ARCHIVED REPORT

For data and forecasts on current programs please visit

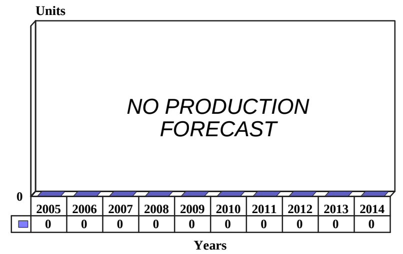
www.forecastinternational.com or call +1 203.426.0800

Charles de Gaulle Class - Archived 11/2006

Outlook

- No repeat of Charles de Gaulle design planned
- Lessons learned from program benefiting French naval construction as a whole
- New French carrier semi-sister to British Queen Elizabeth class
- This report will be archived next year

10 Year Unit Production Forecast
2005 - 2014



Orientation

Description. Nuclear-powered conventional take-off and landing aircraft carrier (CVN).

Sponsor
DCN International
19-21, rue du Colonél Pierre Avia
B.P. 532
F-75015 Paris
France
Tel: + 33 1 4736 8080
Fax: + 33 1 4097 5772
Telex: 650421 paris f

Status. In service.

Total Produced. One

Pennant List

Name	Builder	Launch Date	Commission Date
R91 *Charles de Gaulle*	Brest Naval Dockyard	7/1994	5/18/2001

Mission. The *Charles de Gaulle* is tasked with providing sea-based tactical air power to defend sea lanes and provide overseas air and sea power projection.

Price Range. At the time of its handover to the French Navy in February 1997, the *Charles de Gaulle* was quoted to cost $3.4 billion, or 18 percent above initial projections. If a second ship of the series were to be built, its cost would be a little more than $2 billion, not including the added cost of the air group and shore support facilities.

Contractors

Direction des Constructions Navales (DCN), http://www.dcn.fr, 2, rue Sextius Michel, Paris, 75732 France, Tel: + 33 1 40 59 50 00, Fax: + 33 1 40 59 56 48, Email: info@dcn.fr, Prime

Commissariat A L'Energie Atomique (CEA), Atomic Energy Commissariat, http://www.cea.fr, 31-33, rue de la Fédération, Paris, 75752 France, Tel: + 33 01 4056 1000, Email: dcom@aramis.cea.fr, Second Prime

Thales Defence Sector, http://www.thalesgroup.com, 45, rue de Villiers, Paris, 92526 France, Tel: + 33 1 57 77 80 00, Fax: + 33 1 57 77 86 59, Email: defence-info@thalesgroup.com, Consortium Member

Brown Brothers, Rosebank Wks, Broughton Road, Edinburgh, EH7 4LF United Kingdom, Consortium Member

Metalastik Ltd, Evington Valley Road, Leicester, LE5 5LY Leics, United Kingdom, Consortium Member

SNPE, 12, quai Henri IV, Paris Cedex 04, F-75181 France, Tel: + 33 1 48 04 66 66, Fax: + 33 1 48 04 68 87, Consortium Member

Railko Ltd Uk, Loudwater, High Wycombe, HP10 9QU Buckinghamshire, United Kingdom, Consortium Member

Eurosam Gie, http://www.eurosam.com, 12, rue de la Redoute, PO Box 9, Fontenay aux Roses, 92266 France, Tel: + 33 1 4187 1476, Fax: + 33 1 4187 1442, Consortium Member

Giat Industries, http://www.giat-industries.fr, 13, rue de la Minière, Versailles, 78034 France, Tel: + 33 1 30 97 37 37, Fax: + 33 1 30 97 39 00, Email: ccr@giat-industries.fr, Consortium Member

