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MITTLER REPORT

May 2021 • www.maritime-security-defence.com • ISSN 1617-7983

Photo: author

Britain's Integrated Review: Setting a Course for Change

March 2021 saw the conclusion of a long-awaited review of the United Kingdom's future security and defence policy with the publication of two important documents aimed at setting out a framework for the post-Brexit era. Whilst squarely directed towards defining "Global Britain's" strategic relationship with the rest of the world, the review's conclusions contain much of relevance to other western democracies struggling to chart a course against the backdrop of a fast-changing world order. Moreover, both documents provide some insights into the political and technological factors that will influence future global maritime developments.

Launched on 26 February 2020, the UK's Integrated Review of foreign policy, defence, security and international development has been trumpeted as the most significant British security revamp since the Cold War's end. Its conclusions were finally published in *Global Britain in a competitive age* on Tuesday 16 March 2021 after delays caused by the Covid-19 pandemic. Perhaps inevitably, the long shadow of Brexit has been a major influence. Some, particularly in Europe, may perceive that the review marks a further distancing in engagement with the continent. Arguably, the reality is more complex. In essence, the review attempts to balance a continued commitment to European – and NATO – security with a desire to develop a more persistent worldwide presence. Seeking to make Britain "match-fit for a competitive world", it looks to adapt to a more difficult and fluid international environment and combat the rising danger posed by threats ranging from cyber-attacks to the use of weapons of mass destruction. Amongst headline-catching announcements were a decision to increase the stockpile of warheads deployed on the Royal Navy's strategic submarines from no more than 180 to no more than 260. This is to ensure the nuclear deterrent remains credible against a full spectrum of state-based nuclear threats.

Whilst *Global Britain in a competitive age* set the direction of travel, it was the Defence Command Paper *Defence in a competitive age* published the following week that explained the means by which this journey will be achieved. The authorised strength of the British Army will be reduced by nearly 10,000 to just 72,500 trained personnel as part of a move towards a more maritime focused, techno-centric strategy. This will be accompanied by the wholesale early retirement of so-called "legacy equipment" – including two Type 23 frigates – to help fund new systems that include a substantial programme of naval shipping.

Amongst the many inferences that can be drawn from the Integrated Review's conclusions, three stand out in this editor's mind. The first was revealed sometime before its publication when, in November 2020, Prime Minister Boris Johnson announced a GBP24.1Bn (c. 14%) increase in the defence budget over the following four years to help fund the review's conclusions. The uplift, marking the largest sustained expansion in British military spending since the Cold War, is all the more remarkable given the havoc on government finances caused by the coronavirus pandemic. It certainly speaks volumes about the deteriorating international environment. Following on from similar increases in spending announced by other NATO members and partners, it is yet another indication that the lengthy period of real-terms defence reductions suffered by many of the western armed forces have now reached a conclusion.

Secondly, a particularly notable feature of Global Britain in a competitive age is its focus on Russia and China as security threats. This is a clear reflection of the return to great power rivalry that has become increasingly evident over the past decade, with all the consequences for a re-prioritisation of naval warfighting technologies over stabilisation operations that this implies. However, whilst Russia is singled out as "the most acute threat", the stance taken towards China's emerging power is more nuanced. The inherent conflict that exists between China's leading contribution to driving forward global trade and its less benign role as a systemic challenger to western values in the South China Sea and elsewhere is one that will not be easy to resolve.

Finally, and by contrast, *Defence in a competitive age* propounds a much clearer technological vision. The threats of today will be met by the technology of tomorrow, with investment in space and autonomy accorded a high priority. For the Royal Navy, one consequence will be the eventual replacement of all of its existing manned HUNT and SANDOWN class mine countermeasures vessels (MCMVs) with autonomous mine hunting and clearance equipment. Again reflecting trends apparent in other navy's future plans, the influence of artificial intelligence in maritime operations appears to be gaining momentum.

Many of these themes – be they the revitalisation of Russian naval power, the need for Europe to develop a considered response to an emergent China and the changing nature of MCMVs – are explored further in this edition of MSD. We hope they make interesting reading.

Yours aye
Conrad

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Photo: Crown Copyright 20290

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Photo: Abeking & Rasmussen

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Rolls-Roiyce Deliversd Its First 16-Cylinder mtu Series 8000 Engines

(cw) Rolls-Royce Power Systems AG has delivered the first of its new, 16 cylinder version of the established mtu Series 8000 of diesel engines. Premiered at the Euronaval trade show at Paris in October 2016, the 16V 8000 is designed to deliver up to 8 MW of power. A completely new engine that incorporates various technological improvements in the areas of ease of maintenance, efficiency and environmental compliance over its predecessors, it is far more than simply a different cylinder variant of the current, highly successful Series 8000 engines

Photo: Rolls-Royce

already in service. The first two 16V 8000 M71L engines are destined for a class of new patrol vessels being completed for the Taiwanese Coast Guard and will be installed by the local CSBC Corporation. A total of six vessels of this class are to be built with mtu engines, which will all be delivered to the shipyard before the end of 2022. An order for additional 16V 8000 engines from a second customer has already been secured.

France Launches New Strategic Submarine Programme

(cw) The French Minister of the Armed Forces, Florence Parly, has announced the launch of a programme to replace

Photo: Naval Group

France's existing LE TRIOMPHANT class nuclear ballistic missile-armed strategic submarines with a new generation of vessels. Current plans envisage the first Sous-Marin Nucléaire Lanceur d'Engins de Troisieme Génération (SNLE 3G) entering operational service by 2035, with three subsequent boats following at five-yearly intervals. Construction will be focused on Naval Group's shipyard at Cherbourg, which will integrate equipment and systems sourced from group facilities and other contractors throughout France. The programme represents a massive financial and industrial commitment at a time when the French Navy will also be undertaking construction of its Porte-Avions Nouvelle Génération (PANG) aircraft carrier, a project that is also due for delivery in the latter half of the 2030s.

