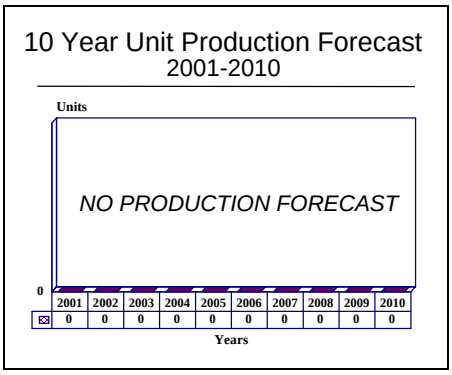
F-123 Brandenburg Class – Archived 10/2002

Outlook

- Mature design; further construction unlikely
- Unsuited to demands of export market
- Most investment now concentrated on upgrades and improvements
- Successor designs stress AAW over ASW
- Report to be archived next year



Orientation

Description. The F-123 frigates are optimized for anti-submarine warfare (ASW) operations.

Sponsor

Bundesamt für Wehrtechnik und Beschaffung (BWB)
Konrad-Adenauer-Ufer 2-6
Postfach 7360
D-56057 Koblenz
Germany
Tel: +49 261 4001
Fax: +49 261 400 7630; 400 7964
Telex: 862661 bwb d

Contractors

Thyssen Industrie AG
Blohm + Voss
Naval Div. Defense Technology Div.
PO Box 100720
D-20005 Hamburg
Tel: +49 40 31190
Fax: +49 40 31193396; 31193333
Telex: 211047 bv d

Thyssen Nordseewerke GmbH (TNSW)
Zum Zungenkai
D-26703 Emden
Germany
Tel: +49 4921 850
Fax: +49 4921 31327; 23143; 852447
Telex: 492132 tnsw d

Preussag Group
Howaldtswerke Deutsche Werft AG (HDW)
PO Box 6309
D-24124 Kiel
Germany
Tel: +49 431 7000
Fax: +49 431 700 2314
Telex: 292288-0 hdw d

Rheinmetall GmbH
STN-Atlas Elektronik
Sebaldsbrücker Heerstraße 235
PO Box 448545
D-28305 Bremen Germany
Tel: +49 421 457 0
Fax: +49 421 457 2900
Telex: 2457460

Licensee. No production licenses have been granted.

Status. In service.

Total Produced. Four

Pennant List

Number & Name	Builder	Launch Date	Commission Date
F-215 *Brandenburg*	Blohm + Voss	8/1992	10/1994
F-216 *Schleswig-Holstein*	Howaldtswerke	6/1994	11/1995
F-217 *Bayern*	Thyssen Nordseewerke	6/1994	6/1996
F-218 *Mecklenburg-Vorpommern*	Bremer-Vulkan	7/1995	12/1996

Mission. The F-123 frigates are primarily designed as anti-submarine (ASW) surface combatants with anti-surface (ASuW) and anti-air warfare (AAW) capabilities restricted largely to self-defense. They replace the Hamburg (F-101A) class destroyers.

Price Range. These ships have an estimated unit value of million each.

Technical Data

	Metric	US
Dimensions		
Length	138.85 m	455.7 ft
Beam	16.7 m	54.8 ft
Draft	4.35 m	14.4 ft
Displacement, Full Load	4,500 tonnes	
Performance		
Speed Maximum	54 km/h	29 knots
Speed Cruising	35 km/h	19 knots
Range (Est.)	13,300 km at 33 km/h	4,000 nm at 18 knots
Crew	219	

	Type	Quantity
Armament		
Guns	76 mm Otobreda	1
Missiles – SSM	MM-38 Exocet	4
Missiles – SAM	NATO Sea Sparrow	16
Missile Launchers	Mk 41 VLS	1
	Hughes/BGT RAM 21	2
Torpedo Tubes	Mk 32	4
Torpedoes	Mk 46	
Helicopter	Westland Mk 88 Lynx	2
Electronics		
Radar		
Air/Surface Search	Signaal LW-08	1
Target Designation	Signaal SMART-S	1

	Type	Quantity
Fire Control	Signaal STIR 1.8	2
Sonar		
Bow-Mounted Low-Freq	STN-Atlas DSQS-23BZ	1
Towed Array	LFASS to be fitted from 2003	1
Electronic Warfare		
ESM	FL-1800S	1
ECM	FL-1800S	1
Decoy Launchers	SCLAR	2
Propulsion		
Configuration	CODOG	
Gas Turbines	General Electric LM-2500 SA	2
Diesels	MTU 20V 956 TB92	2
Propellers	Controllable pitch	2

