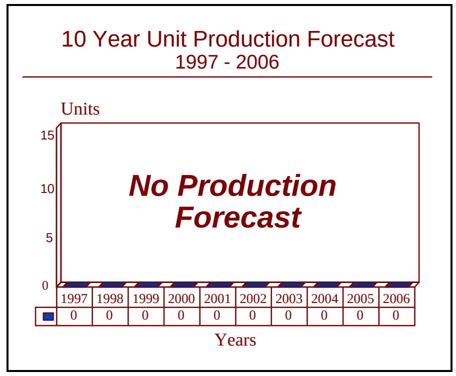
AIM-54A/C/C+ Phoenix - Archived 11/98

Outlook

- New unit production of the Phoenix missile has been terminated; various additional modifications to the existing inventory have been made
- The Phoenix remains in US Navy service onboard its F-14 Tomcat fighters; eventually, this mission could be fulfilled by a follow-on system based on the AIM-120 AMRAAM
- The US Navy is also conducting research into using the Phoenix to examine the viability of air-launched interceptors



Orientation

Description. Long-range air-to-air missile.

Sponsor. The United States Department of Defense through the US Navy with executive management by Naval Air Systems Command, Washington, DC, and Naval Air Development Center, Warminster, PA, USA. The Naval Air Systems Command is responsible for overall management and technical direction for new motor development. The Naval Air Development Center coordinates performance and compatibility requirements of Phoenix Improvement Program.

Contractors. Developed and produced by General Motors Corporation Hughes Aircraft Company, Missile Systems Group, Culver City, CA, USA. Production at Hughes' Tucson, AZ, facility. Hughes Aircraft is responsible for fabrication of the airframe, fire control and guidance system, missile digital processor, digital autopilot and frequency modulated transmitter.

Major Subcontractors. Aerojet Tactical Systems Company, Borg Warner (now known as BWIP), Control Data Corporation, Hercules Incorporated, Hydraulic Research, Moog, Motorola Incorporated, Northrop Corporation Electronics Division and Rockwell International Rocketdyne Division.

Second Source. The Raytheon Corporation Missile Systems Division of Lexington, MA, is the second source for the AIM-54.

Licensee. The AIM-54 Phoenix has not been licensed for production outside of the United States of America.

Status. AIM-54A production was terminated by the US Navy in 1980. Serial production of the AIM-54C+ has been concluded. Hughes was rectifying previous problems which caused the late deliveries of the AIM-54C for several months. Raytheon has also manufactured reprogrammable memory modification kits for the US Navy's Phoenixes. The Phoenix program was stretched into Fiscal 1993 by the US Congress to preserve the Phoenix industrial base in case of a continuation in procurement after the incorporation of the reprogrammable memory system. Actual production of the new Phoenix missile is believed to have ended, although the modification of the existing inventory is likely to continue until a Phoenix replacement is developed.

Total Produced. Over 6,400 AIM-54 Phoenix missiles (new and remanufactured) were completed through the end of 1995. Hughes delivered the 1,000th AIM-

54C missile to the US Navy in August 1989. This total includes over 600 AIM-54C+ missiles. Raytheon delivered its first AIM-54C missile in mid-1989. Some AIM-54A missiles have been cannibalized to produce complete AIM-54Cs. The original AIM-54A had a procurement objective of 2,932 missiles, while the new AIM-54C has one of about 2,200 (previously just over 3,300). The overall desired inventory objective was 7,000 missiles.

Application. Long range, all weather air-to-air missile that is the primary air-launched armament for Grumman F-14As against hostile supersonic aircraft and high- and low-altitude cruise missiles. The Phoenix missile's mission is to defeat multiple air targets using conventional warheads in performance of fleet air defense. A maximum of six missiles can be carried aboard each F-14. Near simultaneous launch is possible against six targets in an all-weather, heavy jamming environment.

Price Range. The Fiscal 1988/89 procurement documents list procurement price of the AIM-54A/C at $830,862 each in Fiscal Year 1989 dollars. The General Accounting Office, however, has placed the per unit cost of the AIM-54C for the purchase of 7,204 missiles at $922,000, closer to our previously quoted price of $972,083. The actual cost to produce an AIM-54, based on the Fiscal 1985 buy of 265 missiles, has been stated to be $650,000.

