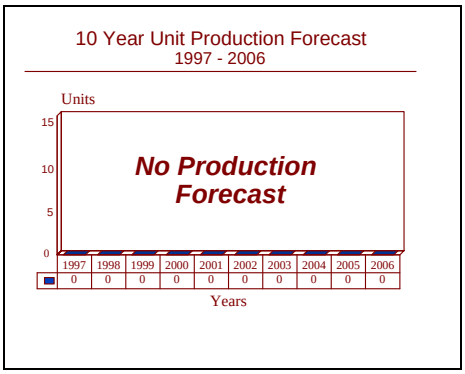
Mk 92 FCS - Archived 5/98

Outlook

- In service, in production, with ongoing logistics support
- About 52 Mod 2 versions and 33 Mod 6s had been produced through 1994
- Dates back to FY72; current sales to various international frigate fleets



Orientation

Description. This is a naval fire control system.

Sponsor
US Navy
Naval Sea Systems Command
Washington, DC
USA

Contractors
Lockheed Martin Corp
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Status. In service, in production, ongoing logistics support.

Total Produced. Through 1996, approximately 52 Mod 2 systems and 40 Mod 6 systems had been produced.

Application. FFG-7 class frigates and other frigates and small ships.

Price Range. Estimated cost is US$8.5 million per system.

Technical Data

Dimensions	Metric	US
Height		
CAS:	344 cm	135 in
STIR:	351 cm	138 in
Diameter		
CAS:	244 cm	96 in
STIR:	254 cm	00 in
Total weight:	10,063 kg	22,166 lb
CAS:	Combined Antenna System	

STIR: Separate Track Illuminating Radar

Characteristics

Power out:	190 kW
Frequency:	8 - 12 GHz
Pulse Width:	0.22/0.45 µsec
PRF:	1800/3600 pps
Scan rate:	60 rpm
Power consumption:	121 kVA
Roll:	± 30°
Roll Rate:	± 25°
Pitch:	± 10°
Pitch Rate:	± 15°/sec
Heading:	360°
Heading Rate:	± 12°/sec

Design Features. The Mk 92 Fire Control System is a lightweight, quick-reaction defense system. Size and weight make it especially adaptable to frigate and corvette-sized combat vessels. The Mk 92 was developed to provide these ships with an anti-air capability. It is a license-built version of the Dutch WM20 fire control radars.

The system provides integrated detection, command and control, as well as multi-channel air, surface or gun control. It offers two Standard missile fire control channels and can interface with the NATO Sea Sparrow and Harpoon anti-ship missile. Performance enhancements have increased its range, detection and tracking ability of the system. Improved clutter rejection and electronic counter-countermeasures capabilities make the Mk 92 more capable for defending against "sea skimming" missiles.

The Mk 92 employs two separate antenna systems, the Combined Antenna System (CAS) and the Separate Track Illuminating Radar (STIR). The CAS antenna is radome-enclosed and is made up of a continuously scanning, high data rate search antenna and an independent track radar antenna. The STIR antenna is used for long range tracking and CW illumination for missile guidance.

Operational Characteristics. Up to four targets can be engaged simultaneously. The Mk 92 provides automated target track files, threat priority criteria, engagement schedules, fire control track assignments, weapon loading and weapon assignment assignments. It integrates with other ship sensors to form an integrated offensive and defensive combat system.

The system provides simplified sequential controls and displays, engagement data displays, engagement intervention controls, missile and gun firing controls, and kill assessment capabilities. The Mk 92 is capable of simultaneously tracking targets while maintaining area surveillance. The Mod 6 upgrade dramatically increased range, tracking, sensitivity, and ECCM capabilities.

Variants/Upgrades

Mod 1 is used aboard the Coast Guard's Bear and Hamilton class cutters to control the 76 mm gun and provide targeting information for the Harpoon Weapons System.

Mod 2 is carried aboard Perry class guided missile frigates. It was designed to control the 76 mm/62 cal dual-purpose gun as well as SM-1 MR (Medium Range) missiles against both air and surface targets. It provides targeting information for the Harpoon Weapon System. The Mod 2 is integrated with a Separate Tracking and Illumination Radar, which can serve as a second Standard missile control channel.

