



NAVAL YEAR BOOK 2021 GROUP



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By Pierre Éric Pommellet,
Chairman and Chief Executive Officer
of Naval Group

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Pierre Éric Pommelot,
Chairman and Chief Executive
Officer of Naval Group



SOLIDITY, PERFORMANCE AND RESPONSIBILITY

2021 was marked by the end of the Australian program but also by major industrial successes in France and internationally. Bolstered by its skills and an exceptional ability to innovate in order to bounce back, our company has successfully met the challenge of moving from resilience to performance, thanks to the three pillars that define its strategy: France, international and innovation. Here's how...

T

THE END OF THE AUSTRALIAN PROGRAM: A SHOCK AT THE GEOPOLITICAL AND STRATEGIC LEVELS

2021 will remain marked by Australia's decision to equip itself with a fleet of nuclear submarines based on US technology, and in doing so

to abandon the project that we had been building with them for the last five years. Although we of course regret this choice, after the considerable efforts we made to meet the milestones of the program, we are aware that this decision was in no way the consequence of a lack of performance on our part. I would also like to acknowledge all the Naval Group employees in France and in Australia who contributed to the program as well as all our partners.

Following this announcement, our priority has been to support all those affected by this decision and remarkable work has been done in France and in Australia to find repositioning solutions.

MAJOR INDUSTRIAL SUCCESSES IN FRANCE, IN EUROPE...

2021 was particularly intensive in terms of industrial achievements. On 19 February, the Minister of the Armed Forces, Florence Parly, announced the launch of the program for third-generation nuclear-powered ballistic missile submarines, the 3G SSBNs: four submarines that will replace the current SSBNs in their mission without interruption.

Another large-scale program: the nuclear-powered new generation aircraft carrier (PA-NG), which was launched at the end of 2020. The joint venture MO Porte-Avions, which we created in 2021 with our partner Chantiers de l'Atlantique, will allow us to conduct this exceptional program, which has received its first preliminary design contract from the French Defence Procurement Agency (DGA).

On the Barracuda program for nuclear attack submarines (SSN), we continued the work that will lead to the entry into service of the first of the series, the *Suffren*, and we transferred the *Duguay-Trouin* to the launching device at our Cherbourg site, where the industrial work will be completed on the vessel before the sea trials. Also in Cherbourg, we repaired the *Perle*, the nuclear attack submarine that had suffered a fire in 2020. In the course of this 11-month project, our teams achieved a unique technical treat: welding the rear section of the *Perle* to the front section of another submarine, the *Saphir*. In October, the *Perle* went on to continue maintenance

work in Toulon, where our teams are hard at work to ensure its return to sea in 2023. In addition to this technical and industrial achievement, this disaster represented an opportunity to make progress with regard to the safety of our sites and our employees, a project at the heart of the company's transformation.

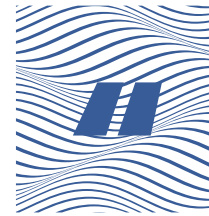
At the European level, on 30 November in Concarneau, we celebrated the keel-laying of the first of the twelve minehunting vessels in the Belgian-Dutch program, rMCM.

Also in Europe, Greece placed its trust in us: in September, we had the honour, alongside MBDA, of signing a memorandum of understanding opening negotiations to provide the Greek navy with three frigates for defence and intervention (FDI) and their equipment, as well as an option on a supplementary frigate. With the FDIs, the Greek Navy will have a state-of-the-art, high-performance surface fleet that is fully interoperable with European and NATO fleets. An asset in terms of power and sovereignty for Greece, which becomes the second customer for this digital multimission frigate, the first being the French Navy, for which five units will be produced.

European cooperation will be on the agenda for us in 2022 with the launch of studies for the future European corvette, the EPC, in cooperation with Italy and Spain, as well as Greece, Denmark and Norway. Together with our Italian partner Fincantieri, we have asked our joint venture Naviris to support this ambition.

... AND INTERNATIONALLY In India, on 25 November, we celebrated the entry into service of the *Vela*, the fourth submarine in a series of six built through transfer of technology. This follows just a few months from the entry into service of the *Karanj*, in March 2021.

In Brazil, the submarine *Riachuelo* will soon enter into active service. This is the first of a series of four submarines, built locally, on the Itaguaí naval



France, international and innovation are the three pillars of our strategy. The intel that rests on these pillars: trust. The trust of our customers in our expertise, of our employees in our company, but also our trust in ourselves, in our victories and in our ability to win."

base, an infrastructure created specifically for this program. With 14 submarines sold around the world, Naval Group's Scorpene® is a benchmark for conventional submarines for navies around the world.

We have an excellent score in services, with 95% of our milestones reached on time in 2021: this includes, among others, our in-service support and modernisation activities. On a global level, for surface ships and submarines, we have ensured fleet availability of over 90%.

INNOVATION AND TECHNOLOGY AT THE HEART OF OUR STRATEGY

At the Naval Innovation Days that we organised in October, we unveiled our key innovation projects. These projects include the oceanic underwater drone demonstrator, representing the autonomous capabilities that the navies of tomorrow will have. One major technological and human challenge will relate to the acceptability and confidence in the controlled decision-making autonomy that we will develop. By relying on new technologies such as artificial

PERFORMANCE AND RESPONSIBILITY

To accomplish our mission efficiently, we must ensure our safety and the quality of our achievements, but also our social, societal and environmental responsibility. Today, CSR is more than an advantage, it has become a *sine qua non* condition. One of our challenges for 2022 will be to move up a gear so that our CSR projects obtain additional results. We will also adapt our own corporate purpose, following the collaborative work undertaken with groups of volunteers at all our sites and in several of our countries.

We owe these CSR efforts to our customers, our partners, our suppliers, our employees but also to our future talent, to the youth we continue to support by introducing them to our professions through our teams of enthusiasts who welcome young people for internships and work-study programs. To convince young people to join our teams and partners to work with us, we have to show them that we are doing everything we can to have a positive impact on society.

At Naval Group, this is our ambition for the future: to commit, together, to being a high-tech company that is both efficient and responsible in serving our customers.



We have the ambition to develop drones and autonomous systems. Thanks to its comprehensive business model and an ecosystem of cutting-edge partners, Naval Group has all the skills for these innovative systems in the context of naval collaborative combat. Through our work on drones, we will also expand our capacities to design and industrialise ships in a different way."

SURFACE SHIPS



2021

A busy year for French customers and for exports

Activity was sustained in 2021, despite the ongoing difficult health context. Two ocean patrol vessels were delivered to the Argentinian Navy, in April and then in October. The first of two multimission frigates with enhanced air defence capability (FREMM DA), the *Alsace*, was delivered in April. The first of two Gowind® corvettes intended for the United Arab Emirates was floated in December. The preliminary design phase for the new generation aircraft carriers (PA-Ng) began in March. The keel was laid for the first frigate for defence and intervention (FDI) and its combat system embedded in the Panoramic Sensors and Intelligence Module (PSIM) was activated in December. The end of the year was also marked by the signing of a memorandum of understanding with Greece, the first country to purchase Belh@rra®, the export version of the FDI.

A complete range of surface ships

GOWIND®
The benchmark multi-role combat ship.

BELH@RRR® / FDI
The latest generation digital frigate.

MULTIMISSION FRIGATES (FREMM)
The expedition-capable multimission frigate.

MISTRAL
The amphibious helicopter carrier with proven efficiency.

AIRCRAFT CARRIER
The flagship of an ocean-going fleet.

40

MILLION EURO

WERE INVESTED IN THE MODERNISATION OF EQUIPMENT
on the Lorient site from 2018 to 2021.



NEW GENERATION AIRCRAFT CARRIERS (PA-Ng) A MULTI-PARTNER, MULTI-SITE PROGRAM

Bringing together teams from MO Porte-Avions, Naval Group, Chantiers de l'Atlantique and TechnicAtome, the study platform for the new generation aircraft carrier (PA-Ng) was launched in Lorient on 29 March. The Minister of the Armed Forces, Florence Parly, also announced the notification of the preliminary design contract.

T

Tailored organisation to maximise synergies

At the end of 2020, the President of the Republic launched the design of the nuclear-powered aircraft carrier that will replace the *Charles de Gaulle* when the latter reaches the end of its life around 2038. Naval Group and Chantiers de l'Atlantique have therefore

created a joint venture dedicated to the program, MO Porte-Avions, to ensure the project management of the armed vessel (excluding boiler rooms). "This alliance will allow the two partners to combine their respective skills and experience. This is a firmly cooperative step", underlines Olivier de Saint-Julien, Chair of the joint venture MO Porte-Avions.

Well distributed tasks

"Naval Group is the overall architect of the armed vessel and responsible for the systems specific to a nuclear aircraft carrier (excluding nuclear boiler rooms proper)", explains Laurent Coudray, PA-Ng Business Manager. That means we are responsible for the implementation of aviation, the combat system, distributed digital systems, the electrical energy production system, the production of nuclear boiler sub-assemblies, the integration of these boilers on the ship and trials. Chantiers de

“Naval Group is working closely with Chantiers de l’Atlantique to ensure that the human factor is taken into account when reflecting on the operation and maintenance conditions of the ship and fitting of the living quarters. Our discussions also focus on the environmental aspect.”

Laurent Coudray,
PA-Ng Business Manager

l’Atlantique is responsible for the ship’s large platform systems: the hull, electric propulsion, life function, manoeuvring and auxiliary facilities, and will manage the industrial coordination. Finally, TechnicAtome is in charge of the nuclear boiler rooms, in conjunction with Naval Group.”

The purpose of the preliminary design contract

The PA-Ng program draws on the expertise of almost all the Naval Group sites, which are participating in the works carried out on the industrial study platform in Lorient. The preliminary design work and risk removal studies started there at the end of March 2021. “The preliminary design means that we can establish a repository of requirements shared between the overall architect and the systems and define the general architecture of the ship and the architectures of the main systems necessary”, adds

Olivier de Saint-Julien. “In particular, this stage will allow Naval Group and Chantiers de l’Atlantique to prepare for consulting the equipment suppliers. Their shared goal is to complete the preliminary design phase in early 2023, to move on to the detailed design phase.”

Anticipating requirements

Mobilisation is gaining momentum, particularly on the Nantes-Indret site, which is in charge of the energy-propulsion system of the future aircraft carrier. “The challenge is the extraordinary dimensions of this system, which means there are many technical challenges to be met. The other big challenge is the planning and the heavy workload that

awaits the site”, explains Gaëlle Kervern, manager of the boiler room part of the program. “In addition to adapting the production tool, we must define new manufacturing processes and de-risk them, which we are preparing with the industrialisation and methods departments.” Preliminary studies on logistical support for the PA-Ng have also begun. “The new infrastructure needs (basin and wharf) of the base port of Toulon must be identified well in advance because these must be completed and available before the end of 2034. In addition, the duration of the civil engineering transformation project is estimated at between four and five years”, adds Franck Bouffety, Aircraft Carrier Maintenance Expert. ■



PERSPECTIVE



“A UNIQUE INDUSTRIAL FEAT.”

Florence Parly,
Minister of the Armed Forces

“As you know better than anyone, building an aircraft carrier is very much a ‘long term’ adventure. For many, it is the work of a lifetime, a passion, a unique industrial and technical feat. Everyone here has a huge responsibility to succeed in this project and maintain France’s reputation of greatness. There is still a long way to go until 2038, the date of entry into active service. After this preliminary design phase that we have started, will come the detailed design phase, then the launch of construction from 2025. The first sea trials will take place just eleven years later, in 2036. And I know we can count on you. Likewise, you can count on the State. The State will keep its commitments. Our aircraft

carrier is a building that projects power, a means of intervention and a deterrent weapon. The challenges it brings are huge and I know that the commitment of the industrial actors, engineers, sailors, civil agents and soldiers of the Ministry of the Armed Forces who work daily on this program will be up to the task.”

Extract from the speech given in Lorient on 29 March 2021, at the inauguration of the study platform for the new generation aircraft carrier (PA-Ng) bringing together teams from Naval Group, Chantiers de l’Atlantique and TechnicAtome. The Minister announced the notification of the preliminary draft contract and attended the signing of the agreements creating our joint-venture with Chantiers de l’Atlantique.

DELIVERY OF THE *PIEDRABUENA*
ON 13 APRIL 2021.



ARGENTINA

ANOTHER SUCCESS FOR NAVAL GROUP AND KERSHIP

The second and third offshore patrol vessels (OPV) ordered by the Argentine Navy were delivered in April and October 2021, respectively, according to the initial schedule.

O

On-time deliveries

Under the contract signed in 2018 by Naval Group with Argentina to supply its navy with four multimission ocean patrol vessels, the *ARA Bouchard* (formerly *L’Adroit*, built by Naval Group) was delivered in 2019. The construction of the following three patrol vessels, with a design adapted to the needs of the Argentinians, was entrusted to Kership – a subsidiary of Naval Group, in partnership with Piriou. Naval Group delivered no fewer than two units this year on the contractual dates: *ARA Piedrabuena* on

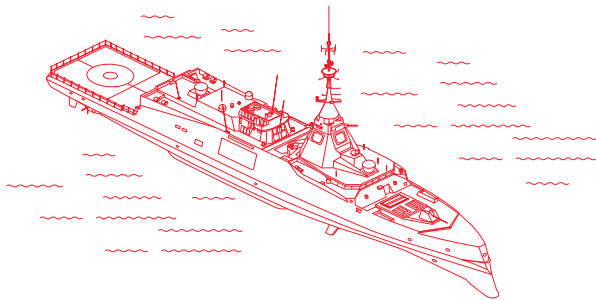
13 April then the *ARA Storni* on 13 October. Their crews, made up of 44 sailors, received training in the operation and maintenance of their vessel from the teams at Naval Group and Kership. “We are aware that delivering two ships in one year is an extremely complex task”, commented Captain Villemur, Head of the Argentinian Inspection Commission in France. “Our thanks and gratitude go to all the men and women of Naval Group, Kership and Piriou and to the many other companies, who have worked tirelessly to achieve this feat.” The excellent 96% customer satisfaction rate obtained for the program in 2021 corroborates these comments.

“The deliveries of these two patrol boats are essential milestones for the program, reached on time despite the health crisis that has marked the past two years”, explains Jean-Claude Flandrin, Program Director. “We are now focusing our efforts on the delivery in April 2022 of the last of the series, which was floated last September.”

All-terrain patrol vessels

Newly built, these second and third offshore patrol vessels 87 offer the same advantages as those of the first series: great endurance, excellent seakeeping, 360° visibility from the bridge, single mast for panoramic coverage of sensors and rapid implementation of intervention boats by a double system of ramps at the stern of the patrol boat. In addition, they are better armed, more motorised, equipped with an active stabilisation system and a bow thruster and above all ice proven, hence adapted to navigation in the cold waters of the Antarctic. ■





FRIGATES FOR DEFENCE AND INTERVENTION (FDI)

THE PROGRAM IS ACCELERATING

On 29 March, the Minister of the Armed Forces, Florence Parly, notified Naval Group of the order for the second and third FDI, to be delivered to the French Navy in 2025.

C

... with ambitious pace that has accelerated

For the following units, while the initial plan provided for deliveries staggered every eighteen months, the State requested in the spring that the second and third frigates in the series both be delivered in 2025. A decision that supports the activity of the Lorient site, as highlighted by Pierre Éric Pommellet: "The trust of the Ministry of the Armed Forces sends a strong positive signal, for the use and maintenance of skills, at Naval Group as well as within its ecosystem, subcontractors and partners, but also for the international navies which could be interested in these frigates."

Construction well underway...

To complete the fleet of first-rate combat ships, the contract providing for the supply of the first of five FDI, new highly innovative multimission frigates, to the French Navy was notified in 2017. The manufacture of FDI no. 1 began in October 2019 and its keel was laid on the Naval Group site in Lorient on 16 December 2021.

On this occasion, Pierre Éric Pommellet unveiled and illuminated the first hull blocks in construction form and powered up the Panoramic Sensors and Intelligence Module (PSIM), the integrated mast comprising part of the combat system.

Spearheading export orders

On 28 September 2021, Greece signed a memorandum of understanding with Naval Group and MBDA opening negotiations to provide the Greek navy with three FDI, logistics, training, ammunition and associated maintenance, as well as an option on a supplementary frigate. According to the Franco-Greek agreement, these FDI are to be built by Naval Group in Lorient and delivered in 2025 and 2026. "This is very good news for Naval Group and the Lorient shipyard, which will benefit from a planned

workload of at least five years", rejoices Pierre Éric Pommellet.

Performance, quality and safety challenges

To be able to meet this rate of orders, the site has undergone transformation since 2018, investing heavily in its industrial tool and pacing its organisation to improve its competitiveness. The goal: to be able to float two to three ships per year.

Digitisation has therefore become a production accelerator. Machining and assembly operations and compliance checks are now carried out using software installed on digital tablets, which contributes to greater control of quality and schedules.

The Lorient shipyard has been able to adapt and organise itself successfully to meet the challenges of the acceleration requested by France. This enabled the consolidation of the international Belh@rra® offering, and the means to deliver to Greece, in line with the country's strong desire to strengthen its navy very quickly, the first two frigates as of 2025.

"The on-board integration and the sea trials of the ship's various systems take place within tight deadlines, which calls for preparation well in advance. For each on-board system, the maximum number of tests are carried out on the integration platform on land, as early as possible in the process", adds Sylvain Perrier, Program Director. ■



ON 13 JANUARY 2022, THE FRENCH MINISTER OF THE ARMED FORCES VISITED THE SITE IN LORIENT, WHERE THE FDI ARE BUILT.



FEATURES OF THE FDI:

- 122 METRES LONG;
- 150 PERSONS ON BOARD;
- 4,500 TONNES OF DISPLACEMENT;
- 27 KNOTS.



THE LIQUID AND SOLID WASTE MANAGEMENT SYSTEM of an FDI complies with the requirements of Marpol, the international convention for the prevention of pollution from ships.

NOTE: the FDI complies with the Bureau Veritas Cleanship certification and the pursuit of energy efficiency is taken into account in the design of the vessel.



THE FREMM PROGRAM CONTINUES TO SHOW EXCELLENT PERFORMANCE

In April 2021, Naval Group delivered the *Alsace*, the first of two multimission frigates with enhanced air defence capability.



