

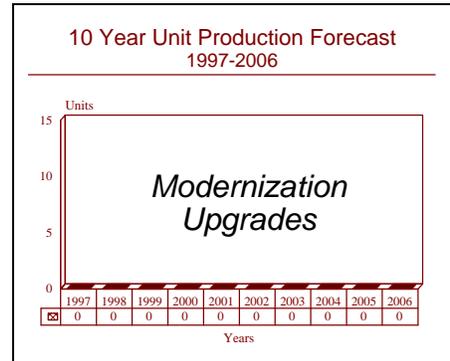
ARCHIVED REPORT

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SSN-688 Los Angeles Class - Archived 10/98

Outlook

- Construction complete, but modernization and upgrades continue
- Key boat for USN future fleet: will comprise 68% of force in 2015
- Upgrades to communications, acoustic processors, sensors, weapons planned for every boat in service
- Littoral warfare calls for improvements in minefield capabilities
- In electronics, more COTS software and hardware to be introduced



Orientation

Description. A high-speed, nuclear-powered fast attack submarine.

Sponsor. US Department of Defense through the US Navy, Naval Sea Systems Command, Arlington, Virginia (overall program management) and the Department of Energy, Washington, DC (nuclear reactor acquisition).

Contractors

General Dynamics Corp
 Electric Boat Division
 75 Eastern Point Rd
 Groton, Connecticut (CT) 06340
 USA
 Tel: +1 203 433 3000
 Fax: +1 203 446 3433
 Telex: 966411; 211677

Newport News Shipbuilding
 4101 Washington Avenue
 Newport News, Virginia (VA) 23607
 USA
 Tel: +1 757 380 2000
 Telex: 823453

Licensees. No production licenses have been granted.

Status. In service. Modernizations and upgrades are being implemented on the existing models well into the 21st century.

Total Produced. A total of 62 Los Angeles class submarines have been built. Of these, 56 are in service currently and 11 more are to go by the year 2000.

Pennant List

^(a) Denotes that the submarine has been decommissioned.

<u>Ship</u>	<u>Builder</u>	<u>Launch Date</u>	<u>Commission Date</u>
SSN-688 <i>Los Angeles</i>	Newport News	4/74	11/1976
SSN-689 <i>Baton Rouge</i> ^(a)	Newport News		6/1977
SSN-690 <i>Philadelphia</i>	Electric Boat	10/74	6/1977
SSN-691 <i>Memphis</i>	Newport News	4/76	12/1977
SSN-692 <i>Omaha</i> ^(a)	Electric Boat		3/1978