Design Features. The F-123 design is basically derived from that of the Type F-122 and MEKO-360 frigates. Modular construction methods are used in many areas, e.g., standardized weapon and sensor containers, pallets for consoles in the Combat Information Center (ClC) and modules for each ship's service systems. The vessel has a full load displacement of approximately 4,275 tons, some 500 tons more than the F-122. The length and width were increased accordingly. The entire crew, including helicopter teams, numbers 219. The ships have a design margin of approximately 225 tons, ample enough to accommodate later modernization.

To obtain more space, the B-deck was extended aft to form a pronounced forecastle deck. The hull and superstructure are made entirely of steel. The sensors and weapons are located on two islands. This ensures improved survivability and good all-round defense. Structural measures, such as slanted sidewalls and superstructures, as well as separate stacks, reduce the radar and infrared signatures, making detection by anti-ship missiles more difficult.

Each vessel has two separate hangars for the two helicopters on board in order to reduce possible fire damage. Each helicopter weighs 10 tons. Initially, the Lynx Mk 88 helicopter will be employed until the new-generation NFH-90 is ready to enter service. The new aircraft can be integrated into the entire system without great effort.

In order to meet the specifications, and for reasons of standardization, the proven CODOG (Combined Diesel or Gas Turbine) propulsion system used on the F-122 has been adopted. At cruising speeds, each shaft will be driven by an MTU 20V 956 TB92 diesel engine, whereas the General Electric LM-2500 gas turbine (max 19,000 kW) will supply power for maximum speed. The propulsion system for each shaft is composed of a new RENK TACKE spur gear unit (in contrast to the F-122) and a five-bladed controllable-pitch propeller from Sulzer-Escher Wyss (as in the F-122). Both of these components have optimal low-noise qualities.

Noise in general has been reduced by means of design and structural improvements over the F-122. These measures were necessary in the light of improvements in submarine design: it was essential that the F-123 have the capability of detecting super-quiet submarines at a safe distance. The entire propulsion system is fully automatic and controlled by a modified version of the DMT/Siemens control system used in the F-122.

The vessel's electronics are also based on concepts for the F-122. For reasons of survivability, two electrical power plants are located in separate areas of the vessel. Each plant has two MWM TBD 602 V 16 U diesel engines equipped with A. van Kaick generators producing 1,500 kW each, which ensures that enough reserve power will be available for emergencies or later upgrading. Two switchboards and 13 Load Centers transmit electrical power throughout the vessel with the help of the automatic generating equipment designed by DMT/Siemens. Power distribution is executed through cables running in the port and starboard box girders. The system components are arranged to maximize protection against missile hits.

There are several new features for damage control and ship service. The hull and the superstructure are completely made of steel. Survivability has been greatly increased by three continuous box girders in the strength deck and six double-skin bulkheads with heavy fire insulation. These measures ensure that explosions and the effects of splinters caused by a missile hit are minimized, the longitudinal strength of the hull is maintained and the hull does not fracture. This structural configuration was based on the results of detailed tests, including detonation tests conducted by the BWB and the Weapon Testing Authorities of the German Forces.

All major sensors and weapons are integrated into the SATIR-III-123 command and weapons control system. This system, with its permanently wired connections, resembles the system structure used in the F-122, but has a significantly greater memory capacity.

The heart of this system is the UYK-43 computer from Lockheed Martin. This unit collects and analyzes all data before providing a situation display and automatically initiating engagement measures. It also provides the fast reactions required during combat – especially with regard to missile defense. System control and situation displays have color display screens – the BM-802-52 Standardized Naval Console from Atlas Elektronik. Automatic data transfer to other naval units and to naval headquarters on land is performed by NATO-standard Link 11. The command and weapons control system is centrally located in the CIC, which is situated near the bridge. The commander's room, with displays and communications equipment, as well as the planning area, is located next to the CIC.