Intermarine Awarded Contract for New Italian Navy MCMVs

(lp) The Italian MoD's Naval Armament directorate has awarded Intermarine, a company of the Immsi Industrial Group, an undisclosed value contract for the risk reduction and definition phase for a new generation family of mine countermeasures vessels (MCMVs) for the Italian Navy. The programme covers the development, design, construction, outfitting, delivery and support of twelve new generation platforms to be built in two versions, further details to be determined. According to Intermarine, an initial version will be approximately 60 metres in length, designated "New Generation MCMV - Coastal" or "Cacciamine di Nuova Generazione - Costiero (CNG-C)", and 'will be the natural evolution of the platforms currently in service. The other larger new generation version called "Cacciamine di Nuova Generazione - d'Altura (CNG-A)" or "New Generation MCMV - Offshore" will have a length of around 80 metres and will accommodate a larger and more capable unmanned vehicle toolbox compared to the smaller platform. The larger variant has no obvious design references either in Italy or internationally with regard to size and performance, although both versions will be built using composite materials. The new platforms are designed and built to operate both outside and inside minefields.

Egypt Becomes First International Customer for VL MICA NG

(cw) On 23 February 2021, it was revealed that the Egyptian Navy had become the first international customer for MBDA's VL MICA New Generation (NG) surface-to-air missile. VL MICA NG is claimed to offer improved capabilities against asym-

Photo: MBDA

metric threats such as UAVs and small aircraft, as well as against future threats characterised by low observable infrared and radio frequency signatures. The new missile will be used in conjunction with other VL MICA systems on board Egypt's four new GOWIND type corvettes. The second unit of the class – and the first assembled in Egypt at the Alexandria Shipyard – was delivered on 6 January 2021.

JMSDF Launches Lead 30FFM Frigate

(cw) On 3 March 2021, Mitsubishi Heavy Industries launched the Japan Maritime Self Defence Force's (JMSDF's) lead 30FFM type frigate, MOGAMI, from its Nagasaki shipyard. The new warship marks

Photo: JMSDF

a departure from recent JMSDF surface combatants, adopting a smaller but more automated design configuration as part of attempts to increase Japan's frontline surface fleet to a total of 54 units. The resulting ships will remain powerfully armed in spite of their relatively diminutive size and utilise innovations such as a panoramic 360 degree screen incorporating augmented reality know-how that will be installed in their combat management centre. Six of an initial batch of eight ships have been authorised to date, with MOGAMI and sister ship KUMANO both expected to enter service early in 2022. Although nominally the first ship of the class, construction delays have meant that MOGAMI's launch actually followed that of KUMANO, which hit the water at Mitsui Engineering & Shipbuilding's facility at Tamano on 19 November 2020.

MBDA Announces First Order for ALBATROS NG

(cw) On 3 March 2021, European missile manufacturer MBDA reported a further success for its Common Anti-air Modular Missile (CAMM) family of missiles with the receipt of its first order for ALBATROS NG, which is based on the extended range CAMM-ER variant of the system. Initially developed to replace legacy British land-based and naval surface-to-air

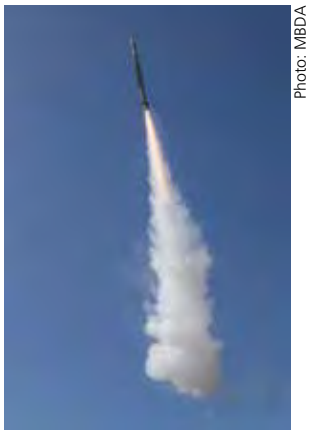
Photo: MBDA

missiles, CAMM has also been selected by the navies of Brazil, Canada, Chile and New Zealand, with the CAMM-ER variant devised to meet an Italian requirement to replace the existing ASPIDE. The extended range missile is equipped with an additional rocket booster to extend range to in excess of 40 km compared with the more than 25 km claimed for the original weapon. Delivery of the new ALBATROS NG to its lead "undisclosed international customer" is scheduled for 2024.

Formal Launch Ceremony for Spanish Submarine ISAAC PERAL

(cw) Presided over by HM King Felipe VI, the formal launch ceremony for the lead Spanish S-80 class submarine, ISAAC PERAL (S-81), was held at Navantia's Cartagena yard on 22 April 2021. The first submarine to be both designed and built in Spain, ISAAC PERAL has been subject to considerable delay as a result of design problems that emerged during her construction. The ceremony therefore marks a major step forward in delivering a previously troubled programme. Technical launch of the new boat was due to take place shortly after the ceremony and will


Photo: Navantia

be followed by various acceptance tests. ISAAC PERAL's inaugural voyage is scheduled for early in 2022 and will be followed by delivery to the Spanish Navy around a year later. The four submarines that will eventually form the class have an overall length of 80.8 metres, a diameter of 7.3 metres and a submerged displacement of around 3,000 tonnes.

RAFALE F3-R to Enter Operational Service

(jh) On 08 March Admiral Pierre Vandier, Chief of Staff of the French Navy, and Air Force General Philippe Lavigne, Chief of Staff of the French Air and Space Force, jointly approved the RAFALE F3-R fighter jet's entry into operational service. The upgrade of the combat aircraft's capabilities ranks high on the list of priorities of the French military expenditure plan (LPM) which provides for a €2.7Bn investment in the development of the new RAFALE versions between 2019 and 2025.


Photo: Dassault Aviation

Both service branches are now authorised to use all new capabilities developed for the F3-R standard, which has already been integrated with approximately 50% of the fleet and will eventually be installed on all RAFALE aircraft in service. The decision also applies to the RAFALE aircraft of the GAE (carrier air wing) operated from the CHARLES-DE-GAULLE aircraft carrier and those deployed from the forward air base in Jordan within the framework of operation CHAMMAL.
The service introduction completes a process, which included the integration of the METEOR long-range air-to-air missile and the TALIOS land-based target designator. The combination of the AESA RBE2 radar and the long-range METEOR missile gives the RAFALE the air superiority it needs for beyond visual range engagements in all weather. The new version of the RAFALE will continue to carry the enhanced medium-range, air-to-ground missile (ASMPA) as part of airborne nuclear deterrence missions.

