
ISSUES OF AIRCRAFT CARRIER PRODUCTION IN FRANCE

This appendix documents the findings from a set of meetings with the French acquisition corps and members of their *Charles de Gaulle* aircraft carrier program at Paris and at the shipyard at Brest.

FRENCH DEFENSE ORGANIZATIONAL STRUCTURE

The French Ministry of Defense has two major branches: the General Chief of Staff, which encompasses all the French military forces, and the General Delegation for Armament (DGA), which develops, procures, and repairs the weapon systems for all the military forces. The DGA has operational directorates that align with major types of systems (land, naval, air) and functional directorates that provide specific capabilities across the weapon system acquisition community.¹

One of the operational directorates of the DGA is the Directorate for Naval Construction (DCN), which is responsible for all naval ships, both submarine and surface. The DCN is the only branch of the DGA that has major industrial activities. It operates several shipyards throughout France that perform detailed design, construction, and maintenance functions.² The directorates for the air and land-based weapon systems either use the private sector (the Air Force) or state-owned (but not part of the DGA) facilities (the Army)³ for their weapon system procurement and support.

¹Since our meetings in France, the DGA has been reorganized. There are now three major operational directorates dealing mainly with program management (DSP for future and joint programs; DSA for management of conventional programs; and DPM for program management methods), plus several functional directorates (international relations, personnel, etc.) and three industrial entities (DCN for shipyards, DCE for test and evaluation, and SMA for aircraft maintenance).

²The directorate that has responsibility for aircraft has a few small depot-level maintenance activities in France.

³The state-owned Army production activities will soon shift to the private sector.

The DCN has three missions: (1) to provide the French Navy with combat ships and submarines required to fulfill the defense and public-service missions ordered by the French government; (2) to continuously maintain optimal performance levels of the ships and equipment in service; and (3) to provide its competence in the service of export programs and technical assistance to friendly foreign navies within the framework of government-defined political programs. To perform these missions, the DCN is divided into three subdirectorates: the Directorate for Naval Programs and International Cooperation, which provides the design, procurement, program management, and maintenance planning functions for the Navy; the Directorate for Industrial Activities, which manages the seven shipyards in France and provides a small staff for international trading activities; and the Directorate for Administrative Services, which provides staff administration and support functions.

The DCN is currently undergoing a major reorganization and downsizing in order to incorporate better business practices and to respond to the effects of reduced defense budgets. It is moving from a vertical structure, in which each service has divisions that provide the functional activities, to a horizontal structure organized around those functional activities (research and development, procurement, and maintenance). Downsizing within DCN has been difficult, whether at the Paris headquarters or at the various shipyards, since the civilian positions are civil service jobs governed by strict constraints on hiring and firing. Also, the shipyards are typically the major employers in their districts, and any reduction in force has a major impact on the regional economies.

The conceptual and initial design functions for submarines and surface ships are performed at DCN headquarters in Paris. The majority of the design efforts, including the final production design, are performed at the various shipyards. There are also design facilities at Toulon (DCN Engineering Center South) for combat systems and at Saint-Tropez for torpedoes. DCN Indret designs and builds the pressure vessels for nuclear reactors; Technicatome designs and builds the reactors.

DCN INDUSTRIAL FACILITIES

The DCN operates several industrial facilities throughout France.⁴ The location and approximate personnel levels for these facilities are shown in Figure G.1.

⁴DCN also has a facility (approximately 400 personnel) at Papeete, Tahiti, to support the French naval vessels in the Pacific Ocean.

