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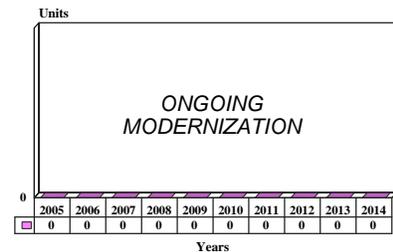
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CVN-68 Nimitz Class - Archived 9/2006

Outlook

- USS *Ronald Reagan* now operational with Pacific Fleet
- Future carriers will be significantly different in basic design
- Ongoing modernization will continue for decades to come
- Backbone of U.S. Navy operations

10 Year Unit Production Forecast
2005 - 2014



Orientation

Description. Nuclear-powered aircraft carriers.

Status. Production and service.

Sponsor

United States Department of Defense
U.S. Navy
Naval Sea Systems Command (NAVSEA)
2531 Jefferson Davis Highway
Arlington, Virginia (VA) 22242-5160
USA
Tel: +1 (703) 602-6920

Total Produced. Eight ships have been launched; the ninth ship is being completed. The 10th, the last of the series (CVN-77), should be launched in 2005 or 2006.

Pennant List

<u>Number & Name</u>	<u>Launch</u>	<u>Commissioning</u>	<u>Fleet</u>
CVN-68 <i>Nimitz</i>	5/1972	5/3/1975	Pacific
CVN-69 <i>Dwight D. Eisenhower</i>	10/1975	10/18/1977	Atlantic
CVN-70 <i>Carl Vinson</i>	3/1980	3/13/1982	Pacific
CVN-71 <i>Theodore Roosevelt</i>	10/1984	10/25/1986	Atlantic
CVN-72 <i>Abraham Lincoln</i>	2/1988	11/11/1989	Pacific
CVN-73 <i>George Washington</i>	7/1990	7/4/1992	Atlantic
CVN-74 <i>John C Stennis</i>	11/1993	12/9/1995	Pacific
CVN-75 <i>Harry S. Truman</i>	9/1996	7/25/1998	Atlantic
CVN-76 <i>Ronald Reagan</i>	9/2000	6/2003	Pacific

Mission. The mission of the U.S. aircraft carriers includes the provision of a credible, sustainable, independent forward presence and conventional deterrence in peacetime; operation as the cornerstone of joint/allied maritime expeditionary forces in times of crisis; and operation and support of aircraft attacks on

enemies, protection of friendly forces, and engagement in sustained independent operations in war.

Price Range. About \$4.5 billion each. The price of the last of the series (CVN-77) was quoted as \$5.2 billion in 1997.

Contractors

Northrop Grumman Newport News, Division HQ, <http://www.nn.northropgrumman.com>, 4101 Washington Ave, Newport News, VA 23607-2770 United States, Tel: + 1 (757) 380-2000, Email: nnwebmaster@ngc.com, Prime

Boeing Missile Defense Systems - Huntsville, Jetplex Facility, 499 Boeing Blvd, Huntsville, AL 35806 United States, Tel: + 1 (205) 721-7535, Consortium Member

Brown Brothers & Company Ltd, The Sales Department, Broughton Road, Edinburgh, EH7 4LF United Kingdom, Consortium Member

DRS Electronic Systems Inc, <http://www.drs.com>, 200 Professional Dr, Gaithersburg, MD 20879 United States, Tel: + 1 (301) 921-8100, Fax: + 1 (301) 977-6158, Consortium Member

Duramax Marine, 17990 Great Lakes Parkway, Hiram, OH United States, Consortium Member

Fairmount Automation Inc, 1220 Valley Forge Rd, Unit 37, Phoenixville, PA 19460 United States, Consortium Member

Thordon Bearings, 3225 Mainway, Burlington, L7M 1A6 Ontario, Canada, Consortium Member

