SOCIETY MEMBERS' BULLETIN

Issue 16 - September 2017

HMS Queen Elizabeth Britain's largest ever Warship on her way to Portsmouth.

Inside this issue:

Royal Naval Engineers' Benevolent Society
Founded in 1872

ROYAL NAVAL ENGINEERS' BENEVOLENT SOCIETY

Society Members' Bulletin

Well, we have made it to Issue 16 and there still appears to be a lot of interest in the magazine although perhaps not so much in the crosswords. I will decide whether to compile another one depending upon how many responses I get for #003.

Progress on Art150 has been very good with visits to Guildhall and menu tastings completed. The next task will be to allocate the seating for 650 attendees and update the website with the seating plan and menu.

The Executive Council has been busy with the acquisition and management of 111 North Hill, the proposed changes on how the society is run and managed, proposed changes to the rule book and how to ensure that the investments made on the society's behalf make the best of the very low prevailing interest rates. We are undoubtedly in for interesting times ahead with Brexit so we will keep our fingers crossed and hope for the best.

There are a couple of outstanding articles promised for publication (you know who you are), so please get your fingers limbered up to the keyboard and send in your submissions so that I can include them in a future issue.

Regards

Mark Stevens

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HMS Queen Elizabeth Arrives in Portsmouth

Going home to her base port

The UK's newest £3 billion aircraft carrier arrived in Portsmouth on 16th August. Many thousands of people lined the harbour to welcome the ship to her home port for the first time. Naval personnel and family members also lined the jetty in the Navy base to welcome the ship, while the band of the Royal Marines played to entertain the crowds.

Commanding officer, Captain Jerry Kyd said "HMS Queen Elizabeth's first entry into her home port of Portsmouth is an historic, proud and exciting occasion, not only for those of us serving in her, but also for the wider Royal Navy, the city of Portsmouth and the entire nation."

Preparations for the ship's arrival involved the removal of more than 3.2 million cubic metres of sediment from the harbour to ensure the entrance was deep enough to allow her access to her new berth. During dredging operations more than 20,000 items were removed from the sea bed including eight cannons, an aircraft engine, 36 anchors, a British torpedo, a German sea mine, five large bombs and finally, a human skull which was passed to the local police.

The operation to prepare the harbour and base has cost £100 million and has included new jetties and a new power plant to meet the electricity needs of the ship which is set to be joined by her sister vessel HMS Prince of Wales.

Pictures from MOD.

General Secretary's Report

By Cliff Fiander

Society Reorganisation

The Executive Council, conscious of the many changes there have been in financial regulation, decided that whilst the Society has always conducted its business to the satisfaction of the Auditors, Accountants and HMRC it would be prudent to ensure the Society is fully compliant with all legislation and is well protected from any financial risks. Accordingly a legal firm with expertise in financial regulation has been engaged to provide the Society with professional advice and guidance on what measures, if any, are necessary to established it as a recognised financial entity.

Notwithstanding any advice the Society may receive, it is clear that in a reduced RN the Section based organisation of the Society is cumbersome and inefficient. Chatham has long gone, Portsmouth, despite the efforts of the present Vice President, has not had sufficient attendees for a section meeting for several years and the Society's officers and trustees now meet regularly at the Society's offices in Devonport. Therefore, it has been decided that:

- The Portsmouth Section is now abolished.
- The Devonport Section is renamed the RNEBS Management Committee and consists of the President, Vice President, Managing Secretary, General Secretary, Trustees and 4 members' representatives; 5 to form a quorum.
- The General Secretary and the Managing Secretary will continue in their present roles and with their present activities.
- The Executive Committee's activities will be absorbed by the Management Committee and the EC is abolished.
- The Management Committee will meet monthly in the Shearsby Suite at 113 North Hill, Plymouth to deal with the day to day running of the Society.
- The Management Committee will meet once each year for an AGM and this will replace the EC Meeting

Artificer 150

Preparations for the dinner continue apace and the final numbers have now been reached. It has been decided, and I say this without wishing to be accused of throwing too many bouquets, that the professional reputation and speaking talents of the Guest of Honour and the President would be hard acts for anyone to follow so we do not plan to engage a Guest speaker. This will allow more flexibility in the formal part of the evening and may well provide a little more time to enjoy the port.

IMarEST

The Society is now a Marine Member of the Institute of Marine Engineering Science and Technology. The intention is that membership of a professional institute will raise the profile of the Society and help us work within the engineering community to promote the development of marine engineering and provide opportunities for exchanging ideas and practices whilst maintaining the status, standards and expertise of naval engineers at all levels, helping them to move forward in their careers.

These are grand words and it will take time, effort and a great deal of liaison with the RN before our membership is fully effective but I believe we are moving in the right direction to provide a material benefit from our heritage and traditions of engineering excellence.

See the Society's listing on https://www.imarest.org/marinedirectory

RNEBS Awards

Details of the award winners at RNAESS and WETU appear later in this Bulletin. It is, of course, a most pleasant task to give out prizes, particularly when they are well deserved and well received. Divisions at HMS Sultan at the beginning of August was a precisely executed evolution and a most uplifting military display. I appreciate I only marched a couple of hundred yards during my career but I have a reasonable idea of what should happen and it was good to see so much enthusiasm.

Society's Assets

Members will be aware that the Society now owns Nos. 111 and 113 North Hill. Both buildings are managed by the Managing Secretary as part of his activities and their physical integrity is much improved as a result of his efforts. The Managing Secretary also works closely with the letting agents and the commercial and private occupants of the two buildings to ensure the maximum income is generated for the Society.

National Memorial Arboretum

Following a successful re-dedication, work has continued on the front face of the memorial where a black granite inset with a carved and coloured RNEBS Crest will be mounted above the new commemorative text. Given the high standard of the stonemason's work he will now progress to completion and there will be no further formal inspections. Clearly any observations or comments from members visiting NMA would be most welcome.

In the longer term, cleaning of the memorial will be investigated whilst the "blacking in" of the lettering to make it more easily read in direct sunshine will remain an option.

The SULTAN Show

The Vice President and I enjoyed a very pleasant day at the annual Sultan Show as guests of the Commanding Officer. The sun shone and the crowds were certainly enjoying their day out with loads to do and plenty to see. The Society has no input to this event but it is an excellent way to stay in touch with the Navy and HMS Sultan in particular.

Finally

As I watched the drama of Divisions at HMS Sultan unfold I was reminded of a time there in the late 60s when all things marching and drill were under the unnervingly watchful eye of a Chief GI affectionately known as 'Tick-Tock'. Regrettably, despite being a member of the same mess I had never seen him or even knew his name; although, as with "The Nameless One", I don't think it was ever actually spoken out loud.

On my first divisions after joining from HMS Dolphin I was shuffling about on the edge of the Parade Ground in true submariner fashion waiting to fall in and be extremely neat and tidy when I saw a strikingly smart fellow some distance away on the far side of the Parade Ground marching about being very loud and purposeful. I turned to a colleague and asked conversationally, "Is that Tick-Tock?"

Instantly, 'strikingly smart' stopped his mechanical perambulations spun round and looked straight at me with a most intense and unfriendly expression. Understandably this caused me a considerable amount of anguish and an unsettling reawakening of the belief I had developed at Fisgard which was that the world of gunnery and the occult are more closely connected than any of the wearers of black gaiters would have us believe.

Fortunately all those years of shrinking into the background at Fisgard and Caledonia paid off and I was able to remove myself from his gaze, whereupon he turned smartly and tick-tocked away to provide happiness and enlightenment elsewhere.

Throughout the remainder of my time at Sultan I never saw him again on the Parade Ground; but, of course, that doesn't mean he wasn't there.

Royal Navy Crowsnest

An airborne surveillance system for future aircraft carriers

After a long and complicated evaluation, defence contractor, Thales, was been chosen to provide the Airborne Surveillance and Control (ASaC) capability for the Royal Navy Merlin HM.2 helicopter fleet, in a project named Crowsnest. ASaC will be added to some of the 30-strong Merlin fleet, which is primarily engaged in anti-submarine and anti-ship missions. The Navy is due to retire the seven Sea King Mk7 helicopters that currently perform the ASaC mission in 2018.

The concept of Crowsnest goes back many years, beginning as the Future Organic Airborne Early Warning (FOAEW). In 2001, study contracts were awarded to BAE, Northrop Grumman and Thales. The studies took the baseline as a Merlin with the equipment transferred from the existing Sea Kings, after which other options were evaluated such as the all weather Northdrop Grumman E2C Hawkeye, the moored balloon Aerostat system (TARS) and the Bell Boeing V-22 Osprey tilt-rotor aircraft. The V-22 included options for the Ericsson PS-890 Erieye AEW radar, Thales Searchwater and types of conformal antennas; those that are designed to follow a prescribed shape, i.e. one which is mounted on or embedded in a curved surface

In time honoured tradition, FOAEW mutated into the Maritime Airborne Surveillance and Control (MASC) system and then into Crowsnest. This is a tactic commonly used by the MoD to re-baseline spending on assessment phases that produce absolutely nothing. This is a significant weakness in National Audit Office reporting because when the MoD renames a programme (as it very often does), the slate is wiped clean and any costs tends to get 'lost'

in previous reports, thus failing to highlight the true cost of the programme.

The Crowsnest assessment phase ran from March 2013 to April 2016 allowing the main investment approval decision to be made. This leaves a couple of years before the Sea Kings go out of service. As is likely, when the project overshoots the Royal Navy will face a capability gap. The expected and approved cost for the Crowsnest assessment phase is about £27m, in addition to the FOAEW and MASC costs.

The surveillance capability in its modern format was born out of a requirement to protect the Royal Navy's task group from sea-skimming missile attack such as during the re-capture of the Falkland Islands in 1982.

The Thales Searchwater radar and Cerberus mission system that is carried by the Sea Kings will be updated and repackaged to fit the Merlins, including new modes and data processing. Crowsnest will be capable of performing overland and maritime surface surveillance, as well as airborne early warning. In the latter role, the system will protect the UK's two new Queen Elizabeth-class aircraft carriers when they enter service starting in 2020. Thales is retaining the Searchwater's mechanically-scanned antenna design from the Sea Kings, although its radome deploys in a different manner beneath the Merlin for 360-degree coverage.

The evaluation of this proposed system was made more complicated because Lockheed Martin is the prime contractor for the existing Merlin helicopter fleet and had proposed a competing radar and mission system. Lockheed Martin took part in the evaluation process for the new ASaC capability, together with MoD officials.