Mod 5 is used by the Saudi Arabian Navy for its fast attack craft and corvettes to control the 76 mm gun. It is very similar to the Mod 1 system.

Mod 6 CORT was selected for the FFG-7 class guided missile cruisers. This system includes all the modifications and improvements resulting from a three-phase upgrade program. It will be part of the FFG-61 Combat System Configuration, which includes the SPS-49(V)5, SYS-2(V), Weapons System Processor (WSP), and Weapons Alternate Processor (WAP).

Company officials report that the Mod 6 doubles the detection and tracking range, improves target acquisition and track maintenance, has a 100-fold increase in clutter rejection, and can handle a 10-fold decrease in target cross section. The system's ECCM capabilities are better and the MTBF is doubled.

Other improvements include adding Guard Gate, Priority Engage, and Sector Scan modes. Other enhancements will improve the reliability of some components with a high failure rate and increasing the rate transmission of the antenna system.

Program Review

Background. Mk 92 development was initiated in FY72, coinciding with the detailed design of the FFG-7 class frigate that began in FY73. At-sea technical and operational evaluations (TECH/OPEVAL) were conducted aboard the frigate *USS Talbot*, FFG-4. During OPEVAL in 1978 and 1979, the Mk 92 exhibited major performance and reliability problems in heavy rain and a sea/land clutter environment. Despite good performance in clear weather, the Mk 92 failed at-sea TECH/OPEVAL during heavy weather in tropical conditions. The problems were eliminated.

The Navy developed a three-phase Mk 92 Upgrade Program.

Phase I was a near-term improvement of the system, emphasizing project completion.

Phase II, Concentrated on improving system performance for FFG-7 class ships in a heavy ECM or clutter. It included designing a new coherent receiver/transmitter to improve the Mk 92's performance in adverse weather/ECM environments and the developing improved signal processing.

Phase III was the most ambitious part of the program and focused on increased subclutter visibility, improved electronic counter countermeasures (ECCM)/burn through capability and increased detection and track range.

Phase III included developing the capability to counter high-altitude and heavy ECM threats projected for the 1990s. Four major considerations were addressed:

Improved Reaction Time, called for an automatic 3D track file with multiple track capability, improved probability of kill determination, improved target maneuverability detection capability and 3D designation for Mk 92 illuminators.

Improved Survivability, focused on high-elevation coverage, improved performance in clutter/ECCM, increased acquisition altitude in heavy jamming, and detection.

Improved Availability would result from overlapping radar capability for medium-range and fast/low elevation and non-catastrophic degradation of upgraded FCS for the Mk 92.

Growth Capability, will be integrated into the ship by providing as much spare room as possible for future add-ons.

FY83 saw the design and development of a coherent receiver/transmitter (CORT), while Mk 92 engineering development model refurbishment, a computer program update, and hardware/software designs began. A phased-array radar RFP was issued and contract negotiations conducted while long-lead equipment and materials were ordered.

In FY84, design and development of the CORT continued. Prototype hardware was fabricated and system integration initiated. Phase II computer coding was completed and debugging continued. The antennas were updated with a new design. Sperry proposed a program to modify and upgrade the Mk 92 aboard the last FFG-7 class ship, FFG-61, by installing an X-band phased array radar. The plan was to give the system the ability to have constant tracking in all directions.

The Navy canceled the effort and decided to install an upgraded Mk 92 aboard the FFG-61 without the X-band phased array. Cost was the issue, US$476 million, instead of the US$336 million for a ship without the new array.

Engineering development of the CORT and digital signal processor was completed and tests were held at a land-based site in FY85.

In late FY85, an engineering development model of the CORT was installed aboard the frigate *USS Estocin* (FFG-15) for sea trials. The Mk 92 computer program was recompiled, tested, and certified; and FFG-7 class combat system computer programs were developed.

In FY87, the service obtained approval for limited production of the CORT. The EDM was removed from the frigate Estocin and installed at the Combat Systems Test Center MacArthur Field to support integration testing for the frigate Ingraham (FFG-61). All deficiencies identified were rectified on-site. The Navy also finished developing computer programs for the Mk 92 and the Weapons System Processor/Weapons Alternate Processor (WAS/WAP) Baseline 8.