<u>Ship</u>	<u>Builder</u>	<u>Launch Date</u>	<u>Commission Date</u>
SSN-693 <i>Cincinnati</i> ^(a)	Newport News		6/1978
SSN-694 <i>Groton</i>	Electric Boat	10/76	7/1978
SSN-695 <i>Birmingham</i>	Newport News	10/77	12/1978
SSN-696 <i>New York City</i>	Electric Boat	6/77	3/1979
SSN-697 <i>Indianapolis</i>	Electric Boat	7/77	1/1980
SSN-698 <i>Bremerton</i>	Electric Boat	7/78	3/1981
SSN-699 <i>Jacksonville</i>	Electric Boat	11/78	5/1981
SSN-700 <i>Dallas</i>	Electric Boat	4/79	7/1981
SSN-701 <i>La Jolla</i>	Electric Boat	8/79	10/1981
SSN-702 <i>Phoenix</i>	Electric Boat	12/79	12/1981
SSN-703 <i>Boston</i>	Electric Boat	4/80	1/1982
SSN-704 <i>Baltimore</i>	Electric Boat	12/80	7/1982
SSN-705 <i>City of Corpus Christi</i>	Electric Boat	4/81	1/1983
SSN-706 <i>Albuquerque</i>	Electric Boat	3/82	5/1983
SSN-707 <i>Portsmouth</i>	Electric Boat	9/82	10/1983
SSN-708 <i>Minneapolis-Saint Paul</i>	Electric Boat	3/83	3/1984
SSN-709 <i>Hyman G Rickover</i>	Electric Boat	8/83	7/1984
SSN-710 <i>Augusta</i>	Electric Boat	1/84	1/1985
SSN-711 <i>San Francisco</i>	Newport News	10/79	4/1981
SSN-712 <i>Atlanta</i>	Newport News	8/80	3/1982
SSN-713 <i>Houston</i>	Newport News	3/81	9/1982
SSN-714 <i>Norfolk</i>	Newport News	10/81	5/1983
SSN-715 <i>Buffalo</i>	Newport News	5/82	11/1983
SSN-716 <i>Salt Lake City</i>	Newport News	10/82	5/1984
SSN-717 <i>Olympia</i>	Newport News	4/83	11/1984
SSN-718 <i>Honolulu</i>	Newport News	9/83	7/1985
SSN-719 <i>Providence</i>	Electric Boat	8/84	8/1985
SSN-720 <i>Pittsburgh</i>	Electric Boat	12/84	11/1985
SSN-721 <i>Chicago</i>	Newport News	10/84	9/1986
SSN-722 <i>Key West</i>	Newport News	7/85	9/1987
SSN-723 <i>Oklahoma City</i>	Newport News	11/85	6/1988
SSN-724 <i>Louisville</i>	Electric Boat	11/85	11/1986
SSN-725 <i>Helena</i>	Electric Boat	6/86	7/1987
SSN-750 <i>Newport News</i>	Newport News	3/86	6/1989
SSN-751 <i>San Juan</i>	Electric Boat	12/86	8/1988
SSN-752 <i>Pasadena</i>	Electric Boat	9/87	2/1989
SSN-753 <i>Albany</i>	Newport News	6/87	4/1990
SSN-754 <i>Topeka</i>	Electric Boat	1/88	10/1989
SSN-755 <i>Miami</i>	Electric Boat	11/88	6/1990
SSN-756 <i>Scranton</i>	Newport News	7/89	1/1991
SSN-757 <i>Alexandria</i>	Electric Boat	7/90	6/1991
SSN-758 <i>Asheville</i>	Newport News	10/89	9/1991
SSN-759 <i>Jefferson City</i>	Newport News	3/90	1/1992
SSN-760 <i>Annapolis</i>	Electric Boat	5/91	4/1992
SSN-761 <i>Springfield</i>	Electric Boat	1/92	1/1993
SSN-762 <i>Columbus</i>	Electric Boat	8/92	7/1993
SSN-763 <i>Santa Fe</i>	Electric Boat	12/92	1/1994
SSN-764 <i>Boise</i>	Newport News	10/90	11/1992
SSN-765 <i>Montpelier</i>	Newport News	4/91	3/1993
SSN-766 <i>Charlotte</i>	Newport News	10/92	10/1994
SSN-767 <i>Hampton</i>	Newport News	9/91	11/1993
SSN-768 <i>Hartford</i>	Electric Boat	12/93	12/1994
SSN-769 <i>Toledo</i>	Newport News	8/93	2/1995
SSN-770 <i>Tucson</i>	Newport News	3/94	9/1995

<u>Ship</u>	<u>Builder</u>	<u>Launch Date</u>	<u>Commission Date</u>
SSN-771 <i>Columbia</i>	Electric Boat	9/94	10/1995
SSN-772 <i>Greeneville</i>	Newport News	9/94	2/1996
SSN-773 <i>Cheyenne</i>	Newport News	4/95	8/1996

Mission. The Los Angeles class is designed to protect naval battle groups and task forces; to detect and destroy enemy submarines and surface ships in order to prohibit the employment of such forces in attack and destruction of United States or allied targets.

Price Range. The latest boats have a unit price of approximately US\$883 million.