Technical Data

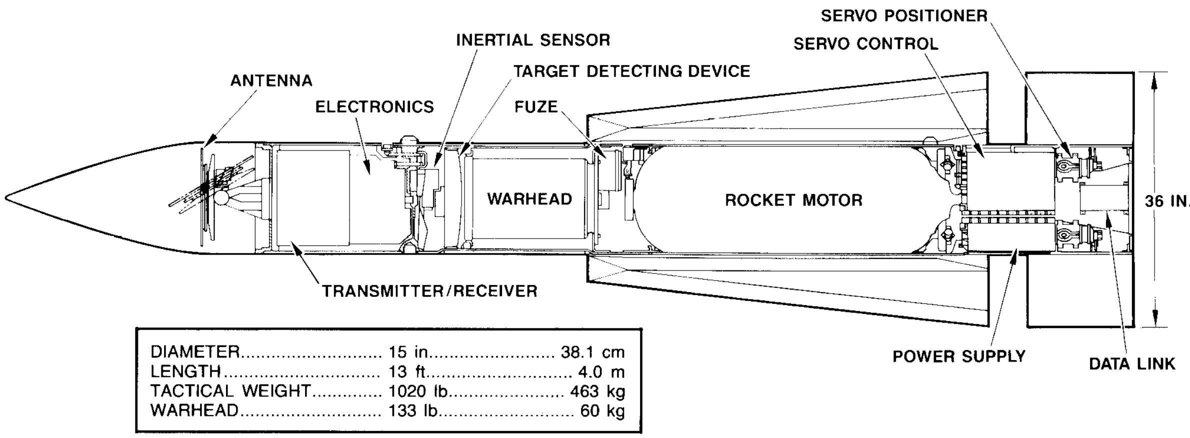
Dimensions	**Metric**	**Metric**	**US**	**US**
	AIM-54A	AIM-54C	AIM-54A	AIM-54C
Missile Length	401 cm	401 cm	13.15 ft	13.15 ft
Missile Diameter	38 cm	38 cm	14.96 in	14.96 in
Missile Weight	447.72 kg	465.45 kg	985 lb	1,024 lb
Wingspan	92.5 cm	92.5	36.41 in	36.41 in
Performance				
Speed	Mach 4.3	Mach 5+	Mach 4.3	Mach 5+
Range (Min)	203.25 m	203.25 m	2.1 nm	2.1 nm
Range (Max)	200 km	200 km	107.92 nm	107.92 nm
Maximum Altitude (Launch)	14,878 m	18,292.68 m	48,800 ft	60,000 ft
Maximum Altitude (Missile)	24,817 m	30,487.81 m	81,400 ft	100,000 ft
Reliability	Operational tests indicate a nearly 90% kill rate overall.			

Propulsion. The AIM-54A used an Aerojet Tactical Systems Company or Hercules Incorporated Mk 60 Mod 0 solid-propellant rocket motor, while the AIM-54C uses a Mk 47 Mod 1 motor from Hercules or Rockwell International Rocketdyne Division. Both motors are polybutadiene-based, but the Mk 47 is a more smokeless design.

Control & Guidance. Both missiles use the Hughes AWG-9 Doppler radar fire control system, with an infrared subsystem. The central processing computer is built by Control Data Corporation. The missile incorporates command/inertial guidance through the mid-course and active terminal guidance; the onboard guidance system is designated DSQ-26, the detection device is designated the DSU-28, and the safety fuze the FSU-10/A. Northrop Corporation Electronics Division supplies the inertial reference component. The AIM-54C features an all-new Digital Electronics Unit with all-digital processing and an ability to identify targets by individual characteristics through pre-stored computer simulations. The aerodynamic control surfaces are electro-hydraulically actuated with components supplied by Hydraulic Research and Moog. Borg Warner has developed a pneumatic actuation system for the AIM-54.

Launcher Mode. Fired from underwing-mounted Hughes LAU-132A missile launchers on F-14 aircraft. An F-14 Tomcat can carry a maximum of six AIM-54 Phoenix missiles.