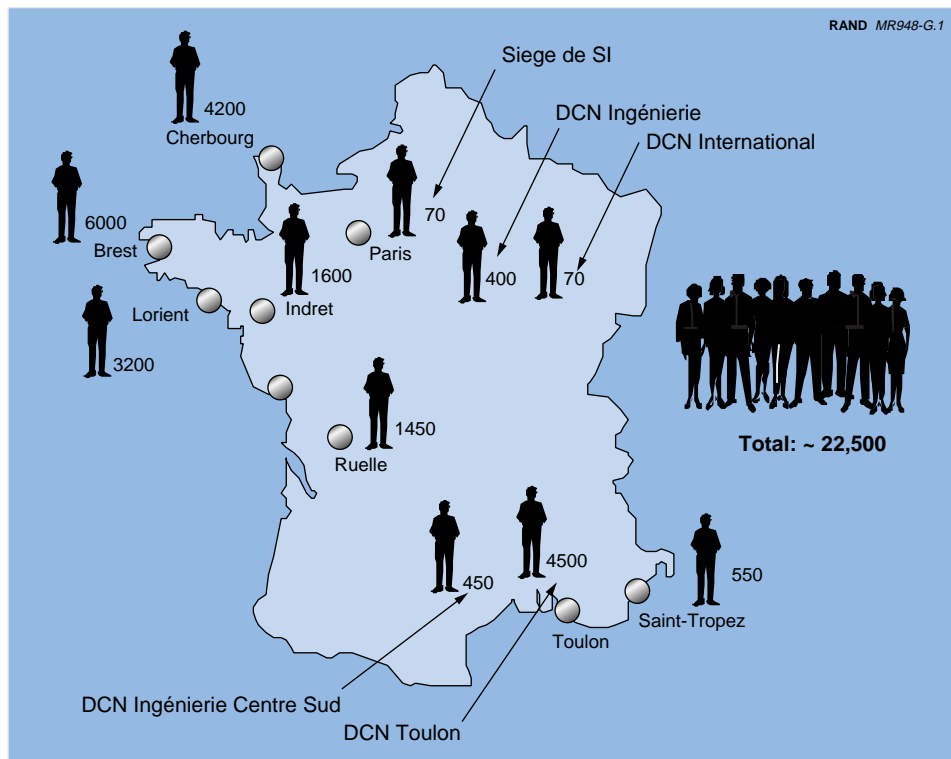


Figure G.1—DCN Industrial Activities in France

The French Navy is divided between an Atlantic Fleet homeported at Brest and the Mediterranean Fleet homeported at Toulon. These shipyards provide the logistics support and repair of the two fleets, as well as storing and maintaining their ammunition and missiles. DCN Brest is the primary shipyard for the construction of large surface ships, DCN Lorient constructs middle-tonnage ships, and DCN Cherbourg builds submarines. DCN Ruelle is the prime contractor for naval cybernetics, platform equipment, weapon-control systems, and missile launchers. DCN Saint-Tropez designs, produces, and tests torpedoes and countermeasure systems. DCN Toulon, in addition to supporting the ships of the French Mediterranean fleet, also has a center for combat system integration. DCN Indret designs, produces, and maintains naval propulsion systems, both conventional and nuclear (in conjunction with Technicatome).

Ship-procurement programs draw on the capabilities of all DCN facilities. Also, to balance workloads, construction may be shared across the various shipyards. For example, DCN Cherbourg and DCN Brest have constructed portions of frigates that were assembled and outfitted at DCN Lorient.

Currently, there are approximately 22,500 employees (down from approximately 26,600 in 1993) at DCN facilities (including Paris). These are primarily civil service employees; a small segment is uniformed personnel. The public, civil service nature of the shipyards makes it difficult for DCN to control their labor force, owing to tight restrictions on releasing civil service employees.

DCN BREST

DCN Brest is the largest public shipyard in France. In addition to constructing large surface ships, Brest is the home port for all French ships based in the Atlantic Ocean, including the French nuclear ballistic-missile submarine (SSBN) fleet. As such, it provides maintenance and repair functions for these ships, in addition to storing and maintaining their ammunition and missiles.

Brest has approximately 5,800 employees: 4,100 shipyard workers and 1,700 engineers (both ship design and integration/maintenance of electronic equipment) and management personnel. The shipyard is organized around three primary departments—Studies, Production, and Project Management—and its workload is divided almost equally between the maintenance of the surface fleet, the maintenance of the SSBNs, and new-ship construction. A small workload (about 10 percent of the total) is dedicated to missile and ammunition maintenance. These 5,800 civil service and uniformed personnel are augmented by both temporary hires (approximately 1,500, depending on budget availability) and subcontractors (approximately 500) who perform specific functions (e.g., sandblasting and painting) or are responsible for specific subsystems of a ship.

As the shipyard at Brest is downsized, excess DCN Brest employees are being offered positions with the French Navy that were formerly filled by conscripts. (Conscripts in the French Navy are being phased out.) These French Navy positions will be land-based. The ships constructed at Brest, along with the major reworks for SSBNs over the past 20 years, are listed in Figure G.2. Two large ships are currently under construction at Brest, the LPD *Siroco* and the CVN *Charles de Gaulle*. Brest is also building segments of Lafayette-class frigates that will be assembled in Lorient and that are intended for foreign military sales to Saudi Arabia and Taiwan.