Inspec Foams Inc, Suite 201, 101 East Park Blvd, Plano, TX 75074 United States, Tel: + 1 (972) 516-0702, Fax: + 1 (972) 516-0624, Email: dan.trahan@degussa.com, Consortium Member

L-3 Communications - Ocean Systems, <http://www.L-3Com.com/os>, 15825 Roxford Street, Sylmar, CA 91342-3597 United States, Tel: + 1 (818) 367-0111, Fax: + 1 (818) 367-6999, Email: Cam.Mcdonald@L-3Com.com, Consortium Member

Raytheon - Integrated Air Defense Systems, 350 Lowell St, Andover, MA 01810 United States, Tel: + 1 (978) 470-4446, Fax: + 1 (978) 470-4449, Consortium Member

Technical Data

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Length (overall)	332.9 m	1,092 ft
Length (WL)	317 m	1,040 ft
Beam	40.8 m	134 ft
Width at flight deck	76.3 m	256 ft
Length of flight deck	332.9 m	1,092 ft
Flight deck (angled)	237.7 m	779.8 ft
Draft	11.3 m	37 ft
Displacement		
Light	78,852 tonnes	73,607 tons
Full load	98,555 tonnes	97,000 tons
Performance		
Speed	55+ kmph	30+ kt
Endurance	(13 yr reactor core life)	
Aircraft elevators	4	
Catapults	4 x C-13 Mod 1	
Crew	155 officers, 2,981 enlisted	
Air wing	366 officers, 2,434 enlisted	
Total accommodations	6,500 personnel	
Armament		
	<u>Type</u>	<u>Qty</u>
Guns	Mark 15 Phalanx CIWS	3-4
Surface-to-air missiles	Mark 29 Sea Sparrow	2-3x8

	<u>Type</u>	<u>Qty</u>
Aircraft		
Heavy fighter	F-14A/B/D Tomcat or F/A-18E/F	12
Multirole	F/A-18C/D Hornet	36
EW	EA-6B Prowler	4
AEWC	E-2C Hawkeye	4
ASW fixed wing	S-3A Shadow	7
ASW rotary wing	SH-60F, HH-60H Seahawk	7
Electronics – Radar		
3-D air search	SPS-48E	1
2-D air search	SPS-49(V)5	1
Surface search	SPS-67(V)1	1
Target acquisition	Mark 23 TAS	1
Missile fire control	Mark 95	6
Navigation	SPS-64(V)9	1
	Furuno 900	1
CCA	SPN-44	1
Electronics - Electronic Warfare		
ESM/ECM	SLQ-32(V)4	2
Decoy launchers	Mark 36 SRBOC	8
Floating decoy	SLQ-49	
Chaff buoy	SLQ-39	
Floating jammer	SSQ-95	
Torpedo decoy	SLQ-25 Nixie	2
Electronics - Command Control		
Satellite Communications	OE-82	
	SSR-1	
	WSC-3	
	NTDS	
Navigation	GPS, Loran, Omega: TACAN, URN-25	
Machinery		
Nuclear reactors	General Electric A4W/A1G	2x140,000 shp
Steam turbines	Westinghouse	4
Propellers	Fixed pitch	4
Ships services	Emergency diesel generators	4x2 MW
Distilling plants	Soloshell	4

Design Features. The CVN-68 Nimitz class nuclear-powered aircraft carriers are the world's largest warships, with a full-load displacement of 91,700 tons (96,700 for the CVN-72 and later) and an overall length of 1,089 feet. The basic configuration of the class is similar to the CV-63 Kitty Hawk class, with two elevators before the island (superstructure), one aft of the island, and one on the port (left) side at the end of the angle deck. Each elevator is 25.91 by 15.85 meters (85 by 52 ft). The hanger deck is 208.5 meters (684 ft) long, 32.92 meters (108 ft) wide, and 8.01 meters (26.5 ft) high. There are four Mark 13 Mod 1 steam catapults and four arresting wires. Each ship has enough aviation

fuel and ordnance for 13 days of unreplenished air strike operations.