Warhead. High-explosive warhead of 60.68 kilograms (133.5 pounds) weight. The warhead is proximity fuzed and of an annular blast fragmentation/continuous rod type to enhance lethality. Problems with the Micronics International, Brea, California, FSU-10/A composite fuze have been corrected. Raymond Engineering, Middletown, Connecticut, provides the FSU-10/A to Hughes Aircraft. The FSU-10/A combines warhead fuze components and the rocket motor ignition safety mechanism - five units altogether - into one. Difficulties with an Asher Engineering Corporation, Los Angeles, switch also have been solved.



Source: Forecast International

Variants/Upgrades

The Phoenix has been manufactured in a number of different models. The following provides a brief listing of the various Phoenix missile versions: AIM-54A, the first Phoenix missile version; AIM-54B, the second Phoenix missile version, which incorporated several upgrades including sheet-metal wings and fins; AIM-54C Improved Phoenix, developed for anticipated threats, optimized for use against multiple close-interval cruise missiles and waves or streams of hostile aircraft; AIM-54C+, also known as Dry Phoenix, eliminated the need for taping into the aircraft's coolant system; AIM-54D, another Phoenix version incorporating additional modifications.

For additional information on these missile models, please see the pertinent entries under the Program Review section.

Program Review

Background. Hughes began the development of the originally designated AAM-N-11 Phoenix in 1960 for the US Navy's F-111B aircraft, which was subsequently canceled. In 1962, it was redesignated AIM-54. The Phoenix has been optimized for the long range destruction of fighter aircraft and subsonic command and control platforms. While in engineering development, the AIM-54A was selected as the primary weapon for stand-off fleet defense for the Navy's Grumman F-14 Tomcat. Six missiles are carried on this carrier-based fighter, which is to date the only application for the AIM-54.

AIM-54 Phoenix Operation. The F-14's AWG-9 fire control system locks on to hostile aircraft, surface-launched cruise missiles, or air-to-surface missiles, regardless of weather conditions or target altitude, and launches the Phoenix. The missile then takes over to intercept. The AN/AWG-9 Doppler radar is equipped with look-down capabilities and can lock on to moving targets in ground clutter, while the infrared subsystem provides an independent search and track system. Because the AN/AWG-9 incorporates a track-while-scan feature, it is possible to launch and guide as many as six AIM-54 missiles against separate targets, while scanning for additional targets.

The first Phoenix firing took place in May 1969 and pilot production was started in 1970 under an initial contract for 69 units at $85.0 million. Through 1980, over 2,580 AIM-54A missiles were produced at a typical rate of approximately 40 missiles per month. Phoenix -54A production was first superseded by the vastly improved AIM-54C with the Fiscal 1980 buy; the C has now been superseded by the improved -54C+ variant.

Successful Test Program. In airborne testing, the AIM-54A achieved enviable results, with the success rate reportedly running at 88 percent over the entire test program. Of the 56 missiles fired during contractor tests, 43 were scored as hits. During 1973 the Phoenix hit targets at ranges of 202 kilometers (109 nautical miles) and attained an altitude of more than 30,480 meters (100,000 feet). A Phoenix also hit a BQM-34A drone simulating a cruise missile at an altitude of only 15 meters (50 feet) above the sea. In one conclusive test in 1973, six AIM-54As were launched within 37 seconds against six drones at ranges up to 80 kilometers

(43.19 nautical miles), with four of these scoring direct hits. The fifth Phoenix was unable to intercept as the drone veered off course, while the sixth missile experienced hardware failure. Through 1980 the Navy reported 126 F-14A/Phoenix missile firings, resulting in 97 successful hits.

The Phoenix was first deployed in late 1974 with two F-14 squadrons aboard the aircraft carrier USS *Enterprise* (CVN-65). The following year saw Phoenix-equipped F-14s deployed on the USS *John F. Kennedy* (CV-67). The estimated total cost for the -54A Phoenix program through Fiscal 1984 was $3.4 billion.

Production Problems. The first AIM-54C was delivered in October 1981, and 30 pilot production examples followed. As of late 1987, the Navy was still evaluating the missile's performance in light of the failure of several government-supplied components, particularly the safe/arm fuze mechanism. In mid-1984, the Navy refused to accept new shipments of the AIM-54C because of marginal workmanship and possible questionable quality control procedures which might need strengthening. Hughes voluntarily stopped production in August of 1984. By late February of 1985, deliveries were resumed with the US Navy closely monitoring the production. Between 120 and 150 AIM-54C missiles delivered before discovery of the quality control problems are being rebuilt at no cost to the Navy. As of January 1, 1985, the Navy had 66 AIM-54C missiles in its inventory. The Navy test fires five AIM-54C missiles each year.

