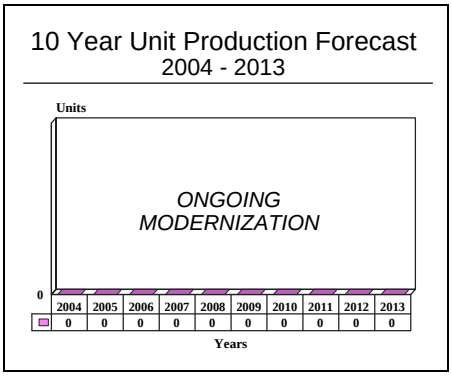
FFG-7 Oliver Hazard Perry Class - Archived 9/2005

Outlook

- Mark 13 launcher decommissioned on U.S. ships
- Two members of class transferred to Portugal
- No further construction likely
- Non-U.S. ships candidates for significant modernization



Orientation

Description. Guided missile frigates, with a primary anti-air warfare (AAW) and anti-submarine warfare (ASW) role to protect amphibious expeditionary forces, underway replenishment groups, and merchant convoys.

Sponsor

U.S. Navy
Naval Sea Systems Command (NAVSEA)
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Arlington, Virginia (VA) 22242-5160
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Royal Australian Navy
Navy Office
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Queen Victoria Terrace
PO Box E33
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Tel: +61 6 265 9111
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Spanish Ministry of Defense
Ministerio de Marina
Madrid, Spain

Taiwan Ministry of Defense
Chinese Navy (Chung-Kuo Hai Chen)
Keohsiun, Taipei
Taiwan

Status. In production and service.

Total Produced. About 70 ships of this class have been built worldwide.

Pennant List

Number & Name	Builder	Launch	Commissioning
USA			
FFG-8 *McInerney*	Bath Iron Works	11/1978	12/1977
FFG-28 *Boone*	Todd Shipyards, Seattle	1/1980	5/1982

Number & Name	Builder	Launch	Commissioning
FFG-29 *Stephen W. Groves*	Bath Iron Works	4/1981	4/1982
FFG-32 *John H. Hall*	Bath Iron Works	7/1981	6/1982
FFG-33 *Jarrett*	Todd Shipyards, San Pedro	10/1981	7/1983
FFG-36 *Underwood*	Bath Iron Works	2/1982	1/1983
FFG-37 *Crommelin*	Todd Shipyards, Seattle	7/1981	6/1983
FFG-38 *Curts*	Todd Shipyards, San Pedro	3/1982	5/1983
FFG-39 *Doyle*	Bath Iron Works	5/1982	4/1983
FFG-40 *Halyburton*	Todd Shipyards, Seattle	10/1981	12/1983
FFG-41 *McCluskey*	Todd Shipyards, San Pedro	9/1982	11/1983
FFG-42 *Klakring*	Bath Iron Works	9/1982	8/1983
FFG-43 *Thach*	Todd Shipyards, San Pedro	12/1982	2/1984
FFG-45 *DeWert*	Bath Iron Works	12/1982	11/1983
FFG-46 *Rentz*	Todd Shipyards, San Pedro	7/1983	6/1984
FFG-47 *Nicholas*	Bath Iron Works	4/1983	2/1984
FFG-48 *Vandegrift*	Todd Shipyards, Seattle	10/1982	11/1984
FFG-49 *Robert G. Bradley*	Bath Iron Works	8/1983	6/1984
FFG-50 *Taylor*	Bath Iron Works	11/1983	10/1984
FFG-51 *Gary*	Todd Shipyards, San Pedro	11/1983	10/1984
FFG-52 *Carr*	Todd Shipyards, Seattle	2/1983	7/1985
FFG-53 *Hawes*	Bath Iron Works	2/1984	1/1985
FFG-54 *Ford*	Todd Shipyards, San Pedro	6/1984	4/1985
FFG-55 *Elrod*	Bath Iron Works	5/1984	4/1985
FFG-56 *Simpson*	Bath Iron Works	8/1984	8/1985
FFG-57 *Reuben James*	Todd Shipyards, San Pedro	2/1985	3/1986
FFG-58 *Samuel B. Roberts*	Bath Iron Works	12/1984	4/1986
FFG-59 *Kauffman*	Bath Iron Works	3/1986	2/1987
FFG-60 *Rodney M. Davis*	Todd Shipyards, San Pedro	1/1986	5/1987
FFG-61 *Ingraham*	Todd Shipyards, San Pedro	6/1988	7/1989
AUSTRALIA			
F01 *Adelaide*	Todd Shipyards, Seattle	6/1978	11/1980
F02 *Canberra*	Todd Shipyards, Seattle	12/1978	3/1981
F03 *Sydney*	Todd Shipyards, Seattle	9/1980	1/1983
F04 *Darwin*	Todd Shipyards, Seattle	3/1982	7/1984
F05 *Melbourne*	Williamstown	5/1989	2/1992
F06 *Newcastle*	Williamstown	2/1992	12/1993
BAHRAIN			
90 *Sabha*	Bath Iron Works	8/1980	9/1981
EGYPT			
901 *Sharm el-Sheik*	Todd, Seattle	8/1979	1/1982
906 *Toushka*	Todd, San Pedro	3/1980	4/1982
911 *Mubarak*	Todd, San Pedro	7/1980	8/1982
916 *Taba*	Bath Iron Works	12/1980	12/1981
POLAND			
FRR272 *Pulaski*	Bath Iron Works	3/1979	5/1980
FRR273 *Kosciuszko*	Todd Shipyards, San Pedro	7/1978	4/1980
SPAIN			
F81 *Santa Maria*	Izar, Ferrol	11/1984	10/1986
F82 *Victoria*	Izar, Ferrol	7/1986	11/1987
F83 *Numancia*	Izar, Ferrol	1/1987	11/1988
F84 *Reina Sofia*	Izar, Ferrol	7/1989	10/1990