The LPD *Siroco*, the second of the Foudre-class ships built at Brest, is 168 meters in length and displaces approximately 12,000 tons. It has provisions for 10 equipment-transportation barges, six heavy-duty tanks, and 23 light tanks, in addition to four helicopters of the Super Puma type. There are accommodations for almost 500 personnel. The first of its class, *Foudre* was commissioned in 1990 after a 6-year build period. *Siroco* is scheduled for commissioning

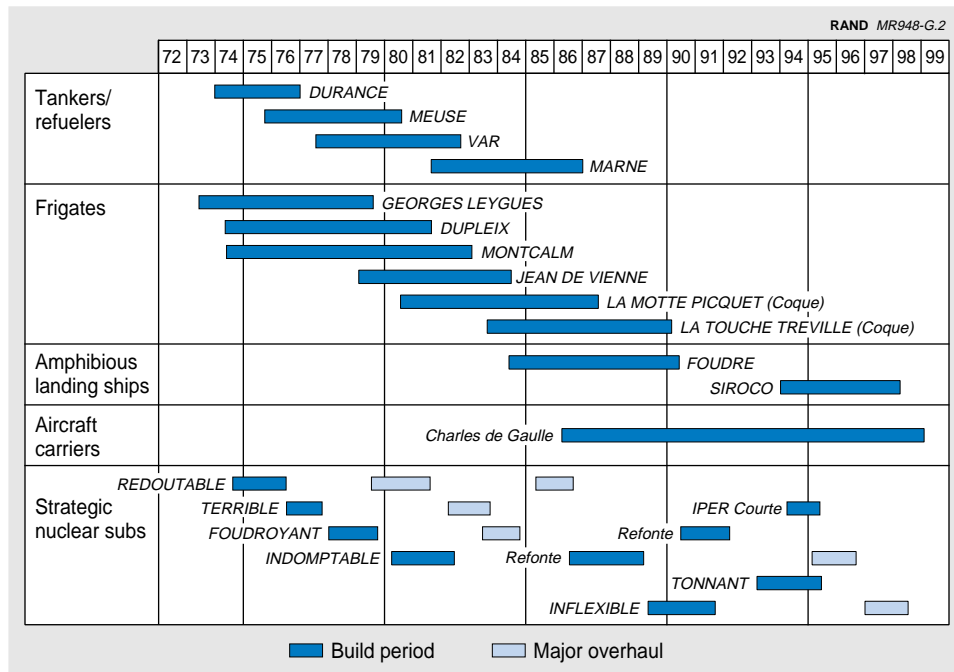


Figure G.2—Brest Ship Construction and Overhauls

in February 1998, after a 4-year construction period. In addition to the reduced construction time of *Siroco*, Brest officials state that the cost of *Siroco* is approximately 20 percent less than the cost of *Foudre*.

As mentioned, Brest also provides maintenance on the ships based there and is the only DCN shipyard that performs both new construction and maintenance. A large part of the maintenance workload is for the SSBN fleet, both for routine maintenance between patrols and for major overhaul and modernization.⁵ At any one time, one of the SSBNs is in major-overhaul status. Each SSBN goes through a major overhaul and modernization approximately once every six years, and each major overhaul lasts 18 to 24 months.

THE CHARLES DE GAULLE PROGRAM

The French Navy currently operates two conventionally powered aircraft carriers, *Clemenceau* and *Foch*. These carriers are approximately 168 meters in

⁵The French Navy currently has five of the L'Inflexible class. The first of the new Le Triomphant class was scheduled to become operational in 1996.

length and displace approximately 33,000 tons, fully loaded. The build period for these carriers is shown in Table G.1.

In 1980, the French Defense Council decided to build two nuclear-powered carriers to replace *Clemenceau* in 1996 and *Foch* some years later. The decision to build a nuclear-powered ship was motivated by the then-Soviet threat, concern about the availability and cost of diesel fuel, and the reduced overhead costs to France's submarine program because of the larger nuclear industrial base. The first of this class, named *Charles de Gaulle* (also referred to as *de Gaulle*), was ordered in February 1986; construction was started in November 1987. The keel was laid in April 1989, and the ship was launched in May 1994. Originally planned for delivery in 1996, budget problems have caused the program to stretch on, with a current planned commissioning date in 1999, at the earliest. The second carrier of the class has not yet been approved for construction, although it is recognized that *Foch* will go out of service early in the twenty-first century and that two carriers will be needed to provide continuous capability.⁶

De Gaulle will be approximately 261 meters long and have a displacement of approximately 40,000 tons.⁷ It will accommodate 40 aircraft, including the new Rafale SU 0 class, the Super Etendard (to be replaced by the Rafale SU 2 in 2005), and E-2C Hawkeye early-warning aircraft, as well as several helicopters. There are two catapults, each capable of launching an aircraft every minute.⁸ Propulsion is provided by two nuclear reactors of the same design as those used for the new-generation SSBNs.