Indian Submarine KARANJ Commissioned

(cw) On 10 March 2021, the Indian Navy held a ceremony at Mumbai to mark the commissioning of INS KARANJ, the third of six planned SCORPÈNE class submarines built by Mazagon Dock Shipbuilders Limited (MDSL) to the French Naval Group design. Her induction marks welcome progress with a contract that has been significantly delayed since it was first agreed in 2005 and which has seen significant pressure on India's underwater arm as existing boats have aged without replacement. Construction of the three remaining submarines is now well advanced following the launch of the fifth boat, VAGIR, on 12 December 2020. Meanwhile, selection of a design for the follow-on Project 75I class remains pending.


Photo: Naval Group

US State Department Approves Possible P-8A Sale to Germany

(hum) Will ORION Become POSEIDON? There seems to be some movement in the replacement efforts for the German Navy's P-3C ORION maritime patrol aircraft. The Defense Security Cooperation Agency (DSCA), an organisation in the subordinate structure of the US State Department, announced on 12 March 2021 the decision to approve a possible Foreign Military Sale (FMS) programme for five P-8A POSEIDON aircraft to the German Government. The deal is reported to amount to US$1.77Bn (€1.5Bn). DSCA notified the US Congress of the decision on the same day.


Photo: US Navy

The P-8A POSEIDON is a modern maritime patrol aircraft based on the proven design of the Boeing 737-800. Apart from the US Navy, it is in service in Australia, India and the United Kingdom. In addition, New Zealand, Norway and the Republic of Korea have selected the aircraft.
This decision could support the German Government's intention to seamlessly provide a new weapon system following the retirement of the P-3C ORION by 2025, according to current plans. Thus the P-8A could be accepted as a gap filler until the Franco-German project for a joint maritime reconnaissance/ASW Maritime Airborne Warfare System (MAWS) can be introduced from 2032 (although based on the experience of the NH 90 helicopter, 2035 may be more likely).

Fincantieri Delivers VULCANO Logistic Support ship (LSS) to Italian Navy

(lp) The Italian Navy's Fleet Renewal Plan (legge navale) reached a significant milestone on 12 March, when the VULCANO (A 5335) Logistic Support Ship (LSS) was delivered by Fincantieri. Managed by the OCCAR procurement agency on behalf of the Italian and French MoDs, the LSS programme is expected to include three ships for the Marina Militare and four for the Marine Nationale in different national variations. Designed to conduct both military and HADR missions, the new double-hulled unit has a full load displacement of 27,200 tonnes, a length of 193 metres long and a beam of 24 metres beam and features a one-spot flight deck and hangar capable of accommodating up to two EH101 or NFH90 helicopters, NATO Role 2 NATO Role 2 medical accommodation and maintenance/repair facilities. The

Photo: Luca Peruzzi

ship can carry liquid and solid payloads and can accommodate up to 235 personnel including 167 crew members. The LSS will be capable of transporting and transferring respectively 8,700 and 3,900 m^3 of marine and JP5 fuel, 800 m^3 of fresh water, 220t and 15t of ammunitions and lube oil respectively, 40t of food rations, 20t spare parts, and up to 28 20ft ISO standard containers.

French Navy Selects SonoFlash Sonobuoy from Thales

(jh) The French defence procurement agency (DGA) has awarded Thales a contract to develop, qualify and manufacture the SonoFlash air-droppable sonobuoy. Complementing the other anti-submarine warfare systems in service with the French Navy, the new-sonobuoy is believed to be a strategic asset that allows France to have a sovereign solution in high-performance sonobuoys. Manufactured in France with local SMEs, the sonobuoy is to provide extended capabilities for naval aviation units.

Photo: Thales

The French Navy will be the first operational user of the SonoFlash buoy, which will be deployed by the modernised ATLANTIQUE 2 maritime patrol aircraft and NH90 CAIMAN tactical transport helicopters. It will be delivered to the Navy from 2025 and could be available in export markets to equip modern maritime patrol aircraft and helicopters as well as all types of unmanned platforms, including autonomous surface vehicles and rotary-wing (VTOL) and fixed-wing UAVs equipped with a suitable multi-sonobuoy dispenser.

MBDA's TESEO Mk2/E Anti-Ship Missile for the Italian Navy

(lp) The MBDA group will provide the Italian Navy with the new TESEO Mk2/E long-range anti-ship missile. MBDA provided few details but MSD understands that building on the development of the legacy TESEO family, namely the OTOMAT and MARTE missile systems, TESEO Mk2/E will have a completely new airframe, propulsion system, dual-mode homing guidance and navigation system, alongside a scaleable warhead. According to information released on the occasion of the programme approval by the Italian Parliament, the new missile will have a range of 300+ km as well as a new single-shot launcher and an advanced guidance system. MSD understands the new missile will have an RF-seeker and EO sensor guidance suite for

Photo: MBDA

high-precision engagement of both sea and land targets, as well as the capability to control the mission up to the end of the engagement. Apparently the Italian Navy, MBDA and Leonardo are working to provide a new generation AESA RF-seeker as a development option. The missile programme approved by Parliament is divided into two phases: the first phase, with funding almost entirely provided, covers the development, qualification and industrialisation of the missile, while the second phase, for which funds have yet to be provided, extends to the series-production as well as the life-management.

Improved Autonomy and Safety for SEAGULL USV

(jh) Elbit Systems is introducing new technologies on-board the SEAGULL Unmanned Surface Vessel (USV) further en-

Photo: Elbit

hancing its capability to operate autonomously in a busy maritime environment and to overcome communication challenges. A 360-degrees panoramic video system with an automatic target recognition capability and a patented automatic navigation system complement the USV's sense and avoid capability, thus enabling the vessel to operate in compliance with the International Regulations for Preventing Collisions at Sea 1972 (COLREGs). This contributes the SEAGULL USV's capability to operate safely in dense harbours, at sea with heavy traffic and autonomously complete missions even without communication with the control station.

According to the company, SEAGULL is a multi-mission USV that features a modular mission payload suite supporting anti-submarine warfare, mine Countermeasure missions, electronic warfare, maritime security, underwater surveys and other missions using the same vessel, mission control system and data links. The SEAGULL USV has been in service with the Israeli Navy since 2017 and is currently in production for international users.