Number & Name	Builder	Launch	Commissioning
F85 *Navarra*	Izar, Ferrol	10/1992	5/1994
F86 *Canarias*	Izar, Ferrol	7/1993	12/1994
TAIWAN			
1101 *Cheung Kung*	China Shipbuilding	10/1991	5/1993
1103 *Cheung Ho*	China Shipbuilding	10/1992	3/1994
1105 *Chi Kuang*	China Shipbuilding	9/1993	3/1995
1106 *Yeuh Fei*	China Shipbuilding	8/1994	2/1996
1107 *Tzu-I*	China Shipbuilding	7/1995	1/1997
1108 *Pan Chao*	China Shipbuilding	3/1997	2/1998
1109 *Chang Chien*	China Shipbuilding	7/1997	11/1998
1110 *Tien-tan*	China Shipbuilding	9/2001	10/2003
TURKEY			
F490 *Gaziantep*	Bath Iron Works	2/1980	3/1981
F491 *Giresun*	Todd, Seattle	3/1979	9/1981
F492 *Gemlik*	Bath Iron Works	5/1980	6/1981
F493 *Gelibolu*	Todd, San Pedro	6/1981	2/1983
F494 *Gokceada*	Todd, San Pedro	2/1981	11/1982
F495 *Gediz*	Todd, San Pedro	10/1979	11/1981
F496 *Gokova*	Bath Iron Works	7/1979	10/1980

(Taiwan does not use pennant number 1104 since the number four is believed to bring bad luck. For the same reason, 1102 is not used, as the digits add up to four.)

Mission. The FFG-7 class destroyers are designed to escort and protect convoys, underway replenishment groups, amphibious landing groups, and carrier battle groups. The ship's missile, gun, and anti-submarine warfare systems, combined with its quick reaction and high speed capability, make the FFG-7 Perry class a valuable asset in today's multithreat environment.

Price Range. The price varies based on the equipment used. It is estimated to have been between US$250 million and US$350 million per ship. In 1999, Taiwan stated that the per-ship price of its hulls has been the equivalent of US$215.4 million. The latest recorded cost of these ships as sold by the U.S. Navy to its allies is US$60 million.

Contractors

General Dynamics Bath Iron Works, http://www.gdbiw.com, 700 Washington St, Bath, ME 04530 United States, Tel: + 1 (207) 442-3311, Fax: + 1 (207) 442-1567, Email: info@gdbiw.com, Lead Contractor

Todd Shipyards Corp, 1801 16Th Ave SW, Seattle, WA 98134-1017 United States, Lead Contractor

Transfield Group Of Companies, Seven Hills, Australia, Licensee

Izar, http://www.izar.es, Velázquez Street, 132, Madrid, 28006 Spain, Tel: + 34 91 335 84 00, Fax: + 34 91 355 86 52, Email: izar@izar.es, Licensee

China Government Republic Of, Hsing-Ho Arsenal, Kaohsuing, Taiwan R.O.C., Licensee

Technical Data

The data for the long version are given where applicable.

	Metric	U.S.
Dimensions		
Length, overall:	135.64 m	445.0 (455.37) ft
Long version:	138.1 m	453.0 ft
Beam:	13.7 m	45 ft
Draft:	4.5 m	14.8 ft
with sonar:	7.5 m	24.5 ft