Technical Data

	Metric	U.S.
Dimensions		
Length, Overall	261.5 m	857.9 ft
Length, Waterline	238.0 m	780.8 ft
Length, Flight Deck	261.5 m	857.9 ft
Runway Length	195.0 m	640 ft
Flight Deck Height Above Sea	17.2 m	56.4 ft
Beam, Overall	64.4 m	211.3 ft
Beam, Waterline	31.8 m	104.3 ft
Flight Deck Width	62.0 m	203.4 ft
Draft	8.5 m	27.9 ft
Hangar Floor Area	140x30 m	460x98 ft
Catapult Length	75.0 m	246 ft
Displacement		
Standard		36,600 tons
Full Load		40,600 tons
Performance		
Speed	50 km/h	27 kt
Endurance	45 days normal operations (food, stores)	
Range	5 years continuous steaming at 25 kt before reactor refueling	
Crew (regular)	1,150 plus 550 air group plus 50 Flag Staff	
Catapult Launch Capacity	1 aircraft/minute, up to 22 tons/aircraft	

	Type	Number
Military Lift Capacity		
Air Group	(all types combined)	40 max.
Fighter	Rafale-M	12
Strike	Super Etendard	12
AEW	E-2C	4
ASW	Helicopters	12
Hangar	Aircraft capacity	20-25
Accommodation (maximum)	Regular + 800 marines	2,750
Catapults	USN Type C13 (steam)	2 (1 in bow, 1 in angled deck)
Elevators	19x12.5 m; cap. 36 tons	2 (on starboard deck edge)

Armament

Missiles

	Type	Number
SAM	ASTER-15 VLS	32
CIWS	Mistral	12
Guns	20mm	8
Electronics		
Radars		
Long-Range Air Search	DRBV 27	1
Target Designation	DRBJ IIB	1
Surface Search	DRBV 15	1
Fire Control	Arabel	1
Navigation	Thales 1229	2
IRST	DIBV-1A Vampir	1
Electronic Warfare		
ESM	ARBR-17	1
ECM	ARBB-33	2
Decoy Launchers	Sagaie	4
COMINT	Enigme	
Command & Control		
Command System	SENIT 7	1
Datalinks	Link 11, 14 and 16	
TACAN	NRBP-20A	1
SATCOM	Syracuse II	1
Propulsion		
Nuclear Reactors	K-15	2x150 MW
Steam Turbines	Geared turbines	2x41,500 shp
Generators	Turbo-alternators	4x4,000 kW
	Diesel alternators	4x1,000 kW
Propellers	5-bladed fixed pitch	2

Design Features. The *Charles de Gaulle* has an 8.5° angled flight deck and a hull similar in dimensions and displacement to the Foch class carriers. The hull design is a modified version of that used for the Foch class. The flight deck, having a surface total of 12,000 square meters, is 1.4 times larger than that on the Foch class. The ship can thus operate five more aircraft (40 instead of 35) of a heavier type (15-25 tonnes in lieu of 10-15 tonnes).

Stabilization is provided by two sets of fins amidships, which operate in conjunction with rudder stabilization using data obtained by a series of above-water sensors for ambient conditions. These also control the SATRAP stabilization and list compensation gear, a mechanism involving two “wagonettes,” each loaded with 260 tons of lead ingots, which run on rails mounted transversely under the flight deck. These arrangements limit the roll rate to 0.5° and permit flight operations in up to Sea State 6.

The island is small and situated well forward, an unfavorable location determined by the flight deck configuration and the need to provide access to the reactors. Width restrictions further aft prohibited the installation of the island in the desirable position for controlling aircraft movements. The forward position of the island has some benefit in that it provides additional shelter for the deck park and lifts aft, but this is offset by the small size of the hull. Electronic propagation modeling has suggested serious interference between the radars mounted on the island. It is not known how that has been addressed in the final fitting-out of the ship.

Facilities available to the crew include a 50-bed hospital, two operating theaters, a recovery ward, an X-ray theater, laboratories, and a dental center. Casualties can be brought directly to the hospital from the flight deck via one of the munitions lifts. Accommodation includes provision for an unusually high number of petty officers, reflecting the technical sophistication of the ship and the problems inherent in running such a ship with a largely conscript crew. Accommodation is provided for up to 50 female crew members.