ON 16 APRIL 2021 IN TOULON, IN THE PRESENCE OF FLORENCE PARLY, THE MINISTER OF THE ARMED FORCES, NAVAL GROUP DELIVERED THE FREMM DA ALSACE.

D



Delivery schedule met

The delivery of the frigate *Alsace* to its base port in Toulon, was made by the contractual deadline, despite the health crisis and the request from the Organisation for Joint Armament Cooperation (OCCAR) to integrate the latest capability developments, particularly in the field of cyber defence, without changing the schedule. "Between 2018 and 2020, the FREMM entered the era of cyber surveillance and, although we were late getting on board, we were able to quickly rise to a very advanced level of protection", confirms Nicolas Gaspard, FREMM Program Director.

A Herculean program

The frigate *Alsace* also benefited from the continuous development intrinsic to the program. From its design to its delivery, it represented approximately three million hours of work, provided in equal parts by Naval Group and its partners and subcontractors. It mobilised over a hundred different trades and called on many skills, spread

over all the group's sites. The seventh unit delivered to the French Navy after the frigate *Aquitaine*, in 2012, it will be followed by the *Lorraine*, powered up in 2021, with delivery scheduled for November 2022. In total, the Lorient site will have built ten multimission frigates!

Industrial success

Like her sisterships, whose architecture she shares, the frigate *Alsace* incorporates environmentally virtuous technologies: hybrid propulsion, which allows her to sail in coastal areas without polluting emissions linked to diesel combustion, or even a treatment plant for liquid waste and a space for compacting and crushing solid waste (in accordance with regulations). From an operational point of view, the performance of the FREMM frigates in terms of anti-submarine warfare has once again been demonstrated – and praised by the US Navy (four FREMM in two years distinguished by the award for anti-submarine warfare excellence – the Hook'em Award) – in operations such as during the "high intensity" combined exercise Polaris 21, which took place at the end of November in the Mediterranean

and in which the FREMM *Provence* and *Languedoc* participated within the carrier battle group. In 2021, in order to support the frigate *Languedoc* during a long-term operation, Naval Group notably successfully organised a short technical shutdown in Abu Dhabi, involving a multi-speciality team on site.

An enhanced frigate

The frigate *Alsace* stands apart from previous units by her increased anti-aircraft capabilities. Like her sisterships, she uses the most efficient weapon systems and equipment (Herakles multifunction radar, Aster 15 and 30 and Exocet MM 40 missiles, MU90 torpedoes). The performance of her combat system is reinforced by radar capabilities, increased communication and command capabilities, a Setis® combat management system, equipped with specific air defence functions and new radar and electro-optical fire control. ■

In early 2021, Naviris, the joint-venture formed by Fincantieri and Naval Group, signed a memorandum of understanding with Navantia to expand industrial cooperation around the European Patrol Corvette (EPC) program. The teams of the three manufacturers are working together to imagine the offshore corvette of tomorrow. In total, the EPC program provides for the construction of around twenty ships for the three nations.

EPC: STRENGTHENING EUROPEAN COOPERATION

INNOVATIVE, THE FUTURE EPCs will be financed by the European Defence Fund (EDF) and will allow Spain, France and Italy, as well as other European countries that join the program, to exercise their sovereignty and protect their interests in their exclusive economic zone. "In 2021, we started to identify the needs of our navies and begin work to define a first draft of this new class of ships", says Bruno Rattez, EPC Program Director. "We seek to set up standards and working methods that are innovative and common to the three countries, with standardised interfaces for the equipment." While the common base for all EPCs will be as developed as possible, each one will then be able to equip the ship according to its doctrine and its needs. The Franco-Italian-Spanish consortium, of which Naviris is the coordinator vis-à-vis the European Union, submitted its proposal to the EDF on 9 December.



SUB- MARINES



2021

Support for the whole life cycle

In terms of submarine activity at Naval Group, a highlight of 2021 will notably be the arrival of the nuclear-powered ballistic missile submarine (SSBN) *Le Terrible* at the Brest naval base as part of its periodic full cycle docking (FCD) of fourteen months, the official launch of the third-generation ballistic missile nuclear submarine program (3G SSBN) in Val-de-Reuil, the entry into active service of two *Scorpène*® in India, the end of the first maintenance of the nuclear attack submarine (SSN) *Suffren* in Toulon, the departure of the SSN *Perle* from Cherbourg, where it was repaired, for Toulon, the successful implementation of the first exercise torpedo (F21) by the *Riachuelo*, the first of the Brazilian *Scorpène*®, the transfer of SSN *Duguay-Trouin*, second in the *Barracuda* series, to its launching device in Cherbourg etc.

A full range of submarines

NUCLEAR-POWERED BALLISTIC MISSILE SUBMARINE (SSBN)

The best performance for nuclear dissuasion. Invulnerable because undetectable.

BARRACUDA

A nuclear stealth attack submarine that is particularly mobile and has great endurance.

SCORPÈNE®

The international benchmark for conventional submarines. Discreet and enduring.

50

YEARS

IN THE SERVICE OF THE FRENCH DETERRENT FORCE.

Since January 1972, Naval Group has ensured the in-service support (ISS) of French nuclear submarines based in Île Longue. And has been part of the French nuclear deterrent since it began.

SSBN 3G

COLLECTIVE MOBILISATION!

Several decades after the creation of the nuclear deterrent force, the keystone of French sovereignty, 2021 was marked by the launch of a new generation of nuclear-powered ballistic missile submarines (SSBN), the third. Hundreds of specific skills are already mobilised, everywhere in France.

A

A French industrial story

Symbolic in more ways than one, 2021 also celebrated fifty years of permanent patrol by nuclear-powered ballistic missile submarines (SSBN), in waters around the globe. The Minister of the Armed Forces, Florence Parly, recalled: "The success of this oceanic component of deterrence is

first and foremost the story of exceptional will and technological and scientific achievement." As the first of four second-generation SSBNs retires from active service between 2030 and 2040, all who work to renew it will be part of this extraordinary legacy. Naval Group is the prime contractor for this major program, in association with the partner TechnicAtome for the boiler section. We work jointly on behalf of our contracting authorities, the French Defence Procurement Agency (DGA) and the Commissariat for Atomic Energy and Alternative Energies (CEA). More than two hundred companies from the French naval defence industrial ecosystem, four hundred skills and three thousand people throughout the territory will be involved. These include leading forgers Framatome and Aubert & Duval who, for sixty years, have been supplying parts for nuclear boiler rooms, with the support of the entire French nuclear industrial fabric. All Naval Group sites will be mobilised.



Cherbourg will host the design activities (with the contribution of Lorient), construction of the platform and integration of equipment and systems, then trials. Nantes-Indret will supply the propulsion system as well as the main components of the nuclear boiler room. Its launch started from the detailed preliminary project phase in order to allow the qualification of the drafts of its main components. This anticipation aims to de-risk the forge work in order, ultimately, to meet the milestones of the program.

All our sites on deck

The main components of the deterrent weapon system (gas generators, upper closures, side access etc.), weapon launch

Signs of longevity

The 3G SSBN program represents 100 million hours of work over the next 30 years, including 15 million hours of design for 3,000 employees, and 80 million hours of construction for 2,000 employees, over the long term. The first of the series should be launched during 2030-2040, while the last of the Le Triomphant class is set to be withdrawn from active service around 2050. She and her three sisterships will patrol until 2080.

tubes, masts, the weapon handling system will be produced in Angoulême-Ruelle. The deterrent weapon system and the combat system will be designed in Ollioules. Bagneux will focus on various program management activities and Brest will contribute to the preparation of the Services activity (logistics and infrastructure) as well as to the design and production of ship modules and platform equipment. This vast program includes a component dedicated to specific means of production (in particular for resistant hulls in Cherbourg and machining in Indret), which, financed by the DGA, was contracted in February. It allows Naval Group to put itself in order to design and supply these means and equipment. Infrastructure adaptation work has begun in various places, and new machines will soon be introduced.

Renewed to adapt to new threats, the 3G SSBN will be slightly longer and heavier than the Le Triomphant class. It will also be more discreet, thanks to acoustic coatings and quieter propulsion.

This means its acoustic footprint should be no louder than a school of shrimp! With regard to its environmental footprint, the DGA asked Naval Group to draw up an Eco-design and environmental risk management file, the health and safety at work (HS) section of which was delivered in 2021. This study underlines the consideration of the risks associated with polluting discharges and hazardous substances, in particular at the end of the boat's life. The challenge is, over this long period, to be as least a burden as possible for the future generations who will disassemble this class of submarines. This "extraordinary inheritance" should not come with an inconvenience. ■



THE DELIVERY OF THE *KARANJ*, ON 10 MARCH 2021.



SCORPÈNE®

SEA PROVEN AND SO MUCH MORE

Sold in fourteen units, the Scorpène® submarine is a benchmark on the international market for conventional submarines. Naval Group has designed and developed it for all types of missions. Two of them entered active service in India in 2021.

A

A 2021 list that ranges from India...

2021 has been buzzing with Scorpène® news across the globe! India has made a name for itself with not one but two submarines admitted to active service in the same year: the INS *Karanj*, on 10 March, followed by the INS *Vela*, on 25 November. Entirely built via transfer of technology (ToT) led by dedicated Naval Group and

Naval Group India teams, at the Indian shipyard Mazagon Dock Shipbuilders Limited (MDL), the first four Kalvari-class submarines demonstrate the success of the localisation strategy of the P75 program in India. They illustrate the success of the *Atmanirbhar Bharat* (autonomy) of the Indian Navy and the naval defence industry. Part of this is due to the organisation put in place by Naval Group's Scorpène® department and which, thanks to the teams deployed on our sites, in France and locally, provide support to export customers under technical assistance contracts. At the same time, the sourcing of local companies resulted in the launch of the qualification process for the manufacturers selected and resulted in the awarding of the first certificates of technical aptitude relating to the execution of special processes, necessary for the manufacture of Naval Group-designed spare parts. Also on the Indian-French track record, Naval Group has - for the first time in the history of its partnership with India - won a

new contract directly with the Indian Navy, for the in-service support (ISS) of the Scorpène®. Here again, local execution of part of the operations will be favoured.

... to Brazil

2021 was also a year of renewal for the Brazilian Navy: on 11 November, the first Brazilian Scorpène® type submarine, the *Riachuelo*, successfully performed a practice torpedo F21. Brazil thus became the first export customer to launch an F21 practice torpedo, and the *Riachuelo* became the first Scorpène® to be equipped with one. Resulting from a ToT agreement supported by Naval Group, the Prosub program aims to cover all the needs of Brazil's submarine fleet (infrastructure, construction of submarines, ISS, crew training) from the Itaguaí naval base, near Rio de Janeiro. A 2000 tonne conventionally powered submarine, the Scorpène® is designed and developed to respond to different types of missions: anti-surface or anti-submarine warfare, long-range fire, special operations or intelligence. Fast and extremely discreet, its level of automation allows it to be operated by a small crew. Effective in combat, it is equipped with six launchers and eighteen weapons (torpedoes, missiles, mines). Its continuous improvement by its Naval Group designers makes it a must have thanks to the permanent integration of advanced technologies. ■



PERSPECTIVE

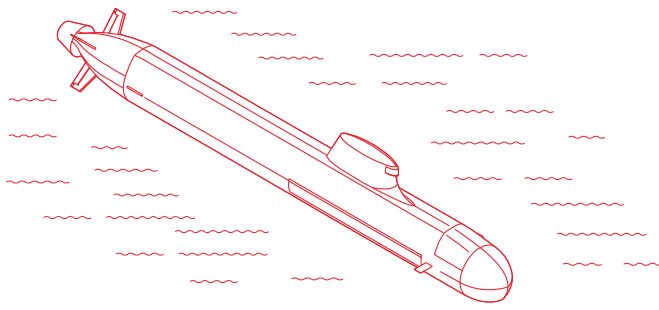


"OUR STRATEGY IS CENTRED ON SUSTAINABLE DEVELOPMENT."

Fabien Chêne,
Sustainable Development Account Manager at Schneider Electric.

Naval Group's strategic partner of over 30 years, Schneider Electric, is pursuing very ambitious objectives in terms of corporate social responsibility (CSR), in order to influence its entire value chain. "Schneider Electric's commitment has followed a logic of continuous improvement since 2005, with the creation of a sustainable development barometer. The 'Schneider Sustainability Impact' now includes six CSR-related pillars: climate, resources, trust, equality, support for different generations and local action. For each of them, we have set very high targets for 2025, which we monitor quarterly using a set of indicators. For the climate, for example, we are aiming for carbon neutrality and helping our thousand major suppliers

to halve their CO₂ emissions by 2025. In 2021, Schneider Electric was voted the most sustainable company in the world by Corporate Knights. This recognition of our early commitment against global warming encourages us to be ever more demanding for ourselves and reinforces our legitimacy to support our customers. We help them define a climate strategy through a carbon neutrality roadmap and implement solutions to achieve it."



BARRACUDA A WELL-PACED SERIES

The renewal of the French nuclear attack submarines (SSN) fleet has begun. After the delivery of the *Suffren*, another chapter in the Barracuda epic began, marked by the permanent efficiency required by the simultaneous construction of five other boats, delivered at the rate of approximately one unit every two years by the end of the decade.

E

Ensuring the naval power of France

The SSN *Duguay-Trouin*, second in the series of submarines in the Barracuda program, left the Laubeuf shipyard at the Naval Group site in Cherbourg, on 26 November 2021, for the Cachin infrastructure launching device. This transfer symbolises its entry into the completion phase, before its first dockside trials. To work on board, nearly 1500 employees and contractors have been trained and certified in health, safety at work and environment (HS&E), nuclear safety and diving safety. Among the most efficient in the world, the *Suffren* type nuclear attack submarines

(SSN) produced under the Barracuda program will enable France to maintain its rank as a great naval power. It is one of the flagship programs of Naval Group and its teams, mobilised to meet the challenges of quality, costs and deadlines with an extreme degree of care and completeness. Incremental improvement proposals have been initiated in terms of operational capabilities in a world in the midst of a redefining of threats. Thanks to the experience acquired on the first two submarines, the parallelisation of the construction of the following units is optimised. The pace is picking up on the sites involved in the program. At the end of August, the closure of the rear of the *Tourville* (third unit in the series of submarines of the Barracuda program) was carried out after boarding the “propulsion system” module in July. The “reactor exchanger pool” module began its integration process on board the *De Grasse* (4th in the series) at the end of December. Assembly of the “propulsion system” and “reactor exchanger pool” modules for the *Rubis* (5th) has begun on the Nantes-Indret site. The sections of the boiler room of the *Casabianca* (6th) were delivered to the Laubeuf shipyard at the end of 2021 to begin the hull equipment phase.

THE *DUGUAY-TROUIN*
ON ITS LAUNCHING DEVICE,
IN NOVEMBER 2021.



Ongoing maintenance

On the Services side in Toulon, the right-of-way dedicated to parking and maintenance (five quays, three basins and the associated secret basic nuclear installation [INBS]) of these new submarines with specific dimensions and requirements is being renovated. In January 2021, the old and the new generations crossed paths there: the nuclear attack submarine (SSN) *Perle*, for repair, and the *Suffren*, for its first intermediate maintenance period. The maintenance tasks and the remaining on the water work

were completed there in ultra-constrained time thanks to the extraordinary determination of the teams from Cherbourg, Nantes-Indret and Angoulême-Ruelle, who came to lend a hand to the teams in Toulon. In this pivotal period with the gradual exit from active service of one class and the arrival of the next, Naval Group and the Fleet Support Service (SSF) have signed a new in-service support (ISS) agreement, which came into effect in the summer for more than three years. And in July, the latest versions of the training platforms were received

by the customer. Since they were commissioned in 2015, they have enabled submarine crews to practise on realistic on-board equipment to train in the operation of the combat system, the boiler room and the operation of the submarine, before their first outings to sea. ■



DID YOU SAY “INFRA”?

While ships are at the heart of all that Naval Group does, its internationalisation strategy has boosted another of its activities: infrastructure. It has even risen to the rank of an essential component of the offers provided for export. The group's ability to develop infrastructure adapted to ships over the entire life cycle, from design to in-service support (ISS) is very specific, resulting of course from its perfect knowledge of ships and their construction processes. Its skills in this area have, in recent years, been enriched by the experience acquired on colossal sites such as Missiessy, the site dedicated to the reception of Barracudas in Toulon. The approach is focused on optimising the availability of ships at sea through the efficiency of on-shore ship support, nuclear safety and finally, national sovereignty.



STRENGTHENING AND ACCELERATING CYBER PERFORMANCE
THE CHALLENGE OF AN ENTIRE ECOSYSTEM

In 2022, it is no longer just a question of managing cyber risks, but of anticipating them and, above all, of demonstrating robust and appropriate performance in this area to ensure the success of the digitisation of systems and spaces.

C

Cybersecurity is now a major field of combat with a constant increase in the number of cybernetic operations conducted in operational theatres and on the various players in the ecosystem.

This observation makes cybersecurity a strategic issue for our customers, comparable to the issue of the acoustic discretion of submarines or electronic warfare that appeared in the previous century.

Because the entire naval defence ecosystem is concerned by this issue, the various players need to organise themselves and combine their efforts to strengthen and accelerate their performance in terms of cybersecurity.

It is with the aim of supporting its cybersecurity strategy that Naval Group co-signed a cyber agreement in September 2019 with the manufacturers Airbus, Ariane Group, Dassault Aviation, MBDA, Nexter, Safran and Thales.

Among the aims of this agreement: to strengthen the level of cybersecurity of weapon systems and the data they process or transport, as well as of information systems and their digital ecosystems, in the construction and maintenance phases. The first results of this alliance have made it possible to highlight the necessary evolution of armament programs by considering cybersecurity as a performance to be achieved, taking into account the challenges of scalability of capabilities. ■

Naval Group did not wait for a rise in cyber attacks to equip its ships with the best means of resisting them, starting with their design. The operational superiority of our customer navies depends on it. This robust and reliable protection, adjusted to the cyber needs of each customer and the type of mission of the boats, offers modularity throughout their life cycle.

READY FOR CYBER!

AGILE AND SEA PROVEN, Naval Group's cyber defence offering is the result of constant innovation, reconciling the imperative need for ship protection with the demands of operational continuity and safety at sea for crews. It is based on four axes that come in different ranges of performance, autonomy and on-board autonomisation.

01

IDENTIFY

Know the attack scenarios and the operation of the ship.

02

PROTECT

Prevent an intrusion.