	Metric	**U.S.**
Displacement		
Light:	2,813 tonnes	2,769 tons
Full load:	3,657 tonnes	3,600 tons
Long version:	4,165 tonnes	4,100 tons
Performance		
Maximum speed:	54 kmph	29 kt, sustained
Range:	7,800 km at 37 kmph	4,200 nm at 20 kt
Crew:	200 (15 officers), 19 air crew	
	Type	**Quantity**
Armament		
Missile launcher:	Mk 13 Mod 4	1
Missiles		
AAW:	Standard SM-1 MR Block VI	36
SSM:	Harpoon	4
Torpedo tubes:	Mk 32 Mod 5	2x3
Torpedo:	Mk 46 Mod 5	24
Guns		
Medium caliber:	Mk 75 76 mm L62	1
CIWS:	Mk 15 Phalanx	1
Light:	0.5 in M-2HB	4
	25 mm L87 Mk 38	2
Helicopters:	SH-60B LAMPS III	2
Electronics		
Radar		
Surface search:	SPS-55	1
Air search:	SPS-49(V)4	1
Fire control:	Mk 92 Mod 2	1
	STIR (modified SPG-60)	1
Electronic Warfare		
ESM:	SLQ-32(V)2	2
ECM:	Sidekick	2
Decoy launchers:	Mk 36 SRBOC	4
Torpedo decoy:	SLQ-25 NIXIE	2
Sonars		
Hull mounted:	SQS-56	1
Towed array:	SQR-19	1
Bathythermograph:	SSQ-61	1
Track recorder:	UNQ-7F	1
Fathometer:	UQN-4	1
Command and Control		
PPI display console:	OJ-194 (V)3/UYA-4(V)	1
IFF decoder group:	UPA-59A	1
Radar indicator group:	SPA-25B	1
ASW combat system:	SQQ-89 (US active ships only)	1
Computer:	UYK-7V	

	Type	Quantity
Electronics (continued)		
Communications		
Satcom transceiver:	WSC-3(V)	2
Satcom receiver:	SSR-1	2
Transceivers:	URC-80(V)5 SRC-20A SRC-21A PRC-96	
Navigation:	SRN-12 OMEGA receiver	
Machinery		
Gas turbines:	GE LM2500	2x20,500 shp
Propeller – Main:	Controllable pitch	1
Auxiliary Propulsion:	Retractable propeller pods	2

Design Features. The FFG-7 class was intended to provide a low-cost supplement to the Spruance class destroyers for escorting convoys, underway replenishment groups, and other slow moving carrier forces. Although considered by the U.S. Navy to be a frigate, the FFG-7 is classified as a destroyer by the rest of the world.

The FFG-7 represented the first major break in U.S. Navy escort design since the early 1950s. The hull itself is a typical Navy design, flush decked with very pronounced flare and sheer and a steeply raked prow. In contrast, the superstructure is angular and boxy, a combination that results in high radar cross-section, which has aroused much adverse comment. In fact, the angularity is caused by the upward extension of inboard hull bulkheads. This has resulted in an immensely strong structure, making the ships able to withstand more damage than any others in their class. This sturdiness is emphasized by the inclusion of significant armored protection, including 19 mm aluminum alloy armor over the engine rooms, 16 mm steel over the engine room control station, and 19 mm Kevlar armor over the command spaces.

The bulky superstructure also supplies large amounts of internal volume that can be used for upgrades. Although this will not be exploited by the U.S. Navy, it has provided other users of the FFG-7 design with the ability to increase the operational capability of the ships by the inclusion of integrated command systems and additional electronics. The problem is that the ships are overweight by 500 tons (with the original design margin being only 39 tons), and the resulting stability problems limit the utilization of available space.

The power train is exactly half that of the DD-963 Spruance class. The two gas turbines drive a single shaft fitted with a controllable pitch propeller. This arrangement has been criticized on grounds of vulnerability, but the single shaft is buried deep in the hull structure, and combat damage sufficient to destroy it would sink the ship first. Two auxiliary propulsion plants are installed forward to provide get-home power in case of a mechanical casualty disabling the ship. Such a casualty is more likely to result from turbine or gearing failure than the single shaft.

These ships are officially rated at 28.5 knots. In fact, they all comfortably exceed this speed, and the Australian ships were rated at between 30.85 and 32.1 knots following their full-speed sea trials. The ships have a proven ability to maintain 25 knots on one gas turbine.

Operational Characteristics. The primary anti-aircraft battery of these ships is the single-rail Mk 13 launcher, which has a 40-round magazine underneath. The magazine can accommodate SM-1 MR Block VIB AAW missiles, Harpoon anti-ship missiles, or ASROC anti-submarine rockets, although the latter option is rarely carried. The normal load-out is 36 Standard AAW missiles and four Harpoons, although the ships may carry up to 26 Harpoons in dedicated surface warfare configuration. An additional eight Harpoon missiles can be carried in two quadruple banks if required. Plans to equip the U.S. ships with the SYS-2 New Threat Upgrade system and SM-2 missiles have been abandoned. Note: the missile launcher on American ships is being withdrawn from operational use.

The Mk 92 fire control system forward and the STIR aft give a total of four missile guidance channels. This is fully comparable with the Charles F. Adams class missile destroyers and is substantially greater than most other non-U.S. AAW-orientated warships (the British Type 42 and French Cassard class destroyers, both comparable in size to the FFG-7, have only one or two guidance channels per ship).

The ship's missile armament is backed up by a single Mk 75 76 mm L62 gun, a license-built derivative of the Otobreda 76 mm super-rapid. This was a last-minute substitution for an abortive Sea Mauler AAW point

defense missile installation. The gun has a very limited arc of fire and has suffered mechanical problems due to its proximity to the gas turbine exhausts.

