

ARCHIVED REPORT

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Agosta-90B

Outlook

- Last Pakistani Agosta-90B commissioned in September 2008
- Pakistan Navy has opted for Type 214 as its next submarine
- No other sales prospects
- Agosta-90B no longer being promoted on the market
- Future sales efforts are concentrating on Scorpene

Orientation

Description. Diesel-electric patrol/attack submarine (SSK).

Status. In service.

Total Produced. Three completed.

Sponsor

Direction des Construction Navales (DCN) International
10 Rue Sextius Michel
F-75015 Paris
France
Tel: + 33 1 4059 5000
Fax: + 33 1 4059 5408

Pennant List

<u>Name</u>	<u>Builder</u>	<u>Launch Date</u>	<u>Commission Date</u>
S-137 <i>Khalid</i>	DCN, Cherbourg (France)	8/8/1998	9/13/1999
S-138 <i>Saad</i>	DCN, Cherbourg/Karachi DY	8/2002	12/12/2003
S-139 <i>Hamza</i>	Karachi Dockyard	9/2006	9/2008

Mission. Anti-submarine and anti-surface ship warfare, special operations and intelligence gathering.

Price Range. Based on the publicized contract value, the price of a single unit is roughly \$320 million.

Contractors

Prime

DCNS

<http://www.dcn.fr>, 2, rue Sextius Michel, Paris, 75732 France, Tel: + 33 1 40 59 50 00, Fax: + 33 1 40 59 56 48, Email: info@dcn.fr, Prime

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Thales Naval France	http://www.thalesgroup.com/naval , 7-9 rue des Mathurins, Bagneux, 92221 France, Tel: + 33 40 84 20 00, Fax: + 33 40 84 2915, Second Prime
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Subcontractor

Bainbridge International	8, Flanders Park, Hedge End, Southampton, SO30 2FZ Hampshire, United Kingdom (Flame Retardant Protection Systems)
Calzoni Srl	http://www.calzonispa.com , Via Bargellino 25/A, Calderara di Reno, Bologna, 40012 Italy, Tel: + 39 0514 1377, Fax: + 39 0514 1375 55, Email: calzoni@calzonispa.com (Hoistable Masts)
Compagnie Deutsch	http://www.compagnie-deutsch.com , 65 ave de Colmar, Rueil-Malmaison, 92507 Cedex, France, Tel: + 33 155472550 (Cable Assemblies)
EPCOTS	http://www.epcots.fr/anglais/index.html , 66 Impasse Branly, Zone Industrielle BP99, Toulon, 83079 France, Tel: + 33 498 080000, Fax: + 33 498 080008 (Sound Isolation)
Eurotorp	http://www.eurotorp.com , 525 route des Dolines, Sophia Antipolis, 06903 France, Tel: + 33 4 92 96 38 50, Fax: + 33 4 92 96 38 55, Email: et@eurotorp.com (Torpedoes)
Hale Hamilton Valves UK Ltd	http://www.halehamilton.com/ , Cowley Rd, Uxbridge, UB8 2AF Middlesex, United Kingdom, Tel: + 44 0 1895 236525, Fax: + 44 0 1895 231407 (Valves)
L-3 Communications - ELAC-Nautik GmbH	http://www.elac-nautik.de , Neufeldtstrasse, Kiel, 24118 Germany, Tel: + 49 431 883 0, Fax: + 49 431 883 496, Email: marketing@elac-nautik.com (Echosounders)
MAN B&W Diesel AG	http://www.manbw.com , Stadtbachstrass 1, Augsburg, 86153 Germany, Tel: + 49 821 322 0, Fax: + 49 821 322 3382, Email: info@manbw.de (Diesel Engines)
SMAC	http://www.caoutchouc-elastomere-suspension.com/ , 66 Impasse Branly, Zone Industrielle BP11966, Toulon, 83079 France, Tel: + 33 494 752488, Fax: + 33 494 4759499 (Rafting)
Thales Information Systems	http://www.thalesgroup.com/security-services/ , 66-68 Av Pierre Brossolette, Malakoff, 92247 France, Tel: + 33 1 41 48 00 00, Fax: + 33 1 41 48 00 10 (Communication Equipment)
Thales Underwater Systems	http://www.thalesgroup.com/naval , 525 Route Des Dolines, BP 157, Sophia Antipolis, 06903 France, Tel: + 33 4 92 96 30 00, Fax: + 33 4 92 96 39 50, Email: TUS@thales-underwater.com (DSUV 62 Sonar)