Technical Data

Characteristics

<i>Speed:</i>	30+ knots
<i>Depth:</i>	1,475 ft maximum
<i>Crew:</i>	13 officers, 120 enlisted

Dimensions

	<u>Metric</u>	<u>US</u>
<i>Length:</i>	109.7 m	360 ft
<i>Draft:</i>	9.8 m	32 ft
<i>Beam:</i>	10.1 m	33 ft
<i>Displacement, surface:</i>		6,000 tons
<i>Displacement, submerged:</i>		6,927 tons

Electronics

	<u>Type</u>	<u>Quantity</u>
<i>Fire control system:</i>	Mark 117	1
<i>Acoustic warfare system:</i>	Submarine Acoustic Warfare System (SAWS)	1
<i>Sonar beacon:</i>	BQN-13	1
<i>Depth sounding sonar:</i>	BQN-17	1
<i>Sonar detection set:</i>	BQR-15	1
<i>Integrated sonar:</i>	BQQ-5	1
<i>Towed array:</i>	TB-16	1
<i>Close contact sonar:</i>	BQS-15	1
<i>ESM receiver:</i>	WLR-8(V)2	
<i>Computer systems:</i>	UYK-7	
<i>Periscope:</i>	Mark 18	1
	Mark 2	1
<i>Communications antenna:</i>	BRA-34	
<i>Radio D/F receiver:</i>	BRD-7	
<i>Radar:</i>	BPS-15A	1
<i>Computers:</i>	UYK-7	

Armament

	<u>Type</u>	<u>Quantity</u>
<i>Torpedoes:</i>	Mark 48	14
<i>Missiles:</i>	UGM-84 Harpoon	4
	UGM-109 Tomahawk	8

Propulsion

	<u>Type</u>	<u>Quantity</u>
<i>Main engines:</i>	Steam turbines	2
<i>Reactor:</i>	S6G	1
<i>Propeller:</i>	Fixed pitch/7 blade	1

Design features. The SSN-688 is a nuclear-powered attack submarine designed to deal with both enemy submarines and surface combatants. It has a largely cylindrical pressure hull in place of the Albacore hull

adopted by the Permit and Sturgeon classes. The pressure hull itself is thinner than the earlier designs, reducing safe diving depths. The submarine structure itself is a single-hull design in which the pressure hull also forms the outer skin of the hull. The only exception to this is the bow and stern where an outer hull sheaths the sonar domes and ballast tanks. These design features all relate to a concentration on speed over other characteristics.

The primary weapon systems of the class are the Mark 48 torpedo, the UGM-84 Harpoon anti-ship missile and the UGM-109 Tomahawk cruise missile. The first 12 units of the SSN-688 class were equipped with the Mark 113 Mod 10 fire control system and could fire the UUM-44A SUBROC anti-submarine rocket, but not the Tomahawk cruise missile. All boats built since SSN-700 have the Mark 117 fire control system, and can fire Tomahawk, but not the SUBROC.

The Los Angeles class is powered by an S6G reactor derived from the D2G powerplant of the CGN-25 class cruisers. All boats are equipped with a Fairbanks-Morse

38D8Q diesel-powered electric generator and batteries for emergency operations.

Operational characteristics The US Navy has upgraded SSN-688 through SSN-699 by retrofitting the digital Mark 117 weapons control system in place of the analog Mark 113 fire control system. The newer system can handle the Harpoon and Tomahawk cruise missiles. Both systems can handle Mark 48 torpedoes. All three weapons are launched through the submarine's torpedo tubes. The US Navy installed a 12-tube Vertical Launch System into boats of the class beginning with SSN-719. This allows the use of additional Tomahawk cruise missiles.

The SSN-688 class uses a BQQ-5 sonar and BQS-15 towed array sonar. Beginning with the SSN-751, the class received the BSY-1 submarine combat system. The BSY-1 is the successor to the SUBACS (Basic Submarine Advanced Combat Systems) program. Besides the basic offensive weapons array, the SSN-688 class is being modified to launch Captor Mark 60 and Mark 67 mines.

Variants/Upgrades

During the 20 years that the class has been under construction, several changes and modifications have evolved.

SSN-690 – all ships are equipped with the Mark 117 torpedo fire control system.

SSN-719 – all ships have an external 12-tube vertical launch system. This system increases the fire power of the submarine and, by shifting missiles to the external tubes, permits it to carry additional torpedoes.

