

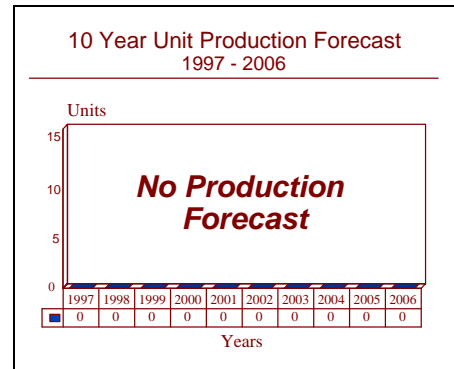
ARCHIVED REPORT

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Amethyste Class - Archived 3/98

Outlook

- Further evolution of Rubis class nuclear attack subs
- Program complete; last two ships of class canceled
- Third class of fast-attack submarines still being developed
- May become a joint project with Britain



Orientation

Description. Nuclear-powered fast attack submarine.

Cherbourg Naval Dockyard
 Cherbourg
 France

Sponsor

Délégation Générale pour l'Armement
 10/14, Rue Saint Dominique
 F-75997 Paris Armées
 France
 Tel: +31 1 42194555

Licensee. No production licenses have been granted.

Status. In service (see table below)

Total Produced. Four submarines of the class were ordered; two of these have been canceled.

Contractor

DCN International
 19 -21, Rue du Colonel Pierre Avia
 B.P. 532
 F-75015 Paris
 France
 Tel: +33 (0) 1 41087171
 Fax: +33 (0) 1 41080027
 Telex: 631 697 f

Pennant List

<u>Name</u>	<u>Builder</u>	<u>Ordered</u>	<u>Commissioned</u>
S605 <i>Améthyste</i>	Cherbourg	10/1984	3/1992
S606 <i>Perle</i>	Cherbourg	10/1984	7/1993
S607 <i>Turquoise</i>	Cherbourg	4/1990	Canceled 6/1992
S608 <i>Diamant</i>	Cherbourg	1989	Canceled 9/1991

Application. The location, classification and destruction of hostile submarines, the protection of French Navy

ballistic missile submarines, and the destruction of hostile surface forces.

Price Range. Between US\$655 and US\$665 million in 1990.

Technical Data

Characteristics

<i>Speed:</i>	25 knots
<i>Maximum safe depth:</i>	300 m (1,000 ft)
<i>Endurance:</i>	60 days
<i>Crew:</i>	8 officers, 58 enlisted (2 crews)

Dimensions

	<u>Metric</u>	<u>US</u>
<i>Length:</i>	73.6 m	241.5 ft
<i>Beam:</i>	7.6 m	24.9 ft
<i>Draft:</i>	6.4 m	21.0 ft
<i>Displacement, surfaced:</i>		2,400 tons
<i>Displacement, submerged:</i>		2,660 tons

Armament

	<u>Type</u>	<u>Quantity</u>
<i>Torpedo tubes:</i>	21 in	4
<i>Torpedoes:</i>	F17 Mod 2 and L5 Mod 3	14
<i>Missiles:</i>	SM 39 Exocet	4
<i>Mines:</i>	FG 29 mines	

Electronics

	<u>Type</u>	<u>Quantity</u>
<i>Sonars:</i>		
<i>Passive towed array:</i>	DSUV 62C	1
<i>Passive bow-mounted:</i>	DSUV 22	1
<i>Active hull mounted:</i>	DSUA 2B	1
<i>Flank arrays:</i>	DUUX 5	1
<i>Radar:</i>		
<i>Navigational System:</i>	DRUA 33	1
<i>Electronic warfare:</i>		
<i>ESM:</i>	ARBR-13 (DR-3000)	1
<i>Command and Control:</i>	SADE	1
<i>Periscope:</i>	Sagem	