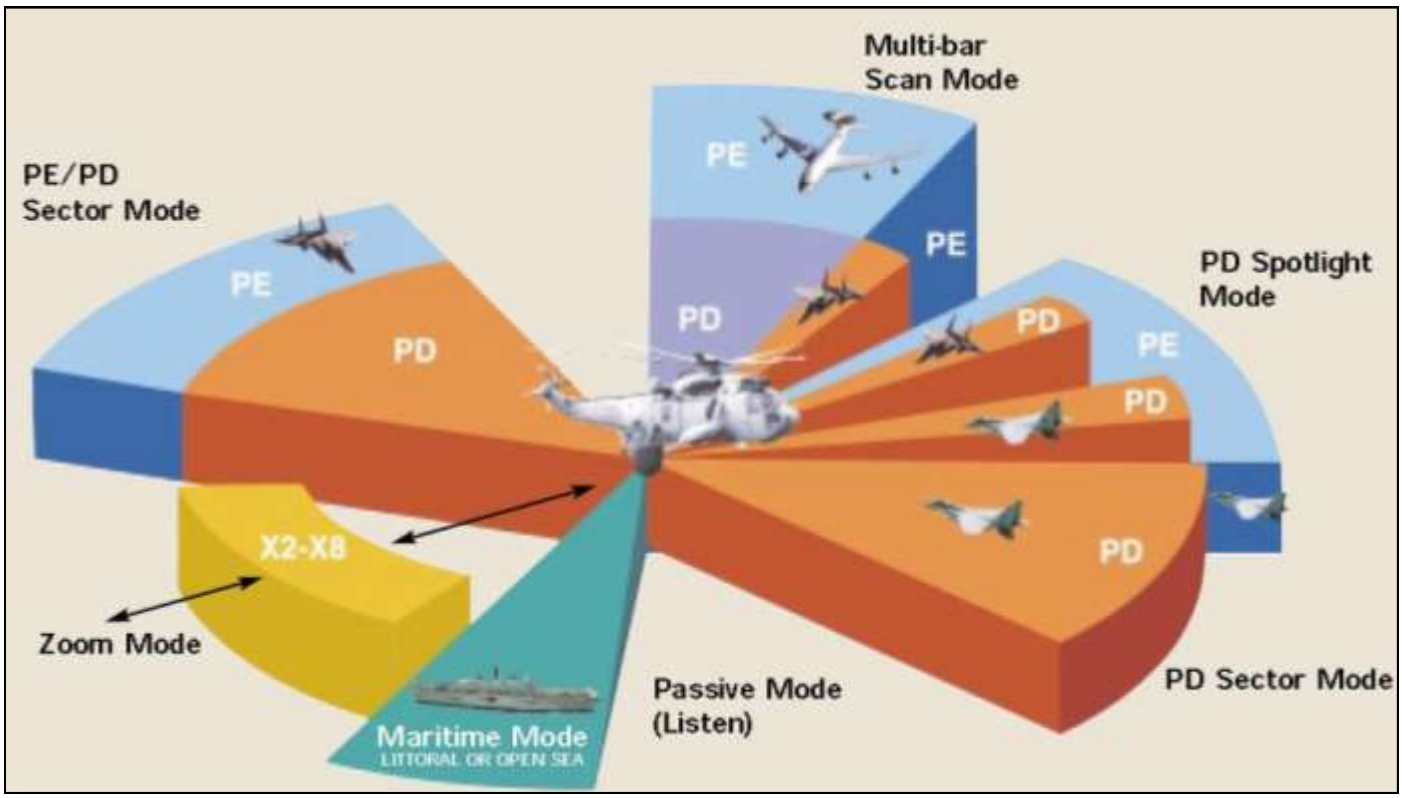
Their solution was an Israel Aerospace Industries (IAI) Elta ELM-2052 radar carried in twin pods on either side of the Merlin, and integrated with the Lockheed Martin Vigilance mission system. The radar's active electronically scanned antenna (AESA) was subdivided into four 120-degree V-shaped arrays to provide overlapping coverage. Lockheed Martin and IAI carried out flight tests of this configuration on a helicopter and a Boeing 737 in Israel in 2012, before it was test-fitted to a Merlin in 2014.

Lockheed Martin has been developing Vigilance as a surveillance system that can be added to various fixed and rotary wing platforms since 2010, including Lockheed C-130s, but has not yet claimed any customers.

As the Prime Contractor, Thales is responsible for the complete mission system upgrade. This system comprises a high-power Pulse Doppler (PD) radar integrated with Mk XII Identification, friend or Foe (IFF), Electronic Support Measures (ESM) and Inertial Navigation System / Global Positioning System (INS/GPS) navigation systems. An advanced Human Computer Interface, specifically designed for AEW operations, using twin operating consoles ensures effective operator interaction.

Data communications between interceptor aircraft and other Command and Control (C2) assets can be via a range of data links such as JTIDS, Link 16, Link 11 and the future Link 22 or by voice communication. The system is light enough to be installed in a wide range of fixed wing aircraft or helicopters operating from on-shore or afloat. From its unique vantage point, the Searchwater 2000 AEW system provides the following:

- Long range warning against high and low level attack
- Intercept direction of fighter aircraft using a high resolution INS/GPS Navigation System
- An autonomous secure air defence C2 unit



- A sophisticated maritime surveillance system providing detection of very small, fleeting targets, including periscopes, against high background clutter
- An extension of surface-based systems to provide Over The Horizon Targeting, Search and Rescue and Coastal Surveillance
- Special Enforcement Operations
- Very capable, key network enabler

Operator Facilities

A comprehensive Human Computer Interface includes large, high resolution, flat-panel colour displays and touch sensitive interactive control panels (ICPs). Each display provides a clutter-free radar picture with pop-up data plaque windows. The ICPs provide system control, mini display areas for target profiles, raid assessment information, zoom-in radar coverage displays, rapid multi-mode system setup and text messages.

Radar

Searchwater 2000 AEW is an advanced, high powered, Pulse Doppler radar with long range air to air look up/look down capability. The radar is specifically designed for AEW applications over land and sea. The radar incorporates 'multi-bar scanning' for multiple level raid detection. 'Pulse Doppler/Pulse Envelope interlacing' allows targets to be detected at maximum range and tracked through background clutter. In 'pulse doppler mode', the system can be set to either wide area coverage or be spot-lighted on a single target. Operator facilities are provided for manual and automatic, multiple target tracking. Intercept information can be continuously relayed to the interceptor aircraft or surface based assets via data link or voice.

Whilst specifically designed for AEW, the radar still retains Searchwater's outstanding maritime surveillance and maritime reconnaissance capabilities including surface target classification facilities.

Radar Modes

- Air-to-Air (Look Up & Look Down)
- Moving Target Indicator (MTI)
- Maritime Surveillance (ASW/ASuW) for both Littoral and Open Water
- Navigation/Ground Mapping
- Target Classification
- Weather
- Beacon

Pulse Doppler Overland Detection & Tracking

The high performance doppler radar, together with a littoral surveillance mode, allows targets to be tracked over land and through coastal waters. The radar is specifically designed to:

- Detect small targets in sub-land and sea clutter.
- Discriminate between high velocity airborne targets and a multitude of lower velocity land and sea targets.

In January 2015, a fully scaled (1,024 TRM) array was subject to power aperture measurement, thermal testing, and beam forming characterisation. According to Lockheed Martin, these trials provided objective evidence to support the company's radar and thermal performance claims.

Lockheed Martin has elected to re-use the Thales France IFF system currently in service on the SKASaC given that it is relatively new to service. However, it will introduce a new electronically scanned IFFi antenna, to be fitted above the dual radar arrays in each pod.

Inside the rear cabin, Lockheed Martin is proposing a series of ASaC specific mission system embodiments designed to improve picture compilation and reduce operator workload. These include an expanded tactical display, the addition of a secondary tactical display unit, new display formats, automatic track management operator decision aids and the introduction of a sensor correlation engine (based on that already in service on the US Navy's MH-60R helicopter). The ASaC software load will reside in the system alongside the standard ASW software baseline.

Physical role change time is estimated to be no more than three hours. Installation of the sensor pods on the weapon carriers will take about 15 to 20 minutes. Inside the cabin, sonics equipment and sonobouy stowage will be removed, two role fit equipment racks installed on existing seat rails, and a system interface panel installed on the existing console. There is only about 100 kg additional weight between the ASW and Crowsnest fits, consequently there is very little difference in on-station time.

Other contributing companies are:

BAE Systems: supplying its Cayman tactical datalink product. Cayman is a link independent Tactical Data Link (TDL) processor for Land, Maritime and Air platforms and equipment, providing friend and enemy location and positioning situational awareness information.

Vector Aerospace: selected to manufacture the composite sensor pods at their Gosport based Fleetlands facility.

The Decimal Clock

A French revolution in time

If you take a close look at the watch shown here, you will notice some oddities. This is a precision watch with decimal hours and seconds by Robert Robin from circa 1793. In this system there are 100 seconds in a minute and 100 minutes in an hour, i.e. this is decimal time, which is the representation of the time of day using units which are decimally related. This was known as French Revolutionary Time.

The divisions of time were as follows:

100 metric seconds in a metric minute

100 metric minutes in a metric hour

10 metric hours in a day

10 days in a metric week (called a décade)

One hour in Revolutionary Time was 144 conventional minutes (2.4 times as long as a conventional hour), a minute was 86.4 conventional seconds (44% longer than a conventional minute), and a second was 0.864 conventional seconds (13.6% shorter than a conventional second).

In 1788, Claude Boniface Collignon had proposed dividing the day into 10 hours or 1000 minutes, each new hour into 100 minutes, each new minute into 1000 seconds, and each new second into 1000 tierces. The distance the sun travels in one new tierce at the equator, which is one-billionth of the circumference of the earth, would be a new unit of length, provisionally called a half-handbreadth, equal to four modern centimeters. Further, the new tierce would be divided into 1000 quatierces, which he called "microscopic points of time". He also suggested a week of 10 days and dividing the year into 10 "solar months". The full French Republican Calendar was introduced on November 24th 1793 with 30 days in a month and 12 months/ 360 days in a year, using a decimal timescale, adding 5 days of festivities at the end of the year. The Republican Calendar was not a success and lasted only 12 years until 1805.

However, there was some logic behind the scheme. For example 2 decimal hours and 25 decimal minutes would be written as 2.25 hours or 225 minutes. And, 5 hours would be equal to 500 minutes or 50,000 seconds. So it would have been easier to carry out calculations involving time where you could add, multiply or divide as though they were normal numbers—which of course they are.