In late FY87, the Navy began Combat Systems Integration testing of the Mk 92, SPS-49, SYS-2(V) and WSP/WAP Baseline 8 for the FFG-61 Combat System.

In FY88, the Navy and Unisys continued combat systems integration testing for the FFG-61 Combat System. Computer programs were developed and tested, and plans made to correct the deficiencies discovered during the sea trials of the *USS Ingraham.*

The development and testing of the design corrections were completed in FY89 and the changes were initiated for backfitting the CORT onto FFG-7 ships that did not have SPS-49(V)5 and SYS-2(V)2 systems.

The Navy completed FCS Mk 92 Mod 6 development and land based testing in FY90. Developmental Testing II/Operational Testing IIB plans were completed for the FFG-61. IDS documentation baseline was also completed.

During FY91, the Navy conducted Mod 6 CORT operational testing aboard FFG-61, and initiated corrective action for deficiencies discovered during the OPEVAL. In releasing the original FY92/93 budget request, the Navy indicated that it may not fund upgrading all FFG-7 Mk 92s to the Mod 6 capability. This generated concern in the industry and brought about a major effort by the manufacturer to change this.

FY92 saw the development of modifications to correct deficiencies noted in Developmental and Operational testing aboard FFG-61. Fixes were installed on FFG-61 and all other applicable ships. The Navy determined that the Standard Missile-1 Block VI B is applicable for incorporation in FFG Mk 92 Mod 6 Coherent Receiver Transmitter/Integrated Automatic Detection and Tracking (CORT/IADT) ships. Planners developed at-sea test plans and evaluation milestones, and then conducted at-sea testing.

Engineers continued embedded trainer development and completed a re-compile and certification of the Fire Control Systems (FCS) Mk 92 Mod 6 computer program. They developed and evaluated Mk 92 tactical improvements; including Guard Gate, Priority Engage, and Sector Scan. Planners conducted at-sea testing aboard FFG-48. Program personnel continued development of a heavy duty transmission for the Combined Antenna System (CAS) and supported a higher echelon strategy in defining roles within ship self defense distribution.

Engineers initiated feasibility studies for Mk 92 Mod 6 improvements in Target Acquisition/Search and Processing and initiated studies to develop an improved automatic weapon scheduler for Mk 92 FCS Combat system integration.

In FY93, the Navy spent US$819,000 to develop the Mk 92 MOD 6 Frigate AAW Weapon System Trainer (FAST) to support FFG-7 Class Battle Force Tactical Training (BFTT) program milestones. Engineers evaluated a Mk 92 MOD 6 FAST Advanced Development Model (ADM) at the land-based test facility. Program personnel planned to execute Mk 92 MOD 6 FAST ADM testing at-sea.

The Navy also evaluated the Mk 92 FCS MOD 6/ Standard Missile-1 Block VIB concept at-sea firing test. This was completed in September 1992 to support FY94 IOC milestones, at a cost of US$411,000. The planned execution and support of FCS Mk 92 MOD 6/Standard Missile-1 Block VIB full-up- round at-sea firing test in support of FY94 IOC milestones was estimated to cost US$95,000. US$481,000 was programmed for continued analysis of weapon system capabilities and limitations while operating against various threats in various environments. Support analysis/tradeoff studies to coordinate and define element roles for the FFG-7 AAW Weapon System within the ship self-defense strategy were also planned at a cost of US$25,000.

In FY94 the Navy continued evaluating the Mk 92 MOD 6 FAST in preparation for production prototype procurement FY 96 milestone. US$225,000 was programmed for this. The Navy conducted Mk 92 Mod 6 FAST ADM at-sea testing. Engineers evaluated Standard Missile-1 Block VIB full up round at sea test data, programming US$303,000 for this. Planners would also provide support for FCS Mk 92 MOD 6/Standard Missile-1 Block VIB full-up-round at-sea firing test in support of FY94 IOC milestones.

