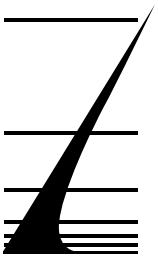
The Market for Naval Surface Combatants

Product Code #F670

A Special Focused Market Segment Analysis by:



FORECAST INTERNATIONAL

Analysis 2
The Market for
Naval Surface Combatants
2010-2019

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Introduction

Any consideration of the market for surface combatants must start with an attempt to define a surface combatant. The term "surface combatant" itself is a relatively recent innovation, intended to rationalize a situation where warship classification has become increasingly vague and arbitrary. A combination of national preferences, linguistic nuances, and efforts to persuade government financial controllers that certain ships are less expensive than is really the case have resulted in multiple, ill-defined, and barely distinguishable categories. Perhaps the most extreme case has been the recent Japanese DDH-181 *Hyuga*, which the Japanese Navy calls a destroyer and everyone else calls an aircraft carrier. The second pair of ships in the Japanese DDH program are yet more extreme examples with displacements of up to 28,000 tons. This is identical in size to a World War II Essex-class fleet carrier. Even without going to this extreme, "cruisers," "destroyers," "frigates," and "corvettes" are all featured in the pages of naval reference manuals without any clear idea of the distinctions (if any) between them.

Most of these terms were inappropriate, and their survival was a matter of tradition and historical inertia. These ships do, however, share common factors when their mode of use is studied. They are supporting ships, intended to supplement the primary striking arm of the fleet – either by screening the capital ships against attack or by replacing them in environments where the power and presence of a capital ship would represent an inappropriate use of resources. They can either operate with the fleet or independently. This division of roles has been further subdivided over time.

The independent deployment role falls into two distinct parts. The first is where the ships are intended to operate in home waters and, thus, in a relatively benign environment where their primary duties are maritime patrol and policing. The second involves deployment in foreign parts where the situation is, potentially at least, considerably more hostile. Both roles involve remaining at sea for substantial periods, showing the flag, and patrolling sea lanes. These cruising duties are the source of the original name – cruisers – for ships of this class.

The fleet support role also falls into two distinct categories. Almost by definition, a power projection fleet has to go to the scene of planned operations and then conduct those operations. In the past, the task of the ships assigned to support the fleet was to escort it to the scene of operations and then to act in support of the fleet once there. Again, there was a marked difference in the degree of threat facing the ships performing the two roles. Escorting the fleet to its destination was a relatively low-threat task; until quite recently, a fleet out of sight of land was virtually undetectable and the only danger to it was in chance encounters. Once the fleets engaged, though, that situation drastically changed and the life of the ships supporting the main body of the fleet became hazardous.

Escorting the fleet to its destination was primarily a task that required sweeping ahead of the main body to locate any potential chance encounters and to remove enemy picket ships attempting to give warning of the approach. This task required fast, agile ships that substituted speed for firepower. Such ships were originally described by the Dutch adjective "fregated" to indicate a warship that had been modified for high speed at the expense of its other characteristics. Thus, they became known as frigates. In a fleet action, these ships were inconsequential; their firepower was insignificant compared with that of the capital ships, and their main role was to keep out of the way. This changed when it became possible to mount ship-killing weapons on small ships. The first ships to mount such weapons were torpedo boats, and defending the capital ship was the role of torpedo boat destroyers. Doing so in the middle of a pitched naval battle was an exceptionally hazardous task, not least because it was impossible to determine with great certainty which of the small ships were friendly and which were hostile. Inevitably, all became regarded as fair game.

High Threat/Low Threat

The basic distinction between high-threat-environment and low-threat-environment ships served to distinguish between ship types for many years. It persisted as late as the 1970s when Admiral Zumwalt proposed his Hi-Lo mix of warship types intended to provide for both convoy escort and main fleet operations. Unfortunately, by the time he had formalized this distinction, it was already being rendered obsolete by rapid advances in naval technology that were slowly but surely eliminating the "low-threat" or "benign" environments. The development of nuclear-powered attack submarines and long-range bombers armed with powerful anti-ship cruise missiles, and the proliferation of ship-launched missiles, all resulted in leveling the threat environments. Even home waters could not be considered a benign environment in a world where hostile nuclear-powered submarines could enter and operate there.