03

DETECT

Spot an intrusion.

04

RESPOND

Implement tools and solutions.

This offer is accompanied by remote assistance services, if necessary, and capacity upgrades to improve the cyber performance of ships in service.





2021

Maintain and modernise, decommission and disassemble...

Naval Group supports its customer navies over the long term and with them aims for operational excellence throughout the life cycle of the ships. More than 5,000 employees, in France and abroad, follow the same course: guarantee the best availability of the vessel entrusted to them, provide the crew with a boat at the highest level of performance, take into account environmental issues, both at sea and in basins. Major maintenance of a nuclear-powered ballistic missile submarine (SSBN), modernisation of La Fayette class frigates, repair of the nuclear attack submarine (SSN) *Perle*: in 2021, the Brest, Cherbourg and Toulon sites were the scene of exceptional – and in some cases unprecedented – work carried out within the framework of national programs. Carried out in collaboration with our partners and calling on the skills spread over all of our sites, we have seen all the know-how of Naval Group, as prime contractor, expressed there, but also a tremendous collective momentum based on the strong commitment of its employees alongside its customers and partners.

A range of bespoke services to ensure the operational availability of surface ships and submarines.

EDUCATION AND TRAINING

A complete range of education and training solutions for crews and maintenance and industry personnel.

MAINTENANCE, LOGISTICS SUPPORT AND MODERNISATION

Solutions for in-service support (ISS) and for modernisation adapted to all types of ships and all navies.

NAVAL INFRASTRUCTURES

Rare skills for infrastructure upgrades, complete program management for new infrastructures and the operation and maintenance of naval infrastructures.

SERVICES

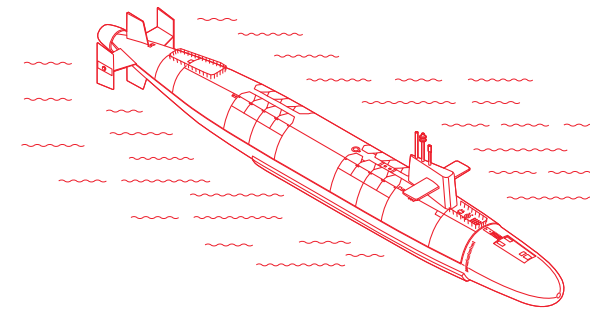


20

MAJORS PROGRAMS

FOR IN-SERVICE SUPPORT (ISS) IN FRANCE
AND INTERNATIONALLY.

SERVICES



NUCLEAR-POWERED BALLISTIC MISSILE SUBMARINE (SSBN) *LE TERRIBLE* AN EXEMPLARY AND EXCEPTIONAL PROJECT

Le Terrible, the newest of the four French SSBNs, joined the Brest naval base in January for its first full cycle docking (FCD). As overall prime contractor, Naval Group took over responsibility for the submarine in November 2020. Project management is provided by the French Navy's Fleet Support Service (SSF). A major and exceptional project in more ways than one.

T

The latest of four French Triumphant-class nuclear-powered ballistic missile submarines (SSBN), *Le Terrible* joined the Brest naval base in early January 2021 for its first major refit. This major maintenance should restore the SSBN, which entered active service in 2010, to its full operational potential for the next ten years. The transfer of *Le Terrible* occurred after two major preparatory operations – the removal of weapons and fuel elements from the nuclear boiler room – carried out at the Île Longue submarine base, the home port of the French SSBNs. The main work concerns the maintenance of the hull and structures, energy and propulsion, diving safety, platform ▶



LE TERRIBLE'S FULL CYCLE DOCKING (FCD)

has placed an emphasis on environmental care from its start: at the Île Longue naval base, the wash water from the SSBN hull was treated before being discharged into the natural environment.

In Brest, in basin 8, the focus is prevention of accidental spills and the immediate intervention of teams in the event of a spill. Particular attention is paid to waste recycling and recovery. In addition, the Brest site signed the Tomorrow climate commitment charter with Brest Métropole in 2021. This charter is structured around five points:

- energy savings and switching to renewable energy;
- other forms of travel;
- sustainable eating;
- reducing and recovering waste;
- raising awareness and instigating behavioural change.



SERVICES

THE CHALLENGE FOR NAVAL GROUP IS, THROUGH THE QUALITY OF THE MAINTENANCE CARRIED OUT ON THESE SUBMARINES, TO ENABLE THE FRENCH NAVY TO GUARANTEE THE PERMANENCE AT SEA OF THE FRENCH SSBNS, 365 DAYS A YEAR, 24 HOURS A DAY.

control and operating systems, easements related to life on board, detection and fight against threats and, lastly, the system of deterrent weapons.

An extraordinary industrial challenge

At the Brest naval base, basin 8 was the scene of exceptional activity throughout 2021 for several reasons: first full cycle docking (FCD) of an SSBN armed with M51 missiles, certain operations concerning the deterrent weapon system are unprecedented. In addition, the significant scope of the works (450 change orders), their implementation under health protocol and the particularly tight deadlines of this FCD – it has been reduced to 24 months – constitute a real technical and human challenge. For Naval Group, the stakes are high since it is a question of enabling the

French Navy to ensure the permanence at sea of nuclear deterrents and thus to respect the schedule of the Coelacanth program. Since the beginning of the year, at the Brest naval base, but also at the Nantes-Indret, Angoulême-Ruelle and Ollioules sites, the Naval Group teams – and alongside them those of 45 companies in the Grand Ouest region – embarked on a real race against time to deliver a fully operational SSBN to the French Navy at the end of 2023.

Security and quality at the heart of our actions

“This race against time can only be won by a close-knit collective. And for it to be able to express itself fully, it needs a solid foundation: security and quality are the pillars. This is also the foundation on which we build a relationship of trust with our customer day after day”, explains Laurent Mocard, Program Director. Relying on past experience to progress, aiming for the highest level in terms of prevention, maintaining effort over time: on the construction site, risk management is everyone’s business. Reinforcement of fire safety protocols, new system for securing evacuations, regular checks set up with the SSF: we have learnt our lessons from the past. On the quality side, the FCD of *Le Terrible* demonstrates the results of the quality action plan launched by the Services department in 2020 to ensure work is “done right the first time.” These efforts are bearing fruit, as the 2021 milestones were achieved in line with the provisional schedule. At the end of the work, scheduled for 2022, the SSBN was taken back to its operational base for the reloading of the core and the restarting of the facilities. The sea trials will complete this extraordinary industrial adventure before *Le Terrible* returns to its operational cycle. ■

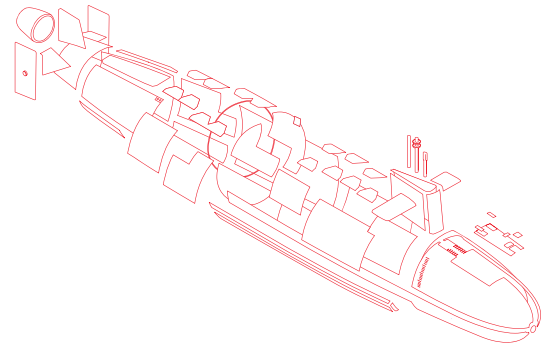


“I WANT TO COMMEND THE EFFORTS MADE BY THE NAVAL GROUP TEAMS.”

Jean-Yves Bruxelle,
Director of SSF Brest

“In the FCD of *Le Terrible*, we are tackling three major challenges together. The first relates to the quality of the service, which, given the complexity of the site, is expected to be of the highest standard.

This means that all of us must learn from previous FCD in order to progress. The second challenge is, of course, safety. Prevention, detection, fire safety: we are doing everything to control these risks. This is a constant effort, vigilance cannot be relaxed. I want to commend the effort made by the Naval Group teams that we are supporting with this key matter. The third challenge, and definitely not the easiest one, is the particularly tight deadline for this FCD, because it must meet the schedule requirements of the Coelacanth program, the oceanic component of the deterrent. I would also like to highlight the commitment of all the players who are working collectively for the success of this extraordinary program.”



DISASSEMBLY, THE LAST STAGE OF THE LIFE CYCLE

Final odyssey for *Le Foudroyant*: on 9 September, the hull of the first generation French nuclear-powered ballistic missile submarine (SSBN) entered form 5 at the Cherbourg site to be disassembled. This new project is part of the French Navy's ex-SSBN disassembly program: an unprecedented program launched in 2016 that demonstrates Naval Group's expertise in the last stage of the life cycle of ships.



O

On 9 September, the hull of the former SSBN *Le Foudroyant*, the third in series of the five first-generation French SSBNs, entered form 5 at the Cherbourg site to be completely disassembled. Launched in 1971, in service from 1974 to 1998, *Le Foudroyant* is therefore entering the fifth and final phase of its life cycle. Following the former

Le Tonnant and the former *L'Indomptable* – disassembled between September 2018 and August 2021 – the entry into basin 5 of this third hull (120 metres long, 6,000 tonnes) kicks off a new project and marks the beginning of a new stage in the disassembly program for the French former SSBNs. The contract had been notified to Naval Group by the French Defence Procurement Agency (DGA) in 2016. Veolia and NEOM (a subsidiary of Vinci Construction France) are the two main partner companies of Naval Group, prime contractor for all operations. “Naval Group is proud to continue with its partners a completely new program in France”, says Olivier Lezin, Program Director.

Two former SSBNs disassembled in less than three years

On the strength of the feedback from the first two hulls, employees and subcontractors will therefore carry out disassembly and depollution operations for around sixteen months within an installation classified for the protection of the environment. A project that continues to be placed under the sign of safety and respect for the environment, as had already confirmed the audit carried out by the French Association for Standardisation (Afnor) at the start of the year. The shared objective for all disassembled submarines is to recover over 87.5% of their solid mass. In the case of the former

L'Indomptable, whose disassembly was completed in August, this objective was exceeded, as almost 92% of the solid mass of the ship (i.e. 5,500 tonnes) has integrated recycling circuits. “A rate that improves from one vessel to the next, as we improve our means for recycling materials. Moreover, while the contractual deadline for a project is eighteen months, we complete it in sixteen,” adds Olivier Lezin. From 2023, the hulls of the former *Le Terrible* and the former *L'Inflexible* – the last two first-generation SSBNs – will follow on to basin 5. Their disassembly will be completed in 2026, the year in which a page in the history of French nuclear deterrence will have definitely turned. ■

IN 2016, NAVAL GROUP LAUNCHED THE DISASSEMBLY PROGRAM FOR THE FORMER FIRST-GENERATION NUCLEAR-POWERED BALLISTIC MISSILE SUBMARINES (SSBN) AT ITS CHERBOURG SITE, THE FINAL STAGE IN THE LIFE OF THESE FIVE FORMER FRENCH NAVY SUBMARINES.



THE COURBET ENDED ITS TECHNICAL SHUTDOWN IN JULY 2021, IN LINE WITH THE SCHEDULE.

LA FAYETTE FRIGATES

THE CHALLENGES OF MODERNISATION

Toulon naval base, Castigneau basin: activity is in full swing on the site for the modernisation of the La Fayette-class frigates (FLF). Signed in 2017, the contract covers the modernisation of three of the five French stealth frigates commissioned between 1996 and 2001. 2021 saw the end of the technical shutdown of FLF *Courbet* and the basin entry of FLF *La Fayette*: an incredible year!

E

Ollioules and Saint-Tropez, Naval Group teams have worked to restore the ship to its potential for the decade to come. The main changes concern the hull, the combat system and the control of the platform. One condition, however: each boat must return to its operational cycle as quickly as possible. It's official: the schedule will be tight! Especially since, in parallel with the modernisations planned under the contract, in-service support (ISS) operations will be carried out in partnership with Chantiers de l'Atlantique, for which Naval Group is the prime contractor.

Flawless mobilisation

The first of the frigates to be in technical shutdown, the *Courbet*, entered the basin in October 2020. "Given the volume of work and the very tight schedule, the activity on the site reached an exceptional density, with at times 250 people on board on a single day. An important co-activity that had to be organised to guarantee everyone's safety", explains Jean-Michel Coquelle, Program Director. Challenge met. On 23 July

2021, nine months after the start of work and in accordance with the provisional schedule, the end of the technical shutdown of the *Courbet* came to an end. A success crowned a few weeks later by the successful firing of an M3 missile from the Sadral air defence system, a new combat system capability. "Completing such a major project in such a short time was a real challenge. It was very difficult but we persevered and we are proud of what we have accomplished", adds Jean-Michel Coquelle. In mid-September, the *La Fayette* frigate entered the Castigneau basin: a new project that had to be prepared and started while the work on the *Courbet* was not yet finished. Here again, the teams did not waver! For this second frigate, the project benefits from valuable feedback from the *Courbet*, allowing progress to be made quickly with the goal to return the *La Fayette* frigate with its new capabilities to the French Navy in the summer of 2022. ■

Extending the life of ships: this is the purpose of the mid-life modernisation program for three La Fayette-class frigates, boats that were designed in the 1990s. From bow to stern, all sections of the frigate are impacted. Significant work which, at the same time, gives the frigates new capabilities. Design and integration studies, system development and equipment manufacturing, site preparation: from 2017 to 2020, in Brest, Nantes-Indret, Angoulême-Ruelle, Toulon,

REPAIRED, THE PERLE BACK IN TOULON

On 31 October 2021, after nine months of work in Cherbourg, the nuclear attack submarine (SSN) *Perle* returned to Toulon. The repaired SSN with the bow of the former *Saphir* returned to the basin where it went back into its full cycle docking (FCD) works that had been interrupted by a fire in June 2020.

T

This is an unprecedented operation carried out by Naval Group teams to repair the SSN *Perle*, the front part of which had been damaged by a fire in June 2020. Shortly after the incident, the expert studies carried out by Naval Group teams and shared with experts from the French Defence Procurement Agency (DGA) concluded that it was possible to repair the *Perle* by replacing the front part with that of her sistership, the former *Saphir*

– decommissioned in 2019. The Minister of the Armed Forces, Florence Parly, then announced in October 2020 her decision to launch the repair site. Prepared and installed on the launching system of the Cherbourg shipyard, the two SSNs were cut in February and March 2021. Preparation work for the joining was carried out on the two open submarines until April. Then came the welding and connection operations following which the *Perle* saw its length increase by a little over one metre due to the integration of an area for connecting the electrical cables. Since November, work on the submarine has continued at the Toulon naval base, within fully renovated infrastructures to accommodate Barracuda-class SSNs. Works that are set to last eleven months and which include in particular the operations to be carried out on the nuclear boiler room and on the platform, where some 10,000 pieces of equipment must be reassembled and then put back into operation. The return of the *Perle* to the operational cycle is scheduled for the first half of 2023. ■



STARTED IN CHERBOURG IN JANUARY 2021, THE PROJECT LASTED NINE MONTHS and involved around a third of the submarine's installations. The operation represented 250,000 hours of industrial work in the first half of 2021, on top of 100,000 hours of study. A total of 300 people were mobilised.



APRIL 2021: INSTALLATION OF THE FRONT SECTION OF THE SAPHIR.

CHARLES DE GAULLE
AIRCRAFT CARRIER.



A TWO-PART TECHNICAL SHUTDOWN:

- **preventive maintenance work**, in particular on the nuclear boiler rooms, repairs on the machine lifts and on several aircraft installations, which underwent heavy use during the three and a half months of the Clemenceau mission;
- **work to improve the living conditions of the crew**: reorganisation of the stations, modernisation of the "hygiene" areas and redesigned catering spaces.



AIRCRAFT CARRIER NAVAL GROUP AIRCRAFT CARRIER AT WORK FOR THREE MONTHS OF TECHNICAL SHUTDOWN

July, August and September: at the Toulon naval base, the three summer months saw the technical shutdown of the aircraft carrier *Charles de Gaulle*, returning from mission. Maintenance of installations, repairs and modification of living areas on board: the program was dense but the operations were all carried out on time and successfully.

O

On 5 July, just back from the Clemenceau mission, the *Charles de Gaulle* entered a technical shutdown in the Vauban area of the Toulon naval base. On the schedule for this three-month technical shutdown, for which Naval Group is the prime contractor: preventive maintenance work on installations and repairs, as well as the continuation of major work undertaken in 2019 for the improvement and adaptation of living areas on board. A dense schedule in a tight time-frame, and still in a complex health context. Coming to lend a hand, employees from the

Brest, Nantes-Indret and Angoulême-Ruelle sites joined the Toulon teams to carry out engineering studies, provide expertise on propulsion and maintenance work on machine lifts. "Despite its density, this technical shutdown was carried out masterfully and in complete safety by the Naval Group teams, who knew how to capitalise on lessons from previous experience, and prepared and organised the work with the State bodies. The synergy between the industrial teams and the crew and the mutual trust also contributed to this success. In operational terms, this made it possible to ensure the ambitious ramp-up of the aircraft carrier from the end of the summer", says Captain Sébastien Martinot, the aircraft carrier's commander. A few weeks after the end of the technical shutdown, the *Charles de Gaulle* took part in the high-intensity Polaris 21 exercise: "The ship met the operational needs and the readiness of the aircraft installations, again in high demand, was up to par!" Captain Martinot added. ■

Increase the availability of ships, improve the autonomy of the crews and provide them with support at any time and in any place: these are the objectives of the i-maintenance and remote assistance services offered by Naval Group to its French and international customers and developed, for remote assistance, in partnership with MBDA.

I-MAINTENANCE AND REMOTE ASSISTANCE

RESPONDING TO VESSEL AVAILABILITY ISSUES

In 2021, Naval Group and MBDA combined their know-how to offer the French Navy a secure multimedia communication system linking the ship to its shore support. This remote assistance service allows the crew to dialogue in complete confidentiality and in real time with both State experts and industrial experts to help with diagnosis in the event of damage, to provide more autonomy to sailors in charge of maintenance and allow them to prepare for the next maintenance period. Its deployment began on the multimission frigates (FREMM) and the *Charles de Gaulle* aircraft carrier as well as within the Fleet Support Service (SSF) in Toulon and the one in Brest and the industrial sites of MBDA and Naval Group. For its French and international customers, Naval Group has developed the Intelligence Maintenance System, which offers three services based on a function of recording and analysis of ship data: system monitoring, anticipation of damage and problem solving assistance. The objective is twofold: in addition to switching from a systematic maintenance plan to a logic of maintenance as needed and at the right time - which would increase the availability of ships - i-maintenance aims to improve the autonomy of crews, a common request from customers.