Decimal time was part of the decimal system of measurements that was introduced by the French Republic in 1799 and gave us the metre, the litre and the gramme. You have to wonder how we would calculate time related measurements such as power and velocity if the French system of time has been universally adopted. Here we would have the force of gravity changing from $9.81 ms^{-1}$ to 4.0875 metres per decimal second. Also, how long would the weekend be if there were 10 days in a week?

The Chatham Chest

Occupational pensions for wounded seamen

In 1590 a fund was established by Admiral Sir John Hawkins, who was a keen promoter of welfare of the common seaman, to provide pensions to wounded seamen of the Royal Navy following the defeat of the Spanish Armada. This was probably the first funded occupational pension fund in the world. Each month sixpence (about 5%) was deducted from seamen's wages and paid into a specially constructed wooden chest that was held in the dockyard at Chatham hence the "Chatham Chest". Pensions were payable on a fixed scale according to the degree of injury. These pensions were payable for life but were regularly reviewed and could be reduced or terminated if the pensioner was found to have recovered sufficiently to be capable of employment.

Hawkins himself supervised the income and expenditure, but after his death in 1595 the fund was mismanaged by a number of people, particularly Sir Robert Mansel, who after being appointed as Treasurer of the Navy by James I, used the chest as a personal source of funds. An enquiry in 1608 found that money was being misappropriated but nothing was done to remedy the situation. A second enquiry in 1617 concluded the same.

The iron chest show here in the photograph was only manufactured in 1625 and has five locks, the four hasps for padlocks and a disguised keyhole in the top. The keyhole on the front of the chest is false. The custodians of the fund, known as the Governors of the Chest, were a purser, a master attendant, a master shipwright, a boatswain and one of the Principle Officers of the Navy. Each of these five would hold one keys each. The purser would act as the Clerk of the Chest and was responsible for maintaining accurate records of monies received and issued. These five officers were changed every year during a general assembly of fellow officers.

During the early to mid-1600's there were only about 60 pensioners so there was more money coming in than was being paid out. However by 1657, after the wars against the Dutch and against Spain, the numbers of pensioners increased to between 800 to 900. By 1667 the money was running out and additional funding of £2000 had to be provided by the Treasury. In 1673 the Navy Commissioners were warned that the chest could not continue to pay out pensions in the years to come and so arrangements were made for the government to cover any excess payments as required. This arrangement continued up until 1814.

Information Warrior 17

Testing Artificial Intelligence concepts for the Royal Navy

Earlier in the year an exercise to test the protection of submarines and warships against cyber attacks was hosted at the Royal Marine Barracks Stonehouse and at QinetiQ's Portsdown Technology Park. More than 1,000 Royal Navy personnel took part, including regular and reserve forces from the Navy's surface and submarine fleets, the Fleet Air Arm and the Royal Marines. QinetiQ's Portsdown Technology Park has, for 45 years, integrated and tested complex combat and communications equipment and software for all Royal Navy warships prior to their deployment.

The exercise was to demonstrate innovative ways of using and interpreting information and intelligence via five key themes, which QinetiQ would integrate into the overall exercise. The five themes focused on:

- Artificial Intelligence (AI): How building a ship's AI 'mind' will enable the fleet to operate faster, better and more effectively
- Command, Control, Communications, Computers and Intelligence (C4I): Developing the most efficient and comprehensive computer system possible for the Navy
- Information Exploitation (IX): Exploiting open source information effectively
- Cyber and Electromagnetic Activity (CEMA): Offensive and defensive cyber operations to protect UK national interests
- Intelligence, Surveillance and Reconnaissance (ISR): Building the intelligence picture with unmanned systems to further enhance command decisions

The Royal Navy-led Information Warrior developed and tested a new innovative range of Information Warfare capabilities through a series of trials that included Defensive Cyber Operations, Digital Influence Operations and Artificial Intelligence (AI).

As technology rapidly changes, the Royal Navy needs to be prepared to meet the challenges faced by AI, robotics, automation and quantum computing and to understand how they can be used effectively to improve

weapons targeting and survivability, while reducing risk and costs. The Information Warrior exercises are used to experiment, test and rehearse new innovative technology in a safe environment for the benefit of the Royal Navy.

Working in partnership with the Royal Navy, QinetiQ also provide the critical infrastructure as well as logistical support and technical expertise to deliver the exercises. This event, the first in a series of Information Warriors, will provide a benchmark of current capability and allow for further testing over time with the intention of enabling greater involvement from industry.

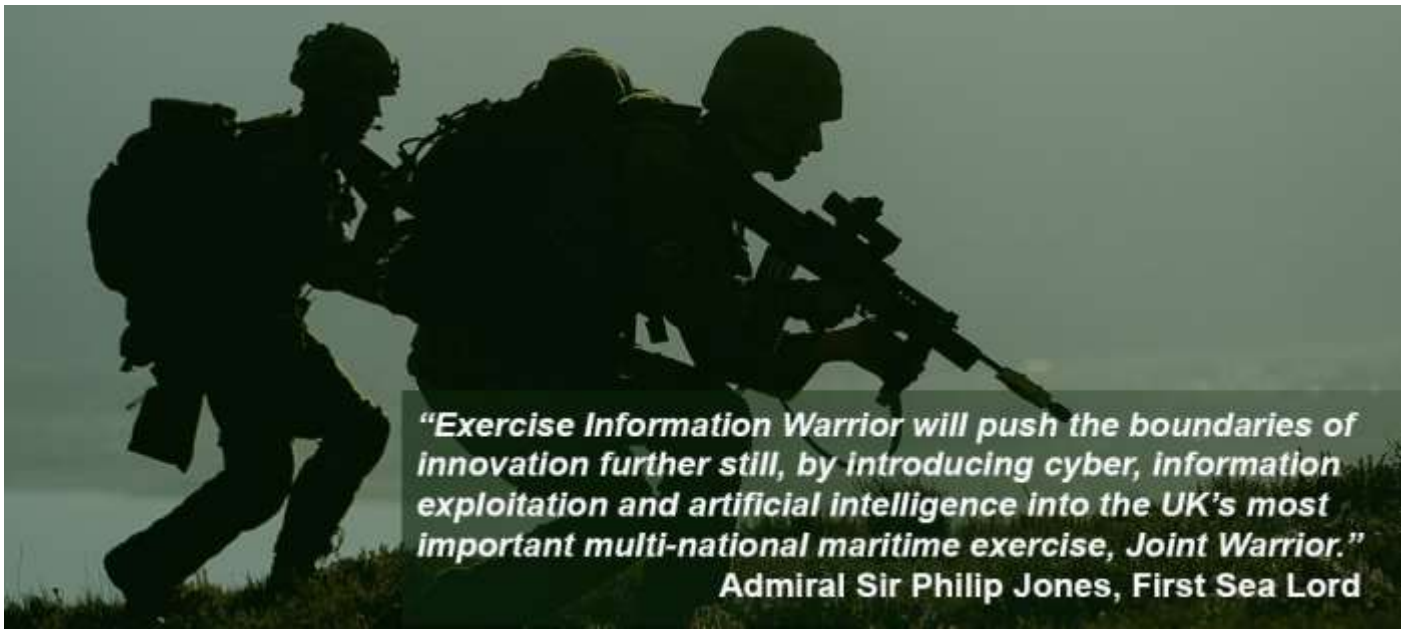
Information Warrior ties into the £800m Defence Innovation Fund, which was announced last year. The Fund has been established to provide the freedom to pursue and deliver innovative solutions. It will take forward the best proposals, from inside and outside of Defence, in an open competitive process. What the Ministry of Defence wants to do is to make use of the private technology sector's expertise in fields of interest to it, such as developing autonomous sensor systems and drones.

Information Warrior is the computer-based practical side of that funding exercise, complementing Ex Unmanned Warrior, which focused on drones and was held late last year. It appears that the ministry is outwardly keen to stop big defence contractors from sewing up the market with full-service offerings, and seems to be moving towards using DSTL's Open Architecture Combat System (OACS), a standard that will allow any company to build and integrate its wares with current and future warships, 'tanks' or platforms.

OACS underpinned the success of Unmanned Warrior 16 and will be used during Information Warrior to allow artificial intelligence applications such as STARTLE to be deployed. STARTLE uses AI-based reasoning to help operators analyse air movements to identify potential threats in seconds. Other DSTL projects will apply AI and Big Data to enhance the analysis of imagery from Unmanned Aerial Vehicles to assess potential landing sites and routes to support landing forces.

The risk of cyber attacks against ships and submarines is as real a threat as traditional weapons such as rockets, missiles and torpedoes. Combat and communications systems, power and propulsion control systems are all run by computers and a successful cyber attack could potentially disable a ship, rendering it ineffective.

All pictures in this article were provided from MOD sources.



The L135A1 Long Range Sniper Rifle

The British version of the American Barrett M82A1

Anyone who has an interest in shooting will recognise that this weapon is known in service as the L135A1 Long Range Precision Anti Structure rifle. It is a recoil operated semi-automatic anti-materiel rifle originally developed by the American Barrett Firearms Manufacturing company. It is also know as the "Light Fifty" for its half inch calibre chambering. The original weapon was developed in the early 1980's to become the M82 and the M82A1. Various changes were made to the original M82A1 to create the M107, with new features such as a lengthened accessory rail, rear grip, and monopod socket.

This weapon has an effective range of 1800 metres (1.1 miles) and is primarily used against targets such as trucks, radar cabins and parked aircraft and it can also used against hidden personnel as the round can penetrate substantial amounts of body armour.

As the cartridge is fired the energy from the projectile drives the barrel rearward. The rearward moving barrel drives the bolt carrier rearward also. During the rearward motion the cartridge is extracted and ejected from the rifle. The bolt is fully extended and the rifle is cocked. Toward the end of the rearward motion, the main spring buffer is compressed. As the bolt carrier starts its forward motion, it feeds a new cartridge into the chamber and locks into position ready to fire again.

Like its predecessors, the L135A1 rifle is said to have manageable recoil for a weapon of its size owing to the barrel assembly that itself absorbs force, moving inward toward the receiver against large springs with every shot. Additionally, the weapon's weight and large muzzle brake also assist in recoil reduction.