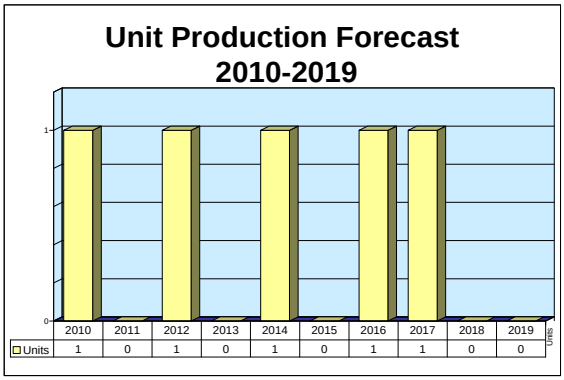
The result has been the elimination of the low-threat-environment warship. As early as the 1980s, the trade protection (ostensibly low-threat) Type 22 class frigates

Continued…

F-100 Alvaro de Bazan

Outlook

- No new orders placed over the last year
- Leading ship in its type and size bracket
- Eight F-85 frigates for Australia possible
- Sixth ship for Spanish Navy may be ordered
- Other export orders depend on release of AEGIS system



Orientation

Description. Surface combatant tasked with area air defense as primary mission.

Sponsor
Spanish Ministry of Defense
Ministerio de Marina
Madrid, Spain

Status. In production and service.

Total Produced. A total of 13 ships are in service, under construction, or on order.

Pennant List

Number, Name	Builder	Type	Launch Date	Commission Date
Spain				
F-101 *Alvaro de Bazan*	Navantia, Ferrol Shipyard	F-100	10/27/2000	9/19/2002
F-102 *Almirante Don Juan de Borbon*	Navantia, Ferrol Shipyard	F-100	2/28/2002	11/30/2003
F-103 *Blas de Lezo*	Navantia, Ferrol Shipyard	F-100	5/16/2003	12/31/2004
F-104 *Mendez Nunez*	Navantia, Ferrol Shipyard	F-100	11/12/2004	2/28/2006
F-105 *Roger de Lauria**	Navantia, Ferrol Shipyard	F-100	11/2010	7/2012
Norway				
F-310 *Fridtjof Nansen*	Navantia, Ferrol Shipyard	F-85	6/3/2004	5/2006
F-311 *Roald Amundsen*	Navantia, Ferrol Shipyard	F-85	5/25/2005	5/2007
F-312 *Otto Sverdrup*	Navantia, Ferrol Shipyard	F-85	5/2006	7/2008
F-313 *Helge Ingstad*	Navantia, Ferrol Shipyard	F-85	11/2007	9/2009
F-314 *Thor Heyerdahl*	Navantia, Ferrol Shipyard	F-85	2008	9/2010
Australia				
Hobart	ASC	F-105	10/2013	2014
Brisbane	ASC	F-105		2016
Sydney	ASC	F-105		2017

** Name not confirmed; may be El Graveleau*

Mission. Anti-air warfare with anti-missile capability, as well as anti-surface and anti-submarine warfare. In addition, the ship is tasked with crisis management and fleet protection functions, and can serve as the flagship for a national or allied combat group.

Price Range. In December 1996, when the 1997 state budget was being drafted, the value of the entire program was stated to be approximately $2.15 billion. However, in 1997, the program was estimated to have a value of ESP287.315 billion ($1.9 billion), or $475 million per ship.

F-100 Alvaro de Bazan

Contractors

Prime

Navantia Shipbuilding	http://www.navantia.es, Velázquez St, 132, Madrid, 28006 Spain, Tel: + 34 91 335 84 00, Fax: + 34 91 355 86 52, Email: navantia@navantia.es, Prime
Australian Submarine Corporation Pty Ltd	http://www.subcorp.com.au, GPO Box 2472, Adelaide, 5001 SA, Australia, Tel: + 61 8 83 48 70 00, Fax: + 61 8 83 48 70 01, Licensee
Lockheed Martin Information Systems & Global Services, Division HQ	http://www.lockheedmartin.com/isgs/, 700 N Frederick Ave, Bldg 181, Gaithersburg, MD 20879 United States, Tel: + 1 (301) 240-7500, Second Prime