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Technical Data

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Length	67.6 m	221.7 ft
Beam	6.8 m	22.3 ft
Draft	5.4 m	17.7 ft
Height (keel to top of sail)	11.7 m	38.5 ft
Displacement		
Standard	1,270 tonnes	1,250 tons
Surfaced	1,595 tonnes	1,570 tons
Submerged	1,788 tonnes (2,082 with AIP)	1,760 tons (2,050)
Performance		
Speed – Surfaced	22 kmph	12 kt
Speed – Submerged (max, 5 min)	37 kmph	20 kt
Speed – Submerged (60 min)	31 kmph	17 kt
Range – Transit	>18,500 km at 13 kph	>10,000 nm at 7 kt
Range – Snorting	15,750 km at 17 kph	8,500 nm at 9 kt
Range – Submerged	650 km at 6.5 kph	350 nm at 3.5 kt
Diving Depth	350 m	1,150 ft
Endurance	68 days	68 days
Crew	36 (7 officers) + 6 spares	36 (7 officers) + 6 spares
Reverse Osmosis Capability (fresh water)	2 tonnes/day	2 tons/day
	<u>Type</u>	<u>Number</u>
Weaponry		
Missiles	Exocet SM39 anti-ship	N/A (using torpedo tubes)
Torpedoes	F17P Mod 2	16 (total including missiles)
Mines	Stonefish	28 (alternative payload)
Torpedo Tubes	550mm	4
Electronics		
Countermeasures: ESM	Thales DR-3000U	
Weapons Control Suite	Thales Underwater Systems SUBTICS Mk 2	
Radars		
Surface Search	DRUA-33D Calypso	1
Sonars		
Bow Array	DUUA-2B	1
Flank Array	DUUA-1D	1
Distributed Passive Array	DSUV-2H	1
Intercept Array	DUUX-2A	1
Towed Array	DSUV-62	1
Periscopes		
Search	SOPELEM J 95	1
Attack	SOPELEM ST5 95	1
Propulsion		
Diesels	SEMT-Pielstick 16PA4V185G	2x 1,800 shp
Generators (alternators)	N/A	2x 0.85 MW
Electric Propulsion Motor	Jeumont Schneider	1x 3,400 shp (2,200 kW)

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	<u>Type</u>	<u>Number</u>
Creep-speed Motor	N/A	1x 32 shp
Propeller	Single shaft	1

N/A = Not Available.

Design Features. The Agosta-90B class is a direct descendant of the French Agosta class submarine of the 1970s. It retains the original Agosta-70 double-hull design but introduces significant improvements in the boat's acoustic discretion and its ability to detect other submarines. The hydrodynamics of the hull, its appendages, and the propeller have been optimized for maximum sound suppression. Furthermore, the propulsion machinery, diesel engines, and auxiliaries are all rafted, contributing to the lower noise signature.

The acoustic, optical, electromagnetic, and heat sensors have all been upgraded from the earlier Agosta series. The hull has the same external dimensions, but is now built from high-tensile HLES 80 steel, providing deeper diving capability. Meanwhile, the displacement has increased slightly, to 1,570 tonnes (surfaced).

Part of the increased range is attributable to the new-design batteries supplied by CEAC. These consist of two 160-cell units, and offer improved extended underwater performance.

The 90B was the first export platform to utilize the French air independent propulsion (AIP) system known as MESMA (Module d'Énergie Sous-Marin Autonome). The system was developed by a team that consisted of DCN and the French companies L'Air Liquide, Bertin, Framatome, and Technica-tome, plus the Spanish Navantia group. This AIP system is based on the closed-circuit combustion of ethanol and oxygen. MESMA couples a primary high-pressure, 60-bar combustion heat-generation loop with a secondary Rankine thermodynamic loop.

The first and second boats of the series are scheduled to receive the AIP system as a retrofit at their first interim upgrade. Until then, they will operate as traditional diesel-electric SSKs. The MESMA system will be fitted as a plug-in unit that also comprises the liquid oxygen and ethanol storage area, the steam module, and a turbine for electrical power generation. The system is installed as new on the third boat of the class.