EQUIP- MENTS



2021

In the field of equipment, as in other fields, Naval Group responds to a vocation: design, develop, innovate, integrate and maintain the most complex products to contribute to the operational performance of fleets and support the sovereignty of nations at sea. Our innovative range of equipment is supported by three industrial sites in France: Angoulême-Ruelle, Nantes-Indret and Cherbourg.

A full range of systems designed to ensure the security and control of surface ships and submarines in combat.

SYLVER®

Vertical missile launch systems.

SAMAHÉ®

An efficient system for handling heavy on-board helicopters in rough seas.

INTEGRATED DRIVING SYSTEMS FOR SUBMARINES

Integrated control systems ensuring centralised and particularly safe operation of submarines.

TORPEDO LAUNCHER INSTALLATIONS

For submarine and combat ships.



SYLVER® LAUNCHERS

IN OPERATION AROUND THE WORLD.

High-performance, they allow the vertical launch of surface-to-air missiles or naval cruise missiles.

THE SYLVER®
VERTICAL MISSILE
LAUNCH SYSTEM
CAN LAUNCH
SURFACE-TO-AIR
MISSILES OR NAVAL
CRUISE MISSILES.



One of Naval Group's strengths is its ability, beyond the delivery of armed ships, to offer and design stand-alone naval equipment and systems for international navies. From this posture emerges a range of cutting-edge equipment and very high-tech systems. Example: the British BAE Systems relies on Naval Group for the propulsion system of the T26 frigates which will equip the British Royal Navy as well as the Australian and Canadian navies. MBDA also equips the Italian multimission frigates (FREMM), the future multimission patrol boats (PPA) as well as the corvettes sold to the Qatari navy with our vertical launch module Sylver®.

Performance, innovation, competitiveness

Our offer includes high-performance, high-tech equipment, such as Sylver® vertical launch systems, Samahé® helicopter handling systems (landing grids for landing in complete safety), hoistable masts that raise the sensors of submarines during periscopic immersion as well as shaft lines and reducers which ensure the connection between the engine and the thruster. Also in our offer, gun tubes for submarines, torpedo tubes for surface ships as well as sea water

exchangers, which contribute to the performance of ships and submarines in many areas, from acoustic discretion to cooling of embedded systems. Marketed as stand alone with the support of Naval Group experts, they are integrated into ships supplied by other manufacturers.

Three equipment sites

Naval Group relies on three sites to offer navies the most innovative, efficient and

competitive equipment: Angoulême-Ruelle, Nantes-Indret and Cherbourg. The Nantes-Indret site provides propulsion systems: nuclear propulsion for the Barracuda program, for the third-generation nuclear-powered ballistic missile submarine program (3G SSBN) and the new generation aircraft carrier program (PA-Ng). It also provides equipment for conventional propulsion: defence and intervention frigates (FDI) program, Gowind® corvettes, Scorpène®

EQUIPMENTS



BUSINESS INTERNATIONAL EQUIPMENT MANUFACTURER AND INTEGRATOR

Solidly anchored in its role as an equipment supplier serving international customers, Naval Group designs, develops, puts into service and maintains equipment of a very high technical and technological level, even integrating them into armed ships not designed or manufactured by Naval Group. This is a key part of our offer to export customers.

submarines. Angoulême-Ruelle specialises in strategic equipment for combat systems and military ship platforms. Since 2019, the site has had an Innov'Factory which instils a strong culture of innovation and increases its ability to imagine new solutions to equip naval forces. The expertise of Naval Group's equipment sites is illustrated by numerous successes abroad. In addition to supplying shaft lines to Britain's BAE Systems for the British Royal Navy's T26 frigates (design in Nantes-Indret and manufacturing in Angoulême-Ruelle), the relationship with MBDA has only grown stronger over time. Started in the 1990s as part of the Horizon program, with the supply of 60 Sylver® modules for French, Italian and British frigates, it continues with the construction, installation and assistance of 24 vertical launch modules at on board Italian multi-mission frigates (FREMM), 10 modules for multimission patrol boats and 10 modules for Qatari corvettes, a program that confirms Angoulême-Ruelle's equipment manufacturing capabilities internationally.

Cutting-edge equipment

Technicality, high performance, ease of use and competitiveness characterise our autonomous equipment and our systems. All contribute to improved operational performance of platforms and crews and give fleets a decisive strategic and operational advantage.

The Sylver® vertical launching system offers high reliability (over 12,000 hours), requires limited maintenance and entails a low cost of ownership. It allows surface ships to fire a wide variety of missiles, including self-defence, tactical and long-range missiles. A perfect illustration of very high naval technology applied to equipment and capable of meeting the needs of the most demanding customers at any stage of the value chain.

UK Sylver® upgrade

2021 was an opportunity to give the Royal Navy's Sylver® launchers a second life. This equipment increased the performance of the frigate *Duncan* for years and, in 2021, the time had come for its overhaul. To prepare for this in-service support (ISS) phase, the experts at the Angoulême-Ruelle site first established a diagnosis before carrying out the necessary work. What was the objective? Restoring the original abilities and properties of Sylver®. According to Florence Gaches, Product Support Manager at MBDA, the operation was a success thanks in particular to the spirit of cooperation between manufacturers and the professionalism of the teams (see *inset*). ■

OUR INDUSTRIAL TOOL GETS A MAKEOVER

Since 2017, Naval Group has invested heavily in renewing and modernising its industrial facilities wherever the group operates, resulting in sites that are better equipped to meet the needs of their customers. From Nantes-Indret to Angoulême-Ruelle, 2021 news summary.



A

Modernisation of the Nantes-Indret site

Orion is the new tertiary building at Nantes-Indret, which will house engineers, IT specialists and support teams in its three wings as of 2022. In total, more than 600 people will enjoy Orion's modern architecture, its 8,500 m² of space, its innovative modular layout and its sustainable materials, all of which reflect its responsible approach. All of this serves to provide new ways of working, designing and innovating, to better meet the needs of both French and foreign clients. In 2019, a decision was made to competitively re-insource the piping activity at the Indret site. Previously spread amongst the Indret, Cherbourg and Lorient sites, as well as a few subcontractors, these activities are now carried out independently in Indret in a modern, digital factory. Commissioned in 2021, the pipe and prefabrication factory (known as the UTP) is intended to supply all the pipes in the propulsion energy sector for new submarines and those undergoing maintenance. Established on an area of 2,500 m² and built with an investment of 11 million euro, the factory is equipped with three electric bending machines, two heat treatment facilities, a pickling and passivation facility, an X-ray booth and a clean

room for the prefabrication of nuclear boiler system pipes. The site's production capacity has jumped from 2,000 pipes per year to 7,000 pipes per year, with the possibility of increasing to 10,000 pipes per year as part of new programs (3G SSBN and PA-Ng). On the planning side, the goal is to reduce the manufacturing cycle for one pipe to 12 days, compared with the previous 50 days. On the financial side, the goal is to reduce manufacturing costs by around 40%. Submarines 5 and 6 from the Barracuda program will benefit from these new capabilities.

Digitalised processes

Another aspect of the industrial facility's upgrade is the increasing use of digital tools in the workshops, resulting in better compliance monitoring, improved quality and shorter execution times. Of particular note: augmented reality is an asset for de-risking certain assembly operations (seating, pipe inspection etc.). ■

Angoulême-Ruelle sustains its strategic industrial resources

Angoulême-Ruelle has two new industrial machining facilities that are unique in France and rare in Europe. Their promise? Provide machining capacity for shaft lines over the long term, prepare for the future and optimise industrial performance to safeguard the production of this critical equipment for ship propulsion. Specifically, the new milling lathe combines the actions of turning the barrel and boring the cakes originally carried out separately, which limits movement and adjustment times.

In addition, it gives us the ability to machine shaft lines up to 25 metres long and 40 tonnes (compared to 22 metres long and 30 tonnes today). The second machine is a long-body boring machine that can drill the inside of shaft lines to a depth of 25 metres. Both production means have been tested and will be fully operational by summer 2022.



PERSPECTIVE

“A REAL CONSIDERATION OF THE NEEDS EXPRESSED.”

Florence Gaches,
Product Support Manager at MBDA

“The diagnostic phase went smoothly and without a hitch, thanks in particular to a real consideration of the needs expressed, the excellent preparation of the teams and a perfectly orchestrated distribution of tasks.” This type of intervention is set to become more important in the years to come, with Naval Group

being called on more and more to ensure the ISS of its equipment. It is hardly surprising, then, to learn that 180 Sylver® are now in place on fleets in operation around the world. At the end of 2022, all French FREMM frigates should be equipped with it.

FULL CYCLE DOCKING (FCD) OF *LE TERRIBLE* HUMAN COMMITMENT AT ITS PEAK

An extraordinary operation, the FCD of the nuclear-powered ballistic missile submarine (SSBN) *Le Terrible* will require hundreds of people to mobilise over a period of 14 months to restore her to full power after ten years serving French sovereignty at sea (see page 29, Services chapter). This FCD has also involved the expertise of Naval Group's Equipment business. The fourth of the *Le Triomphant* class, equipped with 16 M51 nuclear missiles, *Le Terrible* underwent a major refit in early 2021. In 2022, it will emerge from this refurbishment more powerful than ever.

W

SSBNs are among the most complex vessels in the world. With a goal of being at sea 365 days a year, 24 hours a day, these high-tech gems guarantee French maritime sovereignty.

Committed expert teams

Le Terrible's FCD has mobilised Naval Group sites in Brest, Angoulême-Ruelle, Nantes-Indret and Ollioules (near Toulon) sites. Angoulême-Ruelle, in particular, came into play at the end of November 2020 when it took charge of the maintenance of more than 200 pieces of equipment, the most significant of which include the masts and the 16 upper closures located on the top of the submarine's hull.

While the need to carry out major shutdowns to maintain and upgrade fleets is unavoidable, the downside is that vessels will be unavailable to navies for several months. Respecting the schedule for an operation as major as an FCD is therefore a prerequisite. An extremely careful preparation and planning phase is essential to ensure the timely availability of teams, equipment and materials at each stage of the FCD. When the FCD of *Le Terrible* (or "major refit" in the language of the Navy) is mentioned, there is no shortage of superlatives.

The figures speak for themselves: 2.5 million hours of work, more than 900 people, nearly 45 subcontractors involved, 300 modifications carried out, 40,000 pieces of equipment dismantled and inspected in the Naval Group workshops! Not to mention that

The operation proved to be particularly complex and demanding due to the weight of each closure (nearly 11.5 tonnes) and to the fact that they are critical to the submarine's diving safety. It required perfect coordination over several weeks, with the upper closures being transported to the site two at a time for two months. After unloading and placing the closures on blocks, the team started the refitting operations before beginning the repair phase of about 100 parts for each of the 16 closures.

Once the parts had been reassembled, the teams proceeded with adjustments and functional tests. In total, each of the 16 closures required four weeks of work and involved a team of 12 millwrights and hydraulic engineers to complete the refitting of the 16 closures and the 80 cylinders. ■



THE NUCLEAR-POWERED BALLISTIC MISSILE SUBMARINE
(SSBN), *LE TERRIBLE*.



NANTES-INDRET ALSO WELCOMED 28 AIRBUS EMPLOYEES FOR A PERIOD OF ONE YEAR IN VARIOUS DEPARTMENTS: PRODUCTION, PERFORMANCE, SUPPLY CHAIN ETC. ON 23 NOVEMBER 2021, AT THE NANTES-INDRET SITE, NAVAL GROUP'S TEAMS THANKED THE AIRBUS EMPLOYEES WHO HAD COME TO HELP THEM FOR A YEAR.

INDUSTRIALISTS: SHARING SKILLS

Solidarity among industrialists is a reality, and is the result of voluntary commitment. Naval Group has put this commitment into practice through a one-year loan of employees, allowing 16 expert mechanics from the aeronautical industry to be welcomed to Cherbourg, a site specialising in submarines.

surrounding the nuclear boiler system) of the fourth Barracuda series, the *De Grasse* submarine. The front cofferdam has nine electrical penetrations, which ensure the safety of people thanks to their neutron-absorbing material composition, which absorbs radioactivity and limits radiation from the boiler system. During this experiment, the Naval Group and Airbus employees were also able to share information on their respective operating and management methods: a rich exchange from which each party will benefit in the future.

Positive feedback

Although particularly delicate given the safety requirements inherent to the nuclear environment, the penetrations were successfully assembled. The many parts that make up each penetration were assembled and installed in accordance with the rules of the trade by Naval Group's electricians and Airbus's mechanics, with all the requirements and compliance checks specific to Naval Group. The feedback from Naval Group's teams has been extremely positive, as Airbus's mechanics helped the assembly process run smoothly and were reliable and speedy in their operations. ■

From one industry to another, the skills are similar... and shared. Working together with Naval Group professionals, 16 Airbus mechanics from Nantes have been contributing to Naval Group's submarine assembly and integration site in Cherbourg since 1 March 2021. For the Barracuda program, Airbus mechanics have joined the autonomous rear, front and middle production units alongside the Cherbourg production teams.

Effective collaboration

The skill combination of electricians from the naval defence industry and mechanics from the aeronautical industry made it possible to install many parts of the submarine. In particular, two Airbus mechanics contributed to the assembly of "penetrations" on the front bulkhead of the cofferdam (double bulkhead

The result of a partnership between Naval Group and the Nouvelle-Aquitaine region, supported by a consortium of companies led by Naval Group, the Training Centre 4.0 collaborative project proposes the development and implementation of an innovative training system, particularly for civil and military naval manufacturers.

INNOVATING FOR THE FUTURE OF THE MARITIME INDUSTRY

RENOWNED FOR BEING INNOVATIVE and highly export-oriented, the French naval and nautical industry has achieved many successes throughout the world. On the other hand, it is facing a significant need for manpower and new skills. As such, a joint initiative has been created between a consortium of companies led by Naval Group and the Nouvelle-Aquitaine region, which aims to establish training courses based on new learning methods, including immersive simulation training. These new technologies and ways of learning are gradually being introduced into Naval Group's simulators for its clients. A concrete example: the vessel discovery and facility operation simulators developed for the rMCM mine countermeasures contract for the Belgian and Dutch navies.



SYSTEMS-

TEMS



2021

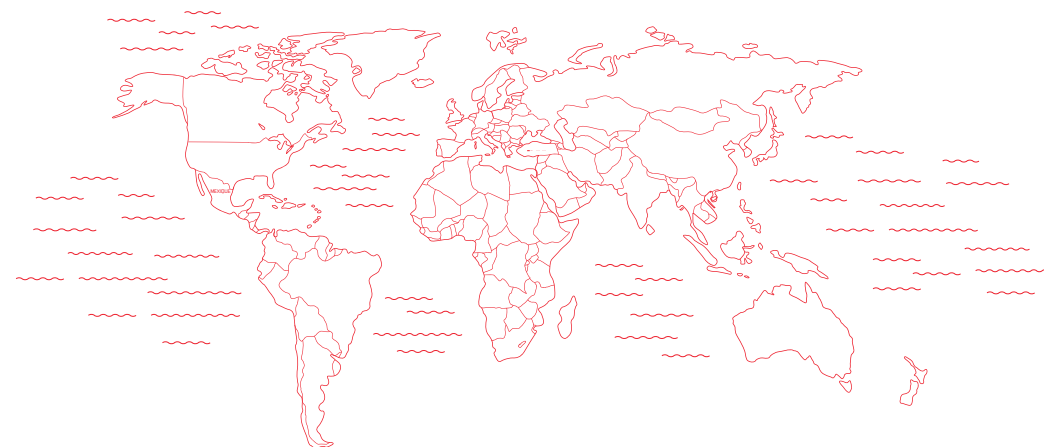
In the naval defence world, technologies are evolving rapidly along with threats, pervading and subtle, leading to new capability requirements. Anticipating the major changes to come, in 2021 Naval Group pursued its strategy as a systems architect and integrator, able to optimise military capabilities and shared features between different systems and vessels, and to incrementally integrate existing and future innovations. The role is in line with the group's ambitions and know-how, as a leader in the design and development of integrated vessel systems and capable of bringing together all of its industrial stakeholders around a structured vision shared with the contracting parties.



YEARS

THIS IS THE DURATION OF THE COMMITMENT MADE BY NAVAL GROUP AND THE FRENCH STATE IN 2020: together, they will merge submarine combat systems by 2034.

SYSTEMS



SYSTEMS AT THE DAWN OF A NEW ERA

An essential component of the group's new construction and services offer in both France and abroad, the systems activity defines and produces, based on the client's needs, the architecture standards for the submarine and surface ship systems that support today's military capabilities, as well as the innovations that will meet future needs.

C



Convergence at all levels

A change in operating methods is under way in navies around the world. Operations are now conducted in a collaborative way among several vessels and in the context of increased interoperability: the ship's combat system is part of a more comprehensive system aimed no longer at defending the individual ship, but the naval force as a whole. More complex but more efficient, and better able to rapidly accommodate future capability and technological developments, the naval force combat system offers modular and coherent solutions while optimising the investments of navies around the world. ▶

Tested and adopted!

The collaborative naval threat detection watch is the first example of a collaborative combat capability within the naval force combat system and the first cross-cutting feature implemented on the Setis 3.0 platform. Successfully tested in 2021, by 2023 it will equip the French Navy's first-rate ships: multimission frigates (FREMM) and frigates for defence and intervention (FDI).

Capability evolutions are developed and incorporated once in a product line and then rolled out as many times as necessary within a naval force, integrating the associated technological innovations throughout the process. Derived from the Barracuda nuclear attack submarine (SSN) combat system, which currently operates the most mature version, Sycobs 3.0 will be rolled out on second-generation nuclear-powered ballistic missile submarines (SSBNs). Successive evolutions will then meet the capability requirements of future third-generation nuclear-powered ballistic missile submarines (3G SSBN), while respecting the deadlines and budgets allocated.



PERSPECTIVE



HIGHER PERFORMING AND LESS ENERGY-INTENSIVE DATA CENTRES

Mathieu Léger-Chiron,
Head of the Architecture and Infrastructure team,
Digital and Information Systems Department (DDSI)

Over a three-year period, Naval Group has been accelerating the modernisation of the data centres on its sites while simplifying the data storage system and server architecture. Although a significant investment is required for this approach, the potential savings are also substantial, as it should result in improved technical performance and a reduced environmental footprint.