Two 19x12.5 meter lifts of 36-ton capacity carry planes between the hangar and flight deck. The relatively shallow depth of the hull places the lifts close to the water when in the lowered position. The limited dimensions forced on the designers compelled them to place both lifts on the starboard side, limiting their utility in rough weather. This has been partly offset by placing them well aft and shielding them with the island. Additionally, there are two ammunition lifts.

The ship has two USN Type C13 catapults which are 75 meters in length. The delivery rate of the catapults is one aircraft per minute. The hangar deck measures 454.4 x 96.5 feet, with a 20-foot height. This is insufficient to accommodate the E-2C aircraft, which is carried in the deck park. The hangar accommodates 20-25 aircraft, with the remainder being carried in the deck park.

Propulsion is provided by two Type K-15 pressurized-water nuclear reactors driving two steam turbines producing 82,000 horsepower. These reactors use a low-enrichment fuel called "Caramel", which results in a relatively short time between refueling (41 months). This, in turn, means that a clear access path between the deck and the reactor compartment was required in the design. A turbo-electric generator is also carried.

The design has been criticized for slow speed due to the use of the same reactor plant installed on the Le Triomphant class submarine. At first glance, these complaints are not justified, since the design speed of 27 knots would be fully compatible with the 25-knot fleet speed of the French Navy. As a matter of fact, the expense of going to a higher speed could not be rationalized. However, current reports indicate a real maximum speed of no more than 25.5 knots, which may be a matter of some concern.

The electronics suite includes a DRBJ-IIB E/F-band three-dimensional air search radar, a DRBV-27 D-band air search radar, and a DRBV-15 E/F-band surface search radar with a capability of detecting low-flying aircraft. All three radars are produced by Thales. Two Decca 1229 navigation radars are also carried: one tasked specifically with navigation, the other with air traffic control.

The electronic support measures (ESM) suite includes the ARBR-17 (DR-4000S) radar intercept/warning system. Electronic countermeasures (ECM) equipment includes four Sagaie countermeasures launchers and two ARBB-36 jammers. The latter are actually Salamandre jammers, an improved derivative of the ARBB-33 designed for the export market. There is a DIBV-10 Vampir infrared detector for surveillance and detection of surface and air targets and target direction to fire control systems. It is particularly assigned to over-the-horizon detection of anti-ship missiles, as it can track their heat plume.

Operational Characteristics. The carrier's defensive weapon system includes four octuple ASTER-15 vertical launch system batteries. There are also two sextuple Sadral trainable launchers, firing the Mistral missile. The ASTER-15 has a 9-nautical-mile range, while the Mistral provides a range of 2.5 nautical miles. There are also eight 20mm cannons on four twin mounts.

The ship is fitted with extensive C^3I capabilities. The operations are fundamentally centered on the AIDCOMER command support system, which assists the task force commander in planning. The ship itself is linked to higher level headquarters and the government on land, through the SYTEX strategic communications system. Meanwhile, the SENIT 8 (Système d'Exploitation des Informations Tactique) provides real-time command and control, as well as a tactical situation picture that is used for air-control operations and the carrier's own self-defense systems. The comprehensive SENIT 8 also employs the Aster missiles, the Sadral missile launchers, and the Sagaie decoy launchers.

Furthermore, the flying squadrons have their own IT-based systems on board, in the form of the SLPRM (Système Local de Préparation et de Restitution de Missions). The movement of the aircraft on deck is planned and controlled with the help of a PC-based system dubbed GESVOL, which has essentially the same function as the model-based manual plotting system used on U.S. carriers.

Deployment to Cape Town can be accomplished in 12 days, while Zaire, on the west coast of Africa, can be reached in eight days from France. The *Charles de Gaulle* can deploy around the Cape to Djibouti in Eastern Africa in 21 days or to the Strait of Hormuz in 22 days, at a sailing speed of 22 knots. Cutting through the Mediterranean and the Suez Canal, the Persian Gulf can be reached in 10 days from Toulon.