However, the shutdown caused delays in deliveries in 1986; Hughes has had to retrain a number of employees on new production machinery and methods as well as installing new production equipment. Despite some further (widely publicized) failures, some due to user errors and others due to the various government-supplied components, it appears that as of late 1987, the AIM-54C program is almost back to normal although the problems have taken their toll in the slipping of the program.

Phoenix Second Sourcing. In a decision that took many industry officials by surprise, the Navy decided in mid-1984 to seek a second source for production of the AIM-54C Phoenix. This decision closely follows the Navy's earlier announcement that it was suspending acceptance of the Phoenix because of the above-mentioned quality control problems at Hughes' Tucson production facility.

Industry sources monitoring the progress of improved Phoenix production felt that production of the missile was too far along to enable second sourcing to be practical. Also, some officials at the Naval Air Systems Command doubted that just a second source production would save money. These arguments notwithstanding, the Navy made the announcement in August 1984, adding that the decision to second source the Phoenix was the result of a Secretary of the Navy budget review decision made on May 15, 1984, and is in no way the result of the June 22, 1984, suspension of acceptance. However, at the time of the suspension, the Navy said any decision to second source would depend on a review of quality control problems at Hughes. The Navy now says that the second source decision was made to achieve savings and was adopted prior to the recent quality control problems in Phoenix production.

According to a notice published in the *Commerce Business Daily* soliciting second sources for Phoenix production, the Navy expected a 10-missile qualification program in Fiscal 1987 followed by procurement of 50 missiles in Fiscal 1988 and 240 missiles in Fiscal 1989 from a second source. The second source was expected to produce some 720 missiles per year beginning in Fiscal 1990 and would be decided in a winner-take-all competition.

The second-source competition was between Raytheon, producer of the MIM-23 HAWK and MIM-104 Patriot surface-to-air missiles, and Ford Aerospace, which manufactures the MIM-72C/F Chaparral surface-to-air missile. In early June of 1986, Raytheon was selected as the second source for the AIM-54. The initial $49.5 million contract calls for the production of an equivalent 10 missiles for qualification, a learning buy of 56 missiles in Fiscal 1987 and includes options for initial low rate production orders totaling 180, 210 or 240 missiles.

In April 1988, Raytheon was awarded a $135.9 million for the production of 180 missiles and an award for $140.3 million for 208 units in January 1989. The latter contract is the first obtained in direct competition with Hughes Aircraft, and represents 52 percent of the Fiscal Year 1989 overall procurement total. Raytheon was expected to be producing 20 to 30 missiles per month by 1990. However, Hughes Aircraft won the supposedly final production buy of 420 Phoenix missiles, worth $210.6 million.

Advanced Air-to-Air Missile. In early 1987, the Navy's designated replacement for the AIM-54, the Advanced Air-to-Air Missile program, got under way. For a review of this program, we refer the reader to the pertinent Advanced Air-to-Air Missile report.

Missile Models. The Phoenix long-range air-to-air missile has been manufactured in several production models. The following provides a detailed explanation of each of these models.

AIM-54A Phoenix. This was the first Phoenix model to be produced. Production commenced in at Hughes Aircraft's Tucson facility in 1973 and ran through mid-1977. This is the only version of the Phoenix ever to be exported by the United States. The missiles were sold to Iran to outfit its fleet of F-14 Tomcat fighters.

AIM-54B Phoenix. This model was said to incorporate sheet-metal wings and fins instead of honeycomb structure, non-liquid hydraulic and thermal-conditioning systems, and somewhat simplified engineering. This new model was introduced in mid-to-late 1977.

AIM-54C Improved Phoenix. To meet anticipated threats in the 1980s and beyond, the Navy initiated development of the improved AIM-54C Phoenix. This development was accelerated due to the compromising of -54A technology in Iran. The C version is optimized for use against multiple, close-interval cruise missiles and waves or streams of hostile aircraft. The C model of the AIM-54 is also capable of operating in a severe electronic countermeasures environment, and features upgraded target detecting devices, electronic units, receiver-transmitter units, and autopilots, as compared with the AIM-54A. The Naval Weapons Center, China Lake, CA, redesigned the target detecting device, which incorporates a pseudo noise feature. This improves the missile's kill probability over a wider threat spectrum, increases its capability in poor weather, and also enhances the missile's reliability in the electronic counter-countermeasures environment.

