planned nuclear-capable and nuclear-powered ships are included when their names are known. For the Soviet Union (USSR), the names or identification number of surface ships are listed when known. Since the individual names of Soviet submarines are not known, they are listed by their NATO-designated class (e.g., AKULA class USSR (SSN)), and the same applies to China's submarines. If a Soviet ship is a candidate for a nuclear weapons system, or if there are unconfirmed reports that a ship has a nuclear weapons capability, that weapon system is enclosed in parentheses.

Ship, country, hull number/designation	Nuclear weapons capability
Abraham Lincoln US (CVN 72)	Aircraft and nuclear bombs
Admiral Fokin (CG)	SS-N-3b SLCM, nuclear torpedoes, SA-N-1 SAMs
Admiral Golovko (CG)	SS-N-3b SLCM, nuclear torpedoes, SA-N-1 SAMs
Admiral Isachenkov USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Admiral Isakov USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Admiral Kharlamov USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Admiral Kuznetzov USSR (CG)	SS-N-12 SLCM, nuclear torpedoes, helicopter (NDBs)
Admiral Levchenko USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Admiral Makarov USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Admiral Nakhimov USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Admiral Oktyabrskiy USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Admiral Spiridonov USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Admiral Tributs USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Admiral Vinogradov USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Admiral Yumashev USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Admiral Zakharov USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Admiral Zozulya USSR (CG)	SS-N-3SS-N-3b SLCM, SA-N-1 SAMs, nuclear torpedoes
AKULA class USSR	SS-N-21 SLCM, SS-N-15 NDB, SS-N-16 ASW, nuclear torpedoes
Alabama US (SSBN 731)	Trident I C4 SLBM
Alambai USSR (AEM)	Transports SLBM liquid fuel
Alaska US (SSBN 732)	Trident I C4 SLBM
Albuquerque US (SSN 706)	TT Tomahawk
Alexander Brykin USSR (AS)	Supports strategic SSBNs
Alexander Hamilton US (SSBN 617)	Poseidon C3 SLBM
ALFA class USSR	SS-N-15 NDB, nuclear torpedoes
America US (CV 66)	Aircraft and nuclear bombs
Amethyste FR (S605)	To be delivered in 1991
Amga USSR (AEM)	Transports SLBMs for SSB/Ns
Amur USSR (AR)	Nuclear material Support for ship and submarine nuclear reactors
Antietam US (CG 54)	VLS Tomahawk
Aragvi USSR (AEM)	Transports SLBM liquid fuel
Argyll UK (F231)	ASW helicopters, nuclear depth bombs
Ark Royal UK (R07)	Aircraft, nuclear bombs
Arkansas US (CGN 41)	ABL Tomahawk
Arkhangelsky Komsomolets USSR (FFG)	Nuclear torpedoes
Arthur W. Radford US (DD 968)	VLS Tomahawk
Artika USSR (AGBN)	Nuclear-powered ice breaker
Aspro US (SSN 648)	TT Tomahawk
Atlanta US (SSN 712)	TT Tomahawk
Augusta US (SSN 710)	TT Tomahawk
Austin US (LPD 04)	Marine Corps nuclear weapons
Azov USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Bainbridge US (CGN 25)	Nuclear-powered, non-nuclear capable ship

APPENDIX F: Alphabetical List of Nuclear Capable and Nuclear-powered Ships and Submarines