The ship offers a fully loaded combat range of 250 nautical miles (450 km) for the SEM (Super Etendard Modernisé) strike aircraft; the Rafale M pushes that range to 400 nautical miles (720 km). In full war scenarios, 24 of the SEMs or Rafales can be launched in an "Alpha Strike" against enemy ships or land targets. It is more likely, however, that the ship would operate a continuous 90-minute cycle of offshore sorties with four to eight combat aircraft over land all the time. These would not include the defensive combat air patrols and E-2Cs.

Variants/Upgrades

A conventionally powered derivative of this design was proposed to the Indian Navy at one point, and initial design work was undertaken. However, this plan has since been abandoned.

In the 1997 French defense review, it was stated that the order of the next French aircraft would be delayed until the next five-year plan had been completed (implying no order until at least 2002), and that less expensive alternatives to nuclear power would be considered. This suggests that the design work done on the conventionally powered Charles de Gaulle proposal for the Indian Navy could be used for a new French ship.

FS Charles de Gaulle

Source: French Navy

Program Review

Background. The French Navy first prepared designs for a nuclear-powered helicopter carrier in 1972. This ship was to have combined anti-submarine warfare/ amphibious assault duties, carrying helicopters and vertical/short take-off and landing (V/STOL) aircraft for self-defense. The ship was designated Porte Helicopters 1975 (PH-75) and was to be started in 1975, with an anticipated commissioning in 1980. In 1974, the French government postponed the PH-75 project for budgetary reasons. The 1977 Defense Plan revived the nuclear carrier idea, but changed the designation to Porte Aeroneufs Nucleaire 1980 (PAN-80) and the mission to carrying fixed-wing aircraft for power projection.

Due to funding crises and a decision to build more surface ships, the PAN-80 was postponed several times in the late 1970s. In September 1980, the Defense Council voted to build two nuclear-powered aircraft carriers as replacements for the two Clemenceau class ships. The 1984-1988 Naval Acquisition Program said that the first ship would be ordered that year, with the keel-laying slated for 1985 and commissioning for 1992.

In 1985, the French Navy built a one-twelfth scale model of the *Charles de Gaulle* for tests on a small lake. It was used for electromagnetic propagation experiments and, most importantly, to test the comprehensive stabilization system. In February 1986, the French Navy placed an order with the Brest Naval Dockyard, announcing that the ship would be named *Richelieu*, and not *Charles de Gaulle* as previously announced. Development of the nuclear reactor and various electronic systems continued, as did tests of the one-twelfth scale model. The first land-based flight tests of the Rafale technology demonstrator took place in 1986. Suitability trials were conducted aboard the French aircraft carrier FS *Foch*, but these did not involve take-offs or landings.

When the first metal for the carrier was cut in October 1987, the Navy announced that the ship would revert to its original name, *Charles de Gaulle*. In early 1988, the

French Navy announced that the second carrier would be ordered in 1991/92. This ship might have heavier elevators and more powerful catapults, to carry larger aircraft. The French Navy also considered placing an interim order for F/A-18 attack fighters to replace the F-8E(FN) Crusader aircraft. This option was evaluated in case the Rafale-M aircraft were not ready for service by the early 1990s. Intense political pressure from Dassault Aviation eventually killed the concept.

The formal keel-laying for the *Charles de Gaulle* took place in April 1989 at the Brest Naval Dockyard. In June 1989, the French Navy once again announced plans to hold flight tests of the F/A-18 aboard the carrier *Foch*, including catapult take-offs and arrested landings. These tests, using aircraft leased from the U.S. Navy, were being held to determine if the aircraft met the French Navy's requirements for the 1990s. Again, the plan was killed in response to political pressure from Dassault Aviation.

In June 1989, the French and Indian navies came to an agreement wherein the French Navy would supply India with the plans for a modified Charles de Gaulle class carrier that would be built in India in the 1990s. This project hit repeated difficulties and was eventually abandoned in favor of an Italian proposal. This proposal was in turn abandoned in favor of purchasing ships from the Russian Navy. Finally, the Indian Navy decided to proceed on its own, but placed the program well behind the construction of nuclear-powered submarines.