Propulsion

	<u>Type</u>	<u>Quantity</u>
<i>Main Propulsion:</i>		
<i>Nuclear reactor:</i>	CAS-48	1
<i>Turboalternators:</i>	3,150 kW	2
<i>Propeller:</i>	7 blade, fixed pitch	1
<i>Emergency diesel:</i>	200 kW	1
<i>Electrical power:</i>	850 kW alternator	2

Design Features. Améthyste is an acronym for "Amélioration Tactique Hydrodynamique Silence Transmission Ecoute," or, Reduced Radiated Noise Transmission. The Rubis class submarines, from which the Améthyste was developed, are much smaller than any other nuclear submarines in commission, except for the US Navy's NR-1 research submarine. Many of the sensor and weapons systems are similar to those installed in Agosta class diesel-electric submarines.

The Améthyste class has an integrated multi-function hull-mounted sonar, including a bow-mounted

active/passive unit, two sets of passive hydrophone arrays along the port and starboard sides of the sub, and a passive warning system. This class also has the DSUV-62C passive towed array, and the DRUA-33 radar unit, for navigation, which can be operated when the submarine is at periscope depth.

The nuclear reactor is a 48 MW pressurized water system. It powers two turbo alternators, which in turn drive a single propeller through the electric motor. A Jeumont-Schneider diesel engine provides emergency

power. The hull is constructed of HLES-80 (HY-80) steel giving it a maximum safe depth of 300 meters.

Operational Characteristics. The Rubis/Améthyste class has four 21-inch torpedo tubes with a loadout of up to 14 torpedoes. These can include the L5 Mod 3, F17, F17 Mod 2. The F17 is an anti-surface/anti-submarine weapon, with a range of 10 nm. The F17 mod 2 is primarily for anti-submarine missions and has an improved guidance system with a 15 nm range. The Rubis class also carries the SM-39 sub-launched Exocet missile, which has a range of 40 nautical miles and can be carried instead of torpedoes. The submarines also can carry mines on a replacement basis of two mines for one torpedo.

The command and control system is the SADE. The torpedo fire control system is a DLT D3, which uses the

CIMSA 15M125 computer with a monitoring and control display console. The computer receives data from all the submarine's sensors, tracking and providing data on eight targets. It can simultaneously control two wire-guided torpedoes and give preliminary launching instruction to a third torpedo. The monitoring and display console allows the operators to view the tactical situation and weapon control status, including torpedo firing paths and an alphanumeric display.

The periscope is made by Sagem and is an optronic unit with an infrared imager, for use at night or in low visibility. It also has a built-in vertical gyroscope, so the line of sight is undisturbed by mast vibration or wave action. A camera or electro-optic viewer and a stadiometer or laser rangefinder can be fitted as accessories.

Variants/Upgrades

The last two submarines of the class, the *FS Turquoise* and the *FS Diamant*, would have been slightly larger, displacing 2,590 tons. No other information had been released about these two submarines prior to their cancellation.

In response to a 1987 Canadian requirement, France offered a derivative of the Améthyste design. The modified design would be 80 meters (261 feet) in length and have a surface displacement of 2,590 tons. It would be able to dive to 350 meters (1,150 feet) and have six torpedo tubes. That submarine would carry 22 torpedoes, as opposed to the four tubes and 14 torpedoes of the Améthyste class. The submarine would have an endurance of 70 days. The modified design would also have a strengthened sail and a spike on the periscope for breaking through 1 m (39 in) of ice.

Améthyste Diesel. A development of the Améthyste in which the nuclear power plant has been replaced by a diesel-electric system. The torpedo tube battery is increased to six tubes with stowage for 22 weapons. Maximum speed underwater is 23 knots (sustainable for five minutes) with a speed of 21 knots sustainable for 1 hour. Maximum underwater endurance is 400 nm at 4 knots.

Améthyste Anaérobie. A further development of the Améthyste Diesel to incorporate the MESMA air-independent propulsion system produced by Bertin. Underwater endurance is increased to 800 nm at 4 knots.