ASW capability is vested in a combination of an SQR-19 towed array (or its equivalents) and two ASW helicopters (normally SH-60 type). The hangars are reported to be large and capacious and provide good maintenance facilities. Some problems have been reported in landing lighter helicopters due to turbulence from the nearby gas turbine exhaust. Although a hull sonar (the SQS-56) is fitted, this is very restricted in capability and is basically used as a torpedo warning set. Users other than the U.S. Navy place considerably greater emphasis on this hull sonar, and its capabilities are expanded accordingly.

The FFG-7 can accommodate new weapons systems and sensors. Perhaps the most important of these, one invisible from the outside, is the inclusion of a fully integrated command system. This greatly increases the combat efficiency of the ships as compared to the U.S. variants that lack such systems. In addition to the well-known European systems of this type, such equipment is now available from both Hughes and Lockheed Martin. The problem in this area is weight; although the design has the internal volume to allow for upgrades, the weight margin has been fully utilized and any further additions are likely to negatively affect stability.

FFG-51 USS *Gary*, Oliver Hazard Perry Class

Source: Todd Shipyards

Variants/Upgrades

The Oliver Hazard Perry class has been very successful in the export markets, and slightly varying versions have been licensed for construction locally. The main difference between the ships built in the U.S. and those under license in Australia, Spain, and Taiwan is the combat system of the latter, which is superior to the USN Perrys, in tactical situation appreciation.

Adelaide Class. The Australian ships do not have the SQR-18 or SQR-19 sonars. The first four ships are equipped with the SQS-56, the final pair with the Mulloka hull-mounted sonar. All six Australian ships have enhanced communications equipment, Radamec Series 2500 electro-optical sensors, rigid inflatable boats, and radar-absorbing material applied to the superstructure. At present, the Australian FFG-7s do not have towed arrays.

A major upgrade program is being carried out for the six Australian FFG-7s. This program was instigated by the Australians because of the high cost of supporting some of the older systems on the ships. Sea 1390 originally anticipated the upgrade program to be completed between 1996 and 2003. Since then, the program execution has slipped from those dates, and the estimated completion date is now early 2006.

The main purpose of carrying out the upgrade program is to buy more service time for the ships that will be replaced by a new surface combatant class known only as Sea 1400. A number of measures will be taken to enhance the Adelaide class's primary air defense roles. These include the installation of phased array search radars, the replacement of the Mk 13 launcher with a 32-round VLS for Standard and Evolved Sea Sparrow AAW missiles, and the installation of a towed array.

The electronic warfare equipment is to be totally replaced and, most importantly, an integrated command system will be installed. The ships are currently fitted with the EA-2118. A reorganization, however, will mean substantial weight addition. Some of the weight could be relieved by replacing the heavy SRBOC launchers with the lighter and more effective Super Barricade system.

Santa Maria Class. The FFG-7 versions built in Spain have significant modifications over the original U.S. version. The hull structure is shorter (137.7 meters) and wider (14.3 meters), and is fitted with improved stabilization equipment, including small fins on the waterline port and starboard. These improve the ship's hydrodynamic performance and save up to 6 percent on fuel consumption. The displacement, at 4,017 tons, is also below that of the Australian or the Taiwanese versions, both of which rate more than 4,100 tons.

The key difference, however, is that the ships are equipped with the TRITAN III integrated command system, which greatly improves the overall capability of the ships and their ability to operate in multirole environments. The SLQ-32/Sidekick EW system has been replaced by Nettunel, the Italian Elettronica Nettuno system, built under license in Spain. The Mk 000 communications intercept system is installed, enabling the ships to undertake COMINT/ELINT duties.

The ships are equipped with the Meroka IIB CIWS in place of the Phalanx Mk 15, and have the associated RAN-12L and RAN-30X radars added to their suite. As for the radars, they are also reported to be fitted with the Raytheon 1650 for navigation and SPS-67s.

Cheung Kung Class. Taiwan originally planned to build its FFG-7 force in three separate groups. The first of these is the PFG-1 group originally intended to include six ships. This is very similar to the U.S. FFG-7 but has eight Hsiung Feng II missiles in quadruple launchers on the bridge, enabling the ships to carry a full outfit of 40 Standard AAW missiles. Two twin 40 mm Bofors guns are mounted amidships. Some local strengthening has been carried out to accommodate these. The ships have SQR-18 towed arrays, but these may be replaced by the BAeSEMA ATAS system.

The PFG-2 group represented a radical revision of the basic design. Plans for six of these ships were canceled in early 1995, and the two hulls for which components had been ordered were reordered as PFG-1 group ships.

The final group, PFG-3, would have been an advanced AAW variant of the design. It has been canceled.

Saudi Arabia/Turkish Proposal. An advanced derivative of the basic FFG-7 was proposed to meet frigate requirements from Saudi Arabia and Turkey. This version featured an enlarged hull – 10 meters longer than the standard and wider to maintain the hull lines. The machinery arrangements were changed so that each gas turbine drives a separate shaft instead of being geared to a single shaft. This resulted in major changes to the aft hull form. The ships were to be equipped with a fully integrated command system.