Originally, the class was considered a unitary whole named after the lead ship, USS *Nimitz* (CVN-68). However, the carriers from CVN-72 are now considered a separate class, the Abraham Lincoln class, due to a number of differences including a major revision of the magazine arrangements coupled with a new and very sophisticated system for magazine protection. This is reported to include louvered sheets of armor plate intended to break up the jet from a shaped-charge missile warhead. The damage control measures include a series of full and empty compartments surrounding vital engineering spaces, weapons magazines, and 2.5-

inch armor and various other measures. However, all details of the protection schemes installed on the CVNs are classified, and any such hypotheses should be regarded as guesswork.

Each ship has two pressurized-water A4W/A1G nuclear reactors, compared to the eight pressurized-water A2W reactors installed on the U.S. Navy's first nuclear carrier, USS *Enterprise* (CVN-65). This results in a much simpler layout of the engineering spaces, whereas the layout of the CVN-65 was an engineering and maintenance nightmare. For many years, the top speeds of the CVNs were classified information, leading to rumors that they were capable of unprecedented speeds that increased over the years to 40, 50, and eventually 60 knots. Such figures were never taken seriously, and when the real speeds were disclosed, they turned out to be much more prosaic. The latest carrier to run trials, the CVN-75 USS *Harry S. Truman*, topped out at 30.9 knots. CVN-76, USS *Ronald Reagan*, is reputed to be a little faster due to her new bulbous bow that improved hydrodynamic efficiency.

The armament of the first three ships has been upgraded to that of the later ships, with four Mark 15 Phalanx terminal defense systems and four Mark 29 NATO Sea Sparrow launchers, instead of the three such systems with which they were completed. The number of missile fire control channels was increased from four to six.

The airgroup on these carriers has been systematically reduced over the last decade and now stands at 12 F-14 Tomcat and 36 F/A-18 Hornet strike aircraft with four EA-6B EW aircraft, four E-2C AEWC aircraft, seven

S-3A, and seven SH-60F ASW aircraft. The F-14s are progressively being withdrawn and replaced by the F/A-18E/F. This reduced airgroup, approximately 60 percent of the carrier's strike aircraft capacity, is causing increasing concern.

Operational Characteristics. The primary functions of aircraft carriers include establishing localized maritime and air superiority, as well as strategic mobility while projecting power and technological prowess in a risk area. Consequently, carriers are equipped with the latest in air and sea control capabilities. In terms of air search radar, the newer ships of the Nimitz class have the three-dimension SPS-48E, versus the SPS-48C model on the older ships. They also have the SPS-64 navigation radar, the SPS-67 surface search, and the SPS-49 two-dimension air search radar. The newer ships are being built with an anti-submarine warfare (CV ASW) module for command, control, and analysis of ASW operations. Older ships are being retrofitted with these newer radars at the time of their normal refueling.

These ships have remarkable firefighting capabilities, normally considered equivalent to those of a medium-sized city, although no civilian firefighting department has access to the level of firefighting technology commonplace on these carriers. Standard equipment includes infrared goggles optimized so that the seat of a fire can be easily identified, handheld sonar and radar scanners to detect obstructions and debris, and equipment for rapidly detecting and removing survivors. Crew training standards in fire containment and elimination are very high on board the carriers.

Variants/Upgrades

CVN-72 Abraham Lincoln Class. These ships are considered a different class from the original CVN-68 group. They have different dimensions: the draft is 11.8 meters (38.7 ft), the displacement (light) is 73,973 tons, and the displacement (heavy) is 96,386 tons. The newer ships also have a different radar suite from the earlier ships. The internal arrangements are reported to be significantly different.

CVN-77. A modified successor to the Nimitz class. This ship is covered in a separate report.

CVN-21. A follow-on class to the Nimitz design. This program is further discussed in a separate report.