The comprehensive tactical software for the SATIR was written by the programming team of the German Federal Office for Military Technology and Procurement (BWB) in cooperation with the naval command staff. Software pertaining to the electronic equipment itself was supplied by industry. Creating the software for the Command and Weapons Control System and then integrating the system into the F-123 were expected to be the most critical aspects of the construction time schedule. As a result, the Naval Command for Control Systems in Wilhelmshaven was made responsible for this task. To support their activities, a new programming and testing center was built in Wilhelmshaven that contained the command system, all the important sensors, and simulators for the weapons. This center eliminated the need for contractors to construct their own land-based testing facilities. Since completion of the systems integration work, the testing center has been employed for training operators and maintenance personnel.

The Brandenburg class shows that the German tradition of sturdy construction is being maintained. The strength of the structure achieved in this design is unmatched by any other comparable naval vessel. These are probably the only frigate-sized warships that could survive an under-the-keel hit from a modern torpedo without breaking in two.

In fact, this structural strength, combined with very high standards of damage control and Germany's elevated wage levels, should have driven the unit cost well above that of comparable ships built elsewhere. This, however, is not the case. The background of experience built up in constructing similar ships for the export market and the efficient construction methods of the yards have held costs to a highly acceptable figure. In effect, the modular construction techniques that are used have offset the costs incurred elsewhere. The short period required for construction (42 months), including comprehensive testing, has been made possible in part by the modular design and production methods.

Operational Characteristics. To fulfill its ASW tasks, the F-123 is equipped with the DSQS-23B high-performance bow sonar system designed by STN-Atlas Elektronik. This is an improved version of the DSQS-21 system and is designed for integration with a passive Towed Array Sonar System (TASS). This TASS is still being developed and is part of preplanned modernization programs. The F-123 already has the necessary space, weight, and power capacities to accommodate this system.

Two twin Mk 32 torpedo tubes, integrated into the superstructure, have been provided for launching the Mk 46 anti-submarine torpedo from the vessel. These sensors and weapons are supplemented by the two onboard helicopters equipped with dipping sonar and up to two ASW torpedoes. The NFH-90, with its low-frequency sonar and automatic data transmission, will give considerably improved performance compared to the Lynx.

The LW-08 2D radar is installed in the aft section to provide long-range detection. The main sensor for locating air and sea targets (especially missiles) is the SMART-S 3D medium-range system. Both radar systems can automatically detect and track a variety of targets, even under adverse electronic conditions – for example, jamming or very dense electromagnetic environments.

The Multipurpose Weapon Control System (MWCS), with two improved STIR fire control radars, will be employed for firing and fire control. Space has been provided for the installation of a third STIR at a later date. The LW-08, SMARTS and MWCS/STIR are manufactured by Signaal and are also used on the eight Dutch Karel Doorman frigates. In fact, the F-123 is basically the weapons/sensor fit of the Karel Doorman in a German-designed hull. The selection of this system will lead to standardization and cooperation with the Netherlands in the areas of training, logistics and software. In previous frigate projects, this kind of cooperation proved beneficial to all parties involved.

The Sea Sparrow missile system is used for point air defense. The missile is deployed in a 16 round Mk 41 vertical launcher. The existing Mk 41 has 16 cells but has been arranged to allow for a subsequent doubling of capacity to 32 rounds. The use of a VLS rather than a trainable launcher doubles the number of deployable

missiles and reduces reaction time. The VLS also requires less maintenance and personnel. In addition, the system is flexible and can be upgraded, as several types of air defense and anti-submarine missiles may be launched from the same standard system.

Other close-in weapons systems carried aboard the F-123 will be two RIM-116 launchers, fore and aft, with 21 missiles each for countering low-level anti-ship missiles. The RAM was developed in cooperation with the US Navy, and the system was first installed as standard equipment on all frigates and destroyers, as well as on some patrol vessels, in 1993.

A 76 mm multipurpose gun, standard armament in many navies, serves as a secondary weapon on the F-123. It is used for air defense (especially anti-aircraft). The air-defense equipment is complemented by important electronic components for coordinating combat operations. The passive detection and radar warning system is the FL-1800S level 2 ESM/ECM system. This detects, localizes and identifies hostile and ambiguous radars. The FL-1800S, which is the standard ESM system in the German Navy, has an integrated deception and barrage jamming capability. The F-123 also has two Alenia SCLAR chaff dispensers removed from the Hamburg class destroyers.

Sea targets will be located using the SMART-S. Anti-ship capability is provided by four MM-38 Exocets fired from two double ITS launchers, also removed from the Hamburg class destroyers. The 76 mm multipurpose gun has a secondary anti-ship role for policing and other low-intensity conflicts.