SYQ-17 RAIDS. The U.S. Navy has placed tender applications for the Rapid Anti-Ship Cruise Missile Integrated Defense System (RAIDS). The RAIDS is an automated tactical decision aid that will enhance the anti-ship missile defense effectiveness of the DD-963 and FFG-7 class surface combatants.

The RAIDS coordinates ship sensor information, provides threat identification and evaluation, assesses the ship's defensive readiness, and recommends an optimized defensive tactical response to counter single or multiple anti-ship missile attacks. The RAIDS system consists of a ruggedized IBM PC/AT-compatible multiprocessor, multidisplay, and hardware architecture. It also includes fiber-optic LAN interfaces. Maximum use of commercial off-the-shelf and nondevelopment components will be sought. A technical evaluation of RAIDS' capability to perform the requirements will be conducted. All electronic components must be rack-mounted and isolated against shock and vibration for a shipboard environment.

Program Review

The FFG-7 design started out as a low-cost replacement for the large number of ships built during World War II. Initially, three versions were planned, optimized for ASW, ASuW, and AAW, respectively. This concept was discarded and the twin hangars of the ASW version were combined with the Mk 13 launcher of the AAW variant to give a general-purpose design.

Detail design of the FFG-7, then known as the Patrol Frigate (PF), began in May 1973. The lead ship was authorized in FY73 when Congress approved the U.S. Navy's request for US$202 million. Bath Iron Works, Bath, Maine, received a US$94.4 million contract for the lead ship on October 30, 1973. Construction began in March 1975, and the lead ship, the USS *Oliver Hazard Perry*, was launched in September 1976. The *Perry* was commissioned on December 17, 1977.

Naval Sea Systems Command issued a Request for Proposals in April 1975 for the three FY75 ships with options for up to 15 additional ships (10 FY76 ships, two for the Royal Australian Navy, and three for

Greece). The RFP went to Todd Shipyards Corporation, Seattle, Washington; Todd Shipyards, San Pedro, California; Ingalls Shipbuilding Division/Litton Industries, Pascagoula, Mississippi; National Steel & Shipbuilding Company, San Diego, California; Bath Iron Works, Bath, Maine; Avondale Shipyards Incorporated, New Orleans, Louisiana; Newport News Shipbuilding & Dry Dock Company, Newport News, Virginia; Defoe Shipbuilding Company, Bay City, Michigan; and Lockheed Shipbuilding & Construction Company, Seattle, Washington.

In February 1976, Todd Shipyards of San Pedro and Seattle won the contracts for second- and third-source shipyards. Later that same year, Greece decided not to take part in the FFG-7 program.

The original FFG-7 design provided for handling the LAMPS I anti-submarine helicopter. The ships were retasked to carry the LAMPS III helicopter when available, although this required a redesign of the ship stern. The U.S. Navy, however, elected to take delivery of the first 26 frigates with the existing stern design and planned stern modification later for LAMPS III. In December 1978, the General Accounting Office put the cost of retrofitting for LAMPS III at US$7.2 million per ship. The GAO also stated that this estimate did not include equipment costs for LAMPS III, for the helicopter RAST system, or for the towed array sonar.

In January 1979, U.S. Navy witnesses before a joint economic subcommittee disputed the GAO estimates. These witnesses told the congressmen that the tentative per-ship cost is US$8.1 million, but that this estimate included LAMPS III, the RAST, and the towed array system costs. Modification of the stern after delivery cost an estimated US$1.3 million per ship, the U.S. Navy said. To accommodate the RAST, the Navy lengthened all ships after the USS *Underwood* (FFG-36) by 2.438 meters (8 ft). This was done by increasing the angle of the transom between the waterline and the fantail from a straight angle to 45 degrees. The FFG-7's sensor suite was the subject of controversy, with the ships being termed blind and deaf by some observers. This ill-judged attitude was to have major economic consequences.

In a report issued in February 1980, the General Accounting Office questioned the performance of the SQS-56 sonar system being produced for the FFG-7. The GAO report cited the sonar's limited detection range as being the main problem. The Perry class ships are the first U.S. Navy escorts since the early 1960s to have a medium frequency sonar. The GAO said this shortcoming, combined with the unavailability of the SQR-19 Tactical Towed Array Sonar system until the mid 1980s, would limit the FFG-7 class frigates to short-range sonar capability well into the 1980s.

The sonar problem was solved by the U.S. Navy's 1985 decision to include the FFG-7 ships in the SQQ-89 Surface Anti-Submarine Warfare Combat System program. The FFG-7 SQQ-89 installation includes the SQR-19 Tactical Towed Array Sonar, the SQQ-28 LAMPS III processing system, the Weapons Alternate Processor, and the Sonar In-Site Mode Assessment System. The Weapons Alternate Processor takes the place of the Mk 116 anti-submarine warfare weapon control system found in other SQQ-89-equipped ships. The FFG-7 ships retain their SQS-56 hull-mounted sonars, meaning that these were to be without the SQQ-89 system integration. (Other SQQ-89 ships carry the SQS-53 sonar, which is integrated within the SQQ-89). The first SQQ-89 systems were installed in the USS *Curts* (FFG-38) and USS *Elrod* (FFG-55) in mid-1986.