"The oldest and most power-hungry equipment is being decommissioned in favour of less energy-consuming, more efficient devices in which we are concentrating our computing power requirements", explains Mathieu Léger-Chiron. "Thanks to virtualisation, a single machine can now house several servers. What's more, we are streamlining and optimising our online data storage requirements. This new equipment also withstands higher operating temperatures in the data centres which will, in turn, enable us to implement air conditioning solutions that consume less energy." The optimisation and streamlining of the data centres will reduce the group's carbon footprint while meeting our needs in terms of digital services and digitalisation.

This is the strategic direction that Naval Group has resolutely adopted with the convergence of its systems and the organisation of its offer in product lines, which are partially common to both surface ships and submarines. The Sycobs 3.0 governance and architecture contract, which defines the convergence stages of the submarine combat systems, is an important recognition of the group's industrial prowess and capacity for innovation. As a result, the French State has entrusted the group with the role of architect-integrator, in charge of bringing all the stakeholders together around a roadmap and shared architecture standards.

Evolving combat systems

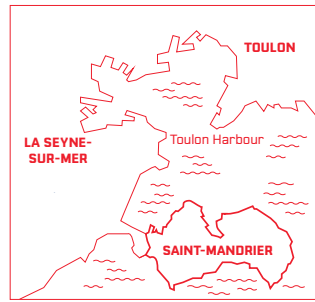
The Sycobs 3.0 combat system for submarines and the Setis 3.0 combat management system for surface ships are developed on the basis of a stable architecture standard, which itself is based on a sufficiently broad functional scope in order to anticipate future capability evolutions and modularity constraints. Each Sycobs 3.0 architecture standard takes into account the different configurations on board the submarines and anticipates the different capability evolutions that will be rolled out during the successive unavailability periods of the vessels.

**Shared engineering**

In 2021, Naval Group achieved several milestones on the path to submarine combat system convergence. The first building blocks of the roadmap have been laid:

- in January 2021, the launch of the development contract for the first version of Sycobs 3.0, with the first roll-out targets being the 2G SSBN *Le Vigilant* and Barracuda #4;
- in February 2021, the first part of the development contract for the 3G SSBNs based on Sycobs 3.0;
- in the summer of 2021, the notification of 2G SSBN *Le Terrible's* predispositions during its current full cycle docking (FCD), to enable it to receive Sycobs 3.0 and its new equipment during a future intermediate maintenance period;

- in October 2021, the French State's approval of the Sycobs 3.0 specification reference system common to 2G SSBNs, Barracudas and 3G SSBNs. This profound transformation, which combines shared engineering and the global governance of combat systems, offers many benefits: cost factorisation, incremental and continuous development of new capabilities and, ultimately, a more homogeneous and efficient global offer at a lower cost. It will also allow the group to improve its attractiveness for exports and to position itself as an architect-integrator of the naval force combat system on the global market. The stakes are high and Naval Group is already on the move. ■



SHORE INTEGRATION FACILITY (SIF) SYSTEMS TESTED AND VALIDATED IN REAL TIME

Systems integrator: an expertise that requires a comprehensive approach to on-board systems and careful attention to each of the components and their interactions, from the pre-project and design studies to the maintenance of the vessel, through both quayside and at-sea tests and the various implementation phases.

Charles de Gaulle to the Horizon and multi-mission frigates (FREMM) – is now home to the work on the frigates for defence and intervention (FDI) program.

A constantly active platform

The site hosts the Shore Integration Facility (SIF), a perfect illustration of the group's role as a systems integrator. The SIF enables the group to de-risk and optimise the integration of several of its systems equipment for all of its first-rate surface ships, whether new or undergoing renovation. Its contribution is fundamental prior to operational commissioning and throughout the integration of the combat system right up to the final on-board tests, as it allows the teams to reduce and control qualification timelines at sea and to ensure that the expected performance is achieved. On the SIF, activity is constant and intense: in 2021, in addition to the first FDI tests, the infrastructures hosted (among others) the tests of the multi-mission frigates with reinforced air-defence capability (FREMM DA).

For the integration tests of the first fully digital FDI frigate, the site has been equipped in a way that is particularly representative of

reality. The Panoramic Sensor Integration Facility (PSIF), located on the cliff, houses a test mast identical to that of future FDI, with its SeaFire® fixed-panel digital radar. An operations centre has been established to replicate 80% of those of the future frigates, and a dedicated space houses the equipment for fighting asymmetric threats. ■

NAVAL GROUP'S TEAMS ARE CARRYING OUT TESTS TO VALIDATE THE PERFORMANCE OF THE COMBAT SYSTEM BEFORE ITS ON-BOARD ROLL-OUT.



THE SHORE INTEGRATION FACILITY (SIF) IN SAINT-MANDRIER.



FOR EGYPT'S GOWIND® CORVETTE PROGRAM, THE PANORAMIC SENSORS AND INTELLIGENCE MODULE (PSIM) INTEGRATED MAST IS BUILT IN LORIENT AND THEN SENT TO THE ALEXANDRIA YARD (EGYPT).

TRANSFER OF TECHNOLOGY INTERNATIONAL SYSTEMS INTEGRATOR

Internationally, the needs of client navies are becoming increasingly diverse: from the implementation of transfer of technology (ToT) projects to the roll-out of expertise and know-how in local yards, the teams work hand-in-hand in the four corners of the world, learning from each other's experiences.

A collective approach for shared know-how

For Egypt's Gowind® corvette program, the Panoramic Sensors and Intelligence Module (PSIM) integrated mast is built in Lorient and then sent to the Alexandria yard in Egypt. Following this phase of the combat system's functional integration on the Lorient integration platform, the tests were finalised in 2021 on board the second vessel of the series built by the Egyptian yard. "This is a great opportunity to be involved in an environment outside of France, an enriching

experience for the team and a new look at our method of working", explains Guillaume Lerda, Functional Integrator who followed all the stages from Lorient to the at-sea trials in Alexandria.

Also in 2021, a major handover took place as part of the Indian P75 Scorpène® conventional submarine program. The combat system software development platform in Ollioules, which has been working on all the hardware and software sub-assemblies of the combat system (CS) and the Combat Management System (CMS) since 2010, has passed the baton to the Services department in Brest, which is now responsible for the in-service operation of the CS platform, with Naval Group India as the front office. The Services team in Brest will provide back-end base support, including fault diagnosis and assessment, equipment monitoring and obsolescence treatment during the life cycle of these conventional submarines. Behind the scenes, the teams of the two departments share the same objectives of excellence in the processing of guarantees and the execution of services; driven by a collective approach, they develop new know-how based on their exchanges.

Advanced technologies in mine countermeasures

Spearheading innovation, the new mine countermeasure systems require advanced skills for their design and implementation, with the use of advanced telecommunications technologies, artificial intelligence for decision-making autonomy and on-board computing on the vessels and drones that make up the systems. Naval Group, which is developing these integrated drone-based solutions for the Belgian-Dutch rMCM program in partnership with ECA Group, is also contributing to the development of European defence capabilities. The group is leading the European consortium that won the MIRICLE project, for the innovation and standardisation of future mine countermeasures, selected in 2021 by the European Commission under the European Defence Industrial Development Programme (EDIDP). ■

SHIPMASTER® THE AUTOMATED CONTROL SYSTEM INTEGRATED IN THE FLOTLOG LOGISTICS FLEET PROGRAM

Designing, building and integrating reliable, high-tech systems for support missions on the high seas: this is the challenge taken on by the Flotlog Logistics Fleet program, a concrete example of the industrial partnership between France and Italy.



THE FIRST UNIT OF THE FLOTLOG PROGRAM WILL BE NAMED AFTER JACQUES CHEVALLIER, A KEY PLAYER IN THE DEVELOPMENT OF THE LE REDOUTABLE-CLASS SSBN.

T

The program includes four replenishment vessels (BRFs) for the French Navy, to be delivered up until 2029, and three sister ships on the Italian side. On the French side, Naval Group is in charge of the design, supply and integration of the platform's combat

and military systems. The BRFs will be equipped with the Shipmaster® automated control system, which is already on board surface ships and submarines for the French Navy – *Charles de Gaulle* aircraft carrier, multimission frigates (FREMM), nuclear attack submarines (SSN) – and in use for exports – projection and command ships (BPC), Scorpène® submarines and Gowind® corvettes. The Shipmaster® version for the Flotlog program takes into account the latest developments in the frigates for defence and intervention (FDI) program.

A Franco-Italian logistics fleet program

Flotlog is a Logistic Support Ship program developed by Naval Group in collaboration with the Italian manufacturer Fincantieri and Chantiers de l'Atlantique, under the aegis of the Organisation for Joint Armament

Cooperation (OCCAr), on behalf of the French Defence Procurement Agency (DGA) and its Italian counterpart, NAVARM. With a refuelling capacity of 13,000 m³, the replenishment vessels have a long-term logistical support mission for the ships of French Navy and the aero-naval group deployed on the high seas, such as aircraft carriers, BPCs, submarines and frigates, which they will supply with fuel, ammunition, spare parts and provisions. ■



THE PERFORMANCE OF THE ALSACE'S COMBAT SYSTEM IS BASED ON EXTENDED RADAR AND COMMUNICATION CAPABILITIES, A NEW RADAR AND ELECTRO-OPTICAL FIRE-CONTROL SYSTEM AND A SETIS® COMBAT MANAGEMENT SYSTEM EQUIPPED WITH SPECIFIC AIR DEFENCE FUNCTIONS.

FREMM ALSACE

WHEN CYBERTECHNOLOGY COMES TO THE HEART OF THE YARD

With this vessel – equipped with exceptional capabilities – Naval Group shows that it is possible to combine the requirements of cyber security with the imperatives of operational continuity and autonomy at sea.

F

From its design and during the different phases of operation, the vessel includes a "base" of cyber systems in its digital systems that guarantee robust protection against threats, while maintaining a normal level of activity on board: detection of anomalies or malicious code, implementation of measures to prevent an attack, alerts and response organisation. Cybersecurity was involved in all aspects of the *Alsace* project, which lasted 30 months with an average of 200 people on board daily. Unprecedented technical and organisational measures were rolled out: software protection, human

training, the installation of an on-board airlock and an advanced Cyber SubSystem (CySS). Good practices that will support future FREMM and Barracuda projects.

An enhanced cyber system

Delivered to Toulon in April 2021, the FREMM *Alsace* is the first of the two multimission frigates with reinforced air-defence capability (FREMM DA) and the seventh in the FREMM series. Heavily armed, it benefits from increased capabilities that ensure the air defence of major units such as the *Charles de Gaulle* aircraft carrier or the amphibious helicopter carriers (PHA). The performance of its combat system is based on extended radar and communication capabilities, a new radar and electro-optical fire-control system and a Setis® Combat Management System equipped with specific air defence functions. It is also equipped with a cyber system enhanced with the latest technological developments and feedback from systems that have already rolled out. ■

With the keel laying taking place in December 2021, the first of five frigates for defence and intervention (FDIs) that will contribute to the French Navy's first-rate fleet ushers in the era of resilient, cyber-secure ships by design, thanks to its capabilities to combat asymmetric threats and its cyber protection system integrated from the very beginning and at every stage of its life cycle.

DETECTING CYBER ATTACKS: THE MISSION OF THE CYMS

THE OPERATIONAL HEART of the cyber strategy of armed vessels, the Cyber Management System (CyMS) detects possible attacks in real time by simultaneously analysing and monitoring the digital exchanges of the vessel's systems. In the event of an anomaly, the CyMS proposes reaction scenarios to the operators who, thanks to simple and intuitive interfaces, have immediate access to the necessary data to adapt the reaction to the situation and thus make the best choice. The CyMS is scalable and updated throughout the vessel's life cycle, and is constantly improved in partnership with the French Navy, in order to better meet the needs and operational constraints of its users.



UNDERWATER WEAPONS



2021

Submarine warfare requires innovative, powerful and intelligent means

At Naval Group, the Underwater Weapons Business Unit, based at the Saint-Tropez and Toulon-Lagoubran sites, has the most advanced expertise in this field. The Artemis program, which aims to equip the French Navy with the next-generation F21 heavyweight torpedo, embodies this technological and technical leadership, which is also being shared with Naval Group's international clients. The Canto® countermeasures range is also highly innovative and embodies Naval Group's in-depth knowledge of the operational needs of navies, whose scope of missions is constantly expanding and which are constantly faced with new, increasingly worrying, rapid and potentially dangerous threats. Naval Group's responses in terms of submarine weapons are in line with these challenges.

An innovative offer

F21 TORPEDO

The latest-generation heavy torpedo for submarines.

MUBO

The best-performing light torpedo in the world, adopted by nine navies and deployable from surface ships and aircraft.

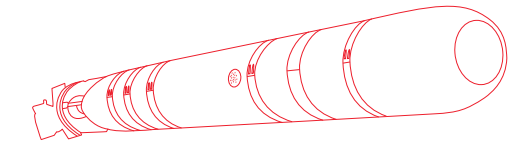
CANTO-V® FOR SURFACE SHIPS AND CANTO-S® FOR SUBMARINES

The countermeasure operating on the principle of confusion/dilution, revolutionary in anti-torpedo warfare for surface ships or submarines.

1000

TORPEDOES

PRODUCED AT THE SAINT-TROPEZ SITE,
AN EXPERT IN SUBMARINE WEAPONS.
The site relies on the expertise of nearly 300 employees,
more than half of whom are engineers.



F21 A REVOLUTION IN TORPEDOES

The Artemis program aims to equip all the French Navy's submarines with the F21 heavyweight torpedo, the most powerful of its generation. Designed and manufactured at the Naval Group site in Saint-Tropez, an expert in the field of submarine weapons, the F21 is meant to destroy or neutralise enemy submarines or surface ships.



It all began in 2008 with the "Future Heavy Torpedo" program, now called Artemis. What was the objective? To equip the 13 French submarines at the time, i.e. four nuclear-powered ballistic missile submarines (SSBN), six next-generation Barracuda-class nuclear attack submarines (SSN), and three Rubis-type SSNs. The aim of the program was to replace the F17, with which the French submarine fleet was equipped, with a next-generation torpedo, which is more agile, faster, more intelligent and has increased operational performance. The F21 began to equip the French fleet operationally in 2020. With its unparalleled range and speed, Naval Group's heavyweight torpedo is designed to operate in deep water, but also in coastal areas that are very noisy and heavy with maritime traffic. With its extremely high

computing power, the F21 has exceptional real-time processing capabilities, and benefits from an advanced mission system and increased autonomy. These technical features greatly expand the possibilities for tactical use, with an unparalleled target discrimination capability, even in very complex environments. These are decisive advantages for navies around the world.

France, Brazil: the F21 is transforming testing

In 2020, after the successful test firing of an F21 heavy torpedo, the SSN *Suffren* definitively became a nuclear attack submarine. This was the demonstration that any test firing requires meticulous preparation

and perfect coordination. While France was the first navy to commit to the Artemis program, the Brazilian Navy is its first export client. The intelligence of the heavyweight torpedo – coupled with its dynamic performance –, integrated tactics and a high level of autonomy make it the forerunner of armed underwater drones. It is not surprising that the Brazilian Navy also chose the F21 to equip its submarines. The *Riachuelo* became the first Brazilian Scorpène® to be equipped with it.

Strengthened collaboration benefiting all parties

The discussions initiated by Naval Group in 2017 led to a win-win model for all

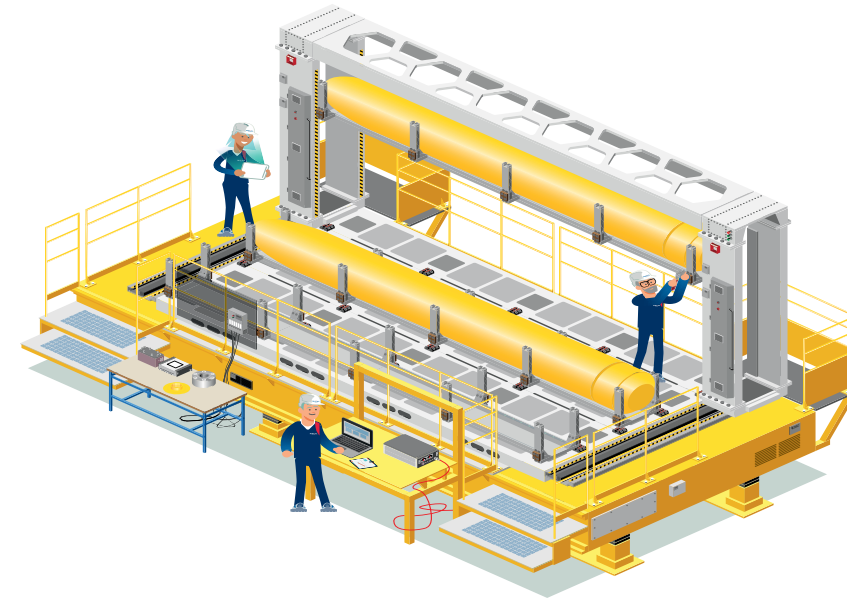
stakeholders in 2021. Based on the incremental model, a framework agreement was concluded between Naval Group and the French Defence Procurement Agency (DGA) as part of the Artemis program. It covers the entire torpedo activity throughout its life cycle, supports production means and provides concrete benefits.

The French Navy will now have an F21 torpedo that remains at the cutting edge of innovation, thanks in particular to continuous feedback from operational employees. The DGA will be better able to anticipate the markets and budgets. And thanks to the incremental approach, the Naval Group site in Saint-Tropez maintains engineering skills that are useful for other activities. Through a long-term view of operational needs, the incremental strategy allows key skills to be maintained, industrial and financial risks to be reduced and contracting phases to be accelerated.

Supporting submarine forces

Located in Toulon, the Underwater Weapons business unit's Lagoubran workshop provides support for submarine weapons on board nuclear attack submarines (SSNs) and nuclear-powered ballistic missile submarines (SSBNs).

A team of 25 employees works on periodic maintenance operations to ensure the availability and reliability of heavyweight combat torpedoes and submarine countermeasures. By also preparing exercise torpedoes and participating in the evaluation of qualification and training firings for crews, the team contributes to maintaining and improving the operational excellence of the French Navy. Close contact with the crews allows the Underwater Weapons Business Unit experts to better understand the operational needs in order to design future weapons. ■



UNDERWATER WEAPONS HANDLING 2.0

Specialising in strategic equipment for combat systems and armed vessel platforms, the Naval Group site at Angoulême-Ruelle also has a strong spirit of innovation. The site houses both the Innov'Factory and an Open Lab. It is thanks to this innovation-driven ecosystem that, in less than three years, a completely new concept of modular weapons handling for submarines emerged.

constrained and every square centimetre is precious, clearly falls into the latter category. In addition to the storage and handling of weapons, this new concept allows for the easy loading and reloading of weapons into the submarine launch tubes.