The SUBTICS integrated submarine sonar, combat, command, and weapons control suite features six twin-

screen, multifunction color consoles for sonar analysis, command and control, and weapon management functions. The consoles are based on ruggedized PowerPC workstation hardware. The entire sonar suite of the submarine is integrated through SUBTICS, and includes a clip-on towed array and an active array in addition to the bow, ranging, and intercept arrays. The SUBTICS combat suite has a distributed modular architecture. It makes extensive use of commercial off-the-shelf (COTS) hardware and software standards. These include high-speed RISC processors, the TCP/IP communications protocol, an X-Windows/Motif graphical user interface, and the UNIX operating system. The applications software is written in C language, and the graphics function in C++.

Operational Characteristics. The Agosta-90B has greater endurance than the earlier Agosta versions, along with a substantially improved propulsion source and better diving capability. When compared to conventional diesel-electric submarines, the MESMA AIP system is intended to provide up to five times longer diving endurance. The longer endurance is attributable to the fact that the batteries can be recharged without having to go to snort mode. An example of a typical mission profile for the submarine is a 40-day patrol mission at a speed of 4 knots, preceded by a 10-day outward transit period at a speed of 7 knots, and followed by another 10-day transit period at 7 knots to return to the base. The range of intervention in such a scenario would be 1,680 nautical miles.

Thanks to its higher degree of automation, the Agosta-90B model is able to operate with fewer men, and requires a crew of only 36 (7 officers and 29 senior and junior mates) as opposed to 54 on the original Agostas. In the control room, for instance, the staffing on each watch is down to nine from 13, including five in combat system watch (previously seven) and four in platform management (down from six). Only one roundsman and one plant watch are now needed for the aft machinery spaces, as opposed to three on the old Agostas.

Variants/Upgrades

Agosta-70. This is the original Agosta class submarine introduced in the 1970s. Four of these were sold to the French Navy, four to the Spanish Armada,

and another two to Pakistan. Pakistan's two Agostas were introduced into service in 1979 and 1980, and are still in use today. These original Agostas were lighter in

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displacement (1,490 tonnes surfaced) and noisier, and had more primitive electronics and weapons systems than the 90B models now being bought.

Agosta-80. This was an upgraded model from the original Agosta, with a new propulsion system whose output was 20 percent higher, at 4,200 kW. This model also had a new type of battery that was recharged by two 850-kW diesel-electric generators while in surface or snorkel mode. As a result, the submarine's maximum cruising speed could be maintained for longer periods.

The -80 was also specifically designed to house the SM39 ASuW missile and the F-17P torpedo. Thanks to its smaller crew (45 versus 50), the Agosta-80 was able to remain submerged for longer periods than the original Agosta. Additionally, the crew quarters of the Agosta-80 were generally superior to those on the original Agosta. Furthermore, the food-preparation machinery had been upgraded, and the submarine was equipped with an air-conditioning system that allowed operations in tropical climates.

Undersea endurance was reportedly up by nine days, to 54, and the cruising range was up to 9,630 nautical miles at 8 knots, from the original Agosta's 8,500 nautical miles at 9 knots.

Khalid. The name of the Agosta-90B class in the Pakistan Navy.

PNS Hamza. The third unit of the Khalid class, the PNS *Hamza*, is equipped with a MESMA AIP system that makes it less dependent on frequent surfacing for renewal of its oxygen stores. Otherwise, the performance of the *Hamza* is similar to that of the other two. The new submarine's length has increased from 67 to 76 meters, and the submerged displacement from 1,760 tons to 2,050 tons. If successful, the air-independent system is expected to expand the diving range and, more importantly, the submarine's ability to stay under water for extended periods of time. Some sources suggest that underwater endurance has tripled.



Agosta-90B Class Submarine of the Pakistan Navy

Source: DCNI

Program Review

Agosta-90B

Background. In 1991, Pakistan began negotiating with potential suppliers for delivery of up to three submarines to replace its aging Daphne class boats. The final bidders included France's DCN International along with Sweden's Kockums, which offered the T-96 variant of the A-19 Gotland model; Britain's MoD/Vickers Shipbuilding & Engineering Ltd team with its Upholders (taken from U.K. service); and China State Shipbuilding, with a modified version of the Project 033 Romeo class boat.