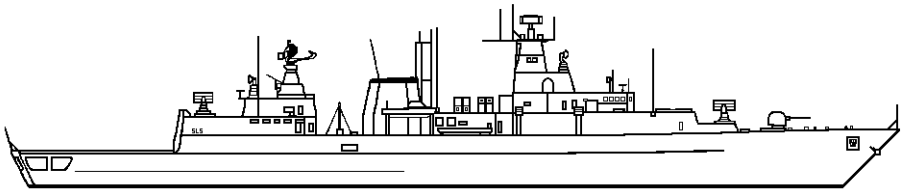
The navigation equipment aboard the F-123 is based on the systems used in the F-122 with the addition of some new standardized units, such as two Raytheon Raypath navigational radars (one fore and one aft), with the aft unit to be used for the onboard helicopters. Other systems include satellite navigation, Doppler log, two leveling gyros (e.g., the PL 41 from LITEF) for fire control, and two automatic plotters – one on the bridge, the other in the CIC – for determining the vessel's own position.

All important navigation sensors are linked to a computer-guided integrated navigation system (INA). The navigation data are transmitted to the individual users by two separate and independent data distributors. Since the F-123 has an assigned flagship role for multinational task groups, the communications systems meet NATO standards concerning numbers of HF and UHF transmitters/receivers. In 1998, SCOT-3 satellite communications equipment was installed, in a departure from earlier plans to provide containerized satellite-communications equipment. The message-handling unit, supplied by TST, featured a new generation of high-performance transmitters and receivers.

Several improvements have been introduced for the damage control and engineering systems, making them superior to those on any other ships of the German Navy. The number of damage control stations has been raised from two to four. The capacities of the ventilation, firefighting and bilge-water systems have been increased to reduce combat damage. New features include vertically arranged independent ventilation systems comprising 12 ventilation modules, and vertically arranged independent seawater fire extinguishing systems, including 12 fire pumps.

Command and control rooms such as the CIC radio, briefing/OTC (Officer in Tactical Command) and computer rooms, which have to be especially protected against the effects of splinters, are fitted with Kevlar armor as an additional means of protection. Further design characteristics such as the sloped walls of the superstructure, separate funnels and special exhaust routes result in radar and infrared signatures well below the levels reached with conventionally built vessels.

The F-123 also meets the latest international environmental requirements, a matter of great importance to the German Navy. The vessel has two biological wastewater treatment units, a bilge-water oil separator and a refuse shredder/compactor. Air conditioning equipment both for crew comfort and to provide the proper environment for sensitive electronic equipment has been installed. Other amenities include laundry rooms, modern hygiene facilities and a galley (kitchen and bakery) that meets the highest standards of cleanliness.



F-123 Brandenburg Frigate

Source: Forecast International

Variants/Upgrades

Original plans called for the F-123 class frigates to enter the shipyards for a preplanned product upgrade in mid-1997. As originally conceived, this would have meant the installation of the towed sonar array system, the installation of a third STIR fire control radar, and the upgrading of the STIRs from the 1.8 to 2.4 standard. This upgrade was subsequently delayed until 2003 on financial grounds, but in a limited upgrade in 1998, SCOT-3 satellite communications equipment was installed and an STN-designed electro-optical fire control system was provided.

F-124. The F-123 series has been followed by F-124 AAW destroyers. These are basically a derivative of the F-123 with Mk 41 VLS surface-to-air missiles whose capacity has been increased from 16 to 32 rounds, and an AAW sensor suite that is being jointly developed by the Netherlands and Canada. The total weight of the ship is about 5,600 tonnes, fully loaded. This project is being developed concurrently with the multinational frigate program of the Netherlands and Canada. The helicopter on the F-124 will be the MH 90, the naval derivative of the NH 90. The Sea Lynxes initially installed on the F-123 will be replaced with MI 90s after the first group of MH 90s have been installed on the -124s starting in 2004. The strength and weight margins built into the F-123 design imply that those ships could be upgraded within the existing hull to approach -124 standards. The F-124 is covered in a separate report.

Program Review

Background. In June 1987, the German Ministry of Defense approved construction of four new frigates to replace the obsolete Hamburg class destroyers. The new frigate project had to meet two basic conditions: the first ship had to be ready for service in 1994, and the cost of the vessel equipped with appropriate systems was not to exceed DM650 million. These stipulations could not be met under the standard armament procurement procedures, which require concept and definition phases.