Subcontractor

BAE Systems Land & Armaments, US Combat Systems, Armament Systems	http://www.baesystems.com/Businesses/LandArmaments, 4800 E River Rd, Minneapolis, MN 55421-1498 United States, Tel: + 1 (763) 571-9201, Fax: + 1 (763) 572-9826 (Mk 45 5-Inch/54 Lightweight Gun)
GE Transportation - Marine Engines	http://www.getransportation.com/na/en/marineengines.html, 1 Neumann Way S-156, Cincinnati, OH 45215 United States, Tel: + 1 (513) 552-5465, Fax: + 1 (513) 552-5005 (LM2500 Marine Gas Turbine)
L-3 Communications - Cincinnati Electronics Inc	http://www.cinele.com, 7500 Innovation Way, Mason, OH 45040-9699 United States, Tel: + 1 (513) 573-6100 (Antenna Assembly)
MTU Friedrichshafen GmbH	http://www.mtu-on-line.com, Maybachplatz 1, Postfach 2040, Friedrichshafen, 88040 Germany, Tel: + 49 7541 90 0, Fax: + 49 7541 90 2724, Email: info@mtu-on-line.com (Diesel Engine)
Oto Melara SpA	http://www.otomelara.it, Via Valdilocchi 15, La Spezia, 19136 Italy, Tel: + 39 0187 5811 11, Fax: + 39 0187 58266, Email: press-office@otomelara.it (76mm L62 Super Rapid)
QinetiQ Ltd	http://www.qinetiq.com, Cody Technology Park, Ively Rd, Farnborough, GU14 0LX Hampshire, United Kingdom, Tel: + 44 0 8700 100 942 (Loki Torpedo Countermeasures)
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 41 24, Email: TUS@thales-underwater.com (MRS-3000 Sonar)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

	Metric	**U.S.**
Dimensions		
Length – Overall	146.7 m	481.3 ft
Length – Waterline	133.2 m	437 ft
Beam	17.5 m	57.5 ft
Draft	4.9 m	16.1 ft
Flight Deck	26.4x17 m	86.6x56 ft
Displacement		
Full Load	5,853 tonnes	
Maximum Displacement (including future growth)	6,211 tonnes	

F-100 Alvaro de Bazan

	Metric	U.S.
Performance		
Speed	52 kmph	28 kt
Range	8,300 km at 33 kmph	4,500 nm at 18 kt
Crew	194 + 35 officers + 21 spare	
	Type	**Quantity**
Armament		
Missiles: SSM	Harpoon	8
SAM	Standard SM-2MR Block IIIA	
Vertical Launch System	Mk 41 (for SAMs)	48 cells
Guns	5-inch Mk 45 L54 Mod 2	1
	Oerlikon 20mm	2
Torpedo Tubes	Mk 32 Mod 5 (fixed)	2x 2
Torpedoes	Mk 46 Mod 5	24
ASW Mortars	ABCAS/SSTDS launchers	2
Helicopter	SH-70L Seahawk Lamps III	1
Electronics		
Radar – Air/Surface Search	AEGIS SPY-1D	
Radar – Surface Search	DRS SPS-67 (RAN 125)	
Combat Data Systems	Lockheed AEGIS Baseline 5 Phase III (DANCS)	
SATCOM	Link 11/16	
Weapons Control	Sirius optronic controller Dorna GFCS Sainsel DLT 309 TFCS	
Fire Control – Missiles	Mk 99, w/SPG-62 radars	2
ECM	Ceselsa Aldebaran, jammer	
ESM	Ceselsa Elnath	
Sonar	Raytheon DE 1160 LF	
Countermeasures	SRBOC Mk 36 Mod 2 chaff l SLQ-25A NIXIE torpedo decoy	4
Machinery		
Configuration	CODOG	
Gas Turbines	GE LM2500	2x 23,664 shp
Diesels	Bazan/Caterpillar Bravo 12	2x 6,120 shp
Propellers	acbLIPS cp, 2 shafts	2
Couplings	848 DCB Series Cardan	2

Design Features. The Alvaro de Bazan class is the first European frigate design to be specifically oriented around the U.S. AEGIS combat system and SPY-1D radar. The installation is a modified version of that adopted for the U.S. Arleigh Burke class destroyers. The demand for packaging the AEGIS system into a hull approximately two-thirds the size of existing platforms required that some basic changes be made to the system configuration.

The four fixed phased-array antennas, characteristic of the SPY-1 radar, required that the superstructure be arranged so that the antenna had clear lines of sight for 360° coverage. In addition, the requirement to use the same wave-guide pallets as those on the Arleigh Burke's SPY-1D systems meant placing the antenna arrays at the same height above the water line.

The Alvaro de Bazan differs from the Arleigh Burke in that the electronic components of the SPY-1 radar and the associated AEGIS battle management system are configured over two decks; in the U.S., they are concentrated on a single deck. This two-deck arrangement also required modifying the wave-guides in the radar system to accommodate the different levels. This configuration is unique to the Spanish AEGIS installation.