The .50 Browning Machine Gun (BMG) cartridge was originally developed in the late 1910's, entered service in 1921 and is still used to this day. The .50 BMG can produce muzzle energies of between 14 and 18 kilojoules depending on the powder used and bullet type. This makes it less susceptible to drift from cross winds making it ideal for sniper rifles. The picture of the right shows the sizes of the most common cartridges used in the military.

From L to R: 5.56 mm, 7.62 mm, .30 in and .50 in.

Petty Officer Air Engineering Technician

Top Academic Award 2017 - POAET(M) Emma Camp

POAET Camp joined the Royal Navy in April 2008 as an Air Engineering Technician. After initial training at HMS Raleigh and HMS Sultan she joined 771 Squadron at HMS Seahawk, completing 'Qualified to Maintain' and 'Qualified to Sign' training on the Sea King MK7. She joined 857 Squadron to gain experience on a frontline unit which included two tours of Afghanistan and Op Ellamy on HMS Ocean.

Emma then joined HMS Heron in 2012, after being assigned to the GRP Bay. Within a year she had been selected for promotion and started LAETQC (M). Working hard throughout her course she achieved Fast Track status to POAET. She successfully completed the Supervisory exam before being deployed to Oman with the Wildcat. In 2016 Emma completed PAOET QC and achieved the highest average marks within the class. Now employed on 845 Squadron she is looking forward to the next chapter in her career.

Picture: PO(PHOT) Nicola Harper

The Robbins Memorial

Essay Prize

"Have you a story to tell, a simple answer to an engineering problem or an amusing anecdote?" Yes, you have seen these words before in the NER. If the answer is yes and you would like the chance to win a cash prize and have a few hundred or even a few thousand well penned words together with a couple of pictures, then send what you have to the Bulletin editor and you may get your name in print. MS-Word and JPG's please.

845 Naval Air Squadron

It is a squadron of the Royal Navy's Fleet Air Arm. Part of the Commando Helicopter Force and is a specialist amphibious unit operating the AgustaWestland Merlin HC3/ HC3A helicopter providing troop transport and load lifting support to 3 Commando Brigade Royal Marines.

In 2012, the squadron celebrated 50 years since it was awarded "commando" status.

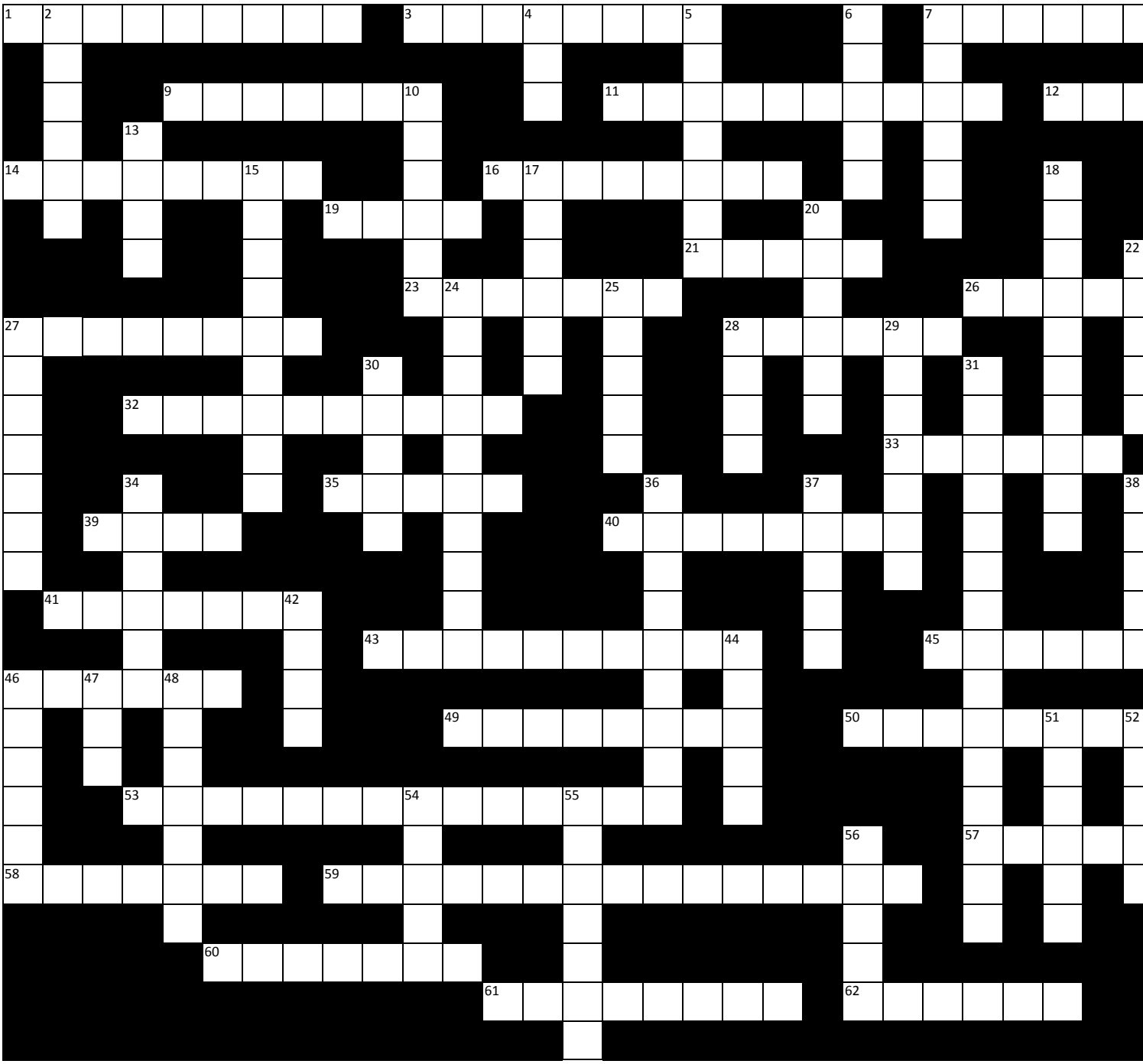
The squadron is based at RNAS Yeovilton in Somerset.

The Big Crossword #003

Here is another chance to win a brand spanking new Society Tie with the Society crest. The theme this time is all about Admirals and should be a bit easier to solve than crossword #002 When you have completed the puzzle, there is the secondary challenge that involves the summation of the value of the first letter of the all the answers. Taking A=1, B=2, C=3 etc., the task is to add up the numbers and find the total value.

When you have worked this out, email the number with your postal contact details to me at Contrabyte@gmail.com for the chance to win the prize for the first correct drawn out of the hat at the next management committee meeting.

The solution to Crossword #002 can be found on page 30.



Across Clues

1 Prime Minister 'Jim'
3 Old Rolling Stone 'Keith'
7 Burnt remains and lots of it
9 Promoted on 30 April 1910
11 "Area of pasture" added to a "dwelling"
12 Deal or No Deal 'Edmonds'
14 Born the son of John Henry Edward Fock
16 Rosyth naval base
19 To look or stare
21 Commanded HMS Onslow at the Battle of Jutland
23 A coal spade?
26 Not cold cured leg of pork
27 Commanded HMS Albion 1972-73
28 Grand Fleet commander has bust in Trafalgar Square
32 Led British forces in the Battle of Cape Spartivento
33 Prime Minister 'Harold'
35 Commanded fleet at the First Battle of Cape Finisterre
39 xxxx?, faith and charity
40 Benjamin was promoted in 1995
41 North Atlantic white fish
43 Rathmines boy became 1st Vicount Hyndhope
45 British black shirt president
46 Resigned in 1919 to give Beatty his job
49 The special reserve port—no s
50 Commanded Exercise Verity in 1949
53 Signed Armistice of Mudros on behalf of Allies in 1918
57 Succeeded Beatty as 1st Sea Lord
58 Encountered von Spee during Battle of Falklands - 1914
59 Commanded the 14-gun sloop HMS St Vincent in 1780
60 Scottish bridge near Glasgow
61 John was created Vicount Brocas in 1925
62 Double O trains

Down Clues

2 Appointed Ranger of Greenwick Park in November 1714
4 Dried grass
5 Clan of The Young Pretender
6 Captured Gibraltar in 1704
7 Brother of writer Jane
8 T.S.?
10 Die Hard 'Bruce'
13 Was in command of the Channel Fleet in 1793
15 Awarded VC with William Thomas Rickard in 1855
17 Cromwell
18 Two of his sons were awarded the Victoria Cross
20 His nickname was "Dry Ginger"
22 Was MP for Portsmouth from 1747 to 1777
24 Became Commander-in-Chief Far East Command in 1969
25 Commanded the vanguard in the Battle of Málaga
27 Commanded HMS Greyhound at War of Spanish Succession
28 Persuaded Government to develop "through-deck cruisers
29 Reginald Yorke commanded the Harwich Force in WW1
30 Alex Alexander (A.A.) was one
31 Promoted three days after accession of William IV
34 Commanded vanguard at the Battle of Toulon in 1744
36 Rear of a dwelling
37 Name for badger
38 Area of land for farming
42 Lord Walter took part in Crimean War and Indiam Mutiny
44 In 1860 he conveyed Gieseppe Garibaldi to Marsala
46 Sir Provo served in the Royal Navy from 1795 to 1892
47 After April
48 Sir Thomas was the son of Rear Admiral Sir William
51 Hailed as "The Last of Nelson's Captains"
52 Son of Henry, Bishop of Litchfield
54 Sounds like another make of shirts
55 First Admiral of the Fleet
56 Persuaded Thatcher to retake the Falklands in 1982

Tomahawk Block IV

Astute Class submarine launched cruise missile

The latest Rolls Royce nuclear powered submarines of the Astute Class, Astute, Ambush and Artful are now operational with the last of the Trafalgar Class, Talent, Trenchant, and Triumph. The next "Astutes", Audacious, Anson and Agamemnon are under construction, and the steel has been cut for the seventh and last of the class, Ajax.

Together with the Spearfish torpedoes, they are equipped with the Raytheon manufactured Tomahawk Block IV land attack cruise missiles.

In 2004, the UK government reached agreement with the US to purchase 64 torpedo tube launched Block IV missiles at a cost of £870,000 each.