Table G.1
Construction Periods for Clemenceau-Class Carriers

Ship	Builders	Laid Down	Launched	Commissioned
<i>Clemenceau</i>	DCN Brest	Sept 1955	21 Dec 1957	22 Nov 1961
<i>Foch</i>	Chantiers de l'Atlantique	Feb 1957	28 July 1960	15 July 1963

SOURCE: *Jane's All the World's Ships*, London: Sampson, Low, Marston and Co., 1993–1994.

⁶Whether the second ship will be nuclear-powered is still undecided.

⁷The size of *de Gaulle* was limited by the capacity of the dry docks at Brest, where she is being built, and at Toulon, where she will be homeported and maintained.

⁸The catapults are of American design but were built in France.

The ship's company was originally planned to be approximately 1,500 persons, but that number has been reduced to about 1,150 by functional analysis of the workloads and through automation.⁹

The initial design for *de Gaulle* was performed at the DCN facilities in Paris; Brest provided the detailed and final-production designs. Toulon has responsibility for the combat systems; Indret has design and production responsibility for the nuclear-propulsion system.

Funding problems have caused an approximate 4-year delay in the delivery of *de Gaulle*. Since the shipyard employees are civil servants, construction was never completely stopped. The funding problems resulted in delay of the services and capabilities provided by the temporary employees and subcontractors.

If they had had additional resources, the program managers would have explored and used more commercial standards and had more interaction with other governments and commercial firms. They are using fiber optics and commercial valves and pumps on board *de Gaulle*, and have the following turnkey systems:

- Fresh water (hot water, pressurized)
- Galley
- Laundry
- List-compensation system
- Commercial computers (Hewlett-Packard)
- Commercial radars for navigation.

FRENCH NAVAL NUCLEAR PROPULSION AND SAFETY

The industrial organization of French naval nuclear-propulsion production is shown in Figure G.3. Two ministries are involved, the Ministry of Defense (MoD) and the Ministry of Industry (MOI). MOI functions as does the U.S. Department of Energy and develops the technology. The STXN organization is equivalent to the U.S. Naval Nuclear Reactors organization and is responsible for hardware development, testing, and prototypes. Figure G.4 outlines the French safety organization.

⁹In addition to its company, the ship will host 550 aircrew and 50 flag staff; total accommodations are for 1,950, which includes the potential for 800 Marines.