Its design was carried out in three stages: firstly, the creation of a demonstrator in less than three months in the Open Lab; secondly, the creation of a definition file and the manufacturing of a full-scale prototype to validate the reliability of the concept; thirdly, the performance of qualification tests.

This next-generation handling system developed in Angoulême-Ruelle is revolutionary in its principle alone: in the past, it was necessary to develop large structures specific to the size of each vessel. Now, modular bricks have been developed that can be

adapted to the size of the ship, based on the Lego® principle.

There are multiple benefits to this, starting with the increased space. In concrete terms, whereas the hold was dedicated solely to weapons, the submariner can now dedicate it to other uses, such as installing bunks or a mini-sports room. Weight, costs and installation time have now been halved, as the modular method is standard, easy to use thanks to an optimal and flexible human-machine interface, and perfectly adapted to the multimission capabilities of submarines and, in the future, surface ships. A prime example of ground-breaking innovation, the modular handling method will equip all future Naval Group vessels.

Angoulême-Ruelle: the spirit of innovation

Inaugurated in September 2019, the Innov'Factory in Angoulême-Ruelle accelerates innovation processes, whether they are technical, technological, organisational or methodological. The approach also speeds up the development process, optimises costs and ultimately enables innovation to be integrated more quickly into Naval Group solutions. Thanks to the dual contribution of the Innov'Factory and the Open Lab, this new concept of modular submarine weapon handling was born on the Angoulême-Ruelle site. ■

Innovation is often incremental, and sometimes disruptive. The new modular weapons handling concept on board submarines, in an environment in which movement is



PERSPECTIVE

"SAINT-TROPEZ: A BROADER VISION OF RESPONSIBILITY."

Fanny Fortuna,
Health, Safety at Work and Environment (HS&E)
Manager at the Saint-Tropez site

Every day, the Saint-Tropez site welcomes several dozen professionals in addition to the 300 or so Naval Group employees. In order to reduce the number of accidents involving these subcontractors as much as possible, in 2020 the site launched a process to improve the safety of people and the environment. The initiative is based on a steering committee, which defines the objectives and action plans required to achieve them.

The initial aim was to limit accidents involving subcontractors at the Saint-Tropez site as much as possible. These external employees belong to companies that provide services in the areas of security, logistics or maintenance. In 2020, the Saint-Tropez Health, Safety at Work and Environment (HS&E) team involved four subcontractors in its discussions in order to improve health and safety at work: Défense Environnement Services (maintenance, facility management), Sogeres (catering), Fiducial (security) and IDEA (logistics). "Protecting the employees of our subcontractors, who are exposed to the same risks as Naval Group

employees, is part of our corporate responsibility. This is why we now involve the companies present on site in improving health, safety and the environment", emphasises Fanny Fortuna. In 2021, after the success of the first round launched in 2020, Saint-Tropez requested the participation of intellectual service providers. As such, the site has included five new subcontractors. The steering committee thus created defines the objectives and means. Among the actions proposed and implemented: the training of a rescue/first-aid worker on each team, a display on "dishwashing waste" to illustrate food waste, a daily exercise warm-up and themed rounds for the security workers. These actions were defined in 2021. The result? Zero accidents in 2021 and significant performance in limiting food waste.



BRAZIL THE F21 IS TRANSFORMING TESTING

In 2008, Brazil entrusted Naval Group with a highly ambitious program, the first part of which was the construction of four conventional submarines for the Brazilian Navy, a new shipyard and a naval base. In 2021, Naval Group delivered the first batch of F21 torpedoes to Brazil and successfully completed the test firing of the *Riachuelo*, the first of the four submarines.



B

Brazil is the first export customer of Naval Group to benefit from the exceptional performance of the F21. The intelligent heavyweight torpedo designed at the Saint-Tropez site is equipped, among other things, with an advanced self-guided mode and deep or shallow and confined water capabilities. The test firing of the *Riachuelo*, the first Brazilian Scorpène® submarine to be delivered as part of the first phase of the Prosub (*Programa Submarino*) program, took place on 11 November 2021. The stakes were

high for both the Brazilian Navy and Naval Group. For the Brazilian fleet in particular, the F21 increases the capabilities of the Scorpène® tenfold, as it makes it possible to carry out complex and tactical missions in perfect autonomy.

Meticulous preparation

This stage required many months of preparation, with the on-board teams of the Underwater Weapons business unit, as well as those of the Mission and Combat Systems (MCS) division, in the front line. In a field as complex as naval defence, the convergence and coordination of the most

advanced expertise are the keys to success. A few months earlier, the F21 boarding test – during which the torpedo was boarded and loaded into a tube on the submarine for the very first time – had also been successful. The 11 November test firing represents a new success for the Prosub program, which itself is the result of close cooperation between Naval Group, its subsidiary Itaguaí Construções Navais (ICN) and the Brazilian Navy (Marinha do Brasil).

Prosub, the Franco-Brazilian program

Prosub is an ambitious naval export program with a strong transfer of technology com-

ponent. The *Riachuelo*, the first Brazilian Scorpène®, was successfully built and assembled in Itaguaí, Brazil. The remaining Brazilian Scorpène® submarines will be delivered before 2025. They will all carry Naval Group's next-generation F21 heavyweight torpedo. The collaboration between France and Brazil, which began in 2008, will continue with the second part of Prosub, i.e. Naval Group's support of the design and construction of a new class of submarines in Brazil. ■



THE TEST FIRING OF THE *RIACHUELO*, THE FIRST BRAZILIAN SCORPÈNE® SUBMARINE TO BE DELIVERED AS PART OF THE FIRST PHASE OF THE PROSUB (*PROGRAMA SUBMARINO*) PROGRAM, TOOK PLACE ON 11 NOVEMBER 2021.



THE NAVAL GROUP SITE IN SAINT-TROPEZ, WHICH SPECIALISES IN THE DESIGN AND PRODUCTION OF SUBMARINE WEAPONS, PARTICULARLY PRODUCES THE F21 HEAVYWEIGHT TORPEDO, WHICH WILL EQUIP THE FRENCH NAVY'S SUBMARINES.

ANTI-TORPEDO WARFARE TIME FOR THE NEXT GENERATION

As underwater threats evolve and multiply, so do Naval Group's responses. Innovative and powerful, its new countermeasures provide innovative responses to the broad spectrum of threats faced by armed vessels. Spotlight on the Canto® range.

T

The concept selected by Naval Group for countermeasures is based on the principle of confusion-dilution. The reality of threats calls for innovative responses. Confusion-dilution consists of overloading torpedo analysis capabilities by creating multiple fleeting targets that trigger multiple responses from enemy systems. Confronted with these false targets, the threatened vessel has enough time to move away and get out of range of the threat.

The Underwater Weapons business unit, based at the Saint-Tropez and Toulon-Lagoubran sites, is committed to developing both new effectors and new use concepts. This is the very nature of the Canto® product line, which is structured in three parts: the

Contralto® tactical evasive manoeuvre assist, the Canto® countermeasure and the launcher part.

For Naval Group, there is no question of limiting itself to the protection of submarines. From the very beginning, and using its own funds, the company wanted to develop countermeasures that could be used by all vessels. In addition, the new countermeasures line must adapt to various types of launchers (and therefore standards) used in anti-torpedo and anti-missile warfare. Frigates, corvettes, as well as aircraft carriers and projection ships will therefore also be able to benefit from this line in the same way as submarines, with a choice between two launchers: pneumatic (designed by Naval Group) or pyrotechnic. It is already a huge success in France (Canto® will equip all the French Navy's frigates) as well as in Brazil, Egypt, Saudi Arabia and some Southeast Asian countries.

Canto®: the convergence of expertise

Ten years of R&D have resulted in the ability to provide fleets with the countermeasures they need in the context of heightened threats. Within Naval Group, many entities possessing the most advanced expertise in their respective fields have contributed to the development of the Canto® line. The countermeasures departments, the design office and testing services of Naval Group site in Saint-Tropez, the Angoulême-Ruelle site for the launch tubes, the Programs Department teams, the Combat Systems department and the Services department for physical and functional integration on board, are behind the development of a complete countermeasures offer including the tactical evasive manoeuvre assist, the countermeasure and the launcher. ■

At the end of 2021, the Naval Group site in Saint-Tropez made a presentation to the elected officials of the Sud region on an ambitious program to transform its development processes, called "Engineering of the Future". In response, the elected officials voted in favour of awarding a grant to support the program. This public funding reflects the willingness of regional elected officials to support a major industrial player with cutting-edge expertise operating in a highly competitive environment.

ENGINEERING OF THE FUTURE: THE SUD REGION SUPPORTS THE SAINT-TROPEZ SITE

LAUNCHED IN 2019, the aim of the "Engineering of the Future" program is to meet the expectations of the French Navy and Naval Group's export clients in the field of underwater weapons and underwater combat. It allows the Underwater Weapons Business Unit to meet the best system engineering and digital simulation standards that currently apply to leading manufacturers (mainly missiles, aeronautics and space). In concrete terms, the program aims to improve simulation means by creating a digital twin of the weapons and to develop sub-system qualification tools to ultimately reduce the number of at-sea tests and shorten development time frames.





2021

Surveillance operations, combat, intelligence...

To anticipate developments in the naval defence market, Naval Group works closely with its partners, experts from the French Defence Procurement Agency (DGA) and representatives of the French Navy to provide naval drone system solutions and multi-drone mission management systems that meet their operational needs as closely as possible.

In 2021, several innovations were presented, tested and selected as part of national and European programs and projects: French Navy aerial drone system (SDAM), the oceanic underwater drone demonstrator, the launch and recovery system (LARS) included in the Belgian-Dutch rMCM mine countermeasure program etc. In September, I4@Drones, the mission management and controlled decision-making system integrated into the combat system, was successfully deployed at sea and in a command centre on land as part of the European collaborative project COMPASS* 2020.

* Coordination of Maritime Assets for Persistent and Systematic Surveillance.

AUTONOMY OF

SYSTEMS AND DRONES



FRENCH NAVY AERIAL DRONES
SYSTEM (SDAM)
**THE PROGRAM
IS ACCELERATING**

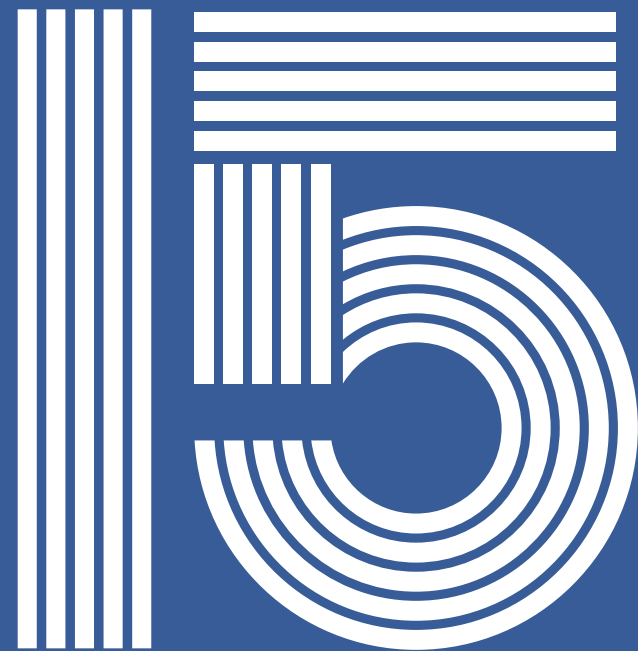
Designed to carry two additional payloads, with an autonomy of ten hours and a range of 100 nautical miles (185 kilometres), the SDAM will be a real pathfinder for spotting, identifying and classifying threats and abnormal behaviour.

capability. Complementary to on-board helicopters, this drone is intended for French Navy vessels with a flight deck. This next-generation helicopter drone represents a real technological breakthrough. It should make it possible to increase the operational effectiveness of naval forces by increasing their control of the tactical situation.

Presenting an operational solution to the client

With Airbus Helicopters in charge of the drones, Naval Group is the project manager responsible for their physical and functional integration with the carrier ship's combat system, along with Safran, Thales and the SME Hélicoptères Guimbal: in four years, the complementary nature of the skills brought together in the program has made it possible to produce a demonstrator of the complete system. After its first autonomous flight in July 2021, the demonstrator is

It all began in 2017 with the notification by the French Defence Procurement Agency (DGA) to the Naval Group and Airbus Helicopters consortium of a technological study contract. What was the objective? Identify, implement, test and derisk the technologies necessary for the integration of a tactical rotary-wing drone system



15
YEARS

OF WORK FOR A DIVERSIFIED OFFER
OF NEW DRONE CAPABILITIES.

continuing its tests. A new objective has been set for 2022 with an at-sea testing campaign on a multimission frigate (FREMM). This will validate the landing and take-off capability of this drone, which weight several hundred kilos.

A second demonstrator close to its final version

The anticipated order for the second SDAM demonstrator, signed on 15 April 2021, and the future XTO contract, which should be signed in 2022, will pave the way from 2024 onwards for a new campaign for the technical and operational testing of the system. Crews will be able to familiarise themselves with this system by using it in real-life situations and over time. Representative of the future SDAM, with all the inherent technological components, this prototype should demonstrate that the system is perfectly reliable, safe and mature. This is a prerequisite for the development and production of the series SDAM drones that will be added to the fleet's range of operational capabilities. The SDAM missions consist of providing support to naval, high-sea and coastal operations, both by day and by night: the detection, recognition, identification, tracking, designation and even engagement of targets, damage assessment, collection of tactical intelligence and communication relays.

SDAMs offer a wide range of technologies: autonomous navigation, automatic take-off and landing, implementation of different payloads, integration with the carrier ship's combat system, secure data link to address cybersecurity issues, and the option of cooperative use along with other vessels in a multi-platform environment. ■



PERSPECTIVE



“TAKING INTO ACCOUNT THE NEEDS OF SAILORS AS EARLY AS POSSIBLE IS ESSENTIAL.”

Leslie Simonneau,
Human Factors (HF) Specialist
at Naval Group

Naval Group's human factors specialists have been involved since the risk assessment contract for the French Navy's naval aerial drones program, supporting the project's partner teams, Airbus Helicopters, and of course sailors throughout the design process. Leslie Simonneau, HF Specialist, takes stock of the situation.

"In any program, taking human factors into account from the very beginning of the design process allows us to optimise the operation of the future system by finding the best compromise between technical constraints and user needs. With the innovations brought about by the SDAM, this is even more true. We worked with sailors to specify their needs as future users in a brand new operational context: organising work in relation to the resources envisioned, sharing space and information with the other operations centre operators, and the human-machine interfaces that would facilitate

the management of payloads and the piloting of drones. This upstream work allowed us to offer them realistic models built on the basis of use cases. Their feedback was utilised in the development of the demonstrator. Taking into account the needs of sailors as early as possible is essential. The sailors are closely involved in this process. They showed us their working environment (drone, consoles, vessel facilities etc.) and our discussions highlighted some key points for the project. Lastly, HF is part of the company's social and environmental responsibility strategy. Contributing to the performance and security of systems requires improving the quality of life of sailors on board by offering them ergonomic and visual improvements."



EUROPEAN COOPERATION AND R&D

The Belgian-Dutch rMCM mine countermeasures program is led by BNR, a Naval Group and ECA Group consortium. It involves many employees from the Naval Group sites in Lorient, Ollioules, Nantes-Indret, Angoulême-Ruelle and Paris. At the end of November 2021, Naval Group and its partners launched the MCM Lab. This collaborative research centre aims to become the European reference centre for mine countermeasure research and development.

LAUNCH AND RECOVERY SYSTEM (LARS) PREPARING FOR FUTURE COMBAT

LARS is an automatic launch and recovery concept developed by Naval Group to operate drones safely in dangerous maritime environments.

B

Because drones are an essential component of future collaborative combat, Naval Group's teams have been working for several years on a global project to physically integrate them in all maritime fields, as organic means for the vessel, and to launch them to level 5 sea states.

As part of these developments, Naval Group offers its clients proven integration solutions via its I4@Drones product line. Today, the innovation programs underway have resulted in a new offer: the implementation and recovery of Unmanned Surface Vehicle (USV) drones by a surface ship.

The LARS solution tested and validated for surface ships

The latest tests carried out as part of the Belgian-Dutch mine countermeasures program (rMCM) have validated the LARS solution. Located on the port and starboard sides of the ship, each LARS consists of a gantry that tilts on the vessel's beam and a large floating cradle that can be used to launch and recover drones of up to 15 metres and 20 tonnes. ■

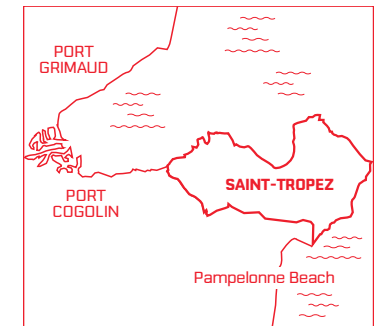


THE OCEANIC UNDERWATER DRONE DEMONSTRATOR

An asset to supplement and rapidly expand the operational capabilities of the French Navy.



DESIGNED AND DEVELOPED WITH ITS OWN FUNDS SINCE 2016, THE OCEANIC UNDERWATER DRONE DEMONSTRATOR IS A PLATFORM TO INTEGRATE UNDERWATER NAVAL TECHNOLOGIES.



U

Underwater threats are evolving, in both number and in technical nature. In fact, this is becoming a major challenge for navies which, in the near future, will need innovative capabilities to maintain their operational upper hand, particularly in the field of underwater warfare. It is in this spirit that Naval Group has initiated a long-term forward-looking approach by developing an oceanic underwater drone demonstrator over the last five years, using its own funds. This Concept Development and Experimentation approach is fully in line with the objectives of the French Navy's Mercator 2030 plan, which identifies the use of technology demonstrators to increase the agility of development processes, acquisition times and quick incremental upgrades.