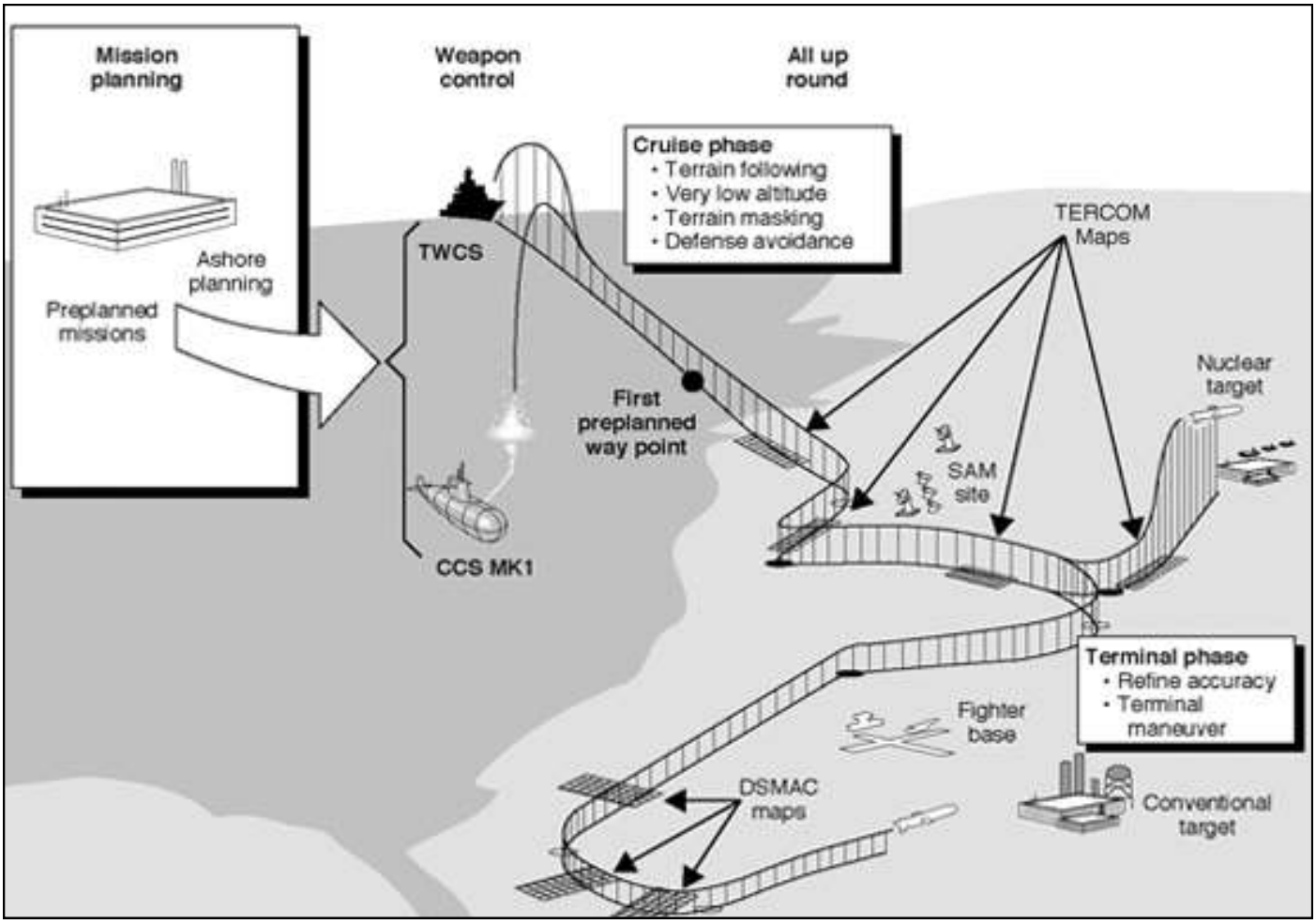
As of 2017, the unit cost of these missiles is approx. £1,460,000.

Tomahawk Cruise Missile

The Tomahawk is a long-range, low altitude, all-weather, subsonic cruise missile in service with the surface ships and submarines of the US and Royal Navy. Originally produced by General Dynamics, Tomahawk is currently manufactured by Raytheon.The BGM-109 Tomahawk family began life in the 1980s as sub-sonic, low-flying nuclear strike weapons, before being developed into long-range RGM/UGM-109 conventional attack missiles.

The picture below shows a mock-up of a Block IV missile with its solid propellant boost motor attached and three deployable tail fins.

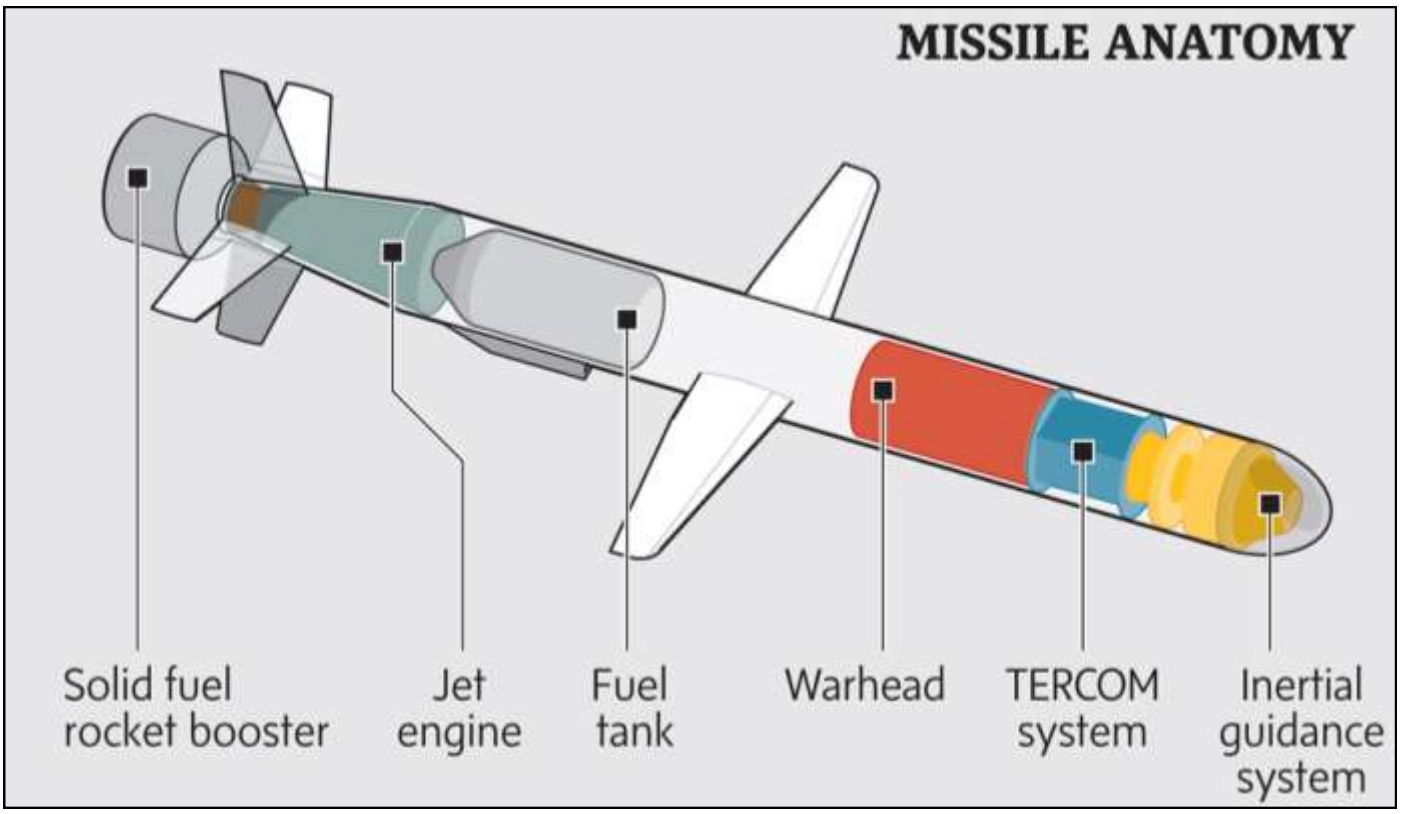
The Tomahawk can strike high value or heavily defended land targets. The Block II TLAM-A missile achieved its Initial Operating Capability in 1984. The missile was first deployed in combat during Operation Desert Storm in 1991. Since then the Tomahawk missile has been used in the Balkans, Afghanistan, Sudan and more recently in Iraq during operation Iraqi Freedom. More than 1,700 Tomahawk cruise missiles have been fired in wartime since 1991.



Guidance and Control

The Tomahawk Block IV uses Global Positioning System (GPS) navigation and a satellite data -link to continue through a pre-set course. The missile can be reprogrammed in-flight to a new target. Two-way satellite communications are utilised to perform post-launch mission changes throughout the flight. The on-board camera provides imagery of the target to the commanders. The guidance system is assisted by Terrain Contour Matching (TERCOM). Guidance is provided by the Digital Scene Matching Area Correlation (DSMAC) system or by GPS. The Tactical Tomahawk Weapons Control System (TTWCS) integrated with the ship's systems computes the path to engage targets. The system allows the planning of new missions aboard the launch vessel. the TTWCS is also used to communicate with multiple missiles for reassigning the targets and redirecting the missiles in flight.

The Fire Control Systems (FCS) on both ships and submarines perform communications management, database management, engagement planning, and launch control functions. These systems provide the interface between the missile and FCS for missile initialization and launch as well as environmental protection. The FCS supporting surface ships is the Advanced Tomahawk Weapon Control System (ATWCS) AN/SWG-3. The FCS on submarines is the Combat Control System (CCS) MK1, CCS Mk2, or AN/BSY-1, the Integrated ASW Combat System. The combat control subsystem provides setting and control of weapons and mines, targeting, combat systems management as well as the piloting and navigation functions. It includes the weapon launch equipment to support horizontal tubes and own ship data displays.



Navigation

Terrain Contour Matching (TERCOM) is a navigation system used primarily by cruise missiles. It uses a pre-recorded contour map of the terrain that is compared to measurements made during flight by an on-board radar altimeter. The TERCOM system considerably increases the accuracy of a missile compared to Inertial Navigation Systems (INS). This increased accuracy allows a TERCOM equipped missile to fly closer to obstacles and at lower altitudes, making it harder to be detected by enemy ground radar.

TERCOM navigation "maps" consist of a series of strips of land that the missile is expected to fly over, encoded as a series of altitudes. Since a radar altimeter measures distances, height over the ground, and not an absolute altitude, the maps generally encode a series of changes in altitude, not the absolute altitude itself. Additionally, the strips of land on either side of the expected path are also stored. A series of such maps are produced, typically from data from radar mapping satellites. When flying over water, contour maps are replaced by magnetic field maps.

