ARCHIVED REPORT

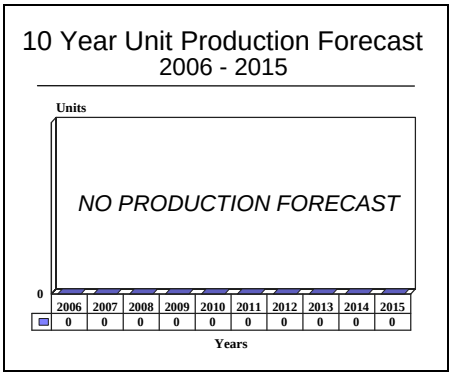
For data and forecasts on current programs please visit

www.forecastinternational.com or call +1 203.426.0800

Tigerfish - Archived 12/2007

Outlook

- Production concluded
- No additional orders for Tigerfish anticipated
- The U.K. Royal Navy has replaced Tigerfish with new Spearfish heavyweight torpedo
- Without U.K. support, development of a Tigerfish upgrade package is doubtful



Orientation

Description. Wire-guided acoustic homing heavyweight torpedo, powered by electrical motor.

Sponsor. United Kingdom Ministry of Defence PE Contracts Branch CB/UW73B Egdon Hall, Lynch Lane, Weymouth, Dorset, United Kingdom.

Status. Production completed. The Tigerfish has been superseded by the new Spearfish. The U.K. was considering a further upgrade of Tigerfish, the Mod 3, but instead retired this torpedo in early 2004.

In 1992, the U.K. Royal Navy Armament Depot at Gosport ceased work on the Tigerfish when the final existing weapons were cycled through their last product upgrade. This work has now been transferred to the Coulsport Armament Depot near the submarine base at Faslane.

Total Produced. An estimated 2,184 Mk 24 Tigerfish torpedoes had been manufactured by the end of 2005.

Application. The Tigerfish is designed for destroying both surface and underwater targets.

Price Range. The Tigerfish development program has been quoted as costing about $1.5 billion at 1984 prices. If all development costs are written off against the 2,000 warstock torpedoes produced for the British Royal Navy, the gross price is about $750,000 per unit. This is roughly comparable to the price charged to customers ($840,000 to Turkey for Mod 1 quoted in 1994).

Contractors

Prime

BAE Systems - Underwater Weapons	http://www.baesystems.com, Elettra Ave, Waterlooville, Hampshire, PO7 7XS United Kingdom, Tel: + 44 0 2392 26 4466, Fax: + 44 0 2392 26 0246, Email: media@baesystems.com, Prime

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

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

Technical Data

Design Features. The Mk 24 Mod 2 Tigerfish is a 21-inch, electrically powered heavyweight torpedo built for anti-submarine and anti-surface-ship warfare. The torpedo can be operated at either low or high speed, selectable at any time. The initial run is performed at low speed, with the torpedo controlled by and responding to the submarine's action information organization (AIO). This is done by means of the guide wire, which is dispensed simultaneously from the torpedo and the platform in order to minimize wire stress and the risk of parting. At this stage, a two-way data exchange occurs between the weapon and the submarine, with AIO instructions going in one direction and data from the torpedo's sonar returning to the launching submarine. In essence, the torpedo and its sonars function as an extended sensor arm for the mother ship.

During this phase, the computer on the torpedo also interprets the data from the sensors and calculates and commands the appropriate course for the weapon. However, the submarine's computer includes a priority overriding steer-off azimuth control. During the attack, the torpedo can operate in passive or active mode. The British appear to use primarily the passive mode in order to maximize the stealthiness of the weapon and the submarine. The interrogation rate is progressively increased during the approach in order to boost the accuracy rate. Once the weapon is committed to an attack, it accelerates to attack velocity and uses data derived from its narrowband passive sonar image to break the wire and home in under the direct control of its processors. At this point, Tigerfish is fully autonomous. Tigerfish automatically carries out lost contact procedures, if necessary, and re-attacks the missed target.

	Metric	**U.S.**
Dimensions		
Length	6,464 mm	21.2 ft
Diameter	533 mm	21 in
Weight	1,550 kg (in air)	3,410 lb
Weight, Warhead (PBXN 105 HE)	134 kg	295 lb
Performance		
Speed, Maximum	65 kmph	35 kt
Range, Active	13 km at 65 kmph	7 nm at 35 kt
Range, Passive	29 km at 45 kmph	15 nm at 24 kt
Operating Depth	610 m (est.)	2,000 ft (est.)