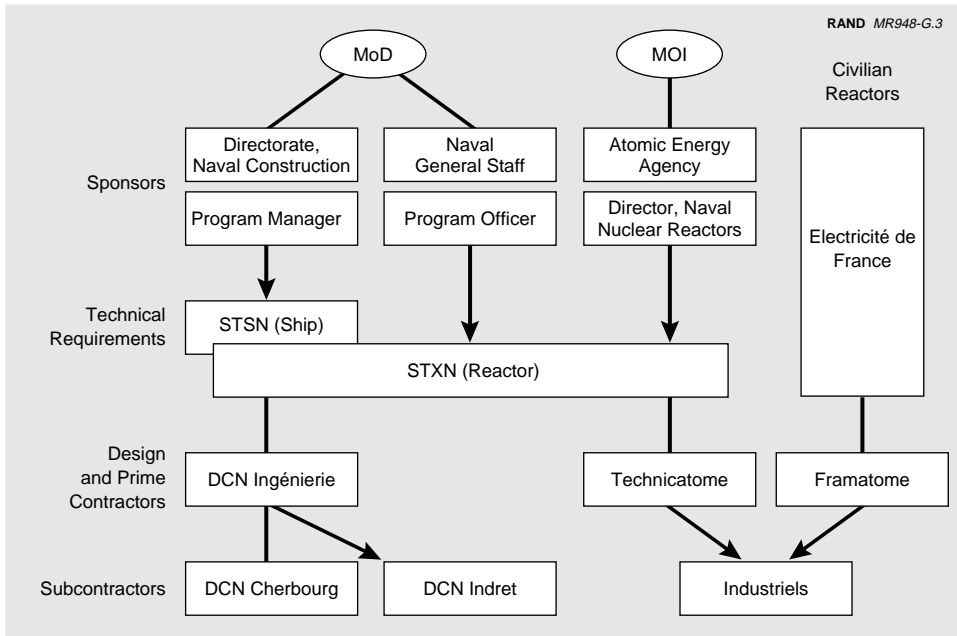


Figure G.3—French Naval Nuclear-Propulsion Organization

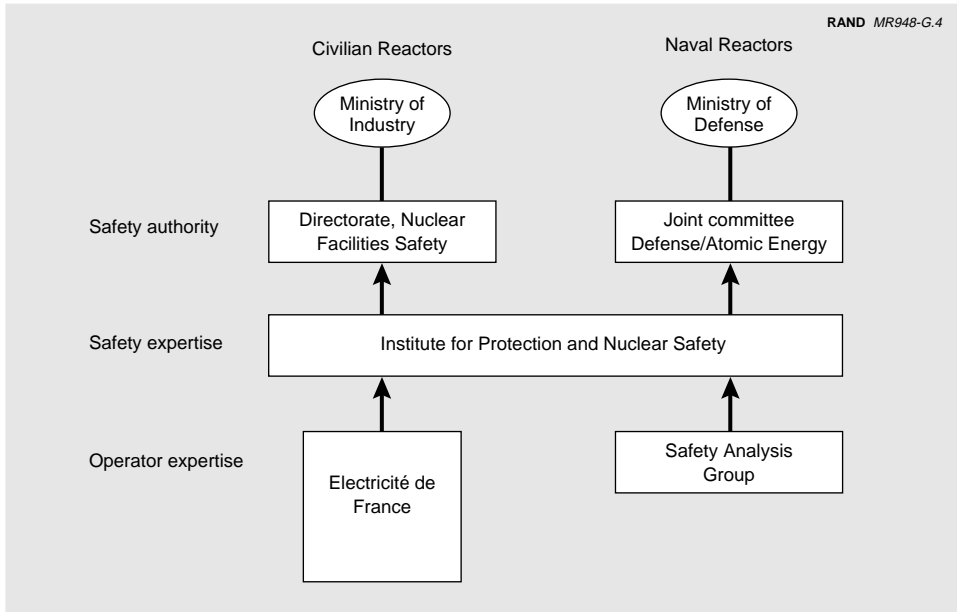


Figure G.4—French Nuclear Reactors Safety Control Organization

The Institute for Protection and Nuclear Safety must grant approval prior to start-up of either a commercial or nuclear reactor. In addition, this organization has authority to ask questions and to require reports and investigations of either military or commercial in-service reactors.

OBSERVATIONS

Our main reason for interacting with the DCN and officials of the *Charles de Gaulle* program was to understand any difficulties and problems associated with constructing a ship as large as an aircraft carrier after a production hiatus of almost two decades. Project personnel felt that the gap in carrier production did not cause any out-of-the-ordinary problems in the construction of *de Gaulle*. The shipyard had been active in building ships, although of a smaller size than a carrier, and these activities provided a sufficient foundation for construction of *de Gaulle*.

Social policies—e.g., maintaining fixed employment levels rather than workload—set the DCN's shipyard personnel levels. When funding is decreased, contractor activities are cut. For example, during one period of austere funding, the aft portion of the ship was sealed off and work continued in the forward sections. When problems did arise with systems unique to carrier construction, DCN turned to the United States for assistance. And for several systems, DCN contracted with U.S. firms that provide similar equipment for U.S. carriers.

The nuclear industry had been sustained by the submarine programs (in addition to a robust civilian nuclear-power industry), and it had taken advantage of the submarine reactor design and development efforts. The only subsystems that had caused problems were those peculiar to aircraft—primarily, the catapults. The French had to rely on American expertise in this area and made several trips to U.S. Navy facilities to gain knowledge and assistance.¹⁰

It is difficult to understand the economic impact of the long gap in the French carrier construction. No data were made available on the cost (or man-hours) of building *Charles de Gaulle*; however, the delays caused by lack of funding undoubtedly had a major effect on cost. One thing is certain: *de Gaulle has been built* after a long gap, suggesting that it is possible to stop building aircraft carriers for a long time and then reconstitute the capability. But this possibility assumes that the shipyard is active in the construction of large surface ships and maintains a nuclear-construction capability—and has access to an indus-

¹⁰This point should not be lost in any analysis of U.S. industrial capabilities: U.S. allies often rely on the United States for specific expertise that is fragile or expensive to maintain.

trial base that has been designing and manufacturing special equipment such as catapults.

In summary, French social policies, relative size of the ship (approximately one-third that of a Nimitz-class carrier), willingness to lengthen the production period, and availability of U.S. expertise and experience with carrier-unique systems obviated their need to worry about the availability of skilled labor.

What is not clear from the French experience is how such a production gap affects cost and the quality of the finished product.