Navantia and Navaris Signs MoU for European Patrol Corvette

(cw) In February 2021, a notable step forward in the industrial framework for the European Union-sponsored European Patrol Corvette (EPC) took place with the signature of a memorandum of understanding

PHOTO: : Fincantieri

between Spain's Navantia and the Franco-Italian Naviris joint venture to collaborate on the programme. Currently the most important naval initiative with the EU's Permanent Structured Cooperation (PESCO), the EPC is intended to be a modular vessel displacing around 3,000 tonnes that can be configured to support a wide range of "low end" operational tasks. As well as France, Italy (project coordinator) and Spain, Greece has also signed up to support the project at PESCO level and additional European partners are being sought. Further analysis of the EPC programme was contained in MSD 1/2021.

HENSOLDT to Purchase MAHYTEC

(jr) HENSOLDT has entered into an agreement to purchase MAHYTEC, a manufacturer of hydrogen storage tanks and renewable energy storage systems. Once the transaction is complete, with all the necessary approvals obtained, HENSOLDT will add technologies for compressed hydrogen storage in composite tanks as well as solid storage with metal hydrides, further complementing its portfolio of solutions to produce, store, and transport hydrogen-based regenerative energy.

Founded in Dole, France, in 2007, MAHYTEC offers specialised hydrogen storage solutions for mobile, nomadic and stationary applications. The company is able to offer compressed storage in composite tanks and solid storage with metal hydrides. Moreover, MAHYTEC provides solutions that integrate the entire hydrogen value chain – from production over storage to electrical conversion. MAHYTEC is therefore positioned as the only company able to provide its clients with a complete low-pressure storage solution. HENSOLDT and MAHYTEC have partnered in the field of intelligent hydrogen to energy solutions since 2015.

Photo: Hensoldt

HENSOLDT also uses its capabilities to store and provide hydrogen-based green energy to reduce its own carbon footprint. One of its sites in France already runs entirely on hydrogen-based energy. The completion of the transaction is expected before summer 2021, depending on the necessary approvals by the relevant authorities.

Ultra Invests in Sonar Centre of Excellence

(jr) Ultra Group has confirmed a significant additional strategic commitment to Canada in the form of new investment to transform its Dartmouth, Nova Scotia site into a global sonar centre of excellence. This comes after recent announcements by Ultra of contract awards for the Hull Mounted Sonar (HMS) and Variable Depth Sonar (VDS) subsystems on the Canadian Surface Combatant (CSC) programme.

The Dartmouth facility will be significantly modernised, reconfigured for expanded capacity and networked to Ultra's other sonar sites in the UK and Australia. These enhancements will provide the world-class sonar capability being delivered for the CSC, as well as sonar systems on other Canadian naval programmes. They will also provide the necessary infrastructure for further growth of sonar exports to Ultra's core five-eyes markets, leveraging Ultra's already significant successes in providing sonar capabilities to major international navies.

As part of this investment, Ultra will also be upgrading areas of its facility involved in sonobuoy production – an activity which commenced in Nova Scotia in 1947. Ultra is Canada's sovereign sonobuoy supplier, and also exports them to a number of allied nations, with demand and staffing levels expected to increase in this area.

Most importantly, Ultra's investment in its Canadian sonar infrastructure will provide the modern, high-performing workplace that underpins the company's dedication to Canadian high-tech job creation. In the two years since having been originally awarded programme definition studies for CSC, working in close partnership with Lockheed Martin Canada and Irving Shipbuilding Inc, Ultra's Canadian team has grown by over 150 employees, with another 80 high-tech roles expected to be made available in 2021 alone. Ultra is immensely proud that new employees – often graduates of Canada's universities and technical colleges – will enjoy high-value roles conducted in a world-class facility based in Atlantic Canada.

Photo: Ultra

New Commander for Royal Netherlands Navy

Photo: RNL Navy

(jk) Rear-Admiral René Tas has been appointed as the new Commander of the Royal Netherlands Navy. Tas is currently Assistant Chief of Staff Capabilities at NATO's Supreme Allied Command Transformation (SACT) and will replace Vice-Admiral Rob Kramer on 9 September 2021. Kramer, who has been Commander of the Navy since 2017, will retire. Tas will be promoted to Vice-Admiral.

Tas joined the Navy in 1982 and sailed almost exclusively on frigates. With HNLMS WITTE DE WITH Tas was deployed during Operation SHARP GUARD in the Adriatic Sea. He took command of HNLMS VAN SPEIJK and participated in the UNIFIL mission off the coast of Lebanon. As the Commanding Officer of HNLMS TROMP, Tas took part in Operation OCEAN SHIELD.

His shore tours included service at NATO SHAPE and at the Directorate of Operational Readiness at the Dutch Defence Staff.

As Commander of the Royal Netherlands Navy, Tas will also hold the position of Admiral Benelux and will be responsible for supervising the Dutch and Belgian naval cooperation.

With this change of command an admiral will not be replaced by a general of the Royal Netherlands Marine Corps, which has been a practice in the Dutch Navy since 2005.

The Russian Navy: What Their Assets Say About Their Naval Strategy

Dr James Bosbotinis

Russia continues to invest in the modernisation of its armed forces, including its navy and maritime strike capabilities. For the Russian Navy, attention has thus far focused on its submarine force, the construction of multiple classes of small surface combatants, namely corvettes and light frigates, and the modernisation of a number of ex-Soviet ships and submarines. Whilst the Russian Navy has stepped back somewhat from the grandiose naval plans articulated in the late 2000s, Moscow remains committed to the vision of Russia as a "Great Maritime Power". This is highlighted by the laying down in July 2020 of two Project 23900 IVAN ROGOV class amphibious assault ships, plans for the construction of a new class of surface combatant – the Project 22350M – and continued interest in aircraft carriers. Moreover, Russia is investing in a significant qualitative improvement in its naval forces, in particular through the development of long-range precision strike capabilities. Russia's growing naval long-range strike capabilities constitute an important additional role for the Navy in wider Russian military strategy, whilst the POSEIDON nuclear-powered unmanned underwater vehicle (UUV) will provide an additional component to Russia's strategic nuclear deterrent forces. However, the Russian economy and industrial base remain constraints on naval and wider military development and raise questions regarding the navy's future potential.