An order for a batch of three was officially signed in Islamabad, Pakistan, on September 20, 1994, by Pakistan's defense minister Aftab Shaban Mirani and his French colleague, François Leotard. It was reported that the decision to go with the French design was substantially influenced by the fact that the French government had made both the MESMA AIP technology and the SM39 anti-ship missiles available to this particular export client. Both are features that had not been available to any other Indian Ocean country. The combination of these two capabilities was said to allow Pakistan to counter the Indian Navy, which operates aircraft carriers and maritime strike aircraft in the region. In short, the equipment was chosen to provide a cost-effective, anti-blockade deterrent against possible actions by India in adjacent sea areas. At the time of the deal, the world press considered the sale a shift in the region's power balance.

Sold to Pakistan

When the contract was awarded, it was also noted that the deal would allow the French shipbuilding industry to keep its submarine construction capability in an active state, since that country's domestic programs were in a transitional phase. The contract was estimated to provide 3.5 million man-hours of work for DCN facilities in Cherbourg, Indret, and Ruelle, as well as for other contractors including Thomson-CSF (now Thales) and Jeumont Schneider.

The technology transfer arrangement, which is considered quite ambitious for Pakistan, stipulated that the first submarine should be built entirely in France, while the second would be assembled in Pakistan from sections manufactured at the French company's Cherbourg site. The third ship would be built entirely in Pakistan at the Karachi shipyard. The materials and equipment for that one, too, would be supplied by DCN from France. Of the total contract sum, it is estimated that \$100 million will be spent to upgrade the Pakistan Navy's Karachi shipyard, and another \$100 million to purchase machine tools from France. In the process, the Karachi shipyard has been upgraded to and certified for the ISO 9002 international quality-assurance standards.

In short, the technology transfer has meant a major leap forward for the shipbuilding capabilities of the region.

In April 1997, Pakistan's chief of naval staff, Admiral Mansurul Haq, was dismissed by the country's Prime Minister Nawaz Sharif. Although reportedly unrelated to the delivery schedule for the new Agostas, Haq's dismissal was presumably in response to his inappropriate involvement in the bidding process. The dismissal followed weeks of growing scandal over alleged financial bungling and the launch of an investigation into a possible kickback scheme surrounding the submarines. Haq was believed to have been involved in the corruption scandal.

At about the same time, the French government sent a French Navy Agosta class submarine on a promotional tour of Southeast Asia. This road show was presumably intended to raise sales for French defense industry suppliers. On tour, the submarine *La Praya* carried both torpedoes and SM39 anti-ship missiles, plus a new color flat-screen display and other more recent electronics systems. The tour was extended to potential submarine client countries in the region, Pakistan included.

First 90B Rolled Out

The first Agosta-90B submarine for Pakistan was rolled out of the manufacturing plant at DCN in August 1998 and launched shortly thereafter. It was commissioned into the Pakistan Navy as the PNS *Khalid* in September 1999. The second boat was delivered to Pakistan in three sections on board a freighter in May 1998, and components for the third boat arrived in the fall of the same year.

A team of about 60 Pakistan Navy personnel was in residence in Cherbourg, France, during the construction process to oversee all aspects of the contract. In 1998, a team of 15 to 20 engineers from DCN was dispatched to the Pakistani shipyard to oversee the technology transfer program.

At the last minute, delivery of the first-in-class was delayed by a political protest by the French government in October 1999. Apparently dismayed by the bloodless military coup in Pakistan on October 12, French authorities notified the departing submarine that its way out of the naval base in Toulon (France) would be blocked. However, in an obvious move to sustain the diplomatic relations between the two countries, the measures were lifted a few days later and the submarine was allowed to leave.

The SM39 anti-ship missile has yet to be procured under a separate contract. This relatively new missile joins the Pakistan Navy's Sub-Harpoons, which were bought in the mid-1980s. The Indian Navy will be the

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first in the world to use submarine versions of both the U.S. and the French weapons side by side.

First AIP System Shipped

The first production module of the MESMA system was shipped to Karachi in 2000. It was installed on the last boat of the series following 12 months of land-based testing at DCN Indret in France. However, the completion of the last boat in the Pakistani Agosta-90B class was slipped to 2008, suggesting that the MESMA program may have suffered some minor delays.

In June 2001, it was reported that the Malaysian Navy was negotiating with DCN International for the supply of two ex-French Navy Agosta class submarines (probably the now-decommissioned FNS *La Praya* and FNS *Ouessant*) and the subsequent construction of two to four Agosta-90B class submarines over the next five years. Malaysian Navy Chief Admiral Abu Bakar Jamal has stated that the procurement of a submarine flotilla for the Malaysian Navy was its highest priority. DCN International was competing with RDM's Moray class for the contract.