Ship, country, hull number/designation	Nuclear weapons capability
Baku USSR (CVHG)	SS-N-12 SLCM, aircraft, possible NDBs
BALCOM-8 class USSR (FFG)	Helicopters (NDBs, nuclear torpedoes)
Baltimore US (SSN 704)	TT Tomahawk
Barguzin USSR (AEM)	Transports SLBM liquid fuel
Bars USSR (FFG)	Nuclear torpedoes
Barsuk USSR (FFG)	Nuclear torpedoes
Baton Rouge US (SSN 689)	TT Tomahawk
Battleaxe UK (F89)	Nuclear depth bombs
Bditel'nyy USSR (FFG)	Nuclear torpedoes
Beaver UK (F93)	ASW helicopters, nuclear depth bombs
Benjamin Franklin US (SSBN 640)	Trident I C4 SLBM
Berezina USSR (AOR)	Subamrine weapons support
Bergall US (SSN 667)	TT Tomahawk
Bessmennyy USSR (FFG)	Nuclear torpedoes
Bezukoriznennyy USSR (FFG)	Nuclear torpedoes
Bezuprechnyy USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
Bezzavetnyy USSR (FFG)	Nuclear torpedoes
Birmingham UK (D86)	ASW helicopters, nuclear depth bombs
Birmingham US (SSN 695)	TT Tomahawk
Bodryy USSR (FFG)	Nuclear torpedoes
Boston US (SSN 703)	TT Tomahawk
Boxer UK (F92)	ASW helicopters, nuclear depth bombs
Boxer US (LHD 4)	Possible wartime nuclear weapons transport
Boyevoy USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
Brave UK (F94)	ASW helicopters, nuclear depth bombs
Brazen UK (F91)	ASW helicopters, nuclear depth bombs
Brilliant UK (F90)	ASW helicopters, nuclear depth bombs
Broadsword UK (F88)	ASW helicopters, nuclear depth bombs
Buffalo US (SSN 715)	TT Tomahawk
Bunker Hill US (CG 52)	VLS Tomahawk
Burnyy USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
Burun USSR (PGG)	SS-N-9 SLCM
Butte US (AE 27)	Transport/service of nuclear weapons
Bystry USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
California US (CGN 36)	Nuclear-powered, non-nuclear capable ship
Camden US (AOE 2)	Transport/service of nuclear weapons
Campbletown UK (F86)	ASW helicopters, nuclear depth bombs
Canopus US (AS 34)	Supports Trident I missiles and warheads
Cardiff UK (D108)	ASW helicopters, nuclear depth bombs
Carl Vinson US (CVN 70)	Aircraft and nuclear bombs
Caron US (DD 970)	VLS Tomahawk
Casablanca FR (S603)	Nuclear-powered, non-nuclear capable ship
Casimir Pulaski US (SSBN 633)	Trident I C4 SLBM
Chancellorsville US (CG 62)	VLS Tomahawk
Charles de Gaulle FR (R91)	(Aircraft, ASMP air-to-surface missiles)
CHARLIE I class USSR	SS-N-7 SLCM, SS-N-15 NDB, nuclear torpedoes
CHARLIE II class USSR	SS-N-9 SLCM, SS-N-15 NDB, nuclear torpedoes
Chatham UK (F87)	ASW helicopters, nuclear depth bombs
Chervona Ukraina USSR (CG)	SS-N-12 SLCM, nuclear torpedoes, helicopter (NDBs)
Chicago US (SSN 721)	VLS+TT Tomahawk
Churchill UK (S46)	Nuclear-powered, non-nuclear capable ship
Cincinnati US (SSN 693)	TT Tomahawk
City of Corpus Christi US (SSN 705)	TT Tomahawk
Clemenceau FR (R98)	Aircraft, nuclear bombs, ASMP air-to-surface missiles
Cleveland US (LPD 07)	Marine Corps nuclear weapons
Comte de Grasse US (DD 974)	ABL Tomahawk
Conolly US (DD 979)	ABL Tomahawk
Conqueror UK (S48)	Nuclear-powered, non-nuclear capable ship

APPENDIX F: Alphabetical List of Nuclear Capable and Nuclear-powered Ships and Submarines

Ship, country, hull number/designation	Nuclear weapons capability
Cornwall UK (F99)	Helicopters, nuclear depth bombs
Courageous UK (S50)	Nuclear powered, non-nuclear capable ship
Coventry UK (F98)	ASW helicopters, nuclear depth bombs
Cumberland UK (F85)	ASW helicopters, nuclear depth bombs
Curtis Wilbur US (DDG 54)	VLS Tomahawk
Daniel Boone US (SSBN 629)	Trident I C4 SLBM
Daugava USSR (AEM)	Transports SLBMs for SSB/Ns
David R. Ray US (DD 971)	VLS Tomahawk
DELTA I class USSR	SS-N-8 SLBM, nuclear torpedoes
DELTA II class USSR	SS-N-8 SLBM, nuclear torpedoes
DELTA III class USSR	SS-N-18 SLBM, nuclear torpedoes
DELTA IV class USSR	SS-N-23 SLBM, nuclear torpedoes
Denver US (LPD 09)	Marine Corps nuclear weapons
DERGACH class USSR (PGGA)	(SS-N-22 SLCM)
Detroit US (AOE 4)	Transport/service of nuclear weapons
Deyatel'nyy USSR (FFG)	Nuclear torpedoes
Deyo US (DD 989)	ABL Tomahawk
Diamant FR (S608)	To be delivered in 1999
Dixon US (AS 37)	Provides Tomahawk support
Dmitriy Galkin USSR (AS)	(Nuclear torpedo transport)
Doblestnyy USSR (FFG)	Nuclear torpedoes
Don USSR (AEM)	Transports SLBM liquid fuel
Dostoynyy USSR (FFG)	Nuclear torpedoes
Drum US (SSN 677)	TT Tomahawk
Druzhnyy USSR (FFG)	Nuclear torpedoes
Dubuque US (LPD 08)	Marine Corps nuclear weapons
Duluth US (LPD 06)	Marine Corps nuclear weapons
Dwight D. Eisenhower US (CVN 69)	Aircraft and nuclear bombs
ECHO I class USSR	Nuclear torpedoes
ECHO II class USSR	SS-N-3c or SS-N-12 SLCM, nuclear torpedoes
Edinburgh UK (D97)	ASW helicopters, nuclear depth bombs
Elliot US (DD 967)	VLS Tomahawk
Emeraude FR (S604)	Nuclear-powered, non-nuclear capable ship
Emory S. Land US (AS 39)	Provides Tomahawk support
Essex US (LHD 2)	Possible wartime nuclear weapons transport
Exeter UK (D89)	ASW helicopters, nuclear depth bombs
Fife US (DD 991)	VLS Tomahawk
Flasher US (SSN 613)	Nuclear-powered, non-nuclear capable ship
Flint US (AE 32)	Transport/service of nuclear weapons
Florida US (SSBN 728)	Trident I C4 SLBM
Flying Fish US (SSN 673)	TT Tomahawk
Foch FR (R99)	Aircraft, nuclear bombs, ASMP air-to-surface missiles
Forrestal US (CV 59)	Aircraft and nuclear bombs
Fort Austin UK (A386)	Logistic support
Fort Grange UK (A385)	Logistic support
Fort Sheverenko USSR (AEM)	Transports missiles
FOXTROT class USSR	Nuclear torpedoes
Francis Scott Key US (SSBN 657)	Trident I C4 SLBM
Frank Cable US (AS 40)	Provides Tomahawk support
Frunze USSR (CGN USSR (CV)	SS-N-19 SLCM, nuclear torpedoes, helicopters (NDBs)
Fulton US (AS 11)	Provides Tomahawk support
Fyodor Vidyaev USSR (AS)	(Nuclear torpedo transport)
Gato US (SSN 615)	Nuclear-powered, non-nuclear capable ship
General Riyabakov USSR (AEM)	Transports SLCMs for ships and submarines
George Bancroft US (SSBN 643)	Trident I C4 SLBM
George C. Marshall US (SSBN 654)	Poseidon C3 SLBM
George Washington Carver US (SSBN 656)	Poseidon C3 SLBM
Georgia US (SSBN 729)	Trident I C4 SLBM