Smart Carrier. This is a reference to using some of the latest carriers of the Nimitz class, starting with USS *Harry S. Truman* (CVN-75), which was commissioned in 1998, as a testbed for technical and procedural changes. The overall aim is to trim the workload of the U.S. Navy ships across the fleet, under the auspices of

the Smart Ship program. An experiment related to this concept was carried out on the cruiser USS *Yorktown* in 1997, and other ships, including the LPD-17 San Antonio class, will be part of it as well.

In June 1999, the Navy announced that the CVN-75 was planned for use as part of the program. No exact time schedule has been publicized as of yet. However, the program is of a dynamic nature, and it appears that the parameters are not strictly defined but adjusted as conditions change. Consequently, it is likely to continue to evolve over the next several years and will most likely be implemented in portions in the next-generation warships of the U.S. Navy. The issue of reduced manning is of growing importance, with the number of people signing up for the service and the increased level of automation of systems freeing some of the previously necessary manpower for other functions on board.



CVN-71 crew members spell out a reference to the quote, "Walk lightly and carry a big stick."

Source: U.S. Navy

Program Review

Development of the Nimitz class began in 1965 to provide a nuclear-powered successor to the CVN-65 Enterprise class carriers. The USS *Nimitz* and USS *Eisenhower* originally were classed as attack aircraft carriers nuclear (CVAN); they were reclassified as multimission carriers nuclear (CVN) in June 1975.

Design studies of the Nimitz class began in 1965. The initial plans envisioned acquiring three ships of the new class. Congress funded the USS *Nimitz* in FY67. In FY68 and FY69, funding was provided for long-lead items for CVN-69, with full funding coming in FY70. The construction of the first two ships was delayed by labor difficulties at Newport News Shipbuilding, and the two ships were commissioned in May 1975 and October 1977, respectively. Long-lead funding for the USS *Carl Vinson* was provided in FY73, and the major funding followed in FY74. The ship was commissioned on March 13, 1982.

Although only three ships of the class were originally planned, U.S. Navy studies of alternative designs in the mid-1970s concluded that building more ships of this class was more cost-effective than designing a new class. These studies also showed the futility of attempting to build a full-scale fleet carrier on restricted dimensions. The studies concluded that fewer aircraft on a small carrier provided diminished striking power compared to air power of the Nimitz class. Another consideration was the high cost of operating a

conventional carrier, since such a carrier would consume 11 million barrels of oil during the same period that a Nimitz class carrier could operate for 13 years on a single fueling of a nuclear core.

As a result, in 1976, the U.S. Navy requested \$350 million for long-lead funding of the CVN-71. The carrier issue became a major dispute during the Carter administration. President Carter opposed all carriers on the grounds that they were force projection instruments. If pushed, he would accept only a conventionally powered aircraft carrier in place of a nuclear-powered hull. When funding requests for the CVN-71 did not appear after the FY77 attempt, Congress took matters into its own hands and in FY79 appropriated \$1.9 billion for the CVN-71. However, President Carter vetoed the bill.

President Carter attempted a compromise by promising to ask for \$1.6 billion for a conventional carrier in the FY80 budget. The U.S. Navy opposed the move, asking for a new CVN class ship. Congress then appropriated \$2.09 billion for the CVN-71. This time, due to strong congressional support for the CVN-71 and the risk of a veto override, President Carter did not contest the bill. In FY80, Newport News Shipbuilding & Dry Dock Co received four contract modifications totaling \$213.2 million for long-lead items for the CVN-71. On September 30, 1980, it received a \$1.155 billion contract for construction of the ship. The keel was laid

on October 13, 1981. However, the tight funding environment surrounding the CVN-70 meant that the Navy was forced to economize severely with its construction, with the ship regarded as the least satisfactory of the class.