The missile's radar altimeter feeds measurements into a smaller buffer, which periodically "gates" the measurements over a period of time and averages them out to produce a single measurement. The series of such numbers held in the buffer produce a strip of measurements similar to those held in the maps. The two are compared to overlay the buffer's strip on the known map and the positioning of the strip within the map produces a location and direction. The guidance system can then use this information to correct the flight path of the missile.

During the flight to the target the accuracy of the system has to be enough only to avoid terrain features. This allows the maps to be relatively low resolution in these areas. Only the portion of the map for the terminal approach has to be higher resolution and would normally be encoded at the highest resolutions available to the satellite mapping system.

TERCOM systems have the advantage of offering accuracy that is not based on the length of the flight; an inertial system slowly drifts after a "fix" and its accuracy is lower for longer distances. TERCOM systems receive constant fixes during the flight and thus do not have any drift. Their absolute accuracy, however, is based on the accuracy of the radar mapping information, which is typically in the range of meters and the ability of the processor to compare the altimeter data to the map quickly enough as the resolution increases. This generally limits first generation TERCOM systems to targets in the order of hundreds of meters, limiting them to the use of nuclear warheads. Use of conventional warheads requires further accuracy, which in turn demands additional terminal guidance systems.

One disadvantage of TERCOM systems is that the entire route has to be pre-planned, including its launch point. If the missile is launched from an unexpected location or flies too far off-course, it will never fly over the features included in the maps and become lost. The INS system can help in this regard, allowing it to fly to the general area of the first patch, but gross errors simply cannot be corrected. This makes TERCOM based systems much less flexible than more modern systems like GPS, which can be set to attack any location from any location and does not require any sort of pre-recorded information which means they can be targeted immediately prior to launch.

Propulsion

The Tomahawk Block IV missile is powered by a Williams International F415 cruise turbo-fan engine that provides a subsonic speed of 880km/hr. An ARC MK 135 solid propellant rocket motor delivering 600 lbs of thrust propels the missile away from the submarine and towards the surface. It also provides vectored thrust to give the missile direction for the 12 seconds before being jettisoned. Once in clear air the turbo-fan engine takes over for the cruise portion of the flight. Missile flight control and stability are maintained by a pair of wings along with four tail fins that are automatically deployed from a recessed position within the missile. A ventral air intake is also deployed in order to maintain air flow to the turbojet

engine. The engine contains an Ultra Compact Combustor (UCC) that was developed to improve combustion efficiency, stability and ignition without sacrificing performance. It is also 69% smaller in volume that the original UCC.

Production History

The U.S. Navy began its development of sea launched cruise missiles in 1972. The programme aimed to provide a ship and submarine-launched missile for attacking ship and land targets. In 1975, General Dynamics was awarded a contract for their 'Tomahawk' design. More than 35 years later, the 2,000th Tomahawk cruise missile was fired during the Libyan mission, Operation Odyssey Dawn.

The Block I Tomahawk Land Attack Missile (TALM) was first deployed in March 1983 and is sometimes referred to as Tactical Anti Shipping Missile (TASM) system. Because it was primarily designed for the anti-shipping role. It employed the AN/DSQ-28 active radar seeker that operates in the J-band of the electromagnetic spectrum. This system is also found on A/R/UGM-84 Harpoon Anti Ship Missile targeting system.

The Block II Tomahawk missiles, whose deliveries began in 1986, contained the Inertial Navigation System (INS) and TERCOM mid-course guidance system also received a new terminal phase guidance and targeting system in the form of Digital Scenery Matching Correlation (DSMAC) AN/DXQ-1 system. This gave the missile added tactical flexibility by allowing it to attack targets in three different ways: a straight attack from the side of a target, a programmable pop-up/terminal dive into the target and a Programmed War head Detonation (PWD) that commands the warhead to explode when the missile is overflying a given target area. Together with the TAINS (TERCOM plus INS), the DSMAC gave the Tomahawk Block II an estimated accuracy of between 10 and 30 metres. Both WDU-25/B and BLU-97/B (from 1988) warheads could be used (TALM-C and TALM-D respectively).

By May of 1993 the Block II was ready to receive its latest upgrades. A jam-resistant GPS came to complement the TAINS and DSMAC guidance system. Allowing the missile to survive in an environment where hostile 'electronic warfare' jamming signals are broadcast became a requirement. A smaller and lighter WDU-36/B explosive blast fragmentation warhead was mated to the missile further improving its range.

Block II missiles would be upgraded to Block III missiles during planned maintenance schedules. Funding for Block III Tomahawk is on-going until the planned expiration date of 2020.

The Block III upgrades included:

- Reducing the time required for mission planning from 80 hours to one hour with the introduction of a GPS navigation system.
- The ability to loiter over targets while waiting for other assets to arrive.
- A new turbofan which uses 3% less fuel and produces 20% more thrust

The Block IV Tactical Tomahawk (TacTom) reached initial operational capabilities in May 2004 and incorporated the latest achievements in network-centric warfare capabilities and resulting tactical benefits. The Block IV missile uses three steerable tail fins (instead of four), two deployed wings and has an improved range of 1605 km.

UK Operational History

In 1995 the US agreed to sell 65 Tomahawk missiles to the UK for torpedo-launch from nuclear submarines. The first missiles were acquired and test-fired in November 1998 and all Royal Navy fleet submarines are now Tomahawk capable. The Kosovo War in 1999 saw HMS Splendid become the first British submarine to fire a Tomahawk in combat. It has been reported that 17 of the 20 Tomahawks fired by the British during that conflict hit their targets accurately. The UK subsequently bought 20 more Block III to replenish stocks. The Royal Navy has since fired Tomahawks during the War in Afghanistan, in Operation Telic as the British contribution to the 2003 Iraq War, and during Operation Ellamy in Libya in 2011.

In April 2004, the US approved the sale to the UK of 64 new generation Block IV Tomahawk missile or TacTom missile. It entered service with the Royal Navy in March 2008, three months ahead of schedule. In July 2014 the US approved the sale to the UK of a further 65 submarine-launched Block IV's at a cost of US$140m including spares and support. As of 2011 the Block III missiles were on Britain's books at £1.1m and the Block IV at £0.87m.

Surface Launch Capability

The Sylver Vertical Launching System on the new Type 45 destroyer is claimed by its manufacturers to have the capability to fire the Tomahawk, although the 5 metre high A50 launcher carried by the Type 45 is too short for the weapon (the 7 metre high A70 silo would be required). Nevertheless, the Type 45 has been designed with weight and space margin for a strike-length Mk41 or Sylver A70 silo to be retrofitted, allowing Type 45 to use the TLAM Block IV if required. The new Type 26 frigates will have strike-length VLS tubes. The French Government is developing MdCN, a version of the Storm Shadow/Scalp cruise missile that has a shorter range but a higher speed than Tomahawk and can be launched from the SYLVER system. The picture on the right shows a Tomahawk missile canister being loaded onboard an American Arleigh Burke-class destroyer.


Photo: U.S. Navy

Replacement

Since 2014 the U.S. Navy has been seeking a replacement for the Tomahawk, the Next Generation Land Attack Weapon, which would be expected to have increased lethality and survivability. Options include Tomahawk improvements or a completely new weapon. The U.S. Navy believes its inventory of 4,000 Tomahawk missiles is sufficient for future scenarios, so production was planned to end after 2016, relying on stocks until the next-generation land-attack weapon is developed.

Future Upgrades

In 2014, Raytheon began testing improvements to the Block IV's ability to attack sea and moving land targets. The new passive radar seeker will pick up the electromagnetic radar signature of a target and follow it before sending an active signal to bounce off the target and confirm its legitimacy before impact. Mounting the multi-mode sensor on the missile's nose would remove fuel space, but designers believe the Navy would be willing to give up space for the sensor's new technologies. The new seeker could make the Tomahawk a candidate for the U.S. Navy's Offensive Anti-Surface Warfare (OASuW) Increment II requirement.

The previous Tomahawk Anti-Ship Missile that retired over a decade ago was equipped with inertial guidance and the seeker of the Harpoon missile. There was concern with its ability to clearly discriminate between targets from a long distance, which would be more reliable with the new seeker's passive detection and active millimetre-wave radar. The Tomahawk would likely compete against a version of the Lockheed Martin Long Range Anti-Ship Missile for ship-launched needs. Raytheon is planning to offer to perform the upgrades as the older Block IVs are brought back to the factory for recertification around 2018.

A supersonic version of the Tomahawk is under consideration for development with a ramjet to increase its speed to Mach 3. A limiting factor to this is the dimensions of shipboard launch tubes. Instead of modifying every ship able to carry cruise missiles, the ramjet-powered Tomahawk would still have to fit within a submarines 21-inch diameter and 20-foot long tube.

In October 2015, Raytheon announced the Tomahawk had demonstrated new capabilities in a test launch, using its on-board camera to take a reconnaissance photo and transmit it to fleet headquarters. It then entered a loitering pattern until given new targeting coordinates to strike.

In January 2016, the Los Alamos National Laboratory was working on a project to turn unburned fuel left over when a Tomahawk reaches its target into an additional explosive force. Simply, the missile's JP-10 fuel is turned into a fuel air explosive to combine with oxygen in the air and burn rapidly. The thermobaric explosion of the burning fuel acts, in effect, as an additional warhead and can even be more powerful than the main warhead itself when there is sufficient fuel left as in the case of a short range target.

2017, The Year of the Royal Navy

Says the UK Government

At the start of 2017 Defence Secretary Sir Michael Fallon stated that "We are investing billions in growing the Royal Navy for the first time in a generation with new aircraft carriers, submarines, frigates, patrol vessels and aircraft all on their way. 2017 is the start of a new era of maritime power, projecting Britain's influence globally and delivering security at home."