Photo: Crown Copyright 2017

The Project 1144.2 battlecruiser PYOTR VELIKIY, seen here in 2017, is one of the core of former Soviet-era vessels on which the Russian Navy continues to rely pending the introduction of new ships.

Naval Modernisation Priorities

The composition of the Russian Navy remains centred on a core of ex-Soviet ships and submarines. For the surface fleet, this principally comprises the Project 11435 aircraft carrier, ADMIRAL KUZNETSOV, one ex Project 1144 KIROV class cruiser PYOTR VELIKIY (with a second, the ADMIRAL NAKHIMOV, currently undergoing a major rebuild), three Project 1164 SLAVA class cruisers, and a destroyer force centred on the Project 1155 UDALOY, Project 11551 UDALOY II, and Project 956 SOVREMMENY classes. Although the Russian naval leadership have, since the mid-2000s, articulated grandiose plans for new ships, including nuclear-powered aircraft carriers, amphibious assault ships, and cruisers, modernisation of the surface fleet has, in terms of replacing major surface combatants, proceeded at a glacial pace. Since 2016, the Russian Navy has received three Project 11356M ADMIRAL GRIGOROVICH class frigates and the first two Project 22350 ADMIRAL GORSHKOV class frigates. A total of six ADMIRAL GRIGOROVICH class frigates were planned, but the imposition of sanctions by Ukraine following Russia's 2014 annexation of Crimea and wider destabilisation activities prevented Russia from importing the gas turbines for the final three ships.

The ADMIRAL GORHSKOV class are critical to the development of Russia's warship building capability, which has had numerous challenges to overcome (for example, developing domestic substitutes for critical Ukrainian components), and significantly, have commenced serial production; the first two ships have entered service with a further six in various stages of construction and another pair ordered in August 2020. It is likely further ships will be built. The first four GORSHKOV class ships are equipped with a 16-cell UKSK vertical launch system (VLS) for the KALIBR family of land attack, anti-ship and anti-submarine missiles, the ONIKS supersonic anti-ship and land-attack missile, and the forthcoming TSIRKON, a hypersonic cruise missile with a speed of Mach 9 and a range exceeding 1,000 km. From the fifth ship onwards, a 24-cell UKSK VLS will be fitted. The GORSHKOV class also provides the basis for an evolved design, the Project 22350M, which will be larger (displacing in excess of 7,000 tons compared to the 4,500-ton GORSHKOV class), equipped with a 48 or 64-cell UKSK VLS, and replace the SOVREMMENY and UDALOY classes. Construction may begin within the next two to three years with the first of class entering service before the end of the decade.

The combination of economic and industrial constraints, shifts in naval and wider defence policy and the likely influence of those who question the need for Russia to invest in major surface combatants, has resulted in a shift in emphasis for naval construction away from the grandiose to small warships. Moreover, Russia's focus on the development of a long-range precision strike capability as a core element of its military modernisation efforts and, for the Navy, the development of the UKSK VLS and the KALIBR long-range cruise missile, has provided Moscow with the opportunity to significantly enhance its naval forces without investment in larger vessels. The development of the UKSK VLS has ena-

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Photo: Conrad Waters

ADMIRAL ESSEN is one of three Project 11356M class frigates delivered to the Russian Navy since 2016.

bled Russia to equip even sub-1,000-ton corvettes (for example, the Project 21631 BUYAN-M class) with the KALIBR, the land-attack variant of which has a range of 2,500 km and can deliver a conventional or nuclear warhead.

This has provided the foundation for a significant expansion in Russia's naval long-range strike capabilities, centring on the series production of multiple classes of corvettes and light frigates armed with the KALIBR. A total of six classes of corvettes/light frigates that can be armed with the missile are under construction. Some of these vessels are already in service with the Russian Navy, with the majority due to commission within the next five years. They encompass: six Project 20385 GREMYASCHIY, "more than 10" Project 20386 MERKURIY (ex DERZKY), 12 BUYAN-M, six Project 22160 BYKOV (although only the latter three may be KALIBR-armed) and 18 Project 22800 KARAKURT surface combatants of various types, as well as two Project 22350 IVAN PAPANIN ice-class patrol ships. The UKSK VLS is also being fitted to ex-Soviet ships as part of modernisation efforts; in particular the UDALOY class destroyers and the former KIROV class nuclear-powered cruiser ADMIRAL NAKHIMOV. The latter is undergoing a comprehensive rebuild, including the replacement of the current armament of 20 SS-N-19 SHIPWRECK anti-ship missiles with an 80-cell UKSK VLS, and is due to re-enter service in 2022. The PYOTR VELIKIY will undergo a similar upgrade. Thus far, one UDALOY class destroyer, the MARSHAL SHAPOSHNIKOV, has been modernised (in addition to the UKSK VLS, it has also received the URAN anti-ship cruise missile system); at least five UDALOY class ships will be upgraded.

The submarine force is another area of focus. At the moment, this also remains principally equipped with ex-Soviet boats, including a sole Project 677BDR DELTA III and six Project 677BDRM DELTA IV class nuclear-powered ballistic missile submarines (SSBNs), Project 949A OSCAR II nuclear-powered guided missile submarines (SSGNs), Project 971 series AKULA/AKULA II, Project 945 series SIERRA/SIERRA II and Project 671 series VICTOR III-class nuclear-powered attack submarines (SSNs), plus Project 877 KILO class diesel-electric submarines (SSKs). A single Project 941 TYPHOON class boat also remains in service as a trials platform. However, new SSBNs, SSGNs and SSKs are entering service; the Project 955/955A BOREI/BOREI-A, Project 885/885M YASEN/YASEN-M and Project 636 VARSHAVYANKA classes respectively. Thus far, three BOREI class boats, each armed with 16 BULAVA submarine-launched ballistic missiles (SLBM), have entered operational service; a total of 10 are planned (five are under construction). At present, the naval strategic nuclear forces can deliver up to 656 warheads on 144 SLBMs; once all 10 BOREIs are deployed, this will grow to 160 SLBMs with a total warhead capacity of 960. The prototype YASEN class boat, SEVERODVINSK, has also been operational for some time, whilst the first improved YASEN-M, KAZAN, is undergoing sea trials and is due to enter service in 2021. The YASEN/YASEN-M represent the apex of Russian nuclear submarine development, are reportedly extremely quiet, and are armed with 32 vertically launched KALIBR or ONIKS missiles. They will also be equipped with the TSIRKON hypersonic cruise missile in due course. The development of a new SSN, the Project 545 LAIKA, has commenced; the LAIKA class will be a more affordable complement to the YASEN/YASEN-M class, and are likely to enter service in the early 2030s.