The sonar system was not the only problem faced by the ships. The U.S. Navy held an Operational Evaluation (OPEVAL) of the *Oliver Hazard Perry* (FFG-7) systems in 1978 and 1979, shortly after it was commissioned. The OPEVAL discovered that the Mk 92 fire control system had major problems with its performance and reliability, particularly during heavy rain and a sea/land clutter environment.

To improve this situation, Congress funded a research and development program in December 1980 to develop an anti-air warfare upgrade for the FFG-7 class. Concurrently, the Chief of Naval Operations mandated a three-phase Mk 92 improvement program. These efforts were conducted under PE#0604301N, Mk 92 Fire Control System Upgrade. The first phase called for correcting all quick-fix items and upgrading the system to handle the Standard SM-2 MR missile. This program, also called the Near Term Improvement Program, was instituted in early 1982. In June 1982, the U.S. Navy signed a development contract with Sperry for Phase II development of the improvement. This provided for the development of a coherent receiver/transmitter and improved signal-processing capabilities.

These upgrades improved detection 50 percent in sea clutter and 70 percent in a jamming environment. The Phase II improvements began their at-sea testing during mid-1985 and were approved for operational service in June 1986. Phase III of the program called for a major anti-air warfare capability upgrade to be installed during the class's half-life modernizations, which normally would occur after 15 years of service.

In March 1980, Sperry submitted an unsolicited proposal for the development and procurement of a four-panel, I/J-band phased-array radar upgrade. The U.S. Navy rejected the proposal because it called for simultaneous development and procurement. The

specifications were unclear, and the impact on the ship was not discussed. Sperry took its case to Congress. The result was the December 1980 research and development program and a debate concerning the ship's capabilities. The Navy stated that the phased-array upgrade would not justify its cost and that Sperry's assessed threats were not what the Navy expected the FFG-7 ships to face.

Congress told the Navy to base Phase III on the phased-array radar, and the Navy signed a development contract with Sperry in August 1984 for Phase III upgrades. Congress appropriated US$300 million in FY84 for the FFG-61 to be equipped with an upgraded Mk 92 system. After a review in November 1984, the U.S. Navy canceled the Phase III improvement program. However, the Phase I and Phase II development efforts continued during FY86 and FY87 as part of PE#0604301N. The coherent receiver/ transmitter underwent successful sea trials aboard the frigate USS *Estocin* (FFG-15) in 1986. The coherent receiver/transmitter is part of the FFG-61 Combat System, which also includes the Mk 92, the SPS-49, the SYS-2(V), and the Weapons System Processor/ Weapons Alternate Processor.

The FFG-61 had been the subject of some controversy, since the Navy originally had not requested it. The Navy's FY83 Five-Year Shipbuilding Plan had called for the construction of 10 frigates between FY84 and FY87, but the FY84 plan dropped this program entirely, and the Navy did not request any funding for an FFG-7 in that year's budget. As a result of pressure from West Coast shipyards and proponents of the anti-air warfare improvement program, Congress added the final frigate, FFG-61, to the budget authorization. The keel for this ship was laid down in December 1986. The Navy commissioned nine FFG-7 ships between January 1985 and May 1987. The Navy commissioned the USS *Ingraham* (FFG-61), the last FFG-7 class frigate, in August 1989. With the delivery of the FFG-61 *Ingraham*, the Navy concluded 14 years of procurement for this class frigate. In 1990, the backfitting of the Phalanx Mk 15 Mod 1 terminal defense system began.

During the spring of 1986, the Navy canceled development work on the FFX/FFGX replacement frigate for the 1990s. The primary reason for this was that experience with the FFG-7 class had shown that the limited hull size restricted opportunities for future modifications to reflect changes in weapons, sensors, and tactical requirements.

Australia ordered four FFG-7 destroyers from U.S. yards and followed these with two more built locally. All six ships are now in service. Taiwan was receiving assistance from Bath Iron Works and the U.S. Navy in producing a version of the FFG-7 suited to that navy's local requirements. The first six ships are minimally modified versions of the Navy's FFG-7 class. Eventually, the Flight II of the FFG-7 ships was canceled. So far, Taiwan has seven of these frigates in its service. In July 1999, a decision was made to order an eighth ship of the class, with essentially the same weapons and electronic systems fit as on the first seven ships. The ship was ordered in late 1999, and first metal was cut in mid-2001. The ship is expected to enter service in late 2003.

Spain laid the keel for the last two of its FFG-7 ships in 1989 and commissioned the fourth ship of the class, *Reina Sofia*, in 1990. However, because of several problems, progress on the last two ships was slow. Work on these ships was halted completely in 1991 because of a combination of funding shortages, labor disputes, and the shipyard itself threatening to go out of business. These problems seemed to have been resolved, and the last two ships entered service in 1994. Spain is now carrying out modernization of these ships while in service; new radars are being fitted, and up-to-date weaponry, including Meroka Mod 2B versions that are equipped with Enosa optronic trackers, are also being added.