With the change in administration, the prospects for more CVN-68 class carriers improved greatly. The new Secretary of the Navy planned a major U.S. Navy modernization, focusing on a 600-ship fleet with 15 aircraft carriers. This required adding two carriers to the fleet to replace the USS *Midway* (CV-41) and the USS *Coral Sea* (CV-43). Long-lead funding for the two carriers was provided in the FY82 budget, while full funding was provided in the FY83 budget. Congress passed this \$6.5 billion budget request without major change. On November 1, 1982, Newport News received a \$280.9 million contract for long-lead funding, followed on December 27, 1982, by a \$3.14 billion contract to build the CVN-72 and CVN-73. GE of Schenectady, New York, received a \$215.3 million contract on December 30, 1982, for nuclear power plant components.

On November 3, 1984, the keel of USS *Abraham Lincoln* (CVN-72) was laid. The USS *Theodore Roosevelt* (CVN-71) was commissioned on October 25, 1986, nearly two years ahead of the original schedule. The reason for the decrease in the construction time was that Newport News started using modular construction. The keel-laying for the USS *George Washington* (CVN-73) took place on August 25, 1986. In contrast to the CVN-70, the construction of CVN-71 through CVN-73 took place at a time when defense funding was generous, and the ships were equipped with an extensive range of additional equipment.

While these carriers were being built, Newport News conducted the first overhaul of the USS *Nimitz* and USS *Eisenhower*, from October 1983 through January 1985, and October 1985 to January 1987, respectively. During these upgrades, the electronics systems, weapons, and various other systems were improved to the same level as those of later ships.

During the FY87 budget hearings, the U.S. Navy indicated a plan to request long-lead funding for a seventh CVN-68 class carrier in the FY91 budget and to order the ship in FY92. One week before President Reagan released his FY88 budget request, the Department of Defense broke all precedents and announced a long-lead funding request for two more CVN-68 class carriers. The service said that these ships were to replace two CV-59 Forrester class carriers, which were scheduled to leave service between 1999 and 2001.

During the FY88 budget hearings, some congressmen challenged the U.S. Navy's need for the two carriers.

Others asked the service whether ordering the two ships at once would save costs. The Navy said that ordering both ships in FY88 allowed for work stability at Newport News Shipbuilding; otherwise, the yard would have to start laying off personnel in 1989. The service also said that by ordering two ships together, it saved \$2 billion, due to combined long-lead orders and shipyard stability. In the FY80 defense budget, Congress had appropriated \$6.325 billion for the two carriers. The Navy was authorized to spend only \$6.4 million in FY88.

The U.S. Navy released the Request for Proposals for the two ships to Newport News in February 1988. On June 30, 1988, the Navy gave the yard a \$2.94 billion modification to a previously issued contract (N00024-88-C-2055) for the two ships. The total value of the contract came to \$3.67 billion. Contract completion date was specified as September 1998. During the FY87 and FY88 budget hearings, some senators had introduced motions to decommission the USS *Midway* or USS *Coral Sea* and reduce the Navy to 13 aircraft carriers; these motions were defeated each year.

The USS *Abraham Lincoln* was commissioned November 11, 1989, four months after the USS *George Washington* was launched. The original plans called for the *Washington* to be commissioned in December 1991, but in February 1989, the Navy and Newport News agreed to postpone its commissioning until July 4, 1992. In theory, this gave the yard time to arrange an orderly transition of workers to CVN-74 and CVN-75; the reality was a simple desire to perpetuate tradition. When the Department of Defense released its revised FY90 budget request in April 1989, it announced that the carrier USS *Coral Sea* would be retired in 1990, about two years ahead of the previous schedule. This change was primarily caused by the ship's material condition having deteriorated to the point where safe operational practice was no longer possible. Accordingly, the *Coral Sea* was decommissioned in June 1990.