Between 1990 and 1993, the construction schedule of the *Charles de Gaulle* was repeatedly extended due to financial difficulties. These delays, however, did not prevent the hull from being floated out of its graving dock in spring 1993, some 18 months prior to the publicized date. The hull was in a very incomplete state at this point. In June 1993, the French government announced the last of the above-mentioned delays, postponing the delivery date of the ship by an additional six months.

In July 1993, the French government announced that it anticipated signing an order with Grumman for four E-2C Block 2 Hawkeye AEW aircraft. These would be to equip the *Charles de Gaulle*, with an additional batch of four aircraft being ordered later to equip the follow-on ship, the *Richelieu*. This decision was made after an extensive evaluation of other alternatives, including helicopters and S-2E aircraft fitted with the RDY radar, proved abortive.

The official "launch" of the *Charles de Gaulle* took place in May 1994 after the ship was unveiled and a number of powertrain system components were lifted into place. In an address at that ceremony, the French minister of defense confirmed that a second ship of the class would be built, but stated that the order would not be placed before 1996. Only one building dock in France is capable of accommodating a ship of this size; at the time it was occupied by the second Foudre class LPD. Thus, in actuality, construction of the second carrier could not start until mid-1997 at the earliest, for a likely service entry date of 2007.

However, these projections were made moot by the French defense funding crisis of early 1996. French defense program costs far exceeded the funding available for their completion, and radical cuts had to be made. These included the postponement of the second carrier from the then-current five-year plan (1996-2001) to "beyond," strongly suggesting that no order would be placed before 2002. The aircraft carrier FS *Foch* was to be decommissioned in 1997, while the *Charles de Gaulle* would not be taken into service until early in 2000. At that point, the FS *Clemenceau* would be withdrawn from service and mothballed. This ship would be briefly commissioned in 2005-6 and again in 2010-12 to cover periods when the *Charles de Gaulle* was in dock for refits and refueling. These new plans confirmed reports that the French Navy expected to be operating with only a single carrier for the foreseeable future, and also that the reactors indeed, have the very short core life previously assumed.

During this period, it was also rumored that the land-based prototypes of the reactors were suffering serious cracking in their support structures. According to reports, the remedial action required to strengthen the supports in the *Charles de Gaulle* would add 4,000 tons to the displacement, delay construction by six to 18 months, and slow the ship's speed by half a knot. The builder maintained that the full-load-displacement increase of the ship (to about 40,600 tonnes from the originally planned 38,000 tonnes) was a normal growth between the original design and construction of the ship. According to DCN, larger reinforcing supports were built for the two K15 reactors, and alterations to the powerplant were made in order to comply with the strict civilian nuclear safety rules now being applied in naval construction. These explanations were not widely accepted in the naval community, which pointed out that 4,000 tons was too large a mass of steel to be attributed purely to reactor support modifications. These sources suggested that the need to modify the reactor supports was being used as an alibi to cover overruns in the ship's displacement caused by growth during design.

The ship was formally handed over to the Navy on February 1, 1997. At that time, the ship was expected to become fully operational by late 2000, instead of the originally estimated full-service introduction date of late 1999. The *Charles de Gaulle* started her sea trials in January 1999. These trials were plagued with problems from the start. The initial set was postponed because of the high seas in the Atlantic, with winds gusting up to 50 miles per hour. The ship finally left port on January 26, and had intended to remain out for 10 days. Instead, she had to make an emergency return to port 48 hours later, following failures in her nuclear propulsion system and a fire in an electric motor.

The cause of the failures interrupting the January sea trials was unclear for some time. The ship was laid up for more than two months so that the problem could be diagnosed. It was eventually determined that there was a failure in the pump motor which feeds cooling water for the reactor's secondary circuit.