Lets look at what was being promised:

- HMS Queen Elizabeth, will sail from Rosyth, ready to conduct sea trials in summer and debut in Portsmouth later in the year. √
- HMS Prince of Wales will enter the water for the first time in the summer as work on her continues and is due to be formally named in the autumn. √
- Design and Manufacture will begin on the multi-million pound Crowsnest, the early-warning 'eyes in the sky' system for 10 of the 30 Merlin helicopters. √
- In the summer, steel will be cut on the first of eight Type 26 frigates in Glasgow. √
- The first of four Tide-class tankers, RFA Tidespring (A136), will arrive from South Korea in the spring to undergo UK customisation work. √
- Similarly, in the spring, the first of the Navy's five next-generation patrol ships, HMS Forth (P222) will begin her sea trials. √
- The fourth Astute Class submarine, HMS Audacious, will enter the water for its commissioning phase in the spring. √
- The keel for the seventh and final Astute-class submarine will be laid in 2017 as work continues on the 5th and 6th, HMS Anson and HMS Agamemnon in Barrow. √
- The opening of the first permanent Royal Navy base East of Suez in nearly half a century, to be named HMS Juffair. √

So all of the promises made appear to have been delivered. However, we have to wonder how we will provide enough trained personnel to man these ships. Maybe the concept of middle management artificers who are guaranteed fast track promotion and an officer corps who are trained as engineers first and foremost would help. Then we have the T45 propulsion problems to fix, the imminent scrapping of Harpoon without a logical replacement and insufficient planes to complement two carriers amongst other problems that need to be resolved and financed. Why wait for a British company to build and test a Directed Energy Weapon by the end of the decade when the US already has the LAWS system installed on some of their ships. Just go out and buy them.

The Type 31 frigate building programme needs to be underway by 2017 to replace the aging Type 23's. You have to wonder how many ships we will actually end up with if we suffer from the usual stringent procurement rules and the endless changes to specification. Every change results in a new contract variation and yet more cost. If you have ever worked in the MoD or as a 3rd party supplier, you know who difficult it is to ever get anything done in a cost effective and timely manner.

Project Spartan

Contender for the Type 31 Frigate

The 2015 Strategic Defence and Security Review (SDSR) announced that the Royal Navy is looking to procure five 'light frigates'. These general purpose vessels would support the range of tasks that the Royal Navy performs, from benign and constabulary operations to high-end warfare. This approach was re-affirmed in November 2016, when Sir John Parker released an independent report to inform the National Ship Building Strategy. In it he stated the need for a "sea change" in naval procurement and a "modern and innovative design" for what he proposed be designated Type 31e. Recently we have learned that these new frigates will be built across different shipyards and assembled at a central site. They will be ready for service by 2023.

The General Purpose Frigate (GPFF) project is aimed at meeting the requirement for light frigates whilst simultaneously achieving export sales for the UK. An adaptable light frigate design, particularly one operated by the Royal Navy, offers an attractive option to the global market.

Steller Systems, a leading independent consultancy practice specialising in Naval Architecture and Systems Engineering, has developed an innovative design for a configurable, modular, survivable, affordable and exportable ship that will meet the Royal Navy's current and future requirements for the GPFF. Their innovative solution includes a reconfigurable aft mission space with ramp access to embark Unmanned Vehicles (UXVs), a large hangar space, sufficient power generation to accommodate systems growth over the next 30 plus years and configurable survivability designed-in from the outset. Their underlying focus on exportability has produced an affordable design solution that will support the UK shipbuilding and defence systems industries and, in turn, will enable the Royal Navy to build fleet numbers.

Steller Systems has worked closely with both the Royal Navy and export customers to define the range of roles and high-level requirements for a light frigate. Engaging with potential operators early in the design process has enabled their team to produce a single solution that meets the most onerous requirements, but which can be scaled back to suit individual budgets. Exporting from the UK will help the efficiency of British shipyards and would reduce the price of the ship for all customers.

The Nodal Modular Physical Architecture (NMPA) approach to the design allows for configurable options. Each node has the ability to accept different systems; for example a customer may wish to have a simple 30mm Small Calibre Gun system in place of the forward Mk41 Vertical Launch System (VLS), or place a SeaRAM or Phalanx in this position. Future capability growth would be enabled by space, electrical power and weight margins.

Here are just two examples.

For the General Purpose Patrol Frigate variant

- Anti-air warfare – self-defence
- Anti-surface warfare – self defence and littoral support
- Anti-submarine warfare – picture contributor

For the Task Group Escort and Goalkeeper variant

- Anti-air warfare – point defence
- Anti-surface warfare – strike and littoral support
- Anti-submarine warfare – picture contributor and light helicopter carrier

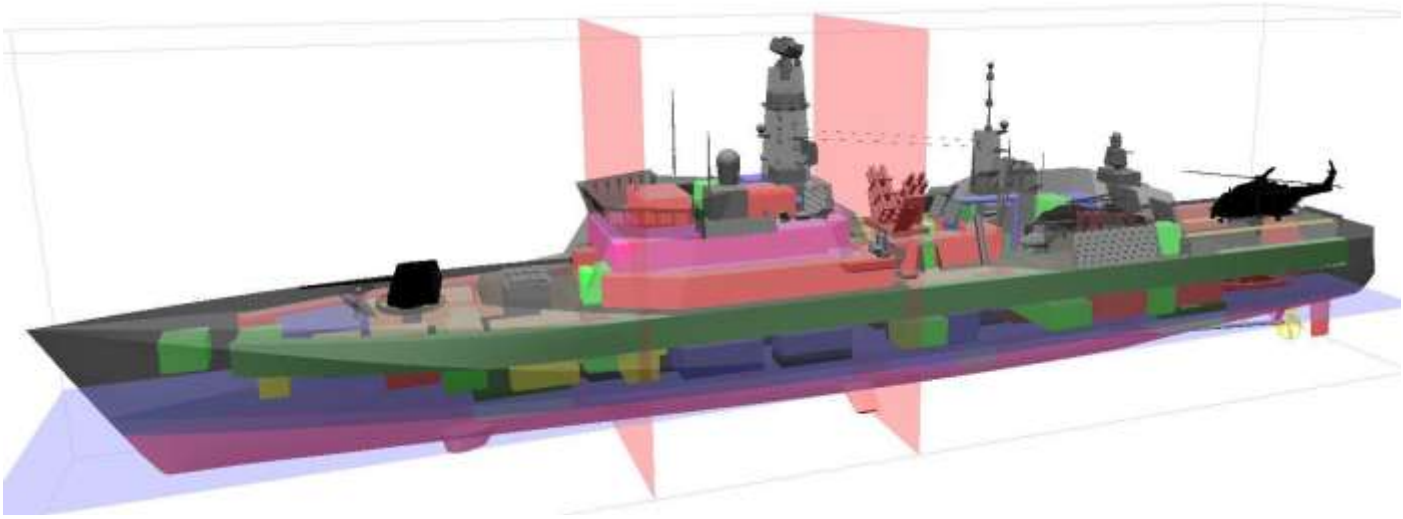
Spartan has been designed with the space and the margins to allow for future growth and through-life upgrades. The design includes a large hangar and a stern garage under the flight deck, capable of accommodating a range of unmanned vehicles as well as future systems. The ship is designed to operate a wide range of unmanned vehicles and deploy Special Forces. There is flexibility in the design through the use of an open architecture combat system. In addition a hybrid propulsion system gives a significant electrical surplus, allowing for next-generation weapons and sensor systems to be fitted in the future to meet changing requirements.

With a large, reconfigurable multi-mission stern garage with access to a stern ramp, Spartan has been designed to be adaptable in a rapidly changing world. This adaptable space is designed to accommodate waterborne assets such as Rigid Inflatable Boats (RIB), Unmanned Underwater Vehicles (UUV), Unmanned Surface Vehicles (USV), Variable Depth Sonars (VDS), humanitarian aid stores and equipment containers. Operational flexibility comes from large, adaptable spaces. The large hangar has space for an organic helicopter capability, based on

an NH90-sized helicopter, as well as other Maritime Unmanned Aerial Vehicles (MUAV) and a crane-launched RIB.

In order to allow for the highest levels of survivability, Spartan has been designed with three separate powered zones, separated sensors and primary weapons, and an alternative operations room. The CODLAD (Combined Operation Diesel-electric and Diesel) propulsion system also has sufficient redundancy to maintain propulsion even after significant damage.

Whilst survivability has been built into the design from the outset, the configurability of the design allows for the survivability to be dialled back for customers to suit their needs and budgets. An optional bow mounted, dropdown propulsor provides 'get you home' thrust in the event of main propulsion system shock or other damage.



The main operations room is supplemented by a secondary operations room with space for five operators, either for UXVs or to take over prime functions in the event of damage. The ship has three zones, all with independent power and the means to fight-on should one be compromised. Blast-proof doors are provided, whilst blast-proof bulkheads are optional. System positioning has been used to reduce vulnerability whilst allowing for a reduction in capability for design to cost. Vertically and horizontally separated passageways and technical galleries allow for ease of movement as well as vulnerability reduction of key services.

Spartan is a highly configurable design that meets many navies' needs now and in the future. The Royal Navy will benefit from a survivable and highly capable ship that will be the backbone of the fleet for many years. Ensuring that the design remains attractive to the global export market will bring economic advantages to the Royal Navy through efficiencies of scale, and will result in wider benefits to UK plc.

Information and pictures regarding this article© Steller Systems 2017

There are of course other companies who wish to take advantage of providing the Royal Navy with the Type 31 frigate. The Cutlass design from BAE offered for the GPFF is a significantly stretched and enhanced derivation of the Al Shamikh-class corvette design and sits at the high end of the cost/capability spectrum. In Omani service, the vessels this design is based on carry one 76mm Oto Melara cannon, two 30mm MSI DS30M cannons, eight MM-40 Block III Exocet SSMs and twelve MBDA VL Mica SAMs. The vessels, despite being smaller than the proposed UK variant, also house an enclosed hangar and are capable of hosting Wildcat sized aircraft.

The **Ships of Edward VI's Navy**

(1547 to 1553)

The son of Henry VIII and Jane Seymour, Edward VI succeeded his father to the throne on 28 January 1547 at the age of nine. He died six years later at the age of fifteen. The predominant naval concern for the first two years of Edwards' reign was the war in Scotland, the origins of which dated back to 1542 when Henry VIII tried and failed to secure an alliance with Scotland by the marriage of the infant Mary Stuart and his young son Edward.

Edward Seymour, the Lord Protector, sent some 30 ships to the area around the River Esk in Lothian where they used their cannon to great effect against the Scottish troops.

The following ships were added to the existing fleet during Edward's reign, however, there are few surviving records so there is not much detailed information available.

Black Pinnace: A pinnace, 17 guns, 80 tons (1548)

Spanish Shallop: A pinnace, 7 guns, 20 tons (1548)

Great Bark Aiger: A ship, 300 tons, a French prize (1549)

Black Galley: Captured in 1549 and retaken by the French in the same year, 200 tons.

Swift: Built 1549, crewed by 30 men, 60 tons. Fate: The hull was sold to Richard Bethell for £20 in 1554.