The improved electronics unit is of digital design and incorporates an autopilot function. This increases the Phoenix's capability against very fast targets at very high altitudes. The unit's autopilot includes an inertial reference system.

The new receiver-transmitter unit is of solid-state design, incorporating some classified features for enhancement against opening targets, cluster threats, and beam aspect situations. The strap-down inertial reference feature is designated a command-inertial function and makes Phoenix much more accurate immediately after launch. With this enhancement, control of the missile is maintained by the AWG-9 fire control system on the F-14 through the mid-course point of flight. This is the command part of the technique. During this time, the missile's radar is also active. For terminal homing, the missile is fully autonomous, the inertial part of this technique. The AIM-54C provides a four-fold increase in missile capability over the AIM-54A. The AIM-54 command-inertial technology has been proven in tests against BQM-34 and BOMARC target drones. The tests were termed successful, and the command-inertial technology has also been incorporated into Hughes' AIM-120 AMRAAM program. (See separate report.) The Phoenix attained its first combat successes in 1982 and 1983 when used by Iran in the Iran-Iraq War. At least two MiG-23s and one MiG-25 have been credited to the missile.

Engineering development of the -54C program slipped some two to three months into early 1981. However, the operational evaluation schedule also slipped some nine months to a completion date of September, 1982. This delayed the full production decision to January, 1983.

The first production model of the AIM-54C was delivered on schedule in 1982. Hughes Aircraft delivered the balance of the 30 pilot production models during Fiscal Year 1982 under a $44 million contract from Naval Air Systems Command. Prior to delivery of the first pilot production missile, Hughes delivered 15 engineering development models to the US Navy.

AIM-54C+ Phoenix. This enhancement was funded under PE#60354, Project #W0614. A sealed cooling system for the onboard guidance system (relieving it of the need for a physical link with the aircraft's system) was developed, and a greater resistance to electronic countermeasures was incorporated in the missile. Hughes Aircraft was awarded $4.8 million on November 21, 1984, for this modification program involving five Phoenix missiles. This program was known as the AIM-54C Phoenix ECCM/Sealed missile or Dry Phoenix, and finally AIM-54C+.

Serial production deliveries of the C+ began in April of 1986. Again, some problems with components supplied by subcontractors, as well as the other problems noted above, caused production/acceptance problems with this enhanced variant. By 1987, Hughes had delivered 325 C+ missiles to the US Navy, putting the company ahead of its contract schedule. Testing has found that the C+ is roughly two-thirds more reliable than the C variant.

AIM-54D. This designation represents the additional modifications that will be incorporated into the Phoenix subsequent to the completion of the AIM-54C+ program. This modification effort could eventually include a wide range of changes, but for the time being appears to be focused on the installation of an expanded reprogrammable memory and composite fuze improvements. Hughes Aircraft Company, Radar Systems Group, Los Angeles, was awarded a $17.5 million contract to study possible improvements to the AIM-54 missile. The further improvements to the AIM-54 Phoenix offered by Hughes involve the incorporation of a reprogrammable memory board, high-power traveling wave tube (TWT) radar transmitter, and a low-sidelobe antenna with upgraded radar seeker electronics. The first new Phoenix missile incorporating all three of these upgrades scored a direct hit in a head-on test firing at Point Mugu on August 14, 1990. This test helped to evaluate the significantly extended launch-and-leave range at which the new traveling wave tube (TWT) transmitter allows the missile's active radar to acquire a target. The new range is in excess of 104+ nautical miles.

Although current plans call for only the reprogrammable memory upgrade to be incorporated into the existing AIM-54C+ missile line, due to budget constraints, a Phoenix incorporating all three of these enhancements could become available before the end of the decade (designated by FI/DMS as the AIM-54D). Newly equipped AIM-54C+ missiles (carrying the new reprogrammable memory board) were delivered beginning in June 1990. The new reprogrammable memory permits the missile's software to be reprogrammed electrically at a test station without the entire missile being disassembled and a new memory board installed as was previously the case. Previously, the replacement of a memory board would have taken one year to complete. The new memory system replaces 45 computer chips with six ultra high speed chips, occupying half the original space, while doubling the memory capacity.