The ships' maximum full-load displacement (6,211 tonnes) includes a generous margin of 450 tonnes for growth. To increase protection, the Combat Direction Center (CDC) is located one deck below the bridge. Splinter protection in critical locations consists of double steel bulkheads, the outer layer of which is reinforced to resist splinters and small-arms fire. The ship has five damage control stations and is divided into a three-zone NBC system.

The machinery spaces are divided into two separate compartments, each of which contains a complete

power train installation. This includes a 17,500-kW LM2500 gas turbine, a single 4,500-kW Bravo 12 diesel engine (a derivative of the Caterpillar CAT-3600 series), and gearing designed and built by Royal Schelde. Each power train drives a single shaft, which terminates in a 4.65-meter, five-bladed controllable pitch propeller. Electrical power is provided by four Izar-built MTU 12V396 diesel generator sets, two located in the hull forward and two aft. This machinery plant is monitored by an Izar-supplied integrated monitoring and control system.

The ship is designed with cambered superstructure sides to minimize radar cross-section. Underwater-radiated noise is reduced through the use of double-reduction gearing and noise-attenuating transmission couplings. The magnetic signature of the ship has been reduced by the use of a sophisticated degaussing system produced by SAES, in partnership with Thales Underwater Systems.

Although the ship is highly automated, the number of crew members is said to be 250 total, including 35 officers and accommodations for another 21 crew members. In contrast, the Dutch De Zeven Provincien (LCF) class has only 202 crew members, including 32 officers and a task group. According to Izar, the reason for the higher manning requirement is the complexity of the AEGIS system.

Operational Characteristics. The main missions of the ship are crisis management and fleet protection (with anti-missile and anti-air capability), and anti-surface and anti-submarine warfare (ASuW and ASW). It can also be used as a flagship for a national or allied combat group. The ship is characterized as a medium-sized escort vessel that has been optimized for crisis management operations, for use as a flagship, or for use as part of a multinational naval task force. It is intended to provide AAW coverage for expeditionary forces that are already ashore and anti-missile protection for the force's own high-value units.

The medium-range Standard Missile SM-2MR Block IIIA from the Standard Missile Company (created by Raytheon and Hughes) provides area defense. SM-2MR has a range of 70 kilometers and a speed of Mach 2.5. It employs a semi-active radar seeker and an AEGIS radio command link. The missiles are installed in a Mk 41 vertical launch system from Lockheed Martin. Owing to the relatively small size of the ship, it has only two Mk 99 target designating radars.

For replenishment at sea (RAS), these ships are equipped with four replenishment stations for dry goods (food, ammo, etc.), plus four stations for fuel transfer. In addition, the ships have one fuel receiving station in the stern and a further two vertical replenishment stations.

Variants/Upgrades

Fridtjof Nansen Class. The successful contender for the Norwegian Navy requirement was the F-85 from Izar. This is a modified and downsized version of the F-100. The changes include a reduction in size to 5,120 tonnes. The hull is 132 meters long with a beam of 16.8 meters. The power train is identical to that on the F-100, with the exception that only one LM2500 gas turbine is installed. The ship is equipped with the SPY-1F lightweight AEGIS system, controlling Evolved SeaSparrow surface-to-air missiles, and Kongsberg NSM anti-ship missiles. The main gun is an Oto Melara 76mm L62, originally planned for the F-100 class.

F-85. Design nomenclature for the Fridtjof Nansen class.

Hobart Class. The Australian Navy selected a derivative of the F-100 to satisfy its requirement for an air warfare destroyer. The differences between the Spanish and Australian versions of the F-100 class include different horizon search radars, communications systems, and electronic warfare equipment. It is reasonable to assume that the Australian ship will be "tropicalized" – fitted with heat insulation and air conditioning equipment of higher capacity. The Hobart class will also carry a sonar produced by Ultra Electronics Australia.

F-105. Design nomenclature for the Hobart class.

F-110. Proposed follow-on to the F-100 class intended as a replacement for the Baleares and Descubierta classes. The characteristics of this design are not yet clear, and the program has been indefinitely postponed in favor of additional F-100 class frigates and the new BAM class corvettes.

Chilean Frigate Bid. A modified and downsized derivative of the F-100 for export to Chile. Presumably, this ship would not have carried AEGIS. The bid was unsuccessful, and the design is now defunct.