In March 1999, a French journal reported that the flight deck had been found to be marginally too short for entirely risk-free operation of the E-C2 Hawkeye surveillance aircraft in specific situations during high operation rates. The angled flight deck would be extended by 4.4 meters at a cost of about FRF5 million ($797,000). The extension would add about 28 tonnes to the ship's weight.

On July 6-7, 1999, the Navy conducted the first take-off and landing trials on the flight deck of the ship, using the Dassault Aviation Rafale fighter and Super Etendard attack aircraft. Those tests had been delayed from April or May because the sea trials had shown excessive vibration in the ship's rudders.

By late summer, it was reported that the ship was already showing signs of structural wear, including peeling and charring of paint on the deck and corrosion on the piping system. These problems were attributed to the excessive time the ship had been under construction, during which the components had been aging. These defects required a further modification program, estimated to cost $85 million, a proportion of which was attributed to the need for further changes to the reactor design.

The tale of woe continued well into 2001. During the latter part of 2000, the *Charles de Gaulle* was assigned to conduct a cruise of the Caribbean, the ship's first prolonged deployment out of home waters. It was brought to an abrupt end when one of her propellers disintegrated. There was some debate as to whether the ship should be recalled or repaired in Norfolk Navy Yard. By November 2000, it was decided that the damage was such that the ship would have to return home. Investigations into the cause of the malfunction quickly pointed to defects in the design of the screws and their construction.

This quickly turned into a major scandal when it was claimed that the propellers had been installed even though flaws in their construction had already been detected. No legal remedies were possible since the company that had cast the screws was already out of business. Unfortunately, although the company had made a set of spare propellers for the ship, these had the same defects as the original pair. For a while it appeared that the *Charles de Gaulle* would be laid up for 18 months while new propellers were cast, but the situation was saved by a decision to use propellers from the decommissioned aircraft carrier *Clemenceau*. These limited the ship's speed to around 23 knots but allowed her to return to service by April 2001.

Sea trials with the replacement propellers quickly showed that they generated unacceptable noise levels and would require reconfiguration to bring them to an acceptable standard. As a result, the ship went into drydock in July 2001 for the propeller work. At that time it was announced that, unless anything else went wrong, the *Charles de Gaulle* would undertake a five-month deployment to the Persian Gulf in 2002.

Of the other two French aircraft carriers, *Clemenceau* was decommissioned in October 1997 due to mechanical defects. The ship was used as a source of spare parts to keep her sister ship running. *Foch* was originally to be kept in service until December 1999, when the *Charles de Gaulle* was due to be formally commissioned. This was extended to July 2000 when the *Charles de Gaulle* was delayed. Then, in September 2000, the ship was sold to Brazil. Since this reduced the French Navy to a single carrier, the need to order a second ship became urgent and the decision was brought forward to 2001. This decision was essentially negative. The French minister of defense, Alain Richard, confirmed that the construction of new multirole frigates and nuclear-powered attack submarines would take priority over the second aircraft carrier. As a result, the construction of a second carrier would not be funded until 2008-2010 at the earliest. By late 2002, it was accepted that a second carrier would not be ordered before 2009 and would not enter service prior to 2015.

The problems inherent in having only a single aircraft carrier became evident in late 2001, following the terrorist attacks on the World Trade Center and the Pentagon. The *Charles de Gaulle* was laid up at the time due to her propeller problems and was therefore unavailable for deployment when needed. She was not free from yardwork until mid-November 2001. The carrier was unable to reach the conflict area off Afghanistan until December 19, 2001. However, once in the area she was able to deploy her Super Etendard aircraft for reconnaissance missions over Afghanistan. These were supplemented by a number of bombing missions in March 2002 before the carrier left station in May 2002 to visit Singapore. She returned to Toulon in June 2002.