APPENDIX F: Alphabetical List of Nuclear Capable and Nuclear-powered Ships and Submarines

Ship, country, hull number/designation	Nuclear weapons capability
Glasgow UK (D88)	ASW helicopters, nuclear depth bombs
Gloucester UK (D96)	ASW helicopters, nuclear depth bombs
GOLF class China (SSB)	CSS-N-3 SLBM
Gordelivyy USSR (FFG)	Nuclear torpedoes
Grad USSR (PGG)	SS-N-9 SLCM
Greenling US (SSN 614)	Nuclear-powered, non-nuclear capable ship
Gremyashchy USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
GRISHA I class USSR (FFG)	Nuclear torpedoes
GRISHA III class USSR (FFG)	Nuclear torpedoes
GRISHA IV class USSR (FFG)	Nuclear torpedoes
GRISHA V class USSR (FFG)	Nuclear torpedoes
Gromkiy USSR (FFG)	Nuclear torpedoes
Groton US (SSN 694)	TT Tomahawk
Groznyy USSR (CG)	SS-N-3b SLCM, nuclear torpedoes, SA-N-1 SAMs
Grozyashchiy USSR (FFG)	Nuclear torpedoes
Guadalcanal US (LPH 07)	Marine Corps nuclear weapons
Guam US (LPH 09)	Marine Corps nuclear weapons
Guardfish US (SSN 612)	Nuclear-powered, non-nuclear capable ship
Guitarro US (SSN 665)	TT Tomahawk
Gurnard US (SSN 662)	TT Tomahawk
Haddo US (SSN 604)	Nuclear-powered, non-nuclear capable ship
Haddock US (SSN 621)	Nuclear-powered, non-nuclear capable ship
Haleakala US (AE 25)	Transport/service of nuclear weapons
Hammerhead US (SSN 663)	TT Tomahawk
HAN class China (SSN)	Nuclear-powered, non-nuclear capable ship
Helena US (SSN 725)	VLS+TT Tomahawk
Henry L. Stimson US (SSBN 655)	Trident I C4 SLBM
Henry M. Jackson US (SSBN 730)	Trident I C4 SLBM
Hewitt US (DD 966)	VLS Tomahawk
Holland US (AS 32)	Supports Poseidon missiles and warheads
Honolulu US (SSN 718)	TT Tomahawk
HOTEL II class USSR (SSN)	Nuclear torpedoes
HOTEL III class USSR (SSN)	SS-N-8 SLBM, nuclear torpedoes
Houston US (SSN 713)	TT Tomahawk
Hunley US (AS 31)	Provides Tomahawk support
Hyman G. Rickover US (SSN 709)	TT Tomahawk
Illustrious UK (R06)	Aircraft, nuclear bombs
Inchon US (LPH 12)	Marine Corps nuclear weapons
Independence US (CV 62)	Aircraft and nuclear bombs
Indirka USSR (AEM)	Transports missiles
Ingersoll US (DD 990)	ABL Tomahawk
Invincible UK (R05)	Aircraft, nuclear bombs
Iowa US (BB 61)	ABL Tomahawk
Iron Duke UK (F234)	ASW helicopters, nuclear depth bombs
Ivan Kolvshkin USSR (AS)	Nuclear transport
Ivan Kucherenko USSR (AS)	Nuclear transport
Ivan Vakhrameev USSR (AS)	Nuclear transport
Iwo Jima US (LPH 02)	Marine Corps nuclear weapons
James K. Polk US (SSBN 645)	Poseidon C3 SLBM
James Madison US (SSBN 627)	Trident I C4 SLBM
John C. Calhoun US (SSBN 630)	Trident I C4 SLBM
John F. Kennedy US (CV 67)	Aircraft and nuclear bombs
John Marshall US (SSN 611)	Nuclear-powered, non-nuclear capable ship
John Rodgers US (DD 983)	ABL Tomahawk
JULIETT class USSR (SSG)	SS-N-3c SLCM, nuclear torpedoes
Juneau US (LPD 10)	Marine Corps nuclear weapons
Kalinin USSR (CGN)	SS-N-19 SLCM, nuclear torpedoes, helicopters (NDBs)
Kama USSR (AEM)	Transports SLBM liquid fuel