During the Iran-Iraq War, two U.S. Navy FFG-7 class ships were damaged in action. The first, the USS *Stark*, was struck by two AM-39 Exocet missiles launched from an Iraqi fighter. Damage was severe, and the ship was nearly lost when the quantity of firefighting water used destroyed the ship's stability. Eventually a truly heroic damage control effort controlled the fires and saved the ship. The second ship to be damaged was the USS *Samuel B. Roberts*, which struck an Iranian-laid Pattern M.08 contact mine. The resulting explosion came close to blowing the ship in two, but the immense structural strength of the FFG-7 class paid off, and the ship was repaired. Reports from Navy sources, however, suggest that neither ship ever fully recovered from the damage inflicted and their performance has been badly affected by hull distortion. The USS *Stark* has now been stricken and sold for scrap.

In August 1994, the Royal Australian Navy program to modernize its fleet of FFG-7 class destroyers (Project Sea 1390) got under way when the register of interest in the program was closed. The original total value of this program was US$148.1 million or roughly US$24.7 million per ship. However, the results of feasibility studies and evaluations later pushed this amount up to US$593 million (US$100 million per ship). In January 1996, Australian Defence Industries (ADI) and Transfield were awarded project definition studies for this upgrade. The final progressive upgrade program contracts were awarded in 1996.

The Australian upgrade program on the Adelaide class was the largest single naval undertaking in Australia's current defense budget. These frigates will be brought up to today's standards in their combat and communications capability through the upgrade project. A prime contract was signed in June 1999 for the upgrade. ADI, which is the lead contractor, has subsequently issued a number of subcontracts from that AUS1 billion project, with heavy involvement of the U.S. Lockheed Martin group through its local units.

The U.S. Navy, under its Bottom-Up Review of 1992-1994, stated plans to retire at least 15 FFG-7 class frigates to reserve (or transfer to other countries) and reduce another 11 to naval reserve training status. The remaining 25 were to be upgraded with new radar-absorbing materials applied to the superstructure and reconfigured masts.

A 16-cell vertical launch system would have been installed to allow the ships to use the Evolved Sea Sparrow Missile for close-in defense. This plan was aborted in February 1995 when Admiral Boorda elected to retain in full commission the 15 ships scheduled for deactivation. Some of the cost would be offset by operating the ships with only a single helicopter on board. Other funding was derived from the US$25 billion defense increment offered by President Clinton. This decision was confirmed, but the fiscal demands of running the 15 frigates (estimated at US$15 million a year) were to be offset by economizing on (or even eliminating) the proposed modernization.

As part of this program, the U.S. Congress was asked to approve the transfer of four FFG-7 class destroyers to foreign navies in January 1996. These transfers involved two frigates for Turkey and one each for Egypt and Bahrain. The ships in question were the FFG-24 USS *Jack Williams* (scheduled for transfer to Bahrain), the FFG-25 USS *Copeland* (scheduled for transfer to Egypt in September 1996), and the FFG-20 USS *Antrim* and the FFG-21 USS *Flatley* (scheduled for transfer to Turkey in May 1996). This program ran into serious problems, with only the ship for Bahrain being confirmed. Egypt later increased its allotment to four ships. The deal with Turkey met strong opposition and at times seemed to be near cancellation. However, in November 1998, the transfer of three Perrys, along with equipment, ammunition, and eight Knox class frigates, was approved.

In early spring 1998, the lease of two more Perrys to Egypt (in addition to the two from September 1996) was converted to a sale at an estimated cost of US$35 million. Taiwan's announcement in 1999 that it would build one more FFG-7-derived Cheung Kung class frigate turned the situation around from only the year before. Up to that point it had seemed that the only future this ship had would be through upgrades and modernization of its onboard systems. In 1999, Turkey received three more Perrys, and an approval was granted to transfer at least two to Poland. The first transferred to Poland, the former U.S. Navy ship *Clark*, was taken into the Polish Navy on March 15, 2000. Turkey requested (and was granted) permission to transfer another ex-USN Perry in May 2000. This US$60 million transaction brings their total to seven.

Meanwhile, the U.S. Navy was struggling to find a way to keep its surface combatant fleet at the level of 116 units, the stated target in 1997. It was suggested in 1999 that this goal could be achieved without adding to the number of new ships by reducing the operating costs of the existing fleet. The means to reach that goal would be to accelerate the retiring of the DD-963 Spruance class destroyers and instead extend the maintenance of the Perrys (the Spruances are more costly to operate and maintain and require more personnel). Under the proposal, 11 Spruances instead of five would be decommissioned within the Navy's Future Years Defense Plan (FYDP); the numbers would be the reverse on the Perrys.