AEGIS Corvette. A 2,600-ton corvette jointly designed by Lockheed Martin and Izar as a platform for the SPY-1K radar and AEGIS air warfare combat management system. The ship will be armed with up to eight vertical launch tubes and a 76mm gun.

Alvaro de Bazan

Source: Navantia Construcciones Navale

Program Review

The F-100 has its origins in the Trilateral Frigate Cooperation (TFC) program with the Netherlands and Germany. That program was intended to replace the ill-fated NATO Frigate for the '90s (NFR-90) project, which collapsed as a result of irreconcilable differences among program members Germany, Spain, France, Italy, the U.K., the Netherlands, and Canada.

The F-100 program was first mentioned in the Spanish Navy's 1989 Plan del Alta Mar fleet architecture document but was delayed a number of times. In 1990-1991, Spain carried out a national study on the necessity and feasibility of an indigenous frigate program. The program was intended to replace the five Baleares class frigates, which date to the 1970s and bear a close resemblance to the U.S. Navy's Knox class frigates.

Going Joint

In November 1992, Spain joined the agreement signed earlier by Germany and the Netherlands to develop a new frigate class. A Memorandum of Understanding (MoU) was signed a year later by Blohm + Voss, Royal Schelde, and EN Izar shipyards to develop a new-generation frigate. The three shipbuilders would cooperate on the combat system. The main common item for all participant navies would be the AAW system (from Hughes and Signaal), which used APAR multifunction radar integrated with the SMART-L long-range three-dimensional search radar. Implicit in the decision would be the use of the U.S. Standard SM-2 Block IIIA Standard Missile and, if required, the ESSM (Evolved SeaSparrow Missile) system. In effect, the TFC represented a very flexible form of multinational cooperation in which partners collaborated on systems for the ships but installed those systems in hulls suited to their own national requirements.

Later, Spain decided to pull out of the TFC AAW team because the technology would not be ready to provide an in-service system within the Spanish Navy's requested timeframe. Spain chose to go with the U.S. AEGIS system instead. In 1994, Izar estimated that the unit price for the ships would be the equivalent of $326 million in 1992 dollars.

In fall 1996, French President Jacques Chirac appealed to Spanish Prime Minister José Maria Aznar to consider buying one version of the Principal Anti-Air Missile System (PAAMS) for Spain's planned new frigates from Eurosam. Aznar agreed to conduct a study of the proposal but, in the end, went along with the Spanish Armada's recommendation to stay with the AEGIS/Standard Missile configuration.

Four Ships Ordered

On January 24, 1997, Spain's Council of Ministers agreed to the construction of four F-100 type frigates at a total cost of ESP287.315 billion, further agreeing that only ESP10 billion of that amount would be spent in

1997. At that time, it was projected that the ships would enter service at one-year intervals beginning in 2002. Moreover, it was resolved that the ships would carry the AEGIS system and that ESP93 billion of the total contract amount would be allocated to U.S. contractors. An order for the AEGIS system valued at ESP55.6 billion ($400 million) was placed with Lockheed Martin before the end of January.

Spain's Ministry of Defense formally specified the AEGIS combat system for its F-100 class by signing a Letter of Agreement with the U.S. Navy in the spring of 1997. That meant Raytheon's SPY-1D radar transmitters and Mk 99 fire control systems would be included on the frigates. This was significant, because it made Spain only the second export customer to be allowed access to AEGIS. The local defense contractor Enosa agreed to become the designated manufacturer of some Mk 99 equipment for the Spanish ships. Enosa was also chosen as the in-country logistics support depot for the Raytheon equipment.

At roughly the same time, the shipbuilder Izar was given an order for a second amphibious assault ship (LPD) of the Galicia class, thus ensuring continued employment at the works. Construction of the F-100 class had not gone into full swing, so the receipt of the LPD order was welcome news for the builder. By winning a contract for a second LPD before it could begin building the new frigates, Izar was able to retain its workforce without interruption, providing for better continuity and allowing Izar to plan purchases of long-lead components that would be needed in anticipation of the F-100 project.