The U.S. Navy completed a study for the carrier of the 21st century. The study recommended that the Nimitz/Roosevelt design be retained. It also recommended that the displacement be increased slightly. There were suggestions that the new carrier should also incorporate the new AEGIS radar/weapons and fire control system, fiber-optic data transmission, and an electromagnetic catapult system. All of the systems, with the exception of the catapults, are either in service or under development. However, the inclusion of an AEGIS system on a fleet carrier was immediately and strongly condemned on the grounds that a carrier's main weapon is its airgroup and that any equipment that limits the efficiency of that airgroup is counterproductive. AEGIS would be an extreme example in that it would

physically consume space otherwise allocated to aircraft, and its emissions would pose a safety and interference hazard to those aircraft.

The contract for CVN-76 was awarded to Newport News in December 1994 with a projected completion date of December 2002. This was followed by a political and emotional debate over the naming of the ship. Eventually the matter was resolved in a compromise in which the CV-75 USS *United States* was renamed the USS *Harry S. Truman* and the CVN-76 became the USS *Ronald Reagan*.

With the construction of CVN-76 well advanced, the primary area of attention on the Abraham Lincoln class switched to refueling, periodic overhaul, and modernization. The USS *Dwight D. Eisenhower* entered Newport News for her midlife refueling in August 2001.

The CVN-68 USS *Nimitz* completed her refueling in April 2000. The CVN-69 USS *Dwight D. Eisenhower* completed her \$405 million refueling in May 2003. Longer term plans include installing enhanced defense systems and tactical communications equipment on the carriers and improving the radar suite by adding the as-yet undesignated multifunction radar to the ship's electronics suite.

On May 8, 2003, Northrop Grumman Corp announced that the *Ronald Reagan* (CVN-76), had returned to the Newport News sector following successful completion of initial sea trials. The sea trials are an aggressive series of operational tests to demonstrate that the *Reagan's* two nuclear propulsion plants and their operators are fully mission capable. Following these trials, the USS *Ronald Reagan* commissioned on July 12, 2003 at the Norfolk Naval Station. She currently serves with the Pacific fleet.

Funding

CVN-71 was authorized in the FY80 budget, with CVN-72 and CVN-73 in FY83, CVN-74 and CVN-75 in FY88, and CVN-76 in FY95. Funding for the CVN-76 was originally to have been included in the FY94 budget, but procedural problems caused a delay. In effect, the Senate appropriated the funds before Congress authorized them, and the resulting impasse eliminated funding for that year. However, funding for the CVN-76 was passed by both the House and Senate Armed Services Committees (SASC) in June 1994 for the FY95 markup, and the contract to construct the ship was awarded in February 1995. The SASC markup allowed \$3.6 billion for the CVN-76.

The price for the CVN-72 and CVN-73 eventually went up by \$200 million over the target. For the CVN-74 and CVN-75, the increase is estimated to have been about \$370 million. The cost escalations are in part due to design changes and change orders. The cost split is shared 75 percent U.S. Navy/25 percent Newport News.

The Senate Armed Services Committee recommendation in May 1999 also included \$24.7 million for development of advanced technologies and \$69.1 million for advanced nuclear power systems development for the new aircraft carriers or the entire upcoming class as a whole.

In October 1999, it was reported in the press that the budget for CVN-76 *Ronald Reagan* had been exceeded by "several hundred million dollars," suggesting that Newport News' \$2 billion share from the project had risen to more than \$2.3 billion.

Recent Contracts

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Newport News Shipbuilding	216.5	Jan 21, 2000 – Three-year overhaul and nuclear reactor refueling of USS <i>Dwight D. Eisenhower</i> , starting in 2001.
Stratos Mobile Networks USA	48.0	Jan 2000 – Lease of up to 75 channels/month for up to 42 months from INMARSAT-B (64 kbps communications service).