In late 2002, the question of a second French aircraft carrier was again raised. Admiral John Louis Battet was questioned by the French National Assembly on the method of propulsion for the second French aircraft carrier. Favoring conventional propulsion over nuclear, the Admiral brandished a photo of the French oil tanker *Limburg*, which had been hit by a suicide attack speedboat off Yemen, evoking the consequences of such attacks against a nuclear-powered ship. Reportedly, this presentation shocked certain parliamentary delegates and hardened opinion against the adoption of nuclear power for future aircraft carriers. It should be noted in this regard that the *Charles de Gaulle* was very well protected against such attacks. This was illustrated on October 30, 2002, with the first firing of an Aster 15 from the *Charles de Gaulle* at the Toulon test-firing range. The target, representing an anti-ship missile, was shot down without difficulty by the Aster. This demonstration showed the automatic defense system of the carrier had finally achieved full effectiveness.

Early in 2003, the ship took part in weeks of exercises in the eastern end of the Mediterranean, deploying an airgroup that included 14 Super Etendards, four Rafales, two Hawkeyes, two Dauphin helicopters and two Pumas of the French Army. Her departure from Toulon Roads was marked by demonstrations from 10 campaigning groups. The *Charles de Gaulle* was accompanied by the anti-aircraft frigate *Cassard*, the ASW frigate *La Motte Piquet*, the La Fayette class frigate *Guépratte*, and the nuclear-powered attack submarine *Saphir*. After six weeks at sea for this exercise, the *Charles de Gaulle* returned to her home port of Toulon for a major refit.

During this period, the question of building a sister-ship for the *Charles de Gaulle* was revived. This issue quickly morphed into the construction of a second aircraft carrier, it being by no means clear that the *Charles de Gaulle* represented a route the French Navy would wish to follow a second time. The situation was complicated by the pivotal role Thales was playing in the British CV(F) program, the winning design for that project being essentially a Thales proposal for a 58,000-ton conventionally-powered carrier. Thales proposed that a modified derivative of this design would be highly suited to French requirements.

The French Parliament responded by urging the French Navy to ignore the Thales proposal and commit to building a repeat of the *Charles de Gaulle* design. As a result of these representations, the decision on the power train for the second carrier was delayed from late 2003 to early 2004. In February 2004, it was announced that the French navy had, as a result of careful evaluation, decided against adopting nuclear power for the second carrier, and that the Thales proposal would be the basis for that ship. It was decided that the new carrier would be built by a joint venture company that would be 65 percent owned by DCN and 35 percent by Thales. From this point onwards any interest in building a repeat of the Charles de Gaulle design appears to have evaporated.

Funding

The Charles de Gaulle program has been funded by the French MoD on behalf of the Navy.

Recent Contracts

Contractor	**Award ($ millions)**	**Date/Description**
Thomson-CSF	18.0	Apr 1992 – French MoD contract for the supply of two communication subsystems for the *Charles de Gaulle* and *Richelieu*.
Thomson-CSF	N/A	Jul 21, 1992 – Support system for shipboard communications system.
Orkot Ltd	N/A	1993 – Upper and lower bearings for the two rudders.
Metalastik France	N/A	Mar 1993 – French MoD contract for machinery shock mounts.
Sagem	N/A	1994 – Order for 20 Vigy 105 EOD units for the anti-missile system.
Primagraphics	N/A	Spring 1994 – Radar and video graphics equipment for display consoles.
Northrop Grumman	925.0	Jan 1995 – Four Hawkeye E-2C surveillance aircraft (two for Foch).
Dassault Aviation	N/A	May 30, 1997 – Ten Rafale M aircraft ordered for the carrier.
Eurosam	N/A	Mid-1997 – Order for 40 Aster 15 SAMs.