Changing Guns

In 1998, Izar announced that it had chosen the U.S.-made Mk 45 5-inch gun for the ship's main gun. The weapons are secondhand Mod 2 units that will be upgraded to Mod 3 standard, with the possibility of accepting the Extended Range Guided Munitions with further modifications in the future. Up to that point, it was believed that the ships would be fitted with the Oto Melara 76mm L62 Compact or Super Rapid guns. The smaller caliber of those guns was expected to be more appealing to the Navy, as it might reduce the likelihood that valuable platforms would be drawn into major gunfire support in a combat situation. A division of Izar already had a license for local manufacture of the 76mm gun in Spain. Later, a decision was made to go with the heavier U.S. guns, as the Mk 45s provide better assistance in amphibious operations and guarantee a longer delivery distance than the 3-inchers. The U.S. guns are from landing ships that no longer need the Mk 45s. A contract for the refurbishment and upgrading of the guns was issued in the spring of 1999. The prime contractor is FABA (Fabrica Artilleria de Izar), the combat systems division of Izar, with United Defense (the original maker of the guns) acting as a subcontractor – overhauling major components at its facility in Kentucky – and providing technical expertise.

In an effort to exploit the expertise gained with the F-100 program, Izar signed an MoU with its U.S. contractors, Bath Iron Works and Lockheed Martin, regarding plans to jointly market, produce, and integrate the frigate design on the international warship market. Even though the F-100 design itself may not be taken directly to another customer, some major elements of the package, such as the GES combat system and the SPY-1D radar, in combination with the general characteristics of the hull and/or superstructure, will be offered to interested navies worldwide. This partnership was instrumental to the ultimately successful Izar bid for the Norwegian frigate program.

The keel for the first ship, the *Alvaro de Bazan*, was laid in June 1999. Izar credited the speed of construction to the technical maturity of the AEGIS/SPY-1 technology, as compared with the new APAR/SMART-L.

Norwegian Order

In February 2000, the Norwegian Defense Ministry announced that Izar had been selected as the winning contender to supply the new class of five frigates for the Norwegian Navy. The order is valued at $1.5 billion, and the ships were originally scheduled for delivery between 2005 and 2009. The Norwegian frigates are a derivative of the F-100 class but have a different command system (a development of the Kongsberg MSI-3000) and the French Spherion bow sonar. The Norwegian ships, however, will retain the AEGIS/SPY-1 system of the F-100. They will use the new SPY-1F lightweight version controlling Evolved SeaSparrow Missiles. The Norwegian decision did not come as a surprise, since the Norwegian Navy's preference for the Spanish design had been apparent since early 1999, and the preference for the Izar ship was made official in January 2000.

In mid-2003, it became apparent that construction of the five Fridtjof Nansen class frigates had been delayed by at least two years, although the reasons have not been made entirely clear. The delay may have been due to budgetary causes, with a decision possibly made to slow down work in order to spread funding more evenly. In any event, by 2005, the ships were back on schedule. The first-of-class was launched on June 3, 2004, and commissioned in October 2005. She is currently running trials.

In March 2001, Empresa Nacional Bazan merged with Astilleros Espanoles to form Izar Construcciones

Navale. Just prior to this, the F-100 class frigate *Alvaro de Bazan* was launched, making it the last ship to be launched under the group's old name. The ship completed its first series of sea trials in April 2002, which apparently were highly successful. At this point, the program for the four Spanish ships was running slightly ahead of schedule.

In March 2002, the existing F-85 (Norwegian frigate) and F-100 (Spanish frigate) members of the family were joined by a new Izar-Lockheed Martin design, a 2,600-ton AEGIS corvette. It was the smallest AEGIS ship yet designed, made possible by the introduction of a further downsized version of the SPY-1 radar, the SPY-1K.

Successful Trials

In July 2003, the *Alvaro de Bazan* conducted the air defense portion of combined combat systems ship qualification trials (CSSQT) off the coast of Wallops Island, Virginia. The USS *Mason* (DDG-87) also participated in the CSSQT, a series of at-sea exercises and tests to verify that shipboard systems are installed correctly and can be operated and maintained safely and effectively. The CSSQT included interoperability testing as well as simulated and live gun firings, and culminated in standard missile firing exercises. The trials allowed both *Mason* and *Alvaro de Bazan* to jointly test their AEGIS weapons systems and command, control, communications, computers, and intelligence (C^4I) systems.

The first group of four Spanish ships is due to enter dockyard hands for upgrade in 2007/2008. This will see the fore funnel raised to reduce the effect of stack gasses infiltrating the bridge – one of the few deficiencies found with these ships on their sea trials. However, the major modification applied during this upgrade will not be easily visible. This will be the modification of the AEGIS system to allow the ships to undertake a missile defense role using Standard SM-3 missiles.