APPENDIX F: Alphabetical List of Nuclear Capable and Nuclear-powered Ships and Submarines

Ship, country, hull number/designation	Nuclear weapons capability
Kamchatskiy Komsomolets USSR (AS)	(Nuclear torpedo transport)
Kamehameha US (SSBN 642)	Poseidon C3 SLBM
KAPSUTA class USSR (AGN)	Nuclear-powered auxiliaries
Kearsage (LHD 3)	Possible wartime nuclear weapons transport
Kerch USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Key West US (SSN 722)	VLS+TT Tomahawk
Kiev USSR (CVHG)	SS-N-12 SLCM, FRAS-1, SA-N-3 SAMs, aircraft, possible NDBs
Kilauea US (TAE 26)	Transport/service of nuclear weapons
KILO class USSR SS)	Nuclear torpedoes
Kirov USSR (CGN) USSR	SS-N-19 SLCM, nuclear torpedoes, helicopters (NDBs)
Kiska US (AE 35)	Transport/service of nuclear weapons
Komsomolets Ukrainyy USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Krasnyy Kavkaz USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Krasnyy Krym USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Kronshtadt USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Kuguar USSR (FFG)	Nuclear torpedoes
Kunitsa USSR (FFG)	Nuclear torpedoes
L. Y. Spear US (AS 36)	Provides Tomahawk support
L'Indomptable FR (S613)	M4B SLBM
L'Inflexible FR (S615)	M4A SLBM
La Jolla US (SSN 701)	TT Tomahawk
Ladnyy USSR (FFG)	Nuclear torpedoes
Lafayette US (SSBN 616)	Poseidon C3 SLBM
Lake Champlain US (CG 57)	VLS Tomahawk
Lancaster UK (F232)	ASW helicopters, nuclear depth bombs
Le Foudroyant FR (S610)	M20 SLBM
Le Redoutable FR (S611)	M20 SLBM
Le Temeraire FR (S617)	(M45 SLBM)
Le Terrible FR (S612)	M4B SLBM
Le Tonnant FR (S614)	M4B SLBM
Le Triomphant FR (S616)	(M45 SLBM)
Leftwich US (DD 984)	ABL Tomahawk
Leningrad USSR (CHG)	SUW-N-1/FRAS-1, SA-N-3 SAMs, helicopters, possible NDBs
Leningradskiy Komsomolets USSR (FFG)	Nuclear torpedoes
Leopard USSR (FFG)	Nuclear torpedoes
Letuchiy USSR (FFG)	Nuclear torpedoes
Lewis and Clark US (SSBN 644)	Poseidon C3 SLBM
Leyte Gulf US (CG 55)	VLS Tomahawk
Liverpool UK (D92)	ASW helicopters, nuclear depth bombs
London UK (F95)	ASW helicopters, nuclear depth bombs
Long Beach US (CGN 9)	ABL Tomahawk
Los Angeles US (SSN 688)	TT Tomahawk
Louisville US (SSN 724)	VLS+TT Tomahawk
Magadanskiy Komsomolets USSR (AS)	(Nuclear torpedo transport)
Magomed Gadziev USSR (AS)	(Nuclear torpedo transport)
Malborough UK (F233)	ASW helicopters, nuclear depth bombs
Manchester UK (D95)	ASW helicopters, nuclear depth bombs
Mariano G. Vallejo US (SSBN 658)	Trident I C4 SLBM
Marshal Timoshenko USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Marshal Ustinov USSR (CG)	SS-N-12 SLCM, nuclear torpedoes, helicopter (NDBs)
Marshal Vasil'yevskiy USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Marshal Voroshilov USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Marshall Shaposhnikov USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Marshfield US (TAK 282)	Transports nuclear weapons
Mauna Kea US (AE 22)	Transport/service of nuclear weapons
McKee US (AS 41)	Provides Tomahawk support
Memphis US (SSN 691)	TT Tomahawk
Merrill US (DD 976)	ABL Tomahawk

APPENDIX F: Alphabetical List of Nuclear Capable and Nuclear-powered Ships and Submarines