However, this program will not result in new production, but in a modification program for the existing inventory of missiles. If the AIM-54D modification program proceeds, the so-called production line could be activated into the late 1990s.

Phoenix Anti-missile Missile?. In another development, we learned in 1984 that the AIM-54 has been successfully tested against the RGM-84 Harpoon anti-ship missile. It is quite possible that these tests were carried out against the enhanced Harpoon which has eliminated the initial pop up technique and has enhanced sea-skimming capability. If this development, which so far has been termed highly successful, is brought to operational status, a great enhancement of US Navy anti-ship missile defenses will take place.

Funding

The reduction in the US inventory objective from 7,000 to 2,200 missiles would leave the only two reduced loadouts available for F-14 aircraft. The US Navy admitted to an inventory shortfall when procurement of the AIM-54 Phoenix concluded with the Fiscal Year 1990 buy. The service said that the decision to terminate the procurement program was justified in light of the current budget situation. Modification funding for Fiscal Year 1992 and 1993 was used to pay for the installation of the expanded reprogrammable memory and composite fuze improvements into the AIM-54C/C+ inventory (designated AIM-54D). No additional procurement or modification funding was requested by the US DoD in FY94 or FY95. However, Motorola is continuing work on development of a Phoenix training capability for the F-14 Tomcat.

US FUNDING

	FY96		FY97		FY98		FY99 (Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E								
Proj - 1	-	5.1	-	3.4	-	3.5	-	3.1

All $ are in millions.

Proj -1 PE#0204571N Consolidated Training Systems Development Proj W0431 Tactical Aircrew Training Systems (TACTS).

NOTE: President Reagan's revised procurement schedule for Phoenix from Fiscal 1983 through Fiscal 1987 called for a total of 1,978 -54C missiles. Total planned procurement costs are estimated at over $5 billion for 2,170 AIM-54C/C+ missiles.

Regarding the RDT&E effort for the AIM-54, PE#64354N, Project W0614 - AIM-54C Improvements, terminated in Fiscal 1984. PE#64354, titled Air-to-Air Missile Systems Engineering, a new funding program with Fiscal 1986 money, shows no RDT&E work on the AIM-54 in the Fiscal 1988/89 justifications.

Recent Contracts

In June 1995, Raytheon Company Missile Systems Division, Bedford, Massachusetts, was awarded a $7.9 million modification to a previous contract for additional funds necessary to meet contractual obligations for previous AIM-

54C Phoenix missile production for the period 1986-1988. Work under this contract was completed in January 1994. Contract Number N00019-86-C-0216.

In September 1992, Raymond Engineering was awarded a $7.9 million contract for the procurement of FSU-10/A fuses for the Phoenix (689 tactical fuses, 31 spares and 64 partial-inert). Contract Number N00019-92-C-0210. Also in September, Hughes Aircraft received $7.1 million modification for engineering services and materials necessary to upgrade the DSM-141 microwave alignment and calibration test sets for the Phoenix.

In October 1991, Raytheon was awarded a $2.6 million contract by the US Naval Air Systems Command for 750 additional reprogrammable memory kits for the Phoenix missile. This award was a modification of an existing contract for 208 kits. Raytheon won this sole source contract in competition with Hughes Aircraft. The kits will allow the modification of the Phoenix's software without the need for disassembling the missile.

Hughes Aircraft Company, Missile Systems Group, Tucson, Arizona, has been awarded a $201.6 million contract for the production of 420 AIM-54C Phoenix missiles for Fiscal Year 1990. Work on this contract, originally expected to be completed in September 1992, was extended to September 1993.