Enter Australia

During late 2003 and early 2004, the Royal Australian Navy placed added urgency on its requirement for a new Air Warfare Destroyer. Some years earlier, it had released this requirement and suggested that the F-100 design was the one that best fit its requirements. The impetus was lost, however, and no orders were placed.

The renewed emphasis on this project led to a belief that the F-100 was, once again, strongly favored. That was confirmed when the Australian Navy released a short list of three contenders for the requirement, the favored candidates being the F-100 Alvaro de Bazan, the DDG-51 Arleigh Burke, and the F-124 Sachsen classes. As a separate issue, the Australian Navy decided to specify the AEGIS air warfare battle-management system, which appeared to rule out the F-124 because the ship was built around the SMART-L/APAR system. Converting it to carry AEGIS/SPY-1 would have been so expensive it would have precluded the ship from entering the contest.

By mid-2005, it was generally perceived that the Australian Air Warfare Destroyer requirement was a straight fight between the Alvaro de Bazan class and a modified version of the DDG-51. Although Gibbs and Cox expressed great confidence that their design would be accepted, information from Australian sources continued to point to the F-100 Alvaro de Bazan class as being in a commanding position in the contest.

These impressions were confirmed in April 2007 when the Spanish F-100 air warfare destroyer was endorsed by the Defence Capability and Investment Committee – the Defence Department's top policy advisory committee. The committee emphatically rejected the case for a larger alternative based on the U.S. Arleigh Burke class destroyer on the grounds that the F100 build was more than AUD1billion cheaper than the U.S. option and more than two years ahead on the delivery schedule for three warships. The tender evaluation of the two bids submitted by Navantia and Gibbs and Cox had found conclusively in favor of the Spanish on all the key criteria. The advantages of the F100 were so strong that a debate between supporters of the two designs was a complete wipeout, according to one senior Australian defense source.

This news made the June 2007 decision to formally select the F-100 Alvaro de Bazan as the new Australian Air Warfare destroyer something of an anti-climax. The AUD8 billion ($6.762 billion) contract covered the construction of three improved F-100 class destroyers to be delivered in 2014, 2016, and 2017, according to Prime Minister John Howard. "This does represent a massive lift in the Royal Australian Navy air warfare capability," he said. "These vessels will be able to perform the full spectrum of joint maritime operations."

The only real surprise in the contract announcement was the possibility that a fourth air warfare destroyer could be ordered. The Navantia design is significantly less expensive than its competitors, and the difference in the cost of three ships is reportedly enough to fund up to 80 percent of the cost of a fourth destroyer. The construction of this fourth destroyer (to which the name *Melbourne* has been allocated) was a significant issue in the November 2007 Australian general election, with both parties competing to establish their "strong on defense" credentials by enthusiastically endorsing the ship's construction. Despite this bipartisan support, the Australian government finally decided that the option for the fourth Hobart class destroyer would not be exercised. However, in its place, the Australian defense

white paper stated that a class of eight frigates would be ordered that would offer enhanced capability over the FFG-7 class presently in service.

Other news of possible contracts was released in 2008, including a possible order from Algeria for four new frigates. On the other side of the ledger, the order for six frigates to equip the Hellenic Navy was won by FREMM; it was suggested that the F-100 came in second based on cost.

Funding

This program is funded by the Spanish Ministry of Defense. Part of the funding had been channeled through the Ministry of Industries as a form of subsidy for the national shipbuilding industry, rather than directly through the Ministry of Defense. In FY97, that amount totaled ESP10,000 million and was granted in the form of a refundable credit to Bazan. The 1996 budget provided ESP1,596 million for the program, which was sufficient only for the procurement of a few long-lead items. In late 1998, it was stated that the Ministry of Industries was to make available about ESP200,000 million toward the setup, tooling, and related costs for a number of high-priority defense programs, including the F-100 frigates.

Contracts/Orders & Options

Contractor	Award ($ millions)	Date/Description
FABA	16.0	Mar 1999 – Refurbishment, upgrading of four Mk 45 Mod 2 naval guns.
Lockheed Martin	23.3	May 1999 – Engineering, technical support contract for AEGIS test site maintenance (multinational contract).
Computer Science	3.8	Jul 1999 – Engineering, technical support for AEGIS (multinational).
QinetiQ	5.0	Apr 2005 – Supply of Loki torpedo countermeasures to Norwegian Navy for Fridtjof Nansen class.
Navantia	6,762.0	Jun 2007 – Supply of three F-105 class destroyers to the Australian Navy with an option on a fourth ship.
Ultra	N/A	Aug 2008 – Supply of sonars for Australian Hobart class destroyers.
BAE Systems	80.0	Sep 2008 – Supply of Mk 45 5-inch guns for Hobart class.
Kongsberg Defense	25.4	Jun 2009 – Supply of tactical interface systems.