Propulsion. The Tigerfish's motors are powered by silver/zinc batteries. Due to its battery-powered motor, the torpedo has a very low noise level. The quietness has been achieved at the cost of top speed. The alternative propulsion sources have been the faster open-cycle Otto or closed-cycle Otto/HAP motors.

The torpedo uses two counter-rotating propellers to achieve its maximum speed of about 35 knots (according to some reports, it could be as high as 50 kt). The speed is selectable between high and low (24-kt) settings at any time. A pair of silver/zinc batteries provides the dual speeds via a compact hydraulic contractor, which powers the electric drive motor. Lower speeds yield longer operating ranges, while the higher speed trades off some of the operating range.

Hydraulically activated cruciform tail surfaces govern high-speed lateral maneuvering, using power derived from an auxiliary rotary pump that is slaved to the outer propshaft. The retractable stub fins in mid-body, used to stabilize the torpedo's roll, derive their power from the same source.

Control & Guidance. The acoustic homing system is automatic and three-dimensional, with passive and active modes selectable, depending on the mission and the position of the torpedo relative to its target.

The torpedo has an onboard computer, which is connected to the launch vessel's fire control system through the reel-out guidance wire.

Launcher Mode. The Tigerfish Mk 24 Mod 2 is designed for launches off submarines. The torpedo can be launched from submarines using either the assisted discharge or swimout method.

Warhead. Tigerfish uses a dual-action (inertia impact/proximity) fuze and a versatile proximity fuze, which is designed to operate at the point of closest approach to the target. The torpedo is outfitted with a 134-kilogram PBXN 105 warhead developed by BAe Royal Ordnance Division. As the torpedo reaches the closest distance to the target, a magnetic proximity fuze and an impact fuze detonate the warhead.

Variants/Upgrades

As is customary in the manufacture of torpedoes, the Mk 24 Mod 2 is available in three different versions: warshot, dummy, and exercise. The warshot version is a fully operational, battle-ready torpedo, with live ammunition.

The dummy versions (also called handling versions) have no motors, guidance systems, computers, or ammunition, but are, in size and mass, similar to the warshot version. The dummy torpedo is used for training purposes to cover all logistics, handling, and discharge requirements where an operational unit is not needed.

Similar to the warshot version, the exercise version torpedo is designed for practice firings and becomes positively buoyant at the end of its run. The torpedo can thus be easily recovered for repeated practice use. It is powered by rechargeable silver/zinc batteries, and is equipped with a full instrumentation pack and recording systems to facilitate post-run analysis.

Other versions of the Tigerfish developed over the years are the following:

Tiger Fish Mk 24 Mod 0. Original production version (with different spelling), soon withdrawn from service due to technical shortcomings.

Tigerfish Mk 24 Mod 1. Tigerfish torpedo originally intended to be dual-purpose, but some of the more obvious faults were rectified at the expense of nearly all anti-surface-vessel (ASV) capability. No longer in U.K. service, but still in use in Brazil.

Mod 2. Fully operational service version, recently upgraded to Mod 2* standard.

Mod 2*. The Mod 2 has been subjected to a continuous series of improvements in batteries, warhead, and guidance system, the latter incorporating technology from the Stingray and Spearfish programs. Most recently, this process led to U.K. Royal Navy Fleet Weapon Acceptance of Tigerfish Mod 2 Enhanced (Mod 2*) torpedoes. The designation for such torpedoes is not officially confirmed, but Mod 2* has been used and is consistent with the U.K. Royal Navy nomenclature. This version can also be floated out of torpedo tubes.

Mod 3. The development of a putative Tigerfish Mod 3 variant is being considered as a more affordable product for export markets, since the high price of the Spearfish may eliminate some of the otherwise potential clients of the British torpedo.

Program Review

Background. Tigerfish was begun in 1959 as Project ONGAR, an Admiralty Underwater Weapon Establishment (AUWE) program exploring ways to replace the Mk 23 torpedo. The Mk 23, a modified Mk 20 torpedo, was the U.K. Royal Navy's first attempt to introduce wire-guided technology as a solution to the problem of torpedo fire control. This torpedo was a very unsatisfactory weapon that was subsequently relegated to training duties.