In April 2002, there were authoritative but unconfirmed reports that the Malaysian government had selected the Scorpene as its new submarine class, and that a single Agosta would be transferred from the French Navy to act as a training ship. Reports differed on whether the Agosta class submarine in question was the *La Praya* or the *Ouessant*, but the latter is currently the systems trial submarine for the Barracuda project, and it seems unlikely that the SSN program would be disrupted by

transferring the ship to another navy. By early May, these reports had become refined to a Letter of Agreement between Malaysia and France for the construction of two Scorpene class submarines and the loan of a single Agosta-70 class boat.

Al-Qaeda Attacks

Pakistani construction of the two remaining Agosta class submarines was delayed by about six months when 11 members of a DCN technical team were killed and another 12 injured by a suicide car bombing in Karachi on May 8, 2002. Talking to reporters after meeting the 12 injured French citizens and visiting the scene of the massive blast, newly appointed French Defense Minister Michele Alliot-Marie dismissed concerns the attack would damage bilateral relations between France and Pakistan and added that "the current agreements will be pursued," referring to the cooperation pact for the construction of the three Agosta-90s. All of DCN's French staff were pulled out of Pakistan after the 9/11 attacks on the United States, but some had returned to assess the security situation. Despite the delays caused by this attack, the second of the Pakistani Agosta-90B class submarines was delivered in January 2003 and commissioned on December 12 of that year.

The third submarine of this class, the *Hamza*, incorporates improvements based on the experience gained by the initial two submarines of the same class and new advances in endurance, acoustic discretion, propulsion, and diving capability. The *Hamza* was launched in August 2006 and was finally commissioned in September 2008.

Related News

Pakistan Selects Type 214 – Pakistan is purchasing three German-designed Type 214 diesel-electric submarines. The submarines were designed by German shipbuilder Howaldtswerke-Deutsche Werft (HDW) and will be built at a Karachi shipyard. This deal, for which a contract is expected to be signed soon, is worth more than \$1 billion. These submarines will be armed with European-built heavyweight torpedoes. Primary options appear to be the DM2A4 and Black Shark. (Seawaves, 4/08)

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Funding

The program has been funded by the Pakistani defense forces through the Pakistan Navy.

Contracts/Orders & Options

<u>Sponsor</u>	<u>Award</u> <u>(\$ millions)</u>	<u>Date/Description</u>
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<u>Sponsor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Pakistan Navy	950	Sep 21, 1994 – Order for a batch of three.
Pakistan Navy	80	Sep 2005 – Order for DM2A4 torpedoes.

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Sep	1992	Provisional order for a batch of three submarines
Sep	1994	Order confirmed
Mar	1995	Pressure hull construction begun for first-of-class
Jan	1996	First hull section completed
	1997	First-of-class laid down
Sep	1997	Fabrication and welding of a full-scale test section completed
May	1998	Three hull sections for second boat delivered to Pakistan
Aug	1998	First-of-class launched, harbor trials begin; second boat laid down "again"
Sep	1998	Parts for third hull sent to Pakistan
4Q	1998	Sea trials for first-of-class begin
	1999	Third boat laid down
Dec	1999	First-of-class arrives in Pakistan after delayed departure from France
	2000	Plans made to install AIP MESMA propulsion system on third hull
	2001	Second boat launched
Dec	2003	Second boat commissioned
Aug	2006	Third ship launched
Sep	2008	Last of class commissioned

Worldwide Distribution/Inventories

France	Four older Agosta-70s now decommissioned
Pakistan	Three Agosta-90Bs, two Agosta-70s in service
Spain	Four Agosta-70s in service

Forecast Rationale

The news that PNS *Hamza*, the last of the three Agosta-90B submarines ordered by Pakistan has finally been commissioned means that construction of the class has now ended. The prospect of any additional construction was terminated when Pakistan ordered the German-designed Type 214 class submarines as its next submarine design. Henceforth, the only activity in this class will be the installation of the MESMA air

independent propulsion system on the first two submarines of the class.

With the slight chance that the Pakistan Navy would opt for a repeat Agosta-90B now eliminated and with the Agosta 90 no longer being promoted in any current or future competitions, it is apparent that no further submarines of this class will be built. This report, therefore, will be archived next year.

Ten-Year Outlook

Due to the completion of all outstanding orders, no forecast is provided at this time.

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