Ship, country, hull number/designation	Nuclear weapons capability
Michigan US (SSBN 727)	Trident I C4 SLBM
Midway US (CV 41)	Aircraft and nuclear bombs
Minneapolis-Saint Paul US (SSN 708)	TT Tomahawk
Minsk USSR (CVHG)	SS-N-12 SLCM, FRAS-1, SA-N-3 SAMs, aircraft, possible NDBs
Mississippi US (CGN 40)	ABL Tomahawk
Missouri US (BB 63)	ABL Tomahawk
Mobile Bay US (CG 53)	VLS Tomahawk
Molniya USSR (PGG)	SS-N-9 SLCM
Monmouth UK (F235)	ASW helicopters, nuclear depth bombs
Monterey US (CG 61)	VLS Tomahawk
Montrose UK (F236)	ASW helicopters, nuclear depth bombs
Moskva USSR (CHG)	SUW-N-1/FRAS-1, SA-N-3 SAMs, helicopters, possible NDBs
Mount Baker US (AE 34)	Transport/service of nuclear weapons
Mount Hood US (AE 29)	Transport/service of nuclear weapons
Musson USSR (PGG)	SS-N-9 SLCM
NANUCHKA III class USSR (PGG)	SS-N-9 SLCM
Narwhal US (SSN 671)	(TT Tomahawk)
Nashville US (LPD 13)	Marine Corps nuclear weapons
Neukrotimyy USSR (FFG)	Nuclear torpedoes
Nevada US (SSBN 733)	Trident I C4 SLBM
New Jersey US (BB 62)	ABL Tomahawk
New York City US (SSN 696)	TT Tomahawk
Newcastle UK (D87)	ASW helicopters, nuclear depth bombs
Nikolayev USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Nimitz US (CVN 68)	Aircraft and nuclear bombs
Nitro US (AE 23)	Transport/service of nuclear weapons
Norfolk UK (F230)	ASW helicopters, nuclear depth bombs
Norfolk US (SSN 714)	TT Tomahawk
Normandy US (CG 60)	VLS Tomahawk
Northumberland UK (F238)	ASW helicopters, nuclear depth bombs
Nottingham UK (D91)	ASW helicopters, nuclear depth bombs
NOVEMBER class USSR (SSN)	Nuclear torpedoes
Novorossiysk USSR (CVHG)	SS-N-12 SLCM, FRAS-1, SA-N-3 SAMs, aircraft, possible NDBs
NR-1 US	Nuclear-powered, non-nuclear capable research vessel
O'Brien US (DD 975)	VLS Tomahawk
Obraztsovyy USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Ochakov USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Odarennyy USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Ogden US (LPD 05)	Marine Corps nuclear weapons
Ohio US (SSBN 726)	Trident I C4 SLBM
Okinawa US (LPH 03)	Marine Corps nuclear weapons
Oklahoma City US (SSN 723)	VLS+TT Tomahawk
Okrylenny USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
Oktyabryskaya Revolutsiya USSR (AGBN)	Nuclear-powered ice breaker
Olympia US (SSN 717)	TT Tomahawk
Omaha US (SSN 692)	TT Tomahawk
Orion US (AS 18)	Provides Tomahawk support
Orleans US (LPH 11)	Marine Corps nuclear weapons
OSCAR I class USSR (SSGN)	SS-N-19 SLCM, SS-N-15 NDB,SS-N-16 ASW, nuclear torpedoes
OSCAR II class USSR (SSGN)	SS-N-19 SLCM, SS-N-15 NDB SS-N-16 ASW, nuclear torpedoes
Osmotritel'nyy USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
Otchayannyy USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
OtlichnyyKa USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
PAPA class USSR ((SSGN)	SS-N-9 SLCM, SS-N-15 NDB, nuclear torpedoes
Parche US (SSN 683)	TT Tomahawk
Pargo US (SSN 650)	TT Tomahawk
Paul F. Foster US (DD 964)	VLS Tomahawk
PB-625 USSR (AEM)	Transports SLCMs for ships and submarines

APPENDIX F: Alphabetical List of Nuclear Capable and Nuclear-powered Ships and Submarines