New Torpedo Needed

A Naval Staff Requirement (NSR) issued in 1959 called for a fast anti-submarine torpedo with an acoustic sensor. The first Mk 24 was a two-speed electrically propelled torpedo with a top speed of 35 knots and a maximum range of 22 kilometers. Quieter running was achieved at a lower speed of 24 knots.

In 1967, the U.K. Royal Navy Torpedo Factory (RNTF) received a GBP1.6 million production contract for an initial batch of 100 weapons. The torpedo was configured for under-keel detonation. While the principle used to achieve this was similar to that in use today, at the time it did not work. Designated Mk 24 Mod 0, the weapon underwent acceptance trials in 1969, during which serious deficiencies were revealed. The U.K. Ministry of Defence then established a Torpedo Project Executive. At the same time, GEC (now BAE Systems) was awarded a GBP5 million contract to address the problems identified during acceptance trials.

One of the satisfactory features of the Mk 24 Mod 0 was its propulsion system. The seeker head was generally considered the most serious of its problems, because it used a wide beam. The wide beam produced so many dead spots in certain oceanographic conditions that only intermittent contact could be maintained with a target. While BAE Systems (then Marconi) built the original seeker head for the Mk 24 Mod 0, it was based on a design developed by the National Research Laboratory.

BAE Systems set to work redesigning the seeker around narrowband sonar technology, while re-engineering the onboard processor and using onboard-generated lead angle techniques, rather than relying on operator

aim-off, to give the Mk 24 greater autonomy. AUWE remained the research and development authority, but a partial shift took place in 1972, when BAE Systems (then Marconi Space and Defence Systems) was given a GBP3 million contract to act as coordinating design authority for the torpedo's internal and external interfaces.

At the same time, BAE Systems received a GBP13 million contract to upgrade the seeker of the original Mk 24 Mod 0 torpedo, and to modify various subsystems to give the Mk 24 an ASV capability. The upgraded weapon was designated Mk 24 Mod 1. Overall program responsibility remained with AUWE, but AUWE Portland supervised the activities of Lucas Aerospace, Chloride Industrial Batteries, Sperry Gyroscope, and three other subcontractors, while AUWE Heston was responsible for most other subcontractors. Interface problems existed between the torpedo, the AIO system, and the launcher systems. Moreover, it was a considerable problem to keep the growing number of potential subsystems for the Mk 24 under some sort of overall control with different subsystems at differing stages of development.

While all this was going on, the U.K. MoD closed down the RNTF, and the Torpedo Production Executive transferred production authority to Plessey Marine's factory at Ilford, England. To maintain stock levels, the Director of Underwater Weapons Procurement (DUWP) awarded Plessey a production order for a further 100 Mk 24 Mod 1 torpedoes, using materials available from the closed RNTF. The DUWP maintained responsibility for some subsystems.

Problems during Testing

A second series of acceptance trials, held in 1973 and 1974, vindicated, to some extent, the improvement program. The overall concept was proven, but reliability remained a major problem, varying between 20 percent and 80 percent. (Fleet average was about 40 percent.) To a large degree, the Mk 24 Mod 1 still relied on post-launch data from the submarine. The transmission of the data was hindered by the torpedo's tendency to dive sharply after launch, and snap the guide wire. BAE Systems, which was still responsible for coordinating the design of the torpedo's internal and external interfaces, gradually assumed more overall responsibility for the program. In 1974, the production contract was transferred to it.

Many key subsystems remained beyond BAE Systems' control, including such vital elements as the guidance kit (Sperry), dispenser (STC), and batteries (Chloride). BAE Systems was awarded a GBP2.5 million contract to act as design maintenance authority, with responsibility for post-design services for the whole Mod 0 program.

In 1978, the Mk 24 Mod 0 and Mod 1 underwent fresh contract acceptance trials. Snapped guidance wires became less of a problem, thanks to a new launching system. But the Mk 24 could only be launched at low speed with minimal maneuvering. Interface difficulties, especially with upgraded Mod 0 weapons, remained a problem. Confidence in the Mk 24 program was somewhat restored at this stage, only to be dealt a fresh blow in 1979, when the weapon failed its fleet acceptance trials. Due to a lack of any alternative, the Mk 24 Mod 0/1 began to enter limited service in August 1980. In 1981, the U.K. MoD awarded BAE Systems a Mod 1 post-design services contract to investigate the torpedo's internal interface problems. At GBP16 million, it was the single largest contract placed with any Mk 24 program contractor up to that time.