Innovative simulation platform

The DDO is developed and produced in partnership with Naval Group's innovative ecosystem. This platform is used as part of the French Navy's and the French Defence Procurement Agency's (DGA) programs. It allows technologies and operational concepts to be evaluated in order to iteratively specify the underwater warfare systems of

tomorrow. Among these developments, a major technological and human challenge is the acceptability and trustworthiness of controlled decision-making autonomy (CDA), which will be at the heart of UAV capabilities. Controlled decision-making autonomy is the ability of the UAV to reconfigure its mission and trajectory by itself, according to the evolution of the tactical situation. To achieve this, Naval Group has developed technological building blocks with an on-board artificial intelligence algorithmic core that will orchestrate a set of functions to automatically, efficiently and reliably ensure that the planned mission is carried out while respecting the behavioural rules and limits set by the operator.

Physical prototype

Launched in November 2020, the ten-metre long, ten-tonne prototype already conducted several test campaigns off the coast of Toulon in 2021. An initial fully autonomous intelligence mission is planned for the summer of 2022.

Future missions for the oceanic underwater drone

With an autonomy of several weeks, this oceanic underwater drone demonstrator will be able to conduct missions covering the collection of information under water or on the surface near the coast: sonar data, surface data with imagery, and video. These missions can be expanded to other areas as required. ■

Increased militarisation of maritime spaces, multiple modes of action, the size and variety of threats, uncertainties about their behaviour and their means of detection: the operational environment in which submarines operate is increasingly complex. In order to continue improving the assessment of these threats and to provide naval force command with optimal decision support solutions, at the 2021 Naval Innovation Days Naval Group unveiled an innovative project to define the safest route to successfully rally submarines.

MANOEUVRE ASSIST UNDER MULTIPLE THREATS

FOR RAPID DECISION MAKING BASED ON OBJECTIVE CRITERIA.

Winner of the 2019 La Pérouse Prize – awarded by Naval Group's Scientific Council – the project is the result of work carried out by Naval Group teams in collaboration with the international academic world. A collaboration that has made it possible to overcome certain technical and scientific obstacles in the fields of digital systems and naval acoustics. The new capabilities offered by the A3M algorithm, integrated into the Combat Management System (CMS), make it possible to calculate an optimal route, depending on the submarine's movement conditions, and to propose manoeuvres to the operator via a human-machine interface, along with assessments of the chances and risks.



SUMMARY

SERVICES

08 JANUARY

The nuclear-powered ballistic missile submarine (SSBN) *Le Terrible* returns to the Brest naval base to continue its full cycle docking (FCD). These industrial operations will upgrade the submarine and restore its operational potential for the next ten years.



13

Naval Group equips one of the French Navy's tripartite-class minehunter with an additive manufacturing propeller.

11 FEBRUARY

Naviris and Navantia sign a memorandum of understanding to expand industrial cooperation for the European Patrol Corvette (EPC) program.



19 FEBRUARY



FLORENCE PARLY, MINISTER OF THE ARMED FORCES, ANNOUNCES THE LAUNCH OF THE THIRD GENERATION BALLISTIC MISSILE SUBMARINE (3G SSBN) PROGRAM INTENDED FOR THE FRENCH NAVY.

5 MARCH

Naval Group signs the Women's Empowerment Principles established by the United Nations Global Compact and UN Women, confirming its commitment to the recruitment of women and their professional development within the industry.

10

THE THIRD INDIAN SCORPÈNE® SUBMARINE, INS *KARANJ*, IS ADMITTED TO ACTIVE SERVICE.



30 MARCH



The Minister of the Armed Forces, Florence Parly, inaugurates the design platform for the next-generation aircraft carrier (PA-Ng) in Lorient, bringing together teams from Naval Group, Chantiers de l'Atlantique and TechnicAtome and announces the notification of the preliminary design contract.

On the occasion of this visit, Naval Group receives notification of the order for two additional frigates for defence and intervention (FDI) from the French Defence Procurement Agency (DGA).



14 APRIL

Naval Group delivers ARA *Piedrabuena*, the second offshore patrol vessel for Argentina.

DELIVERY

16

Naval Group delivers the multimission frigate with reinforced air-defence capability (FREMM DA) *Alsace* to the French Navy.

APRIL

THE NUCLEAR ATTACK SUBMARINE (SSN) *SUFFREN* COMPLETES ITS FIRST SCHEDULED MAINTENANCE AT THE TOULON SITE.



10 MAY

The third of the four Argentine OPV 87 offshore patrol vessels ordered by the Argentine Navy from Naval Group, the ARA *Storni* is launched at the Concarneau shipyard in Brittany.

20

Recruitment

In order to maintain skills within the design and production professions, Naval Group is launching a new recruitment campaign for workers. The challenge of the campaign is also to develop diversity and inclusion in order to integrate truly diverse profiles in the company: workers, technicians, engineers, men and women, with a mix of social backgrounds, training, generations, origins, skills and talents, but also a diversity of life paths.



Modernisation

17 JUNE

As part of the modernisation of the Naval Group site in Brest, the new machining vessel, which will form part of the future multi-speciality workshop, was inaugurated in the presence of several authorities from the French Navy.

30



The Board of Directors of *Groupement des industries de construction et activités navales* (GICAN) elects Pierre Éric Pommellet, Chairman and CEO of Naval Group, as its new Chairman.

INNOVATION

21 JULY

MBDA and Naval Group join forces to develop new solutions in the field of remote assistance for the French Navy's fleet of surface ships. The remote assistance service rolled out by Naval Group and MBDA for the French Navy has several objectives: to provide naval systems users with a diagnostic and troubleshooting solution as quickly as possible, wherever and whenever they are.



JULY

After several months of major upgrade work in Toulon, the La Fayette-class frigate *Courbet* was delivered to the French Navy during the summer.

Disassembly

AUGUST

After eighteen months, the disassembly of the former nuclear-powered ballistic missile submarine (SSBN) *L'Indomptable* is completed in Cherbourg.



SYSTEMS

13

As part of the European collaborative project COMPASS2020, the I4@Drones system is rolled out for the first time at sea and in an operational centre on land. The objective is to improve European maritime surveillance.

15



NAVAL GROUP LEARNS OF THE AUSTRALIAN PRIME MINISTER'S POLITICAL AND STRATEGIC DECISION TO BUILD AUSTRALIA'S NUCLEAR SUBMARINE FLEET IN PARTNERSHIP WITH THE UNITED STATES AND

THE UNITED KINGDOM, THEREBY ENDING THE AUSTRALIAN FUTURE SUBMARINE (AFS) PROGRAM.

28

Greece signs a memorandum of understanding with Naval Group and MBDA opening negotiations for the supply of three frigates for defence and intervention (FDI) and their equipment to the Hellenic Navy, with an additional frigate as an option.



SOCIAL DIALOGUE

01 SEPTEMBER

The agreement signed by Naval Group on quality of life at work enters into force. Three other major agreements were signed in 2021 to offer more flexibility to employees wanting to work remotely, to increase their commitment to the group's overall performance and to develop diversity and inclusion within the company.

07-09

On the occasion of its sixth participation in the International Cyber Security Forum (FIC), Naval Group presents its innovations in the cyber field.

05 OCTOBER

The French Defence Procurement Agency (DGA) awards Naval Group the contract for the preliminary and detailed design of the offshore patrol vessel (OPV) program.



07 OCTOBER

For the fifth edition of Naval Innovation Days, Naval Group brings together its State, industrial and academic partners to present its various innovation programs designed to establish the naval superiority of today's navies. In particular, Naval Group presented the oceanic underwater drone demonstrator, a development platform that will allow clients to make agile choices in order to acquire systems that meet their needs precisely.

OCTOBER

REPAIR

The nuclear attack submarine (SSN) *Perle* leaves Cherbourg for Toulon after its repair, to continue its full cycle docking (FCD).

12 OCTOBER

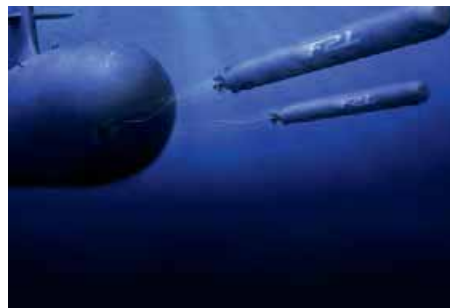


THE PRESIDENT OF THE FRENCH REPUBLIC, EMMANUEL MACRON, PRESENTS THE FRANCE 2030 PLAN, WHICH AIMS TO DEVELOP SMALL MODULAR NUCLEAR REACTORS. THIS IS KEY SUPPORT FOR EDF, TECHNICATOME, NAVAL GROUP AND CEA, WHO ARE WORKING ON A SMALL MODULAR REACTOR (SMR) PROJECT CALLED NUWARD®.

Underwater weapons

11 NOVEMBER

Brazil's first Scorpène® submarine, the *Riachuelo*, successfully launches an F21 exercise torpedo. Brazil thus became the first export client to launch an F21 exercise torpedo, and the *Riachuelo* becomes the first Scorpène® to be equipped with one.



INDUSTRIAL COOPERATION

25 NOVEMBER

Naval Group and its partners launch the MCM Lab, a collaborative research centre dedicated to innovation in mine countermeasures. Coordinated by Naval Group Belgium, the MCM Lab is a major component of the industrial cooperation plan associated with the Belgian-Dutch mine countermeasures program (rMCM) awarded in 2019 to Belgium Naval & Robotics, the consortium composed of Naval Group and ECA Group.



26

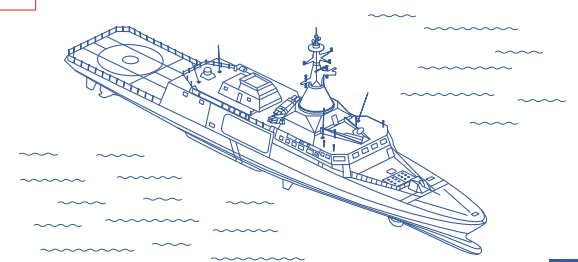
Naval Group celebrates the transfer of the *Duguay-Trouin* nuclear attack submarine (SSN) to the launching system. A key step in the progress of the Barracuda program for the French Navy.

30

Destined for Belgium, the keels of the first of the twelve mine countermeasure vessels of the Belgian-Dutch rMCM program are laid in Concarneau.

4 DECEMBER

THE FIRST OF TWO GOWIND® CORVETTES BUILT BY NAVAL GROUP FOR THE UNITED ARAB EMIRATES NAVY IS SUCCESSFULLY LAUNCHED IN LORIENT.



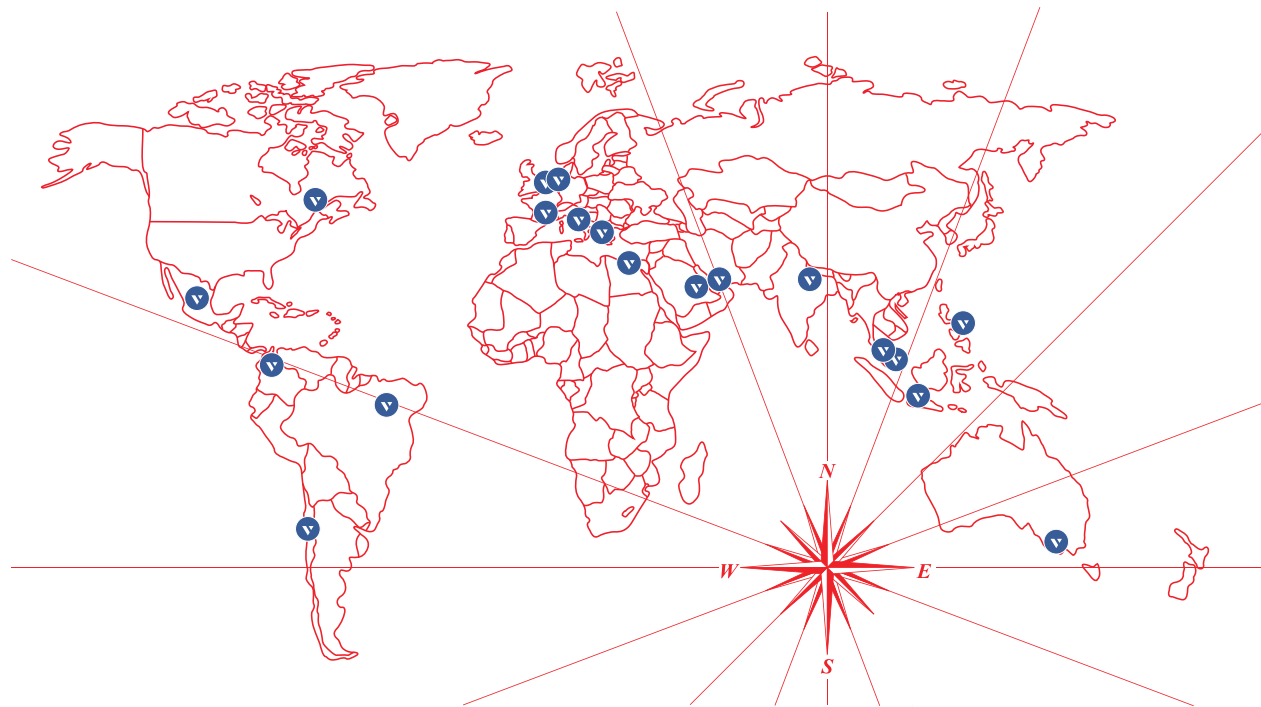
Programs

16

The keels of the first frigate for defence and intervention (FDI) are laid at the Naval Group site in Lorient.



AN INTERNATIONAL GROUP AT THE FOREFRONT OF INNOVATION



SITES IN FRANCE

- ANGOULÊME-RUELLE**
Equipment, simulators and training, control and navigation systems
- BAGNEUX**
Systems
- BREST**
Services
- CHERBOURG**
Submarines
- LORIENT**
Surface vessels
- NANTES**
[Indret, Technocampus Ocean]
Energy/propulsion, R&D, innovation
- OLLIOULES**
Systems
- PARIS**
Headquarters
- SAINT-TROPEZ**
Submarine weapons
- TOULON**
Services



COUNTRIES

- AUSTRALIA / BELGIUM / BRAZIL / CANADA / CHILE / COLOMBIA / EGYPT / FRANCE / GREECE / INDIA / INDONESIA / ITALY / MALAYSIA / MEXICO / NETHERLANDS / PHILIPPINES / SAUDI ARABIA / SINGAPORE / UNITED ARAB EMIRATES



€BN
2021 REVENUE



€BN
FRENCH AND INTERNATIONAL ORDER BOOKS



EMPLOYEES



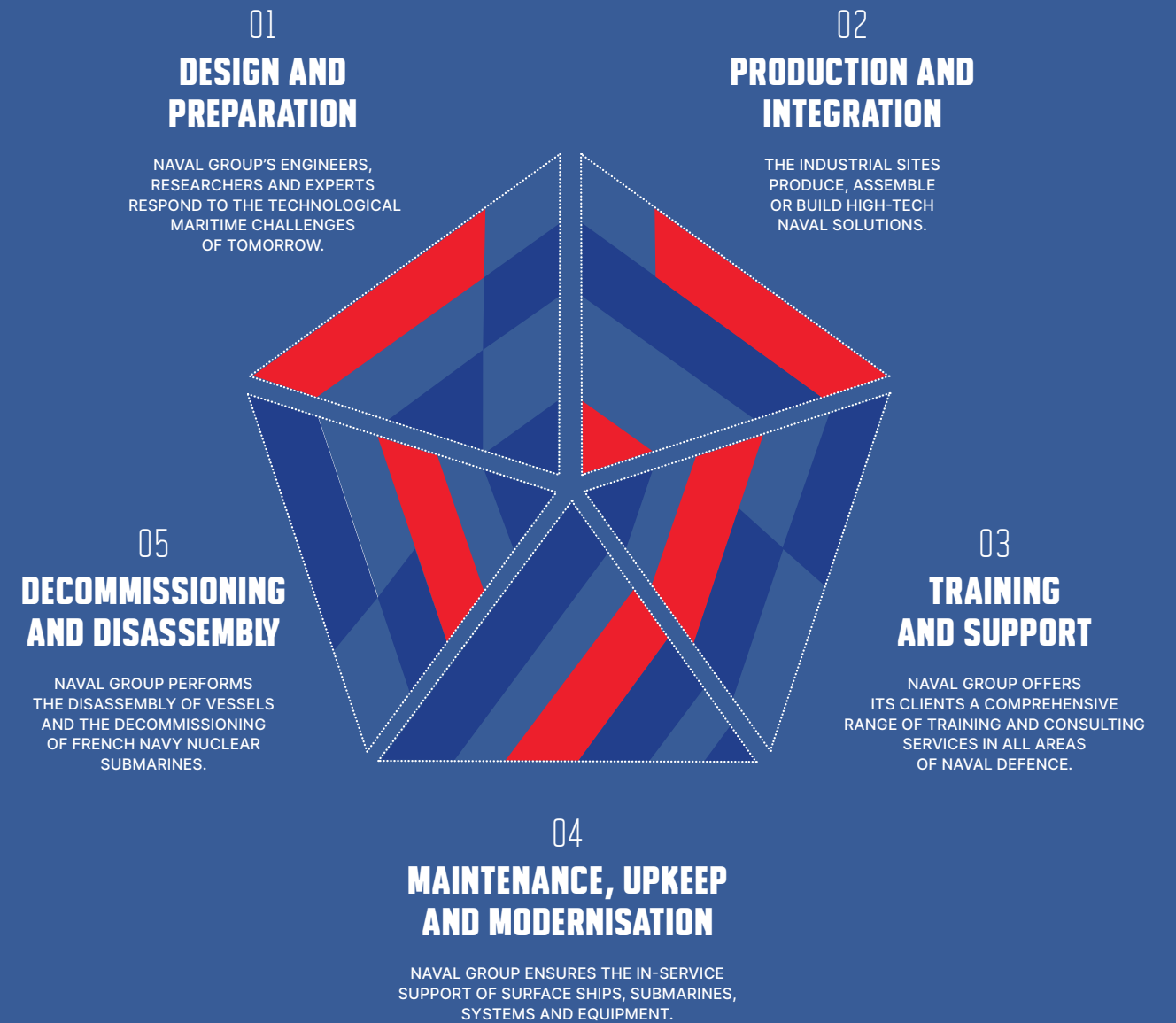
€BN
ORDER INTAKE RECORDED DURING THE 2021 FINANCIAL YEAR

A MAJOR PLAYER IN NAVAL DEFENCE, WITH A UNIQUE MODEL

A

V

As an international player in the naval defence sector and with a rich heritage of French naval expertise, Naval Group partners with various nations in the management of their maritime sovereignty. Naval Group develops innovative solutions to meet its clients' needs. Present throughout the entire vessel life cycle, it designs, builds, integrates, maintains in service and upgrades submarines and surface ships, as well as their systems and equipment, right through to their disassembly and deconstruction. It also provides services for shipyards and naval bases. As a high-tech industrialist, Naval Group relies on its exceptional expertise, unique design and production means and its ability to establish strategic partnerships, particularly through technology transfers. Aware of its corporate social responsibilities, Naval Group is a member of the United Nations Global Compact.