Ship, country, hull number/designation	Nuclear weapons capability
Perle FR (S606)	To be delivered in 1993
Permit US (SSN 594)	Nuclear-powered, non-nuclear capable ship
Petropavlovsk USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Philadelphia US (SSN 690)	TT Tomahawk
Philippine Sea US (CG 58)	VLS Tomahawk
Pinga USSR (AR)	Nuclear material support for ship and submarine nuclear reactors
Pittsburgh US (SSN 720)	VLS+TT Tomahawk
PM-131 USSR (AEM)	Transports SLCMs for ships and submarines
PM-150 USSR (AEM)	Transports SLCMs for ships and submarines
PM-44 USSR (AEM)	Transports SLCMs for ships and submarines
PM-63 USSR (AR)	Nuclear material support for ship and submarine nuclear reactors
PM-74 USSR (AR)	Nuclear material support for ship and submarine nuclear reactors
PM-93 USSR (AEM)	Transports SLCMs for ships and submarines
Ponce US (LPD 15)	Marine Corps nuclear weapons
Portsmouth US (SSN 707)	TT Tomahawk
Poryvistyy USSR (FFG)	Nuclear torpedoes
Princeton US (CG 59)	VLS Tomahawk
Proteus US (AS 19)	Provides Tomahawk support
Providence US (SSN 719)	VLS+TT Tomahawk
Puffer US (SSN 652)	TT Tomahawk
Pylkiy USSR (FFG)	Nuclear torpedoes
Pyro US (AE 24)	Transport/service of nuclear weapons
Pytlivvy USSR (FFG)	Nuclear torpedoes
Queenfish US (SSN 651)	Nuclear-powered, non-nuclear capable ship
R'yanyy USSR (FFG)	Nuclear torpedoes
Raduga USSR (PGG)	SS-N-9 SLCM
Raleigh US (LPD 01)	Possible peacetime transport of nuclear weapons
Ranger US (CV 61)	Aircraft and nuclear bombs
Rastoropny USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
Ray US (SSN 653)	TT Tomahawk
Razitel'nyy USSR (FFG)	Nuclear torpedoes
Razumnyy USSR (FFG)	Nuclear torpedoes
Razyashchiy USSR (FFG)	Nuclear torpedoes
Regent UK (A486)	Logistic support
Renown UK (S26)	Nuclear-powered, non-nuclear capable ship
Repulse UK (S23)	Nuclear-powered, non-nuclear capable ship
Reshitelnyy USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Resolution UK (S22)	Nuclear-powered, non-nuclear capable ship
Resource UK (A480)	Logistic support
Retiyy USSR (FFG)	Nuclear torpedoes
Revenge UK (S27)	Nuclear-powered, non-nuclear capable ship
Revnostnyy USSR (FFG)	Nuclear torpedoes
Rezkiy USSR (FFG)	Nuclear torpedoes
Rezvyy USSR (FFG)	Nuclear torpedoes
Richmond UK (F239)	ASW helicopters, nuclear depth bombs
Riga USSR (CV)	(SS-N-19 SLCM)
Rossiya USSR (AGBN)	Nuclear-powered ice breaker
Rubis FR (S601)	Nuclear-powered, non-nuclear capable ship
Rys USSR (FFG)	Nuclear torpedoes
Sacramento US (AOE 1)	Transport/service of nuclear weapons
Salt Lake City US (SSN 716)	TT Tomahawk
Sam Houston US (SSN 609)	Nuclear-powered, non-nuclear capable ship
SAMUEL GOMPERS class US (AD 37)	(Service ships' nuclear power plants)
San Jacinto US (CG 56)	VLS Tomahawk
Santa Barbara US (AE 28)	Transport/service of nuclear weapons
Saphir FR (S602)	Nuclear-powered, non-nuclear capable ship
SARANCHA class USSR (PGGH)	SS-N-9 SLCM
Saratoga US (CV 60)	Aircraft and nuclear bombs

APPENDIX F: Alphabetical List of Nuclear Capable and Nuclear-powered Ships and Submarines

Ship, country, hull number/designation	Nuclear weapons capability
Sceptre UK (S104)	Nuclear-powered, non-nuclear capable ship
Scranton US (SSN 756)	VLS+TT Tomahawk
Sderzhanny USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Sea Devil US (SSN 664)	Nuclear-powered, non-nuclear capable ship
Seahorse US (SSN 669)	TT Tomahawk
Seattle US (AOE 3)	Transport/service of nuclear weapons
Seawolf US (SSN 21)	TT Tomahawk
Selenga USSR (AEM)	Transports SLBM liquid fuel
Sevastopol USSR (CG)	SS-N-3SS-N-3b SLCM, SA-N-1 SAMs, nuclear torpedoes
SEVMORPUT class USSR	Nuclear-powered barge carrier
Shasta US (AE 33)	Transport/service of nuclear weapons
Sheffield UK (F96)	ASW helicopters, nuclear depth bombs
Shiloh US (CG 67)	VLS Tomahawk
Shkval USSR (PGG)	SS-N-9 SLCM
Shreveport US (LPD 12)	Marine Corps nuclear weapons
Shtorm USSR (PGG)	SS-N-9 SLCM
Sibir' USSR (AGBN)	Nuclear-powered ice breaker
SIERRA class USSR (SSN)	SS-N-21 SLCM, SS-N-15 NDB, SS-N-16 ASW, nuclear torpedoes
Sil'nyy USSR (FFG)	Nuclear torpedoes
Silversides US (SSN 679)	TT Tomahawk
Simferopol USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Simon Bolivar US (SSBN 641)	Trident I C4 SLBM
Simon Lake US (AS 33)	Supports Poseidon and Trident I missiles and warheads
Skoryy USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Slava USSR (CG)	SS-N-12 SLCM, nuclear torpedoes, helicopter (NDBs)
Slavny USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Smetlivvy USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Smyshlenny USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Soobrazitel'nyy USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
South Carolina US (CGN 37)	Nuclear-powered, non-nuclear capable ship
Southampton UK (D90)	ASW helicopters, nuclear depth bombs
Sovereign UK (S108)	Nuclear-powered, non-nuclear capable ship
Sovetskiy Soyuz USSR (AGBN)	Nuclear-powered ice breaker
Sovetsky Azerbaydzhan USSR (FFG)	Nuclear torpedoes
Sovetsky Dagestan USSR (FFG)	Nuclear torpedoes
Sovetsky Turkmenistan USSR (FFG)	Nuclear torpedoes
Sovremennyy USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
Spadefish US (SSN 668)	TT Tomahawk
Spartan UK (S105)	Nuclear-powered, non-nuclear capable ship
Splendid UK (S106)	Nuclear-powered, non-nuclear capable ship
Sposobnyy USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Springfield US (SSN 761)	VLS+TT Tomahawk
Spruance US (DD 963)	VLS Tomahawk
Steregushichiy USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Stonewall Jackson US (SSBN 634)	Trident I C4 SLBM
Storozhevoy USSR (FFG)	Nuclear torpedoes
Stout US (DDG 55)	VLS Tomahawk
Stoyky USSR (DDG)	SS-N-22 SLCM, nuclear torpedoes, helicopters (NDBs)
Strogiy USSR (DDG)	SA-N-1 SAMs, nuclear torpedoes
Stump US (DD 978)	Tomahawk
Sturgeon US (SSN 637)	TT Tomahawk
Sunfish US (SSN 649)	TT Tomahawk
Superb UK (S109)	Nuclear-powered, non-nuclear capable ship
Suribachi US (AE 21)	Transport/service of nuclear weapons
Svirepyy USSR (FFG)	Nuclear torpedoes
Swiftsure UK (S126)	Nuclear-powered, non-nuclear capable ship
Talent UK (S92)	Nuclear-powered, non-nuclear capable ship
Tallinn USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)