At this time, one of the proposals presented by the U.S. and British navies was for the British to abandon Tigerfish and Spearfish (then in the early planning stages) and order the U.S. Mk 48 ADCAP. The U.S. Navy, in turn, would drop development of the Mk 50 Advanced Lightweight Torpedo and order the British Stingray. The British government, however, vetoed these proposals.

During the 1982 Falklands Crisis, the U.K. Royal Navy deployed submarines armed with Tigerfish to the South Atlantic. During the conflict, the submarine HMS *Conqueror* sank the Argentine cruiser ARA *Belgrano*, but used an old Mk 8 torpedo to do it. In 1983, submarines deployed off the Falkland Islands launched three Mk 24 Mod 1s at the burnt-out hulk of HMS *Sir Galahad*. Two were clean misses due to primary battery failure.

Prompted by these failures, the Controller of the Navy held an inquiry into the problems of the Tigerfish (then spelled as two words: Tiger Fish). The conclusion was that a systems approach was the only rational way to solve the problems. BAE Systems was awarded a GBP6 million feasibility study contract in 1983. The result was the Tigerfish Consolidation Program, for which BAE Systems received a GBP42.5 million fixed-price contract in 1984. BAE Systems built new torpedo development and production facilities, spending some $100 million (from 1982 to 1984) on a new factory at Neston, near Liverpool, and about $40 million on test and evaluation facilities.

Contract acceptance trials followed in 1985, during which Tigerfish achieved 80 percent reliability. More than 25 firings of modified Mod 1s, incorporating the results of the Tigerfish Consolidation Program, were

carried out. Two decommissioned warships were sunk during the trials. *Devonshire*, a County class destroyer, was sunk by a torpedo that exploded under the keel and broke its back. *Rhyll*, a Type 12 Rothesay class frigate, was sunk by a torpedo that exploded in the same general area with the same results.

Tigerfish Benefits from Spearfish Program

Some tests were conducted from violently maneuvering submarines, and the wire guidance reportedly achieved 100 percent snag-free performance. The Mk 24 Consolidation Program was helped by spillover technologies from the Spearfish program. A heavier warhead is thought to have been used with the weapon. By the end of 1988, up to 600 warshot Tigerfish of the U.K. Royal Navy had been upgraded to incorporate these improvements. All torpedoes in service were designated Mk 24 Mod 2 Tigerfish.

The modifications have greatly improved the performance and reliability of the Tigerfish torpedo and restored its dual-purpose capability. Additional improvements were instituted in 1988, including an upgraded under-ice capability. This program was completed in 1992, when the upgraded torpedo, thought to be designated Mk 24 Mod 2* (or possibly Mod 3), received the Navy's fleet weapons acceptance. This was followed by the award of contracts for the development of further Tigerfish upgrades, mainly in the area of software improvements.

The major product upgrades applied to Tigerfish since Mod 2 entered service have restored its dual-purpose role as an anti-surface vessel and anti-submarine weapon. A series of test shots have demonstrated the destructive effect of the Tigerfish warhead against surface ships. In fact, the upgraded Tigerfish bears little resemblance to the weapon in service in the mid-1980s, having undergone substantial changes to its batteries, warhead, and homing system seeker. Operational software has been upgraded and is being upgraded again, and the torpedo has been made capable of being launched from swimout tubes.

Acknowledging that the Spearfish will not only be more capable but also inevitably more expensive than Tigerfish, BAE Systems is examining the development of a derivative, designated Mod 3. Presumably, this would be a hybrid torpedo with more capabilities than the Tigerfish Mod 2, but without some of the most sophisticated (and expensive) features of the Spearfish. This upgrade would combine the dynamics and electric power source of Tigerfish, along with Stingray Mod 1's COTS-based signal processing technologies and some Spearfish guidance and homing software features.

Possible customers for this configuration include existing Tigerfish clients such as Brazil and Turkey, which could upgrade their existing warstocks with retrofit kits.

Significant News

BAE Systems Awards Raytheon Contract for Weapon Systems Life Cycle Support – Raytheon was recently awarded a $16 million contract from BAE Systems to provide engineering, technical management services, and fleet support for currently deployed U.S. Navy weapons systems and solutions. This contract continues the whole life services and support partnership between Raytheon Integrated Defense Systems (IDS) and the Naval Undersea Warfare Center (NUWC), Division Keyport, which began in 1979.