Timetable

	1960	Phoenix concept outlined
	1961	Phoenix competition began
	1962	Navy selected Hughes as prime contractor
	1965	Initial flight tests made
	1968	Initial prototype procurement made
	1970	Low-rate production began
	1972	Prototype flight testing completed
Feb	1972	Initial production deliveries made
	1974	Initial operational deployment completed
	1976	RDT&E initiated on Improved Phoenix
	1977	Engineering development started
	1979	Iran canceled -54A buy
	1980	Pilot production of -54C models for flight test began
	1981	Full-scale engineering development completed
Oct	1981	IOT&E initiated
Early	1982	Low rate production of -54C began
Late	1982	IOT&E completed
Jan	1983	Full-scale production decided
Early	1983	US Navy operational tests began
	1984-87	Production problems caused delays in program
Jun	1986	Raytheon selected as AIM-54 second source
Late	1987	Full-scale production by Hughes attained
Late	1988	Full operational capability of AIM-54C
	1990	FY90 420 buy split; production rate slowed
	1991	Raytheon won AIM-54D modification kit contract
	1992	Production of the AIM-54C+ concluded
	1992	Raytheon completed reprogrammable memory kits
	1990s[a]	Modification and support work continuing

[a]estimated

Worldwide Distribution

The only export customer for the Phoenix was the **Imperial Iranian Air Force**. The Shah ordered roughly 438 missiles, although only 280 were delivered by the time his government was overthrown. None of these missiles were used in combat by the new revolutionary government against Iraq, since they were said to have been de-activated prior to the Islamic seizure of power.

Japan has been mentioned as a potential customer for the Phoenix to arm the aircraft of the Japanese Air and Maritime Self-Defense Forces. However, no order has been placed and none are anticipated at this time.

User Country(s). The **United States Navy** and previously the **Imperial Iranian Air Force** are the only users of the AIM-54A Phoenix. The US Navy is the exclusive operator of the AIM-54C and AIM-54C+ Phoenix missiles.

Forecast Rationale

The United States is expected to eventually field a replacement for the AIM-54 Phoenix sometime after the turn of the century. This replacement system will likely be based on a modified AIM-120 AMRAAM, although other options are being explored. In the meantime, the United States will continue to maintain its AIM-54 Phoenix inventory to meet its long-range air-to-air missile engagement requirements.

When deemed necessary, funding will likely be provided for various modifications to maintain or enhance the AIM-54's combat capabilities, as well as for performing routine maintenance and support. Such modifications have been accounted for in the present by the AIM-54D and AIM-54D1 lines. The AIM-54D encompasses units incorporating the Raytheon reprogrammable memory kit, while the AIM-54D1 represents the installation of the Raymond Engineering FSU-10/A fuze. Part of the reprogrammable memory kit production was included within the AIM-54C line, representing new builds and not remanufactured units.

Most hardware and software modifications planned for the Phoenix have been completed. Presently, the chances of the US Navy providing significant outlays for an ambitious performance enhancement program are not foreseen.

NOTE: The US Navy had mentioned on several occasions that it wanted about 4,250 AIM-54C missiles, which included replacing its inventory of AIM-54As. With the restrictions placed on procurement, the US Navy had the option to move ahead with a retrofit and modernization project to bring the A models up to C+ standards. The AIM-54 missile production time is about two years, and although our forecast for the AIM-54C concluded in 1992, work on these units continued through September 1993.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

Missile	(Engine)	thru 96	97 (High Confidence Level)	98 (High Confidence Level)	99 (High Confidence Level)	00 (Good Confidence Level)	01 (Good Confidence Level)	02 (Good Confidence Level)	03 (Speculative)	04 (Speculative)	05 (Speculative)	06	Total 97-06
HUGHES/RAYTHEON													
AIM-54A (a)	MK.60 MOD 0	2657	0	0	0	0	0	0	0	0	0	0	0
AIM-54C (b)	MK.47 MOD 0	2518	0	0	0	0	0	0	0	0	0	0	0
AIM-54D (c)	MK.47 MOD 1	626	0	0	0	0	0	0	0	0	0	0	0
AIM-54D1 (d)	MK.47 MOD 1	689	0	0	0	0	0	0	0	0	0	0	0
Total Production		6490	0	0	0	0	0	0	0	0	0	0	0

(a) Includes all RDT&E missiles and export to Iran for a low-rate production order.
(b) Includes all RDT&E missiles as well as follow-on test missiles. As of November 1st, 1986, the US Navy had accepted 318 AIM-54C missiles. In mid-1986, production switched over to the AIM-54C+. In June 1990, the AIM-54C+ line began incorporating the reprogrammable memory upgrade kit.
(c) Forecast line is for reprogrammable memory modification units, only. No RDT&E units are included in this production line.
(d) Forecast line is for FSU-10/A fuse modification units, only. No RDT&E units are included in this production line.