APPENDIX F: Alphabetical List of Nuclear Capable and Nuclear-powered Ships and Submarines

Ship, country, hull number/designation	Nuclear weapons capability
TANGO class USSR (SS)	Nuclear torpedoes, (SS-N-15 NDB, SS-N-16 ASW)
TARANTUL III class USSR (PGG)	SS-N-22 SLCM
TARAWA class US (LHA 1)	Possible wartime nuclear weapons transport
Tashkent USSR (CG)	SA-N-3 SAMs, nuclear torpedoes,, helicopter (NDBs)
Tautog US (SSN 639)	TT Tomahawk
Tayfun USSR (PGG)	SS-N-9 SLCM
Taymyr USSR (AGBN)	Nuclear-powered ice breaker
Tbilisi USSR (CV)	(SS-N-19 SLCM)
Tecumseh US (SSBN 628)	Poseidon C3 SLBM
Tennessee US (SSBN 734)	Trident II D5 SLBM
Texas US (CGN 39)	ABL Tomahawk
Theodore Roosevelt US (CVN 71)	Aircraft and nuclear bombs
THOMASTON class US (LSD 28)	Possible wartime nuclear weapons transport
Thorn US (DD 988)	Tomahawk
Tinosa US (SSN 606)	Nuclear-powered, non-nuclear capable ship
Tireless UK (S88)	Nuclear-powered, support non-nuclear capable ship
TNT-11 USSR (AEM)	Transports nuclear waste
TNT-12 USSR (AEM)	Transports nuclear waste
TNT-19 USSR (AEM)	Transports nuclear waste
TNT-29 USSR (AEM)	Transports nuclear waste
Tobol USSR (AS)	Nuclear transport
Toledo US (SSN 769)	VLS+TT Tomahawk
Topeka US (SSN 754)	VLS+TT Tomahawk
Torbay UK (S90)	Nuclear-powered, non-nuclear capable ship
Trafalgar UK (S107)	Nuclear-powered, non-nuclear capable ship
Trenchant UK (S91)	Nuclear-powered, non-nuclear capable ship
Trenton US (LPD 14)	Marine Corps nuclear weapons
Trepang US (SSN 674)	TT Tomahawk
Tripoli US (LPH 10)	Marine Corps nuclear weapons
Triumph UK (S93)	Nuclear-powered, non-nuclear capable ship
Truxtun US (CGN 35)	Nuclear-powered, non-nuclear capable ship
Tsiklon USSR (PGG)	SS-N-9 SLCM
Tucson US (SSN 770)	VLS+TT Tomahawk
Tuman USSR (FFG)	Nuclear torpedoes
Tunny US (SSN 682)	TT Tomahawk
Turbulent UK (S87)	Nuclear-powered, non-nuclear capable ship
Turquoise FR (S607)	To be delivered in 1997
TURYA class USSR (PGG)	Nuclear torpedoes
TYPHOON class USSR (SSBN)	SS-N-20 SLBM, SS-N-15 NDB, SS-N-16 ASW, nuclear torpedoes
Udaloy USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Ulysses S. Grant US (SSBN 631)	Poseidon C3 SLBM
United States US (CVN 75)	Aircraft and nuclear bombs
Ural USSR (AEM)	Transports nuclear waste
UTKA class USSR (PGGA)	SS-N-22 SLCM
Valiant UK (S102)	Nuclear-powered, non-nuclear capable ship
Vancouver US (LPD 02)	Marine Corps nuclear weapons
Vanguard UK (SSBN)	(Trident II D5 SLBM)
Varyag USSR (CG)	SS-N-3b SLCM, nuclear torpedoes, SA-N-1 SAMs
Vasiliy Chapayev USSR (CG)	SA-N-3 SAMs, nuclear torpedoes, helicopter (NDBs)
Vaygach USSR (AGBN)	Nuclear-powered ice breaker
Vega US (TAK 286)	Transports nuclear weapons
Vella Gulf US (CG 72)	VLS Tomahawk
Venta USSR (AEM)	Transports SLCMs and SAMs
Vetluga USSR (AEM)	Transports SLBMs for SSB/Ns
Vicksburg US (CG 69)	VLS Tomahawk
VICTOR I class USSR (SSN)	Nuclear torpedoes, (SS-N-15 NDB)
VICTOR II class USSR (SSN)	SS-N-15 NDB, nuclear torpedoes
VICTOR III class USSR (SSN)	SS-N-21 SLCM,SS-N-16 ASW, nuclear torpedoes