Six VARSHAVYANKA class boats were delivered to the Black Sea Fleet between 2014 and 2017; six more boats have been ordered for the Pacific Fleet with deliveries underway (the first two boats have already entered service). Another batch of VARSHAVYANKA class boats may be built for the Baltic Fleet. In the meantime, two Project 677 LADA class SSKs are due to enter Russian Navy service in 2022. Russia is also developing a novel weapon system, POSEIDON, a nuclear-powered, nuclear-armed autonomous intercontinental "torpedo" capable of travelling at high speed (70 knots) and at depths in excess of 1,000 meters. It is a second strike, that is, retaliatory system, although an anti-ship role has also been mentioned. It has been reported that the Russian Navy intends to deploy 32 POSEIDON UUVs on four submarines (including the KHABAROVSK, BELGOROD, and the as yet unnamed Project 09853) divided equally between the Northern and Pacific Fleets.

On 20 July 2020, the Russian Navy achieved what may be a key milestone in its post-Soviet development with the laying down of two YASEN-M class submarines, two GORSHKOV class frigates and, of particular note, two IVAN ROGOV class amphibious assault ships: the IVAN ROGOV and MITROFAN MOSKALENKO. The IVAN ROGOV class will displace in excess of 25,000 tonnes (notably, in December 2020, the Deputy Minister for Armaments, Alexey

Photo: Norwegian Armed Forces

The new ADMIRAL GORSHKOV class frigates – the lead ship is seen here in 2019 – are critical to the Russian Navy's future ability to deploy large surface combatants.

Krivoruchko, stated that the ships would displace 40,000 tonnes). The two ships are due to be delivered in 2026 and 2027 respectively. President Vladimir Putin, in comments at the keel-laying ceremony in Crimea, stated that additional ships are planned, as are modifications to undertake different roles. These would most likely either be anti-submarine warfare or the embarkation of short take-off and vertical landing fixed-wing fighters for sea control missions. Progress with the IVAN ROGOV class may provide an indication of the extent to which Russia's ambitions for building new aircraft carriers can be realised, although it warrants mention that the acquisition of the class may actually be an alternative to replacing the KUZNETSOV.

The issue of a new aircraft carrier was dramatically brought to the fore by the December 2019 fire onboard the ADMIRAL KUZNETSOV whilst she was undergoing a multi-year refit (the ship is due to re-enter service in 2022 but this has been the subject of some doubt). If political support and funding were forthcoming, a new carrier could potentially be built by the early 2030s; the Sevmash shipyard in Severodvinsk, Zvezda shipyard in the Russian Far East, and the Zaliv shipyard in the Crimea would be leading candidates for construction of such a vessel. It has also been reported that the navy is working on an internal tactical and technical requirement for a new carrier in order that the United Shipbuilding Corporation can begin design work. Further, the design documentation prepared for the Soviet-era nuclear-powered, catapult-equipped UL'YANOVSK may be utilised for a new carrier. The UL'YANOVSK was designed by the Nevskoye Design Bureau, which also designed the Soviet Union's previous carriers and is now part of the United Shipbuilding Corporation. Interestingly, Admiral Nikolai Yevmenov, the Commander-in-Chief of the Russian Navy, stated at the International Maritime Defense Show 2019 in St Petersburg, that the Navy will eventually receive a nuclear-powered carrier, albeit not in the short term. In January 2021, a concept for a 45,000-tonne aircraft carrier, VARAN, incorporating a high degree of automation and capable of embarking 24 aircraft, six helicopters and 20 unmanned aerial vehicles, was released by Nevskoye.

Photo: Crown Copyright 2016

The development of the UKSK VLS has enabled Russia to equip even sub-1,000-ton corvettes such as the diminutive the Project 21631 BUYAN-M class – ZELENIY DOL is seen here – with the KALIBR cruise missile.

Russia's Naval Strategy and its Implications

The promulgation of "The Fundamentals of the State Policy of the Russian Federation in the Field of Naval Operations in the Period Until 2030" in 2017 reaffirmed Moscow's naval ambitions, stating that Russia is a "great sea and land power", and that "only the presence of a strong Navy will secure the Russian Federation a leading position in a multipolar world in the 21st century". It also expressed the ambition for the Russian Navy to be "the second most combat capable Navy in the world", as well as the desire to build a new aircraft carrier. Given the development of the Chinese People's Liberation Army Navy, it is most unlikely that Russia's ambition of being the "second most combat capable navy" can be fulfilled. As it also remains to be seen whether a new carrier will ultimately be built, these ambitions may be little more than pipe dreams.

By contrast, the recent incremental approach to naval construction – that is, the focus on small surface combatants whilst deferring construction of larger vessels – has delivered a tangible and transformative boost in capability via the deployment of KALIBR whilst aiding the recovery of the shipbuilding sector from a lengthy period of post-Cold War neglect. Moreover, Russia's focus on the development of a long-range precision strike capability is also reflected in a new role for the Russian Navy, that is, "to destroy enemy land-based facilities at long distances". This capability will be further enhanced with the entry into service from 2022 of the TSIRKON and, from the mid-2020s, the KALIBR-M, an extended-range (4,500 km) derivative capable of delivering a one tonne warhead. Both the TSIRKON and KALIBR-M will be compatible with the UKSK VLS and with modernised OSCAR II and YASEN/YASEN-M class submarines.

By the early 2020s, the continued delivery of small surface combatants to the Baltic and Black Sea Fleets and the Caspian Flotilla, in particular, combined with Russia's anti-access/area denial "bubbles" based centred on Kaliningrad in the Baltic and the Crimea in the Black Sea, will allow

Photo: Crown Copyright 2020

The Project 22160 BYKOV class is one of a range of KALIBR-armed corvettelight frigate-sized warships under construction for the Russian Navy.