Program Review

Background. Prior to 1982, French nuclear-powered submarine emphasis had been on the construction of ballistic missile submarines. Escorting these boats into and out of harbor was a task allocated to the diesel-electric hunter-killers of the Daphne and Agosta classes. The first French nuclear-powered hunter-killers, the Rubis class, were tasked primarily with attacks on surface ships and were heavily optimized for that role.

The requirement issued to the design team was to produce a small nuclear-powered submarine, which would use the basic hull design of the Agosta class diesel-electric submarines. This required the development of a small, compact powerplant. Since the submarines were to be tasked with ASuW operations,

the extreme quieting measures featured in British and American submarine designs were not considered necessary.

Initial operating experience with the Rubis class quickly revealed that the design options chosen had not been entirely satisfactory. The forward hull lines generated excessive flow noise, although this factor was not critical except when the submarine was moving at high speed. The machinery installation was also excessively noisy. Some accounts indicate that the Rubis class actually exceeded the noise levels of the Russian Alpha-II (Project 705K) class. These factors severely limited the operational efficiency of the Rubis class and effectively prevented it from undertaking ASW

functions (for which it had not been intended). However, the Rubis class was capable of carrying out its designed anti-ship mission and displayed substantial performance advantages over diesel-electric designs.

In response to a change in tactical environment which had laid greater stress on the anti-submarine role, the French Navy began the Améthyste (AMElioration Tactique HYdrodynamique Silence Transmission Ecoute) program. This program started in 1982 with the intention of developing an effective ASW derivative of the Rubis class. Some hopes were expressed that the Rubis class submarines could be upgraded to the standards of the Améthyste class, giving them a greater antisubmarine warfare capability. As experienced nuclear submarine design teams predicted at the time, these hopes were quickly revealed as futile.

Most of the electronic systems aboard the Améthyste class, including the sonars, the command and control, and the fire control systems, were upgraded versions of those aboard the Rubis class. The hull lines forward were modified to reduce (though not eliminate) the flow noise problems. The machinery plant was redesigned to incorporate some measure of silencing technology, including rafting the main components. The cramped design of the hull severely limited the applicability of this technology.

A total of four submarines of this new class were ordered. The first two submarines were ordered in October 1984. In July 1985, the French government announced its intention to build two more submarines, with anticipated commissioning dates of 1994 and 1996, respectively. The first submarine of the new group was named *FS Améthyste*, a traditional French submarine name which also reflected the silencing program.

In June 1987, Canada issued a White Paper detailing a program to acquire 8 to 12 nuclear-powered submarines. The two contenders for this requirement were the British Trafalgar design and the French Améthyste class. Canada canceled the program for a nuclear submarine force in April 1989.

The *FS Améthyste* was commissioned in December 1991 and the *FS Perle* commissioning followed in 1993. However, in 1991 the French Government announced that the construction of the fourth member of the class would be indefinitely suspended. This announcement was followed in 1992 by the formal cancellation of the fourth member of the class and the

indefinite suspension of the third ship. This too has now been canceled.

In 1989 the French Navy began upgrading the electronics aboard the first four Rubis class submarines to the same standard as the Améthyste class. This upgrade program took 18 months for each submarine and lasted through 1994.

During the last quarter of 1992, negotiations commenced between Taiwan and the French Government for the purchase of Rubis class nuclear-powered attack submarines from France. Unofficial reports suggest that the deal, worth US\$4 billion, involved the acquisition of two submarines together with their weapons and the necessary support facilities. These discussions faded away without reaching any conclusion.

At this time, two new variants of the Améthyste design were announced. These were a diesel-electric derivative of the nuclear-powered Améthyste and an AIP enhancement to that diesel-electric derivative. These designs are complementary to the smaller Scorpene design now being developed by DCN in parallel with the Spanish Navy.