APPENDIX F: Alphabetical List of Nuclear Capable and Nuclear-powered Ships and Submarines

Ship, country, hull number/designation	Nuclear weapons capability
Victorious UK (SSBN)	(Trident II D5 SLBM)
Vigilant UK (SSBN)	(Trident II D5 SLBM)
Viktor Kotel'nikov USSR (AS)	(Nuclear torpedo transport)
Vilyuy USSR (AEM)	Transports SLCMs and SAMs
Virginia US (CGN 38)	ABL Tomahawk
Vitse Admiral Drozd USSR (CG)	SS-N-3SS-N-3b SLCM, SA-N-1 SAMs, nuclear torpedoes
Vitze Admiral Kulakov USSR (DDG)	Nuclear torpedoes, helicopters (NDBs)
Vladivostok USSR (CG)	SS-N-3SS-N-3b SLCM, SA-N-1 SAMs, nuclear torpedoes
Volga USSR (AS)	Nuclear transport
Volk USSR (FFG)	Nuclear torpedoes
Von Steuben US (SSBN 632)	Trident I C4 SLBM
Voron USSR (FFG)	Nuclear torpedoes
Voronezh (PM-872) USSR (AEM)	Transports SLCMs for ships and submarines
Warspite UK (S103)	Nuclear-powered, non-nuclear capable ship
Wasp US (LHD 1)	Possible wartime nuclear weapons transport
West Virginia US (SSBN 736)	Trident II D5 SLBM
Westminster UK (F237)	ASW helicopters, nuclear depth bombs
Whale US (SSN 638)	TT Tomahawk
WHISKEY class USSR (SS)	Nuclear torpedoes
Will Rogers US (SSBN 659)	Poseidon C3 SLBM
William H. Bates US (SSN 680)	TT Tomahawk
Wisconsin US (BB 64)	ABL Tomahawk
Woodrow Wilson US (SSBN 624)	Poseidon C3 SLBM
XIA class China (SSBN)	CSS-N-3 SLBM
YANKEE class USSR (SSGN)	(SS-NX-24 SLCM, nuclear torpedoes)
YANKEE I class USSR (SSBN)	SS-N-6 SLBM, nuclear torpedoes
YANKEE II class USSR (SSBN)	SS-N-17 SLBM, nuclear torpedoes
YANKEE NOTCH class USSR	(SS-N-21 SLCM), nuclear torpedoes
YELLOWSTONE class US (AD 41)	(Service ships' nuclear power plants)
York UK (D98)	ASW helicopters, nuclear depth bombs
Yuri Andropov USSR (CGN)	SS-N-19 SLCM, nuclear torpedoes, helicopters (NDBs)
Zadornyy USSR (FFG)	Nuclear torpedoes
Zarnitsa USSR (PGG)	SS-N-9 SLCM
Zharkyy USSR (FFG)	Nuclear torpedoes
Zub USSR (PGG)	SS-N-9 SLCM

The Greenpeace Nuclear Free Seas Campaign

The Neptune Papers monograph series is published in support of Greenpeace's Nuclear Free Seas campaign, a campaign whose goal is the elimination of all nuclear weapons and nuclear reactors from sea-going vessels.

The Nuclear Free Seas campaign was launched in July 1987, on the second anniversary of the sinking of the Greenpeace flagship Rainbow Warrior by French secret service agents.

The campaign involves political lobbying, research on naval nuclear issues, and non-violent direct actions to work against the deployment of nuclear weapons and nuclear reactors at sea. The Nuclear Free Seas campaign is active in Europe, North America and the Pacific.

The Neptune Papers

Neptune Papers No. 1: The Nuclear Arms Race at Sea, by William M. Arkin (October 1987), is an overview of the naval arms race in the 1980s.

Neptune Papers No. 2: Nuclear Warships and Naval Nuclear Weapons: A Complete Inventory, by Joshua Handler and William M. Arkin (May 1988), is a comprehensive list of naval vessels in the U.S., Soviet, British, French and Chinese navies that carry nuclear weapons or are propelled by nuclear power.

Neptune Papers No. 3: Naval Accidents 1945-1988, by William M. Arkin and Joshua Handler (June 1989), analyses worldwide naval accidents, with particular attention to nuclear-related accidents, from 1945 to 1988.

Neptune Papers No. 4: Naval Safety 1989, The Year of the Accident (April 1990), by Joshua Handler, Amy Wickenheiser and William M. Arkin, surveys worldwide naval accidents in 1989 and provides data on U.S. naval accident trends in the 1980s.

Neptune Papers No.5: Nuclear Warships and Naval Nuclear Weapons 1990: A Complete Inventory (September 1990), by Joshua Handler and William M. Arkin, updates **Neptune Papers No.2** and examines the changes in naval nuclear forces in the past two years.

Neptune Papers No.6: U.S. Naval Nuclear Weapons in Sweden (September 1990), by Hans M. Kristensen, William M. Arkin and Joshua Handler, documents that U.S. Navy ships visiting Swedish ports between 1960 and 1989 routinely carried nuclear weapons in violation of Swedish non-nuclear policy.

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