Moon: Built in 1548, crewed by 60 men, 12 guns, 80 tons. Fate: She was loaned to a syndicate for trade to Guinea, West Africa, in 1553, was infected by plague in voyage upriver and lost or abandoned.

Seven Stars: Built in 1549 as a pinnace, 60 tons. Listed to 1558

Mary Norwell: A ship built or aquired in 1549, 80 tons.

John: A ship captured in 1549

Lion: An ex-Royal Scots Navy ship captured in 1549. Fate: was lost off the coast of Harwich.

Margaret: A ship built or acquired in 1549, 60 tons.

Nicholas: A ship captured in 1549.

Katherine: A ship, a Scottish prize captured in 1549, 100 tons.

Small Swallow: A pinnace built or acquired in 1550, crewed by 26 men , 4 guns, 30 tons,

Bark of Bullen: a bark built or acquired in 1550. She was given away in 1553

Jerfalcon: Built or acquired in 1550, crewed by 100 men, 120 tons. She served in the French War of 1557, the Western Isles in 1558 and Scotland in 1559. Fate: Sold in 1562 to Francis Lee of Rotherhithe for £80.

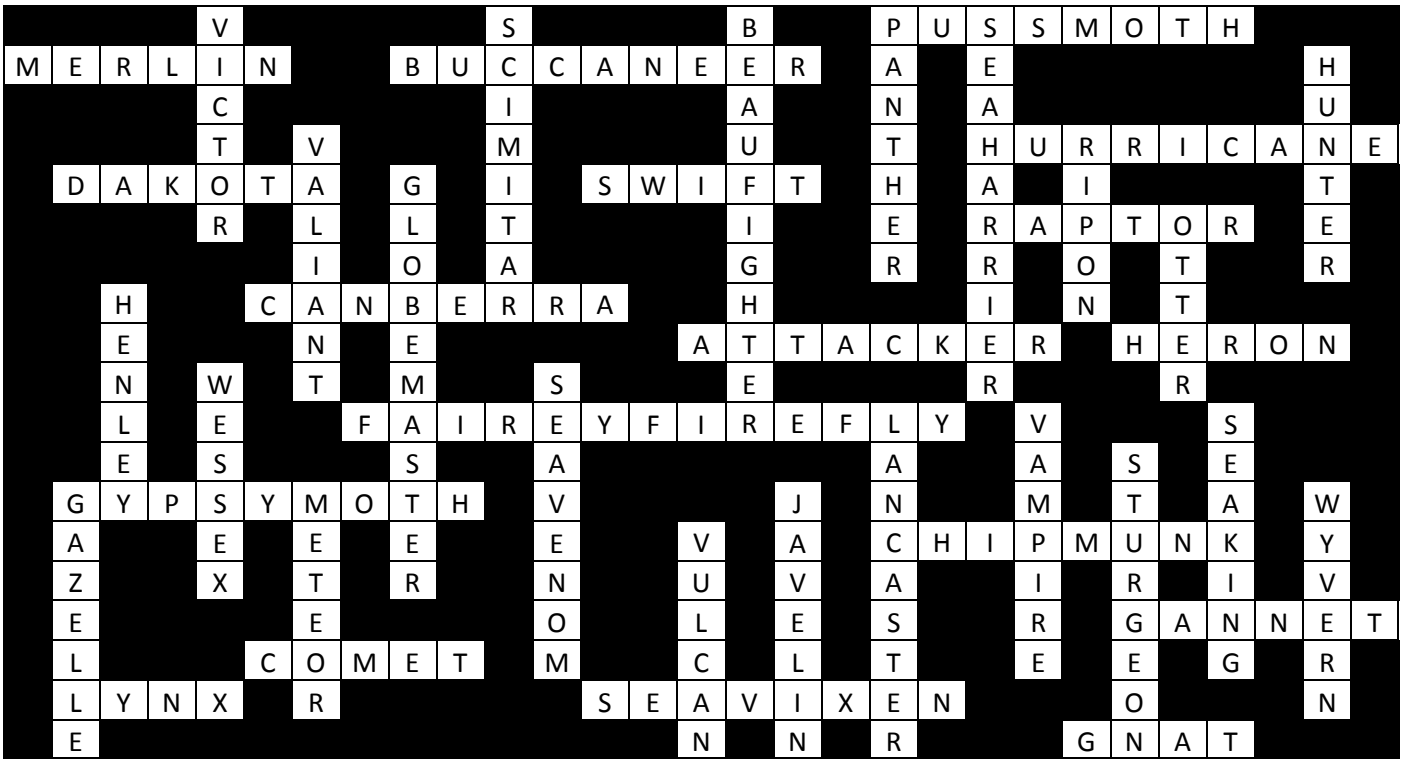
Edward Bonaventure: A ship built or acquired in 1551, 160 tons. She sailed to Russia in 1553 and was wrecked in 1556 off the coast of Aberdeen.

The next Bulletin will continue the story of Early English Warships — 1553 to 1558.

Solution to Crossword #002

Here are the answers to Crossword Puzzle #002. The answer to the secondary task was 489.

Better luck with #003.



4	Across	Pussmoth	P	16
6	Across	Merlin	M	13
7	Across	Buccaneer	B	2
10	Across	Hurricane	H	8
12	Across	Dakota	D	4
14	Across	Swift	S	19
15	Across	Raptor	R	18
19	Across	Canberra	C	3
20	Across	Attacker	A	1
21	Across	Heron	H	8
24	Across	FairyFirefly	F	6
28	Across	Gipsymoth	G	7
33	Across	Chipmunk	C	3
35	Across	Gannet	G	7
36	Across	Comet	C	3
37	Across	Linx	L	12
38	Across	Seavixen	S	19
39	Across	Gnat	G	7

1	Down	Victor	V	22
2	Down	Scimitar	S	19
3	Down	Beaufighter	B	2
4	Down	Panther	P	16
5	Down	Seaharrier	S	19
8	Down	Hunter	H	8
9	Down	Valiant	V	22
11	Down	Ripon	R	18
13	Down	Globemaster	G	7
16	Down	Otter	O	15
18	Down	Henley	H	8
22	Down	Wessex	W	23
23	Down	Seavenom	S	19
25	Down	Vampire	V	22
26	Down	Seaking	S	19
27	Down	Sturgeon	S	19
28	Down	Gazelle	G	7
29	Down	Meteor	M	13
30	Down	Javelin	J	10
31	Down	Wyvern	W	23
32	Down	Vulcan	V	22

Medals for Safe Keeping

Society becomes custodian of CERA Weire's medals

CERA Weaire BEM, 1917 - 1970

Dennis Weaire joined the RN as an Acting ERA 4th Class in December 1938. He was a Direct Entry from industry and a time-served Detail Fitter & Erector. He served in capital ships IRON DUKE (Dreadnought Battleship), NELSON (Battleship) and WARRIOR (Light Carrier) and passed professionally for CERA in September 1944. In 1954 he was awarded the British Empire Medal (Military Division) for "Outstanding skill and devotion to duty whilst serving in HMS MODESTE during operations in Korean waters". He left the RN after 22 years service in December 1960 but remained a member of the Society and an enthusiastic, loyal patron of the RNEBS Club in Southsea for the rest of his life.

CERA Weaire's son Allan donated his father's medals to the RNEBS and has also generously provided sponsorship to 'Artificer150' in his name.

Mr Alan Weaire handing over his fathers' medals to Society President, David Woollard, and General Secretary, Cliff Fiander, in front of the Ark Royal Anchor at Plymouth Hoe.

The anchor was presented to the city of Plymouth by Admiral of the Fleet, The Lord Hill Norton GCB, on behalf of the Admiralty Board on 24th April 1980.

From left to right...
1. British Empire Medal
2. 1929—1945 Star
3. Atlantic Star
4. Burma Star
5. War Medal 1939—1945
6. Korea Medal
7. United Nations Korea Medal
8. Long Service and Good Conduct Medal

Crossing the Bar

Those members who have passed on since April 2017.

Mem no. P0451, Aubrey Bailey: Born 25 June 1922, joined the Society September 1942, died 25 July 2015.

Mem no. 12014, John Prescott: Born 20 June 1957, joined the Society June 1978, died 12 July 2017.

Mem no. 08488, Christopher Vincent Wright: Born 12 January 1946, joined the Society October 1963, died 11 March 2017.

Mem no. 09165, Keith James Mercer: Born 28 June 1948, joined the Society June 1965, died 17 July 2017.

HMS Collingwood Weapons Engineering Training Group

Prize Winners - Summer 2017

POET 1601

POET(WE) Joseph F Beckley

POET Joe Beckley completed POETQC to a high standard not only achieving all pass criteria with ease but also achieving the highest number of additional criteria beyond the mandated standard required for his career course. He joined POET1601 in the summer term of 2016. He integrated quickly into his new class becoming a well-liked and respected member of the group often assisting his peers when they may have struggled academically. A keen recreational sportsman, Beckley enjoys going to the gym or playing golf in his spare time. Due to join HMS WESTMINSTER early 2018, he will undoubtedly be a very effective section head in this assignment as a Radar Maintainer.

LET(SM) 1601

LET(SM) Kieron Hart

ET Hart has completed his LETQC to a good standard, achieving the highest academic performance within his class and in the top four students within the academic year. A mature and motivated student he has shown a responsible attitude throughout his time on course. He demonstrated a high level of confidence in both the theory and practical modules and selected the most challenging of assignments, executing them to a very high degree of accuracy and correctness. With a CPD of 22 July 17 and having successfully completed Leading Rates Leadership Course, Hart will leave Collingwood as an LET to continue with his training under the UGAS (WESM) Scheme.

Whilst on course Hart has represented HMS Collingwood and the Royal Navy on a number of occasions. From ceremonial duties as a member of two funeral parties to numerous appearances in the RN Rugby League team. Hart fully deserves this award as an acknowledgement of his hard work and dedication

SEMC 1603

SLt Elizabeth Kelly

SLt Kelly is this term's winner of the RNEBS Prize. Having firmly established herself during the Engineering Principles Phase of training with an extremely impressive first class mark of 79%, she then embarked on the Management and Administration Phase with a firm determination and desire to succeed. She worked hard throughout the course in order to attain the highest grade this term, with an overall pass mark of 81%.

She was always willing to assist other members of the course and she utilised her previous experience to good effect in order to enhance the learning environment. Acting as the liaison between the students and SEMT staff she ensured that the course and its various visits ran seamlessly.

Reliable, committed and trustworthy, SLt Kelly is well placed for a successful career as a naval officer and is fully deserving of this award.