Timetable

Month	Year	Major Development
	1989	Plan del Alta Mar fleet architecture document mentions F-100 for the first time
Sep	1992	Project definition
Nov	1992	Spain, the Netherlands agree to collaborate on frigate programs
Oct	1993	MoU for project definition of joint frigate program signed
Jun	1995	Spain withdraws from Trilateral Frigate Cooperation, APAR
Jan	1996	Detailed design
Oct	1996	Production order agreed upon
Jan	1997	Building program for four ships approved by Spanish Parliament
Spring	1997	AEGIS w/SPY-1D, Mk 99 FCS specified for F-100
Jun	1997	Construction begun
Jan	1999	MoU on joint marketing of frigate design worldwide with BIW, L-M
Jun	1999	Keel laid for first-of-class
Aug	1999	First AEGIS antenna for F-100s completed

Month	Year	Major Development
Feb	2000	F-100 selected as basis for Norwegian frigate requirement
Oct	2000	Launch of *Alvaro de Bazan*
Mar	2001	AEGIS system embarked
Feb	2002	Platform sea trials begun
Apr	2002	Launch of second-of-class
Jun	2002	Combat system trials begun
Sep	2002	*Alvaro de Bazan* commissioned
Jul	2003	Launch of third ship
Aug	2003	Fourth ship laid down
Nov	2003	Second ship commissioned
Sep	2004	Launch of fourth ship
Dec	2004	Third ship commissioned
Feb	2006	Fourth ship delivered to Spanish Navy
Jun	2007	F-100 ordered by Australia for Air Warfare Destroyer program
	2014	First Australian F-100 to be delivered
	2017	Last Australian F-100 to be delivered

Worldwide Distribution/Inventories

Australia Three F-100 class ships on order, one additional hull on option.

Norway Three ships in service with the Norwegian Navy, two F-85 ships under construction.

Spain Four F-100 class ships in service, one under construction for Spanish Navy.

Forecast Rationale

After the almost frantic activity of the last few years, the marketing team supporting the F-100 Alvaro de Bazan class were finally able to catch their breath in 2009/2010. With the Greek frigate requirement going to FREMM (and then running into severe financial problems as a result of the Greek economic crisis), the Spanish program has hit something of a quiet spot.

This is unlikely to last very long. The F 100 design is now firmly established as a benchmark of what can be achieved on a 6,000-ton destroyer hull. The F-100 Alvaro de Bazan class has quickly proven to be an outstanding success in Spanish service. As evidence of the design's success, the only problem we have heard regarding the F-100 is that of stack gas being drawn down into the bridge, which was quickly solved by modifying the funnel cap design. Already, the Spanish Navy has ordered a fifth member of this class, and a sixth ship appears to be a very strong possibility.

Beyond the existing orders for 13 ships, future clients become harder to find. A new eight-ship frigate program in Australia to replace the four FFG-7 class ships currently in service may offer a potential outlet for a close equivalent to the F-85 class ships supplied by Navantia to Norway. Procuring these ships by the Royal Australian Navy to complement the three Hobart class ships would offer many benefits in the area of commonality and, thus, reduce overall support costs.

It is likely that additional opportunities will arise over the next few years for small numbers of ships. The F-100 is extremely well-placed to win such contracts as they appear. However, at this time, the nature of such opportunities is too clouded to justify a forecast. The following forecast is therefore based on the current construction plans for ships of this class.

F-100 Alvaro de Bazan

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program		**High Confidence**				**Good Confidence**			**Speculative**			
	Thru 2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**Total**
Navantia Shipbuilding												
F-100 <> Australia <> Navy												
	0	0	0	0	0	1	0	1	1	0	0	3
F-100 <> Spain <> Navy												
	4	0	0	1	0	0	0	0	0	0	0	1
Fridtjof Nansen (F85) <> Norway <> Navy												
	4	1	0	0	0	0	0	0	0	0	0	1
Subtotal	8	1	0	1	0	1	0	1	1	0	0	5
Total	8	1	0	1	0	1	0	1	1	0	0	5

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