THE MANAGEMENT TEAM

The governance of Naval Group is based on an Executive Committee. Presided over by the Chairman and Chief Executive Officer, the Executive Committee sets the group's objectives and rules on all matters that have a major impact on the group's strategy, its functioning and its commercial and operational activities:



01 **CAROLINE CHANAVAS**
Director of Human Resources

02 **LILIAN BRAYLÉ**
Program Director
Australian Future Submarine (AFS)

03 **FRANK LE REBELLER**
Senior Executive Vice President, Finance

04 **ÉRIC PAPIN**
Executive Vice President for
Technology and Innovation

05 **VINCENT MARTINOT-LAGARDE**
Executive Vice President, Services

06 **GÉRALDINE LE MAIRE**
General Secretary

07 **PIERRE ÉRIC POMMELLET**
Chairman and Chief Executive Officer

08 **CLAIRE ALLANCHE**
Executive Vice President, Communications

09 **LAURENT ESPINASSE**
Executive Vice President, Industry

10 **ALAIN GUILLOU**
Senior Executive Vice President, Development

11 **DAVID QUANCARD**
Executive Vice President for Operations
and Performance

12 **GUILLAUME ROCHARD**
Executive Vice President for Strategy,
Partnerships and Mergers & Acquisitions

13 **OLIVIER DE LA BOURDONNAYE**
Executive Vice President, Programs

14 **JEAN-YVES BATTESTI**
Special Advisor to the Chairman and
Chief Executive Officer

THE GENERAL MANAGEMENT COMMITTEE

The General Management Committee considers all the major strategic, economic, financial or technological policies relating to the company's activity.

As at 1 January 2022, Naval Group's General Management Committee is composed of:

Chairman: Pierre Éric Pommellet.

Administrator appointed by decree as a representative of the State: Vincent Le Biez.

Administrators appointed by the Shareholders' General Meeting: Pierre Éric Pommellet, Patrice Caine, Nathalie Ravilly, Pascal Bouchiat, Bernard Rétat,

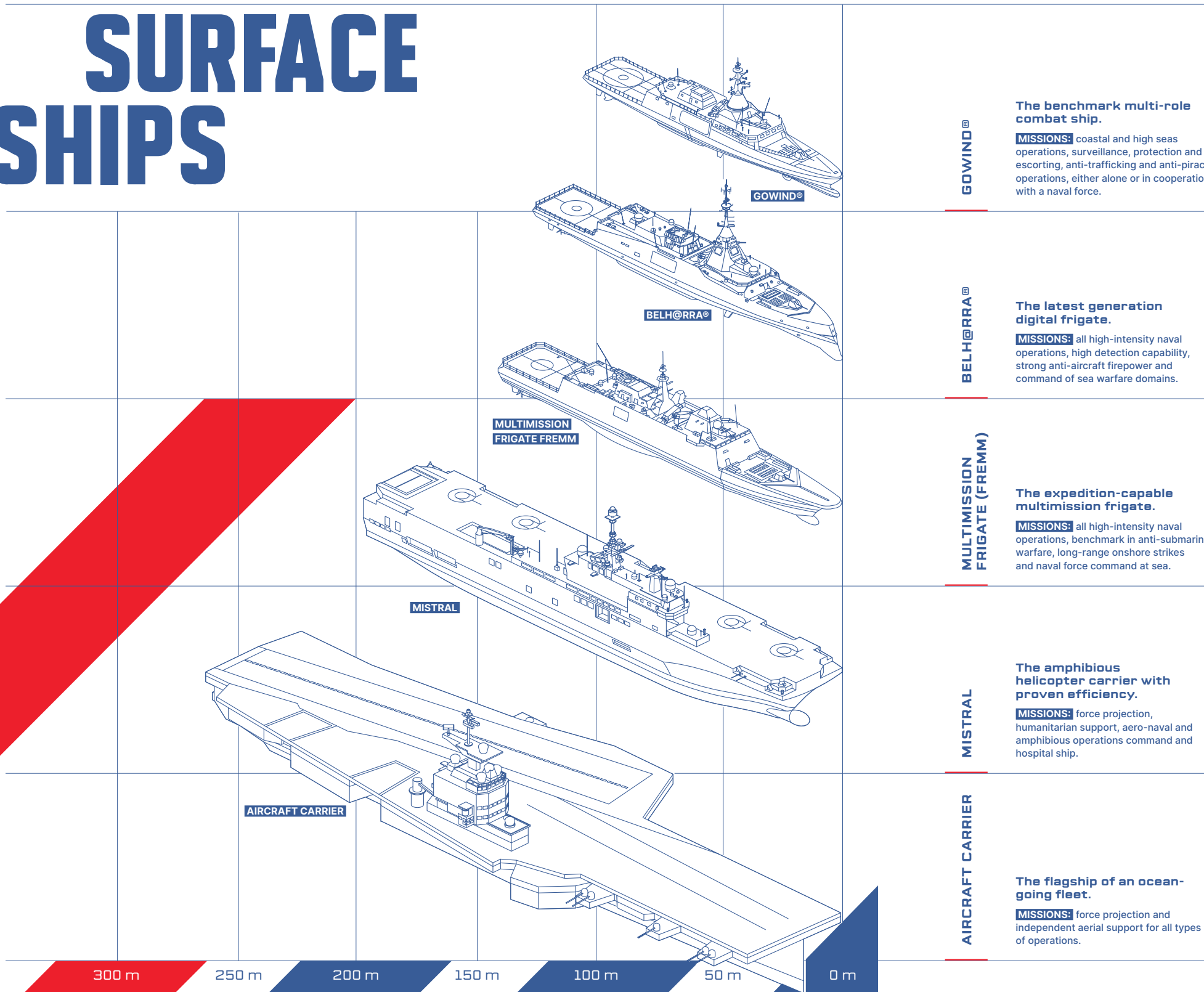
Jacques Hardelay, Valérie Champagne, François Geleznikoff, Guenaëlle Penin de la Raudière, Geneviève Mouillerat, Éveline Spina.

Administrators appointed as staff representatives:

Laurent Chagnas, Didier Chavrier, Tony Lecorps, Olivier Ménard, Béatrice Unia et Yvon Velly.

Censor: Paul Teboul.

SURFACE SHIPS



GOWIND®

The benchmark multi-role combat ship.

MISSIONS: coastal and high seas operations, surveillance, protection and escorting, anti-trafficking and anti-piracy operations, either alone or in cooperation with a naval force.

BELHORRA®

The latest generation digital frigate.

MISSIONS: all high-intensity naval operations, high detection capability, strong anti-aircraft firepower and command of sea warfare domains.

MULTIMISSION FRIGATE FREMM

MULTIMISSION FRIGATE (FREMM)

The expedition-capable multimiission frigate.

MISSIONS: all high-intensity naval operations, benchmark in anti-submarine warfare, long-range onshore strikes and naval force command at sea.

MISTRAL

MISTRAL

The amphibious helicopter carrier with proven efficiency.

MISSIONS: force projection, humanitarian support, aero-naval and amphibious operations command and hospital ship.

AIRCRAFT CARRIER

AIRCRAFT CARRIER

The flagship of an ocean-going fleet.

MISSIONS: force projection and independent aerial support for all types of operations.

PLATFORM SYSTEMS AND EQUIPMENT

A full range of systems designed to ensure the security and control of surface ships and submarines in combat.

SHIPMASTER®
The automated control system for surface ships.

SYLVER®
Vertical missile launch systems.

SAMAHÉ®
An efficient system for handling heavy on-board helicopters in rough seas.

INTEGRATED CONTROL AND PLATFORM MANAGEMENT SYSTEMS FOR SUBMARINES
Integrated control systems ensuring centralised and particularly safe operation of submarines.

TORPEDO LAUNCHING FACILITIES
For submarines and warships.

ON-BOARD MISSION AND COMBAT SYSTEMS

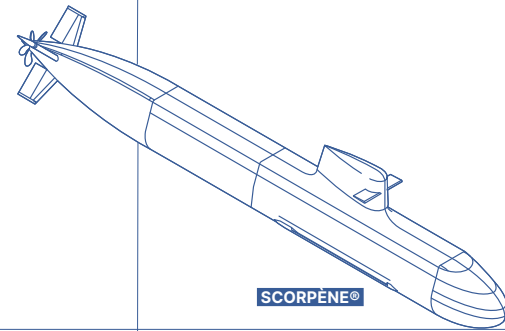
SETIS®
The combat system for warships in high-intensity naval operations.

POLARIS®
The on-board maritime security and surveillance system.

SUBTICS®
An integrated combat system for submarines that is powerful, highly automated and scalable.

I4®DRONES
The management system for unmanned operations.

SUB-MARINES

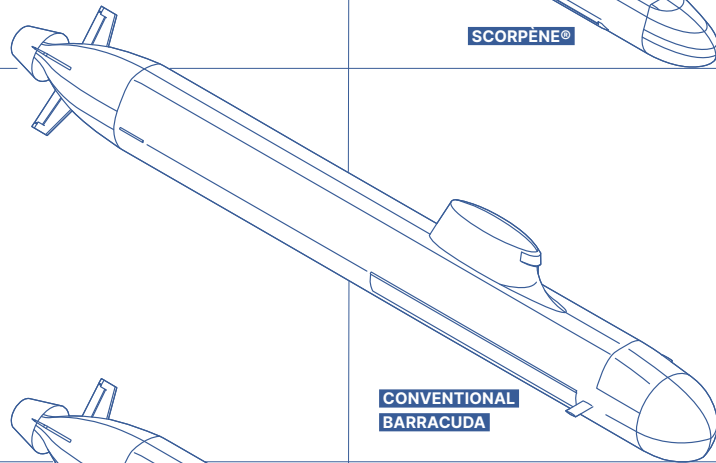


SCORPÈNE®

SCORPÈNE®

The international benchmark for conventional submarines. Discreet and enduring.

MISSIONS: warfare against surface ships and submarines, information gathering and special operations.

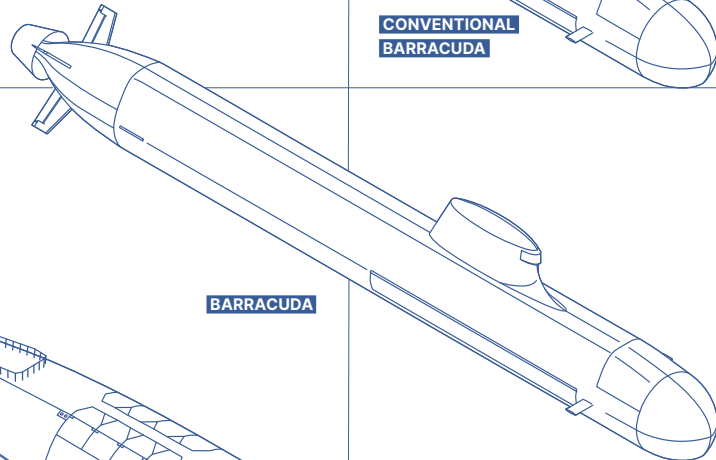


CONVENTIONAL BARRACUDA

CONVENTIONAL BARRACUDA

An extremely quiet, powerful and versatile submarine that can be deployed on distant and lengthy operations.

MISSIONS: all areas of warfare, high weapons carrying capacity, various means of action for special forces, on-shore strikes.

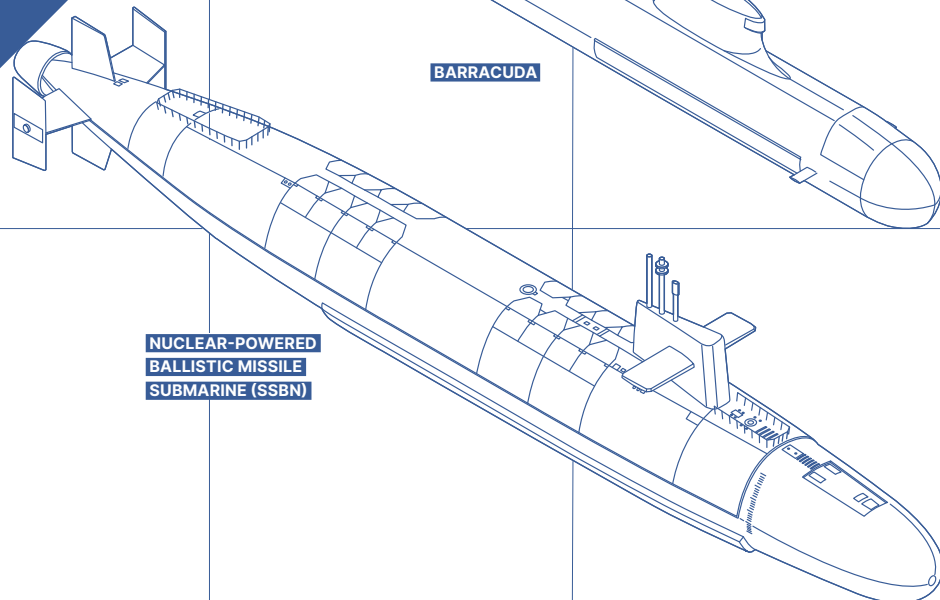


BARRACUDA

BARRACUDA

A nuclear stealth attack submarine that is particularly mobile and has great endurance.

MISSIONS: all areas of warfare, dissuasion support, long-range strikes, wide-area surveillance, deployment with an aero-naval force and coalition deployment.



NUCLEAR-POWERED BALLISTIC MISSILE SUBMARINE (SSBN)

NUCLEAR-POWERED BALLISTIC MISSILE SUBMARINE (SSBN)

The best performance for nuclear dissuasion. Invulnerable because undetectable.

MISSIONS: nuclear dissuasion and ultimate protection of France's vital interests.

150 m

100 m

50 m

0 m

SERVICES

A range of bespoke services to ensure the operational availability of surface vessels and submarines.

EDUCATION AND TRAINING

A complete range of education and training solutions for crews and maintenance and industry personnel.

MAINTENANCE, LOGISTICS SUPPORT AND MODERNISATION

Solutions for in-service support (ISS) and for modernisation adapted to all types of ships and all navies.

NAVAL INFRASTRUCTURES

Rare skills for infrastructure upgrades, complete program management for new infrastructures and the operation and maintenance of naval infrastructures.

UNDERWATER WEAPONS

F21 TORPEDO

The latest-generation heavy torpedo for submarines.

MU90

The best-performing light torpedo in the world, adopted by nine navies and deployable from surface ships and aircraft.

CANTO-V® FOR SURFACE SHIPS AND CANTO-S® FOR SUBMARINES

The countermeasure operating on the principle of confusion/dilution, revolutionary in anti-torpedo warfare for surface ships or submarines.

OUR COMMITMENTS

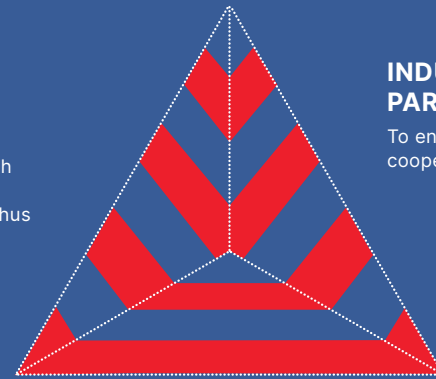
Both in France and internationally, Naval Group wishes to advance its social approach in a collaborative and collective way with all stakeholders affected. Here are our commitments to each of them.

EMPLOYEES

To give meaning to their tasks, to provide them with the keys to develop and commit themselves, and thus actively contribute to the company's performance

INDUSTRIAL PARTNERS

To engage in win-win cooperation



SHAREHOLDERS

To carry out the missions entrusted to us by relying on their support and expertise

PUBLIC AUTHORITIES, INSTITUTIONS, REGIONS

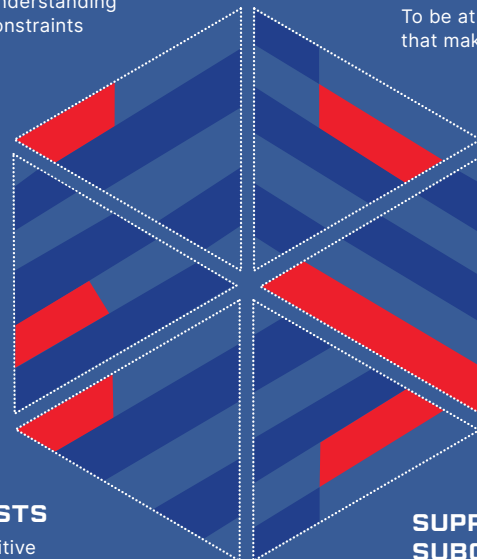
To involve them in decision-making by understanding their local constraints

CHANNELS FOR EXCELLENCE AND INNOVATION

To be at the forefront of technologies that make a difference

CLIENTS (FRANCE AND INTERNATIONAL)

To create a favourable environment to meet their expectations



SCHOOLS, UNIVERSITIES

To ensure the expertise of current and future generations

MEDIA, JOURNALISTS

To create a positive dynamic of outreach and influence

SUPPLIERS AND SUBCONTRACTORS

To unite them around shared growth objectives

As an international player in the naval defence sector and with a rich heritage of French naval expertise, Naval Group partners with various nations in the management of their maritime sovereignty.

Naval Group develops innovative solutions to meet its clients' needs. Present throughout the entire vessel life cycle, it designs, builds, integrates, maintains in service and upgrades submarines and surface ships, as well as their systems and equipment, right through to their disassembly and deconstruction. It also provides services for shipyards and naval bases.

As a high-tech industrialist, Naval Group relies on its exceptional expertise, unique design and production means and its ability to establish strategic partnerships, particularly through technology transfers.

Aware of its corporate social responsibilities, Naval Group is a member of the United Nations Global Compact.



For more information:

NAVAL-GROUP.COM