Fortunately, a substantial amount of expertise was already available: the continuing Type F-122 project (second group), the conceptual work for the NFR-90, and the export program involving the MEKO frigates had all required expert management and technical teams, so a pool of experienced personnel were already at work in industry and government ministries. Therefore, the conceptual and definition phases could be omitted, especially since the industry had stated in mid-1987 that it was prepared to work out the construction specifications and present a binding contract offer which would meet all basic requirements without relying on the usual development funds for such projects.

A detailed technical concept was developed based on the following points: the F-123 was to be a multipurpose frigate with specific ASW capabilities, including two onboard helicopters as major components; and the vessel was to be able to adequately protect itself against anti-ship missiles during ASW operations and provide limited air defense for fleet operations. Surface combat capabilities were only the third priority. The frigate was also to be able to coordinate various means of naval warfare and to lead group forces. The proposed mission tasks and the operational area required a vessel with blue water and all-weather capabilities. Furthermore, the platform was to be designed with growth potential so that it could be economically modernized with the latest sensors and weapons during the course of its projected 30-year service life. The design of the earlier F-122 was limited by treaty regulations restricting ship size.

The leading German shipyards began preparing design studies. Blohm + Voss prepared a modified version of its MEKO 360 Mod 3, while Bremer Vulkan submitted a modified version of the Bremen (Type 122) frigate, itself a modified version of the Dutch Kortenaer class frigate. The Federal German Navy formally evaluated the designs during most of 1988. The modified version of the Type F-122 design was regarded as unsatisfactory on a number of grounds. Many components, especially in the area of weapons and command systems, could not be obtained economically and/or were not available on a long-term basis. In addition, new and more effective technical options had become available since the original design of the ships and were essential to meet the ever-changing nature of potential threats.

Experience and knowledge gained from the deployment of the F-122, and during the Falklands War and the war between Iran and Iraq, were incorporated into the new design to increase the survivability of the proposed vessel. The modular construction method (MEKO principle) would not only shorten the production phase, but also make it easier to perform modifications later

and increase the vessel's availability during deployment. For these reasons, a largely new design was developed employing those components of the F-122 that had been successfully tested and were still available. The detailed Requirements and Standards F-94 (the designation F-123 was applied at a later stage) was completed within only six weeks and approved by the German Undersecretary for Armaments in August 1987.

In October 1988, Blohm + Voss received a contract for one ship. The Navy announced that three more ships would be ordered, with contracts going to Blohm + Voss, Bremer Vulkan, Howaldtswerke Deutsche Werft and Thyssen-Nordseewerke. The orders for the last three ships were placed in 1989. Actual construction of the first ship started in February 1991, two months earlier than scheduled. The keel was laid in February 1992. The lead ship, *Brandenburg*, was launched in August 1992.

The fully equipped lead ship entered service on October 14, 1994, at which time the second Sea Acceptance Trial, which includes extensive testing of the software for the Command and Weapons Control System, was conducted, along with operational and sea trials for machinery. The last of these ships was commissioned to service with the German Navy on December 6, 1996.

A variant of the F-123 design, the F-124, is being designed as the German component of the projected Dutch/German/Canadian anti-air warfare destroyers. The current proposal for this program calls for the joint design of an integrated AAW system comprising Signaal SMART-L long-range surveillance radar, SMART-S target acquisition radar and a new phased-array fire control radar, plus either Evolved Sea Sparrow or Standard SM-2 missiles. This system would then be integrated with a national hull and command system (the F-123 class and SATIR for Germany). Originally, four Type F-124 class ships were projected, but this was reduced to three for financial reasons. The option for a fourth ship was maintained but is unlikely to be exercised before 2004.

In early 1996, the existing US-designed guided missile destroyers of the Lutjens class developed severe machinery problems. The 1,200 psi plant installed in these ships has long had a reputation for unreliability. The premature decommissioning of these ships was contemplated with a consequent acceleration of the Type F-124 program. In the end, the boiler/steam turbine machinery complexes were repaired and the ships will be retained until the Type F-124 class are available.

The adoption of MEKO design practices means that complete prefabricated weapon systems can be installed and integrated within a few days on the F-123. This allows for systems upgrades that could maintain the effectiveness of the Brandenburg class as ASW ships throughout their hull lives. In addition, modularity means this equipment can be upgraded at much lower costs than would otherwise be the case.