Photo: Crown Copyright 2017

The Project 636.3 VARSHAVYANKA class diesel-electric submarine KRASNODAR is one of twelve improved KILO class submarines ordered for the Black Sea and Pacific Fleets.

Photo: Crown Copyright 2017

Whether – and, if so, how – to replace the veteran aircraft carrier ADMIRAL KUZNETSOV is a major question facing the Russian fleet.

the establishment of what will effectively be bastions for the projection of Russian naval power. From operating areas under the cover of extensive land-based anti-ship and surface-to-air missile defences, as well as land-based airpower, KALIBR-armed ships based in Kaliningrad could cover all of Europe bar the southern half of Spain and Portugal. Equally, vessels from Crimea could strike much of Europe as well as, in conjunction with ships of the Caspian Flotilla, much of the Middle East. From Vladivostok, ships of the Pacific Fleet could exert a similar threat to Japan, the Korean Peninsula and much of eastern China. Moreover, the revitalised submarine force – particularly the TSIRKON-armed YASEN/YASEN-M class – will pose a much wider threat.

The distribution of long-range strike capabilities across as wide a range of naval platforms as possible has other implications. Combined with a renewed Russian interest in overseas basing, the strategy highlights the growing geographic extent of the Russian Navy's potential reach. With access already secured in Syria and the conclusion of the December 2020 agreement to establish a naval base in Sudan, it seems that Cuba, Venezuela and possibly Mozambique may also be on the list of potential Russian Navy outposts.

More broadly, it is arguable that the Russian Navy's relative importance in Moscow's wider military strategy is growing. This is particularly highlighted by the navy's expanding contribution to Russia's long-precision strike capabilities (alongside the aerospace forces), the continuing importance of the naval strategic nuclear forces (provided by the BOREI class and the forthcoming POSEIDON), and the Northern Fleet's upgrade to the status of a full military district to defend Russia's interests in the Arctic. Moreover, the start of construction of the IVAN ROGOV class constitutes a significant investment in what will be a new force projection capability for the Russian Navy, and a key indicator as to whether the next stage of naval recapitalisation – series production of frigates, destroyers, amphibious assault ships, and ultimately, aircraft carriers – can be undertaken successfully. Industry's success (or otherwise) in realising the GORSHKOV, IVAN ROGOV, IVAN GREN (the Project 11711 landing ship; the first two ships are in service and two of an enlarged design are under construction), and the Project 22350M programmes in a timely and cost effective fashion will significantly determine the prospects for the Russian Navy over the coming decades.

President Putin has been a leading proponent of Russia as a "great maritime power" and – as long as Russia aspires to be a great power – it seems likely that it will continue to seek a commensurate level of naval capability. The next decade will be critical as the core of ex-Soviet ships, even after modernisation, reach the end of their service lives and fall due for replacement. Irrespective of whether a new carrier is built, a Russian Navy in the 2030s that benefitted from the successful conclusion of the various programmes that are now underway would be a potent force. ■

Photo: Mil.ru

The Project 855 series YASEN/YASEN-M class SSGN – this image shows the prototype submarine SEVERODVINSK – will allow the Russian Navy to pose a credible threat across the world's oceans.

Meeting the Political Face of the German Maritime Industry

Photo: Secrétariat général de la Mer (SGMer)

Norbert Brackmann (left) with his French Counterpart Denis Robin (right), Secrétaire Général de la Mer

Norbert Brackmann – A member of the German Bundestag (parliament) since 2009, he has been the Federal Government's Coordinator for the Maritime Industry since April 2018. Prior to that, in 1982, he joined German broadcaster NDR (Hamburg). In 1979, he earned a law degree from the Christian Albrechts University in Kiel.

MSD: What are the responsibilities of the Federal Government Coordinator for the Maritime Industry? What are the special features of your work?

MP Brackmann: As the Federal Government Coordinator for the Maritime Industry, I am what you might call the political "face" of the maritime industry in Germany. My job is to coordinate the macroeconomic perspective of all fields of maritime policy – the maritime industry, offshore wind, ports, shipping, marine research, the navy, protection of the seas, and the economic policy interests of the sector. In my work, I always focus on the competitiveness of Germany's maritime sector in Europe and globally.

The fact that Germany has a Maritime Coordinator underlines the major macroeconomic significance of the maritime sector for Germany as a trading and exporting nation. For this reason, the Maritime Coordinator is based in the Federal Ministry for Economic Affairs and Energy. The special feature of the Federal Government Coordinator for the Maritime Industry is that he or she can grasp the interests of the sector without being influenced by the respective portfolios of different ministries. He or she has to see the sector as a whole and reconcile all the interests. It's a big task, but also offers plenty of scope for action.

MSD: At the National Maritime Conference two years ago, you announced your intention to work towards the creation of a similar position at EU level. What are the reasons for this? And what has become of the idea?

Brackmann: As is the case here in Germany, with different ministries being responsible for different aspects, the responsibility for the various aspects of the maritime sector is also distributed across various Directorates-General at European level. However, unlike in Germany, the maritime industry lacks a central point of contact and a voice in the European Commission. In practice, this frequently means that, ultimately, no-one feels responsible. A maritime coordinator at EU level could make European maritime interests more visible and give greater weight to them, especially vis-à-vis difficult partners, including China and the United States. A central point of contact could identify cross-sectoral issues at an early stage, press ahead with them, and help make the maritime sector more visible. For these reasons, I still believe it makes sense to appoint a European Maritime Coordinator or establish a coordinating body.

We will continue to raise the issue and point out the need for such a position.

Photo: tkMS

Norbert Brackmann during the presentation of the Modifiable Underwater Mothership (MUM) project at tkMS in Kiel, Germany

MSD: How do you assess the impact of the COVID-19 pandemic on the maritime sector in both Germany and across Europe?

Brackmann: The COVID-19 pandemic severely hit the maritime industry in a phase of growth and stability. At the same time, it made clear how important shipping and ports are for Germany's supplies and for German exports to Europe and the world.