Under the contract, IDS will provide NUWC Division Keyport integrated logistics support, in-service engineering services, and technical support for U.S. Navy surface ship and submarine combat and weapon systems, including submarine sonar, weapon control, fires control, tactical support, training systems, integrated undersea warfare systems, targets, torpedoes, and assigned surface and warfare systems.

The contract was awarded under the Naval Sea Systems Command SeaPort-e Multiple Award Contract vehicle and consists of the current base year award and four one-year exercisable options. Work will be performed at IDS' Torpedo and Readiness Center in Keyport, Washington. (BAE Systems, 8/06)

QinetiQ and Hydroid Train Royal Navy to Use REMUS Unmanned Underwater Vessel – Scientists and engineers from defense and security technology company, QinetiQ, working with U.S. company, Hydroid LLC, have successfully completed a program to train Royal Navy (RN) personnel in the use of REMUS, which is a very shallow water unmanned underwater vehicle (VSW UUV) used for oceanographic surveys. Hydroid has supplied 10 REMUS 100 vehicles to the RN, and six of QinetiQ's Classiphi sea-bed mapping tool systems will be used with these. Eleven other Classiphi systems are already in use with the RN; other customers include the Royal Australian Navy, which also purchased the system.

Tigerfish

Classiphi uses "best-in-class" sonar processing techniques for characterizing seabed type and computer-aided detection of small objects. It provides the means for fully utilizing high-resolution survey data within a network-enabled battlespace, giving commanders accurate reconnaissance information when planning operations. The system is interoperable with industry standard geographic information systems, military command and control systems, and QinetiQ's own tactical tools, including SPM Expert, which is a mine countermeasures self-protection package, and QinetiQ's own UUV/USV mission planning toolkit. Classiphi is also suitable for commercial seabed survey applications.

The REMUS UUV was tailored to the Navy's requirements over an 11-month period. QinetiQ managed the project to provide integrated logistic support aspects alongside Hydroid's hardware expertise. The companies were also supported by Babcock Design & Technology. QinetiQ and Hydroid have worked together since 2003, when QinetiQ was first asked by the U.K.'s Defence Procurement Agency to evaluate two REMUS 100 units.

REMUS can perform intricate sonar and oceanographic surveys over large areas and is ideal for both commercial and military operations. It is similar in shape to a small torpedo and carries a range of environmental sensors with a side scan sonar system. It can operate for prolonged periods at around 3 knots and is usually used in conjunction with a long baseline navigation system. The RN's UUV teams will use REMUS enhanced by Classiphi to carry out a range of surveying tasks worldwide.

Throughout the anticipated five-year life of REMUS, QinetiQ will provide logistic support to the Defence Logistic Organisation (DLO) giving advice, diagnosing faults, and making repairs to the equipment. (QinetiQ, 7/06)

Funding

No information is available on annual Tigerfish development or procurement funding. The program has been funded by the British Ministry of Defence through the Contracts Branch of the Admiralty Research Establishment (ARE) at Weymouth, Dorset. All variants of the Mk 24 Tigerfish have been developed by BAE Systems, formerly GEC-Marconi Underwater Systems Ltd (MUSL), in association with the ARE.

Contracts/Orders & Options

Contractor	Award ($ millions)	Date/Description
MUSL	N/A	December 1988 – U.K. MoD contract for consolidated improvement of and product upgrades for Mk 24 Mod 2 torpedoes to bring them to Mk 24 Mod 2* standard.
MUSL	N/A	March 1990 – License production agreement with Cardoen Industries for production of Tigerfish torpedoes to meet Chilean Navy and export requirements.
MUSL	6.0	February 27, 1991 – U.K. MoD contract for additional upgrades to Tigerfish Mk 24 Mod 2* operational software.
Racal/Serco	N/A	September 1, 1991 – U.K. MoD contract for development of improved automatic test equipment for Tigerfish torpedoes (subcontracting to Serco Systems Ltd).
MUSL	135	December 1991 – Supply of 40 Tigerfish torpedoes to Turkish Navy. Contract includes technology transfer and production license. Options for an additional 120 torpedoes to be assembled in Turkey are included in the $135 million contract.
MUSL	N/A	Spring 1995 – Turkish invitation to tender for future buy of 20 Tigerfish.