According to the proposal, the Perry class frigates would offer a "comparable range of capabilities" while shaving about US$300 million from the Navy's operating costs. The only difference between the two classes is in their naval gunfire support capability. The Spruances have two 5-inch guns, while the frigates have only a 76 mm cannon.

During 2003, there were a number of proposals to modify at least one U.S. Navy FFG-7 class frigate into a testbed for the weapons and systems being proposed for the new Littoral Combat Ship (LCS). A parallel testbed program is already in hand for the DD(X) class, using a decommissioned Spruance class destroyer as a basis. The reduction of the force profile maintained by the FFG-7 Class continued in 2004. The ships were reduced in capability by the elimination of the Mark 13 missile launcher forward, partly as a cost-saving measure (the Mark 13 launcher being a maintenance liability) and partly due to the withdrawal of the SM-1 missile.

Towards mid-2004, it was reported that Portugal would be receiving two FFG-7 class ships, apparently FFG-12 and FFG-14, as replacements for the three Joao Belo class ships.

Funding

This program has been funded by the navy of each user country. No procurement funding has been requested in the United States P-1 documents for several years, since new construction for the USN ended long ago.

Recent Contracts

Contractor	Award ($ millions)	Date/Description
ADI Ltd (prime)	587	May 1999 – Upgrade of six RAN FFGs, with Lockheed Martin and Gibbs & Cox as partnering companies. Projected completion in 2006.
Thomson Marconi Sonar	44	June 1999 – ADI subcontract for Underwater Warfare System.
Lockheed Martin Australia	150	June 14, 1999 – ADI subcontract for weapon, combat system work.
AAI Corp	19	June 24, 1999 – ADI subcontract for onboard training systems.
Lockheed Martin Launching Systems	37.7	July 23, 1999 – Six single-module Mk 41 vertical launch systems to RAN, to be delivered between 2002 and 2005 (ADI subcontract).
Lockheed Martin, GES	10	August 16, 1999 – Engineering, technical, and program management support for PFG-2, to be completed by September 2004.
Rafael	10	Late summer 1999 – C-PEARL ESM system for Adelaides, as part of the RAN frigate upgrade program FFG UP (Project SEA 1390).
Gibbs & Cox	9	December 29, 1999 – Design and support services for PFG-2 program.

Timetable

Month	Year	Major Development
Sep	1970	U.S. Navy initiates studies for new small escort
Jan	1971	CNO approves FFG-7 program conceptual phase
May	1971	Concept formulation completed
Dec	1971	Preliminary design and functional baseline completed
Sep	1972	Lead ship program approved
Sep	1976	FFG-7 launched
Nov	1977	FFG-7 delivered
Nov	1980	First Australian FFG-7 commissioned
Apr	1986	First Spanish FFG-7 commissioned
	1987	Taiwan decides to build FFG-7; U.S. agrees to provide plans
May	1989	Taiwan orders first eight of planned 12 ships
May	1993	First Taiwanese frigate (*Cheung Kung*) commissioned
Jun	1997	Australia's upgrade program given high priority
Oct	1997	Project definition study for upgrade program in Australia expected to be ready
Mar	1998	Two competing bids submitted for Australian upgrade project
Aug	1998	Radamec EO tracking systems begins arriving on Australian ships
Nov	1998	ADI selected as preferred contractor for Australian upgrade; Turkey approved to receive three more ex-USN Perrys
Jun	1999	ADI chosen as prime contractor for upgrade contract on six Australian ships
Jul	1999	Taiwan decides to order eighth ship
Summer	1999	Australia deploys Nulka ASM on board Adelaide class frigate
Mar	2000	Poland receives first of two former USN Perrys
May	2000	Turkey requests sale of seventh Perry class frigate
	2002	Upgrade program activity expected to peak with start of work on first ship

Month	Year	Major Development
	2004	Upgrade to begin on remaining Australian ships, based on experience from first
	2006	Upgrade program expected to be completed

Worldwide Distribution

Australia. 6
Bahrain. 1
Egypt. 4
Poland. 2
Spain. 6
Taiwan. 8
Turkey. 7
U.S. 33 in operation.

Forecast Rationale

For all its virtues, production of the FFG-7 class has now ended with the delivery of the last Taiwanese ship. For a class that was envisaged as a low-capability supplement to the highly capable but costly cruisers and destroyers, the FFG-7 class has had a long and distinguished construction run. Now, in the twilight of its service with the U.S. Navy, it has found a new lease of life, providing area air defense capability to smaller navies that had previously regarded such abilities as beyond their reach. For such navies, the Perry class brings an anti-air warfare capability to the frigate mission that has been lacking in the equivalent Cold War warship designs of similar size.

There now appears to be little chance of additional construction for the export market and, of course, there is no further procurement in view for the U.S. Navy. It is likely that the remaining ships of this class in U.S. service will see out their lives primarily as platforms for their helicopters, since the elimination of their missile launcher forward has taken out much of their available firepower. However, FFG-7 class ships supplied to other navies can be expected to have a long life as valuable and capable assets.

Ten-Year Outlook

No further production is contemplated, therefore the forecast chart has been deleted.

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