SSN-751 – these boats are called the Improved Los Angeles Class or 688I; they are considered Arctic capable boats. The Combat Control System Mark 1 is replaced by the BSY-1. This change also caused the US Navy to replace the UYK-7 computers with the UYK-44. These submarines are also fitted with the Mine Detection and Avoidance System (a mine and ice detection avoidance system) and are clad with acoustic

tiles. In addition, the sail planes have been moved to the bow to allow these submarines to break through the ice.

SSN-768 – feature improved silencing, additional fins at the stern and improved propulsion components.

A-RCI. A-CRI (Acoustic-Rapid COTS Insertion) is a four phase transformation of existing sonar systems AN/BSY-1, BQQ-5 and BQQ-6 from legacy systems to a more capable and upgradeable COTS/open systems architecture. As a result, the 688 and SSBN fleets will also have a common main sonar. Deliveries of Phase I are due in November 1997, followed by annual deliveries through the year 2000.

Near-Term Reconnaissance System, Long-Term Mine Reconnaissance System. These are programs intended to boost the submarines' minefield location and identification ability. NTRS should be fielded by 1997, while the more sophisticated LTMRM will not be fielded until after the year 2000.

Program Review

Background. The development of the SSN-688 Los Angeles class nuclear attack submarines began in 1968. A major motive behind the new program was the appearance of the Russian Charlie class anti-ship missile firing submarines. These, it then appeared, threatened to be able to penetrate US ASW screens to

fire their missiles at high value targets. The tactical objective behind the 688 design was to develop a class of nuclear-powered attack submarines that could sweep ahead of high-value formations, sterilizing the area of Charlies. For this, high submerged speed was essential

if the submarines were to keep station with the fast-stepping carrier task groups.

The maximum speeds of American attack submarines had been dropping through the earlier SSN-594 Permit and SSN-637 Sturgeon programs since the roles adopted by those boats placed greater emphasis on silence than on speed. The SSN-688 was conceived as a limited production special role boat in which these priorities would be reversed. The new class also took advantage of technological advances in undersea detection and weapons development. These improvements included an improved long-range detection and tracking sonar, improved torpedo fire control, a dual inertial navigation system, improved noise reduction and a rubber sonar dome in the bow.

In 1969, the US Navy awarded the SSN-688 class design contract to Newport News Shipbuilding & Drydock. This was the first time that Newport News served as the design yard for a submarine and the first time that General Dynamics, Electric Boat Division, or a naval shipyard did not perform this role. The first SSN-688 contracts were issued in January 1971. Seven went to General Dynamics' Electric Boat Division and five to Newport News. The early construction history was marred by repeated cost overruns and a running dispute between the US Navy and Electric Boat.

The SSN-688 program has featured continuous system improvements including the addition of the Mk.36 Vertical Launch System (VLS) and the BSY-1 (formerly the Submarine Advanced Combat System). The initial funding for the Vertical Launch System procurement began in FY81 with the first 12-tube array being incorporated into the SSN-719 and all subsequent submarines of the class.

The US Navy's FY85 budget included US\$2.97 billion for four SSN-688 boats. The major difficulties encountered by the SSN-688 program during FY85 concerned the Submarine Advanced Combat System, which was designed to integrate the submarine's different sensors and weapons systems to improve detection and engagement rates. This was to have been installed in all SSN-688 boats ordered from FY83 to FY86. The next stage, Submarine Advanced Combat System A, would have gone in all SSN-688 boats ordered in FY87 and FY88. The ultimate stage, Submarine Advanced Combat System B, would have gone in the FY89 and FY90 boats, and the SSN-21 class. Due to numerous problems, the program was scrapped in 1985 and replaced by a two-stage program.

The BSY-1 Command and Control System was installed in all SSN-688 boats ordered in FY83 and after. It uses some of the software and hardware developed for the

Submarine Advanced Combat System. The second stage of the program is an SSN-21 Command and Control System (since redesignated BSY-2) for the SSN-21 Seawolf class submarines. The prime contractors for these programs are IBM, Hughes Aircraft, Raytheon and Rockwell. The keel for the first submarine to be equipped with the BSY-1, *USS San Juan* (SSN-751), was laid down on August 3, 1985, and commissioned in August 1988. The BSY-1 was incomplete, and it lacked most of the active fire control system components.