The design teams have also provided substantial design margins of weight (230 tonnes), volume, electrical power, and stability reserves to allow for future upgrades. Since hull structural steel is not expensive (the hull and machinery on a frigate of this type account for about 10 percent of the total value), economies here are pointless. Adding these design margins at the earliest stages enables the ships to be upgraded far more cost-effectively at a later date.

Funding

The severe competition between the shipyards and contractors during the selection phase led to a 10 percent reduction of the maximum cost estimate, based on system and equipment price levels in effect as of December 1987. The construction contract was signed on a fixed-price basis. The quotation for systems includes all charges for management, software/programming, documentation, spare parts, and initial training as well as the establishment of training facilities. Compared with other projects of this kind, the cost is very favorable.

In addition to the competition factor, the cost of the project was held within reasonable bounds by keeping the vessel's requirements to an effective operational minimum and by employing new methods and standards – including experience gained from export – which hold down costs without affecting performance. However, it must be emphasized that this close price calculation has nearly eliminated the possibility of maintaining reserve funding – and this applies to all contract partners. Therefore, this program was carried out with strict fiscal discipline.

Recent Contracts

Contractor	Award ($ millions)	Date/Description

Contractor	Award ($ millions)	Date/Description
Unisys	27.5	1990 – Provision of data processing systems for the F-123 class.
Signaal	121	1996 – Dutch Navy contract for supply of active phased array radar (APAR) for the successor LCF class.
GKN Westland/ Eurocopter Deutschland	165	September 1996 – Seven Super Lynx Series 100 helicopters operating off the Bremen, Brandenburg class frigates as well as the Nordholz naval air base.
GKN W/ED	132	July 1998 – Upgrading of 17 Mk 88 Lynxes to Super Lynx standard.

Timetable

Month	Year	Major Development
Oct	1987	German Navy begins design studies for new frigate
Oct	1988	Consortium selected as contractor
Mar	1989	Work specifications completed; contract negotiations completed
Apr	1989	Construction permit approved
Jun	1989	Acknowledged by defense budget committee; construction contract closed
	1991	Production of first ship begun
Feb	1992	First keel laid
Aug	1992	Launch of first ship
Oct	1994	First F-123 commissioned
Jun	1996	First three Type F-124 class ships ordered
Dec	1996	Last F-123 commissioned
	1999/2000	First F-124 successor launched

Worldwide Distribution

Germany. four in service.

Forecast Rationale

The Brandenburg class has now entered the plateau of its career. The ships are in service, they have been debugged, and the inevitable design problems experienced with any new ship located and solved. The future upgrade and retrofit programs have now been mapped out and some consideration at least made toward calculating the necessary funding for those programs. In a very real sense, the F-123 class frigates have vanished into the German fleet. They will be found undertaking their routine duties, making port visits and supporting national interests.

Since this class is now mature and construction has ceased, it is unlikely that any additional newsworthy developments will be reported. While an ongoing program of retrofits and upgrades will keep the ships modern and effective, none of the changes will be revolutionary in nature. From a forecasting point of view, these ships are no longer significant market factors.

The only thing that could change this assessment is an export order. At the present time this seems improbable. The ships are ASW-oriented in a world where land attack, surface warfare and anti-air warfare are the driving factors. The majority of potential customers are looking for a general-purpose design with emphasis on anti-ship and anti-air warfare. The F-123 is far removed from this profile and therefore is limited to a small and confining niche that is already addressed by designs well established on the export market.

Also affecting the market for the F-123 are the large number of ex-US and ex-British surface combatants being sold to allies and other customers as they are withdrawn from national service. The most prominent of these is the US Perry class FFGs that are being widely distributed to friendly nations that need a limited

AAW capability. These sales have taken up much of the high end of the frigate-sized surface combatant market.

At one time, the F-123 was seen as the likely basis for a significant family of warships for the larger maritime powers. Over the last four years, changing circumstances have eliminated that possibility, and the orders once projected for this class have gone to its AAW-oriented rivals. So no more F-123s are expected to be built. The four in existence are likely to see long service with the German Navy, where their large reserves of weight, volume and power will allow the system upgrades necessary to keep them viable. This report will be archived next year.

Ten-Year Outlook

The forecast chart is omitted since no new production is projected. The ships will, however, be continuously upgraded throughout their service careers.

* * *