Timetable

Month	Year	Major Development
	1959	NSR issued for new heavyweight torpedo
	1959	ARE guidance and propulsion studies under way
	1966	ARE completes first round of studies
	1969	U.K. Royal Navy awards development contract for Mk 24
	1975	Initial tests with Mk 24 begin
	1977	RN production order for Mk 24
	1982	Brazil orders Mk 24
	1983	First Mk 24 Mod 1 enters UKRN service
	1987	First Mk 24 Mod 2 enters UKRN service
Dec	1988	Further Tigerfish upgrade program starts
	1988	Tigerfish production of Mk 24 Mod 2 ends
	1991	Tigerfish ordered by Chile
	1991	Tigerfish ordered by Turkey
Aug	1992	Tigerfish Mk 24 Mod 2* approved for UKRN service
Mar	1996	First warshot firing of Mod 1 in Brazil off Tupi class submarine
	1997	Development of a Mod 3 variant being examined for export markets
	1997	Production of a second batch for Turkey (Mod 2) reportedly ongoing
Late	2003	Replacement by Spearfish in Royal Navy service
Feb	2004	U.K. retired Tigerfish
	2015	BAE Systems committed to support Tigerfish

Worldwide Distribution/Inventories

Latin America has been a large market for the Tigerfish, although many of the reported purchases remain unconfirmed. **Brazil** procured some 48 Tigerfish Mk 24 Mod 1 torpedoes for deployment aboard its three British-built Oberon class and new Type 209 submarines. Brazil's torpedoes have a hybrid Mk 24 Mod 1 configuration with some of the consolidation program improvements. Additional orders are possible.

Chile reportedly acquired up to 120 units. It is not known whether Chile ever began licensed production of this torpedo, or whether it supplied licensed-produced versions to Brazil, Colombia, and Venezuela, since no confirmation has been obtained from indigenous sources thus far.

Some 40 Tigerfish torpedoes were supplied to **Turkey** as the primary armament of the first two Preveze class submarines (Type 209s). These torpedoes were built in the U.K., using some Turkish components. In May 1995, the Turkish Navy announced its intention to procure another batch of 20 Tigerfish torpedoes to complete its warstock for the existing submarine fleet. The 20 torpedoes probably provide the load-out for the new-build submarine *Sakarya*. Additional orders (for up to 120 weapons) will be satisfied by direct purchase and/or production under license in Turkey. It is presumed that 20 of those were cleared for sale in spring 1995.

BAE Systems has reportedly offered licensed production to potential Southeast Asian customers.

User Countries. **Brazil** (48 Mod 1s), **Chile** (120 units), **Colombia**, **Indonesia** (120 units; licensed production rumored), **Turkey**, **United Kingdom** (2,000 Mk 2s), and **Venezuela** (40 units).

Forecast Rationale

BAE Systems has ceased production of the Tigerfish heavyweight torpedo. The United Kingdom, the most important customer for the Tigerfish, is no longer purchasing this torpedo. Instead, the British Royal Navy is investing its heavyweight torpedo funding in acquiring the Spearfish, the designated successor to the Tigerfish. All Tigerfish torpedoes still in inventory could be offered for export over the next decade or so.

No New Orders Expected

No further export orders for Tigerfish are anticipated. The Tigerfish was not sold widely. Still, the Tigerfish

Tigerfish

will remain the primary heavyweight torpedo used by some navies for many years to come.

If the Tigerfish remains in service long enough, there is a slim chance BAE Systems could offer an upgrade package for this torpedo. Should the production run for the Spearfish be limited, it could serve to push up demand for Tigerfish upgrades. Some observers believe Spearfish will be so expensive that the further upgrade of Tigerfish, perhaps even the fabrication of all-new units, is inevitable.

Yet, the chances of the Tigerfish production line being restarted appear remote, and the procurement of upgrade kits doubtful. The United Kingdom has made no official plans to procure a more improved Tigerfish and, without London's support, no upgrade package is expected to surface. Instead, operators of the Tigerfish will probably decide to replace this torpedo with one of the many alternative systems now available on the international market.

Note: *The Ten-Year Outlook Chart has been omitted from this forecast since production has ended, and no additional orders are anticipated.*

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level				Good Confidence Level			Speculative			
Missile	**(Engine)**	**thru 05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**Total 06-15**
BAE SYSTEMS													
TIGERFISH	UNSPECIFIED	2184	0	0	0	0	0	0	0	0	0	0	0
Total Production		2184	0	0	0	0	0	0	0	0	0	0	0