Congress appropriated US\$2.62 billion in December 1985 for four submarines in the FY86 program. The US Navy delayed awarding contracts for the FY86 submarines, due to General Dynamics' suspension from receiving new government contracts in late 1985. With the lifting of the ban in February 1986, the US Navy took bids from Electric Boat and Newport News. On March 21, 1986, the US Navy awarded all four FY86 submarines to Electric Boat. The award of all four boats to this yard surprised some observers, but the US Navy said if it had split the award, it would have cost US\$100 million more than the US\$1.32 billion that it paid for the four FY86 boats.

The US Navy asked Congress for US\$2.04 billion for four SSN-688 boats in its FY87 budget request. Congress gave the US Navy US\$1.96 billion. On February 6, 1987, the US Navy awarded Newport News Shipbuilding a US\$1.02 billion contract for the four FY87 boats, repeating the FY86 process, where one shipyard received the contract for all four submarines to cut costs.

By 1989, continuous improvements to the SSN-688 design had eaten up the design margin. As a result, the design had no room for new systems or major modifications. This was particularly true for the newer boats, which were to receive the BSY-1 Submarine Combat System. Congress nonetheless directed the service to undertake what improvements it could, bearing in mind that the SSN-688 class would form the majority of the United States' submarine force through the first decade of the next century.

In August 1990, the US Navy designated the *USS Memphis* as the test platform for the SSN program. During the submarine's overhaul during 1993/1994, a single 762 mm torpedo tube replaced a pair of the standard 533 mm tubes. A larger weapons shipping hatch, bolt-on modifications to the stern, magnetic bearing technology and an XBT probe were also provided. These changes will be used to evaluate improvements to both the SSN-688 and SSN-21 class submarines and to develop systems for the new attack submarine.

On November 11, 1991, the US Navy stated that the BSY-1 command and control system, designed specifically for this class, was declared operationally effective and operationally suitable (this means that the system meets or exceeds the design specification). This system provides the submarine with many new features, two of which are mine detection and below-ice surfacing capabilities.

Construction of the class has now ended with the last submarine commissioning on August 15, 1996. The US Navy has already started to decommission the older members of the class rather than go to the expense of refueling them. There are no plans to build any additional submarines of this class; in fact, when this was suggested in 1990 it met stiff opposition from the US Navy. However, as a result of concerns over the preservation of the submarine industrial base, beginning in 1993 there was talk of ordering one additional 688 class boat in lieu of an additional SSN-21. Nothing came of this proposal.

In late 1993, it was announced that one of the oldest Los Angeles class boats, the *USS Baton Rouge*, would be decommissioned and placed in reserve. The official reason for this was that the boat was due for a very expensive refueling and the cost of this could not be justified in the current environment. However, confidential European sources have pointed out that the *Baton Rouge* was involved in a collision with a Russian Sierra class submarine and had not been to sea since. This, they suggested, pointed to serious pressure hull damage rather than refueling costs as being responsible for the decommissioning. It is known that several other US submarines have had their never-exceed depths severely reduced after such collisions. Two additional submarines, the SSN-692 *USS Cincinnati* and the SSN-693 *USS Omaha* were also withdrawn from service when their reactor core lives expired.

Historical Perspective. The history of the Los Angeles class is rich in ironies. Had the designers of the class been told that, within 30 years, it would be the only class of nuclear-powered attack submarine operated by the US Navy, they would have been utterly incredulous. The SSN-688 was conceived as a special-purpose submarine intended for a specific tactical situation, and

was quite outside the mainstream of US Navy submarine development. It was originally intended that no more than six or twelve SSN-688 design boats would be completed, after which construction would revert to an improved and enhanced variant of the Sturgeon/Permit design family, which eventually emerged as the SSN-21 Seawolf.

A further irony is that the threat which gave birth to the SSN-688, the Charlie missile submarine, was considered by the Russians to be an abject failure, too slow and noisy to approach a US carrier battle group and armed with missiles most unlikely to penetrate the excellent defenses of such groups. The Charlie force was relegated to other, less demanding roles, so the role for which the SSN-688 was designed is unlikely to have been of great significance.