Added plans spent US$195,000 to develop an improved automatic weapons system scheduler for FCS Mk 92 Combat System integration. Support (US$23,000) for analysis/tradeoff studies to coordinate and define element roles for the FFG-7 AAW Weapons System within the ship self-defense strategy was budgeted, as was an evaluation and at-sea test of a CASS antenna heavy-duty transmission (US$25,000). US$280,000 went to developing Commercial-off-the-shelf Affordable Near Term Deficiency Correcting ORDALT (CANDO) concepts to help the Navy engineer solutions to the FCS Mk 92 MODS 2/6 ability to detect small targets in near-land environments, and in regions of Multiple Interval Clutter (MIC).

The FY95 plan called for (US$959) testing and evaluating the Mk 92 FCS MOD2 CAS CANDO solution to reliably detect, acquire and automatically engage low-flying, small radar cross-section anti-ship missile threats, defending the ship against today's threat (US$959,000). Planners would also evaluate integration of the SM 1 V1B into the FFG-7 AAW Mk 92 MOD 2 configuration with at-sea testing. Planners hoped to (US$100) develop a Mk 92 MOD 6 track processing improvement to reduce the system's susceptibility to clutter and electromagnetic countermeasures and improve coast mode, spending US$100,000 to do so.

Other FY95 plans included investigating concepts on how to improve low elevation continuous wave illuminator performance against small targets (US$100), and US$50,000 to support analysis/tradeoff studies to coordinate and define elements of the role for the FFG-7 AAW Weapons System within a ship self-defense strategy. Continued engineering and prototype development to test concepts to solve detection and engagements of threat targets in MIC was set at US$767,000.

Funding

Funding for PE 0604301N ended in FY95.

Recent Contracts

(Contracts over US$5 million.)

Contractor	Award ($ millions)	Date/Description
Loral	19.8	Jan 1994 — FMS Contract for Mk 92 FCS assemblies to be used as deep insurance spares and rotatable pool assets for the Taiwanese Navy. Completed Jul 1995 (N00024-94-C-5606)

Timetable

FY72	Development initiated
FY74	At-sea technical/operational evaluations
FY76	Service approval
FY82	CORT design initiated
FY85	CORT design completed
FY86	At-sea tests
	Production decision
FY90	Complete developmental testing of Mod 6
FY91	Developmental/Operational testing aboard FFG-61
1995	Delivery of Taiwanese Mk 92

Worldwide Distribution

Australia The Royal Australian Navy (RAN) has six FFG-7 frigates.
Taiwan (Republic of China) The RoC ordered five Mk 92 CORT systems.
Thailand The Thai Navy is installing the Mk 92 FCS systems on the last of the six frigates it is procuring from China. The first four hulls could not be adapted to accommodate the hardware.
Spain The Royal Spanish Navy procured six FFG-7s from the USA in 1977.
Saudi Arabia The Royal Saudi Navy has four Badr class corvettes and nine al-Siddiq class fast attack craft equipped with the Mk 92 system. All were built in the United States from 1976 to 1981.
United States The US Navy installed 39 systems on its frigate class ships. The Coast Guard uses 13 systems on its *Bear* class cutters.

Forecast Rationale

Advanced weapons control is a priority for navies around the world. Anti-ship weapons have become more capable and are proliferating widely. Ships with limited capability systems have to be updated to modern capabilities. The improvements to the Mk 92 fire control system were a major enhancement for the Perry class frigates.

The high failure rate of early Mk 92 systems was corrected. Phase II upgrades led to a 50-percent improvement in target detection in sea clutter and 70-percent jump in performance in a jamming environment. Navy plans for ship self-protection indicate that frigates not receiving the Mk 92 CORT will have the Ship Self-Defense System (SSDS) Mk 0 tactical decision aid installed.

During initial FY96 defense budget testimony on Capitol Hill, the Chief of Naval Operations said that in order to maintain adequate fleet readiness within budget constraints, retirement of up to 15 frigates would be delayed. This extends the ongoing logistics support needs for the Mk 92 FCS.

The improvements incorporated into FFG-61 combat systems are being retrofitted to the other FFG-7s. Most, if not all, of the ships will feature the improved system. The current international defense fiscal climate precludes developing a replacement system. The next generation DDG-51 class ships are relying on their AEGIS system for fire control.

A steady market for spare and repair parts will continue, since FFG-7s are not expected to leave service until the 2010-2016 time period.

Ten-Year Outlook

No further production contracted.

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