Timetable

Month	Year	Major Development
Feb	1972	Nuclear-powered helicopter carrier first proposed
Sep	1980	Nuclear-powered aircraft carrier proposed
Jul	1983	Funding approved for preliminary contracting
Feb	1983	First carrier ordered
Jun	1984	Pre-project definition studies completed; project outlined
Feb	1986	Ministerial approval to begin construction
Jan	1987	Work approved
Nov	1987	First steel cut
Apr	1989	Laying of the keel (first hull block laid down)
Sep	1991	Turbine installation begins
Dec	1992	*Charles de Gaulle* floated out temporarily
Spring	1993	Ship floated out officially
May	1994	Official launch ceremony
Jun	1994	Installation of nuclear plant
End	1994	Hull and superstructure structurally completed
Jan	1995	Purchase of four E-2C Hawkeyes for the ship announced
	1995	Alongside trials initiated; second six-month delay announced
Feb	1997	Formal handover to the Navy
May	1997	Ten Rafales ordered
Jul	1997	Catapult trials performed at pierside; installation of Arabel FCS
Jan	1999	*Charles de Gaulle* begins sea trials; returns early due to electrical problem
Mar	1999	20 knots exceeded in speed trials
Jul	1999	First flight trials with deck landings
Aug	1999	Further revelations of defects in ship's structure
Fall	2000	*Foch* retired and sold
	2005	Decision not to build sister ship to *Charles de Gaulle* finalized

Worldwide Distribution

France. One

Forecast Rationale

The French decision to reject a nuclear-powered option for the second French carrier has effectively ended the *Charles de Gaulle* program. Since this report will be archived next year, this is a good time to look back on the controversial *Charles de Gaulle* program.

The problems with the *Charles de Gaulle* design have their root at a very early stage in the ship's design. For political reasons, the design was limited to the same size as the ships she was to replace, the aircraft carriers *Foch* and *Clemenceau.* While understandable from the viewpoint of justifying the ship's construction and obtaining the necessary funding, this decision immediately gave the design team an arduous challenge. The size and configuration of an aircraft carrier is primarily determined by her aircraft; it is their performance characteristics and size that determine such things as catapult travel, landing distances, and elevator sizes. The *Foch* and *Clemenceau* were designed in the early 1950s when aircraft performance was much less demanding than it would be thirty years later. Even by the late 1960s, the two carriers were suffering problems in operating the latest combat aircraft and this situation could only get worse.

Designing an aircraft carrier that would be the same size as the older ships but could operate much higher performance aircraft was difficult; the designers were forced to adopt unusual and innovative solutions in order to fit the carrier to the aircraft. In fact, they succeeded quite well; the *Charles de Gaulle* operates her Rafale aircraft quite successfully. However, that achievement was at the expense of much design time and expertise.

Another decision that was to have severe consequences was the adoption of nuclear power. There were many justifications advanced for this, some of which made sense, some did not. Nuclear power has critical advantages when applied to very large aircraft carriers; whether they would be of equal importance to much smaller ships was an open question that, even now, has not been fully answered. However designing a ship for nuclear power also takes away much of the designer's flexibility. In a conventional ship, minor trim errors and design difficulties can be resolved by adjustments in the ship's fuel bunkers and other loading. This option is not available with nuclear power. The designers having been set a severe challenge, the decision to adopt nuclear power took away one of their most important tools in meeting it.

Finally, another grave lesson exhibited by the *Charles de Gaulle* is a stark one. If one is going to build a ship, one should *build it*. The *Charles de Gaulle* program was continually interrupted by funding shortages that brought work to a halt. Reportedly, on many occasions, the ship was effectively in care and maintenance status with work being carried out at a very slow rate, if at all. Not only did this stretch out construction and create extra expense by the need to replace components that had deteriorated due to the delays, it meant that many component suppliers had gone out of business by the time the ship commissioned. This will undoubtedly have a continuing impact on the ship's operations as was exhibited by the problems with her screws.

The successor to the *Charles de Gaulle* appears to show that these lessons have been taken to heart. She will be a much larger ship, one whose dimensions and configuration were set by the demands of the aircraft she will operate and she will be conventionally-powered. As presently constituted, her construction is being properly funded and will not experience the long delays noted with her predecessor. Recent French naval construction has been carried out much more effectively and expeditiously than in the past so the new French carrier appears to be on a firm footing. However, as a semi-sister of the British CV(F) program, her construction will be carried under that report.

Ten-Year Outlook

No new production is projected, and only modernization and upgrade of the onboard systems will continue throughout the forecast period. The forecast chart has therefore been omitted.

* * *