What the SSN-688 story does reveal is the consequences of mobilization. The main period of SSN-688 construction coincided with the defense build-up of the late 1970s and early 1980s. It is possible to argue that this period can be regarded as the mobilization effort for the final (and ultimately successful) phase of the Cold War. If this analogy is apposite, then the Iron Law of mobilization applies (the Iron Law being that a country mobilizing has to build more of what is already on the production lines, not introduce new equipment better suited to its real requirements). Every time a shift to a new design was proposed, the costs and delays incurred were deemed unacceptable and additional SSN-688 boats were ordered instead. As a result, a limited-production special purpose submarine ended up as the sole strength of the US submarine fleet.

The implication of this line of thought would be that the current defense downsizing is equivalent to the rapid demobilization that followed the First and Second World Wars. In these cases, construction effort was best placed in prototypes and small classes, so that the production lines were ready with an advanced design when a new mobilization had to be initiated. In fact, following this logic further, it is possible to argue that the entire 1945-1990 period actually constituted World War III – which the US won – albeit one fought out in very slow motion. This suggests some very profound issues for defense procurement policy.

Funding

Most of the research and development work carried out under program element number 0603569N, Attack Submarine Development, is classified. The Navy had planned to wind down some of the activities in this program, as reflected in funding requests. The Navy's Fiscal 1988/Fiscal 1989 funding request asked for US\$12.9 million for Fiscal 1988 and postulated a Fiscal 1989 request of US\$24 million.

Recent Contracts

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Lockheed Martin Federal Systems	10.7	<i>June 1996</i> — Modification to previously awarded contract N00024-95-C-6535 for accelerated introduction of towed array, hull array, sphere array, and other ship sensor processing improvements, via A-RCI hardware and software. Work is to be completed by November 1998.
Newport News Shipbuilding	516.0	<i>Feb 1997</i> — Undertaking of the SSN-773 <i>Cheyenne</i> post-shakedown availability. Work is expected to be completed by December 1997.
Lockheed Martin Federal Systems	16.6	<i>Nov 1997</i> — Modification to previously awarded contract N00024-95-C-6536 for Acoustic-Rapid COTS Insertion (A-RCI), on SSN 688, 688I and SSBN 726 platforms.
Lockheed Martin Federal Systems	122.8	Total value of the multi-year A-RCI contract, to be carried out in four phases. The above described contract from June 1996 is Phase I of this multiyear program, and the one from November is also part of this. The subsequent deliveries, after November 1996, are due annually through November 2000. The said contract value represents the total potential for Lockheed Martin and includes RDT&E and procurement.

Timetable

	1969	Design contract awarded to Newport News Shipbuilding
Jan	1971	First submarine ordered
Fiscal	1983	First submarine ordered with BSY-1 system
Nov	1986	First submarine of the class commissioned
Nov	1989	Last submarine of the class ordered
	1993	First Los Angeles class boat decommissioned
Jun	1996	Multiyear upgrade programs, including A-RCI, begin
Sep	1996	Last boat commissioned

Worldwide Distribution

US. (62 boats built, six of which now withdrawn from service)

Forecast Rationale

Funding for upgrades and modernization continues, keeping the existing boats in service until 2015-2020 in the most effective manner. The US Navy has in fact stated that every 688 that will be in force will be modified during its lifetime.

It appears that the USN is implementing a similar upgrade and modernization strategy on these submarines as is the case with some of the large surface ship programs that otherwise have been completed. By addition of modern electronics and warfare systems, the

capabilities of these platforms are being changed from their original mission while the cost is below that of buying altogether new boats.

In the fiscal years 1998 through 2003, more than US\$300 million is planned to be invested in upgrades for communications, acoustic processors, sensors and weapons. Furthermore, the growing importance of littoral warfare in today's and future strategies entails that the minefield location and identification abilities of the 688 must be improved.

Ten-Year Outlook

No new production is forecast; the chart is therefore omitted.

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