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Jun	1968	CVN-68 keel laid
Sep	1970	Contract defined for CVN-68 and 69
May	1972	CVN-68 USS <i>Nimitz</i> launched
Apr	1974	Option to build CVN-70 exercised

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Mar	1975	USS <i>Nimitz</i> sea trials completed
May	1975	USS <i>Nimitz</i> commissioned
Oct	1977	USS <i>Eisenhower</i> commissioned
Mar	1982	USS <i>Carl Vinson</i> commissioned
Oct	1986	USS <i>Theodore Roosevelt</i> commissioned
Nov	1989	USS <i>Abraham Lincoln</i> commissioned
Apr	1992	USS <i>George Washington</i> commissioned
Jun	1994	CVN-76 approved by SASC
Feb	1995	USS <i>Ronald Reagan</i> ordered
Jul	1997	USS <i>John C. Stennis</i> transferred to Pacific Fleet; <i>Theodore Roosevelt</i> in for overhaul
Jul	1997	USS <i>Nimitz</i> in 96-hour sortie exercise for extended sustainability
May	1998	Arrival of USS <i>Nimitz</i> at NNS for 33-month refueling of two nuclear reactors
Jun	1998	CVN-75 <i>Harry S. Truman</i> initial acceptance sea trials completed
Jul	1998	<i>Harry S. Truman</i> commissioned
Sep	1998	Advance procurement, advance construction funds granted for CVN-77
	1999	RAM CIWS, SLY-2 intercept system installation begun on all ships
Mar	1999	Arrival of <i>Harry S. Truman</i> at NNS for five-month-long PSA
Dec	1999	USS <i>Nimitz</i> reactor refueling successfully completed
	2000	Full construction authorization for CVN-77
	2000	ACDS Block 1 upgrade completed on existing CVN-68s
Apr	2000	Decision to backfit seven newest Nimitzes with future MF, volume radars
	2000	USS <i>Ronald Reagan</i> launched
Jul	2003	CVN-76 <i>Ronald Reagan</i> commissioned

Worldwide Distribution

United States. 9 in service.

Forecast Rationale

The construction of the Nimitz class carriers has now come to an end with the commissioning of the USS *Ronald Reagan*. Although CVN-77 *George H.W. Bush* is officially considered to be the 10th and last of the class, she is so modified that her similarities with the earlier ships are limited and the ship is really a one-ship class of her own.

Since this report will be archived next year, this is an opportune time to look back on this longest-running program covered in the Warships Forecast. The CVN-68 class are an undoubted success, they are the backbone of the U.S. Navy, and a key element in America's status as a world power. The fact remains though, that the basic design is a product of the 1960s and bears many of the hallmarks of that era. Much of the layout is a result of the class's original concept as a nuclear-armed as well as a nuclear-power ship. Her magazines, large and centralized, reflect the need to provide adequate secure stowage for nuclear weapons while the system for taking weapons to the flight deck is poorly designed for the ship's current role.

Another point that dates the basic Nimitz design is that the flight deck arrangements and arming/fuelling

provisions are all designed to support surge operations. The operational concept was that the ship would run in from the far sea, launch a series of massive "alpha strikes" against the specified targets, then retreat out to sea again to rearm and refuel. Now, operations have switched to essentially conventional missions and the operational pattern is entirely different. The requirement is to launch a sustained cycle of missions with fewer aircraft in the air at any one time, a constant cycling of strikes through the day and night.

Already, as a part of the natural evolution of the design, there has been a major change in the CVN-68 class. The USS *Ronald Reagan* is a much more powerful vessel than her ancestor. In terms of fighting capability, she exploits the latest in technology and exhibits significant fundamental changes in structural design. She provides an interesting glimpse into the future evolution of aircraft carriers design. However, for all of that, the changes in her remain incremental rather than revolutionary. The new CVN-77 will take even more incremental steps towards a new carrier design, yet it will be the CVN-78 that will reflect a new design

approach that suits the revised role of the U.S. Navy's aircraft carriers.

Now, as construction efforts switch to the CVN-77 *George H.W. Bush* and the still-unnamed CVN-78, the

reign of the CVN-68 class is drawing to a close. Despite that, these magnificent ships will remain the backbone of the Navy for decades to come.

Ten-Year Outlook

Since construction of this class has been completed, the forecast chart has been deleted.

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