During 1994 and 1995 there were a series of minor accidents involving Améthyste class submarines, and one major incident that resulted in nine crewmembers losing their lives. These raised questions about the operational safety of this design. These incidents may have added impetus to plans for the design of a new replacement SSN. Originally, work on a new SSN (designated the SNA-NG or Sous-Marins Nucleaires d'Attaque Nouvelle Generation) was scheduled to start in 1997 for a production order in 2001-2002. This has now been brought forward to the 1995-2000 period. The official reason is that the truncation of the Le Triomphant class SSBN program has caused a shortfall in work at the nuclear submarine building facilities.

The new submarines are estimated to be 70 m long, displace 6,000 tonnes, have much-improved silencing and a deeper diving depth resulting from the use of HY-130 equivalent steel. They will have more advanced sensors and vertical launch tubes for cruise missiles. Their cost is estimated at US\$960 million per hull. The length figure provided does not correspond to the tonnage or other details and is probably an error (a length of 90 to 100 meters would be more realistic). This new design will eliminate any possibility of restarting Améthyste class production.

Funding

This program is funded by Delegation Generale pour l'Armement for the French Navy.

Recent Contracts

No contractual information has been released publicly.

Timetable

	1984	French Navy decided to build four submarines to advanced design
Oct	1984	First two submarines of the Amethyst class ordered
	1984	Keel for <i>FS Améthyste</i> laid
Mar	1986	Funding for third submarine approved
	1987	Keel for second submarine laid
	1989	Funding approved for the fourth submarine Announcement that all submarines would be delayed 18 months
Dec	1991	<i>FS Améthyste</i> commissioned
	1992	Second pair of hulls canceled
	1995	Work on follow-on design funded

Worldwide Distribution

France (2 ships in service)

Forecast Rationale

The Rubis class represented the first class of nuclear submarine to be designed for the export market. As such it was severely compromised. In order to depress unit costs to a level acceptable for that market, the hull size was kept down to a minimum. In effect, the hull design team used the basic hull of the Agosta class diesel-electric submarines and faced an extremely difficult challenge in installing all the necessary components of a nuclear power plant in the existing hull lines. The result showed excessive noise generation characteristics. In order to comply with nuclear proliferation restrictions, the reactor system had to use nuclear fuel (Caramel) with a low level of enrichment, as opposed to the weapons-grade Oralloid used in other nuclear-powered submarines, resulting in a much lower power density generation. Coupled with the limited space available in the small hull, the inevitable effect was a relatively slow submarine with a noisy power plant that required refueling at frequent intervals.

There is no doubt, however, that for all its well-publicized limitations, the Rubis class represented a major capability advance over the diesel-electric designs that had preceded it. It was also an effective performer in its anti-ship role. The Améthyste class represented an attempt to extend the capabilities of the basic design to provide adequate efficiency in the ASW role. However, little scope for improvement was

available without entailing a completely new design. Incremental improvements were achieved in some areas, but the Améthyste class remains a mediocre performer, and procurement was curtailed after the first two hulls. The effect of this is to substantially increase the cost of the two remaining hulls, since R&D expenditure must now be attributed to two boats rather than four.

The two non-nuclear derivatives of the Améthyste design may prove to be more attractive propositions. The adoption of an AIP power plant within the hull of the Améthyste class provides a top-line diesel-electric submarine. It should have substantially larger weapons capacity and greater endurance than the smaller Scorpene class, while sound levels will be drastically reduced. These two types may well be of considerable interest to countries in the Pacific region where long range and good endurance are essential.

French acquisition of the Améthyste class has been curtailed with two units built. The likely scenario is that the French design teams will go back to basics and design a nuclear-powered hunter-killer along more conventional lines. This has the virtue of delaying any orders until after the current financial crisis. The Rubis/Améthyste attempt to build a very small nuclear-powered hunter-killer submarine will be written off as an interesting design concept, which could not be

achieved using available technology. This report will be dropped next year and replaced by one covering the new SNA-NG.

Ten-Year Outlook

No production is forecast

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