It is our stated aim that the German maritime industry should emerge from the crisis with a "pushing wind". To make this happen, we need to invest in research, development, and innovation. For this reason, the Federal Government again topped up the funding for the maritime research programmes and for innovation last year. Following the pandemic, the German maritime sector can remain a crisis-resilient global leader only if it presses ahead with the digital and ecological transition and is supported in these efforts.

MSD: Two of the "lessons learnt" during the COVID-19 pandemic refer to "reshoring" which means the relocation of production into one's own country or into the EU, and the restructuring of supply chains. How do you assess the prospects of reaching these goals – especially in the maritime sector?

Brackmann: Germany's export-oriented companies greatly benefit from open markets and rules-based international trade. As elsewhere in the economy, supply chains are also a matter for private-sector decisions in the maritime sector.

When specific supply chains show a lack of reliability or unilateral dependencies, the companies concerned give careful consideration to the opportunities and risks of restructuring supply chains. In our social market economy, Federal Government intervention regarding supply chains or reshoring is very restricted, for example when corporate decisions would pose a threat to public order and/or security or restrain effective competition. In the course of the COVID-19 crisis, the Federal Government has rapidly taken important steps to secure the supply of strategic health products (e.g. pharmaceutical products, medical protective equipment) for the population during the current pandemic and for eventual future pandemics. These policies include funding by the Federal Ministry for Economic Affairs and Energy for the establishment and expansion of national and European value chains for protective equipment, test kits and active ingredients. In this context, the Federal Government aims to limit the duration of crisis-related intervention and prevent the creation of new trade barriers in the long term. This applies to all sectors of the economy, including the maritime industry.

A Navy in Cooperation: The Royal Netherlands Navy

Photo: Dutch MoD

Interview with Vice-Admiral Rob A. Kramer, Commander of the Royal Netherlands Navy (CZSK).

Maritime Security & Defence (MSD) magazine had the chance to exchange with Vice-Admiral Rob A. Kramer, Commander of the Royal Netherlands Navy. While the focus was on the cooperation between the German and the Royal Netherlands Navy, other sensitive issues were raised, such as the threat perception and financial constraints.

Vice-Admiral Rob Kramer was appointed Commander of the Royal Netherlands Navy on 22 September 2017. He is due to retire in September 2021.

The Commander of the Royal Netherlands Navy is responsible for preparing, leading, and concluding operations. His most important task lies in ensuring that navy units are mission ready. He reports to the Chief of Defence (CHOD). The CHOD can also instruct the Commander of the Royal Netherlands Navy to lend support to civil authorities, both in the Netherlands and abroad. The Commander of the Royal Netherlands Navy also holds the position of Admiral Benelux. In this capacity, he is responsible for supervising the Royal Netherlands Navy's close cooperation with the Belgian Navy.

MSD: Sir, you have served as Commander of the Royal Netherlands Navy since 2017, and prior to that as Deputy Commander. All in all, that represents six years in the Navy's most influential role. What has changed? What is your assessment on materiel, training, staff? How do you see the future?

Kramer: The balance of power is changing. China is working hard in Asia on their Silk Road Economic Belt. Putin's expansionary drift appears to be a clear and present danger, as he is currently moving many troops to the Ukrainian border and has declared restrictions on movements of "foreign warships" in the Black Sea. Terrorist attacks are not only a threat in the Middle East but also in Western countries. This, together with a growing global polarisation, forces us to think and act globally. Not only at the most intensive threat levels, but also in the domain of hybrid warfare. The battlespace is changing fast and requires a highly adaptable and resilient response.

I can't ignore the feeling that we are lagging behind. We have to get our act together, literally, in order to cope and compete with current and future threats. "WeAreNATO" means that we work together to build a stronger alliance. Working together, not only shoulder to shoulder, but also by sharing costs & risks. Think together, build together, practice together.

And for that matter I very much appreciated my relationship with Admiral Krause [former Chief German Navy, 28. October 2014 – 24. March 2021]. We worked on the same sheet of music. A good example of how boundaries and borders are not an obstacle when you have the same focus and goals.

MSD: The German Navy and the Royal Netherlands Navy share a long story of mutual cooperation. What are your conclusions?

Kramer: In 2016, an important step was taken in the cooperation between the German and the Dutch navies. It was then that Minister of Defence Jeanine Hennis signed the so-called 'Letter of Intent' (LoI) regarding the joint use of Zr. Ms. KAREL DOORMAN and the integration of the German Seebataillon within the Dutch Navy (Marine Corps) with her German counterpart Ursula von der Leyen. The signing of this document was in line with the German-Dutch desire for more intensive cooperation within Europe in the field of defence.

The joint development and implementation of a European army may currently still be too big a step for many European countries. Therefore, the Dutch defence establishment supports more modest initiatives for cooperation and integration. The integration of the Seebataillon into the Dutch Navy is an excellent example of this. More than four years have passed since the initiative was announced and very big steps have already been taken in this intensive process. Units of the Netherlands Marine Corps and Seebataillon are now being deployed together annually during winter or Arctic training in Norway. In addition, this year, for the first time, Seebataillon soldiers will join mountain training in Norway. The

Photo: Arne Krüger

EAGLE and DINGO of the German Seebataillon ready for embarkation into HNLMS Karel Doormann.

Netherlands Navy is also looking for opportunities of having (future) German officers of the Seebataillon participate in the Netherlands Marine Corps Officers Course [Note: POTOM - Praktische Opleiding tot Officier der Mariniers - officer training for marine officers]. No distinction will be made in quality requirements for the trainees, Dutch or German!

Photos: Guy Toremans

The RNLN has a requirement to replace its ageing fleet of four WALRUS class submarines. Bids submitted and under consideration are based on French, German and Swedish designs.

The best representation of this intensive integration process is, in my opinion, the joint deployment of Dutch marines and German soldiers of the Seebataillon in a Human Disaster and Relief (HADR) operation during the course of hurricane support in the Bahamas in 2019. The plan of action to support the islanders with emergency aid was drawn up jointly en route at sea onboard the Dutch Navy ship Zr. Ms. JOHAN DE WITT. This proved to work extremely well. For example, German divers cleared the "underwater path" of possible obstacles so that naval personnel were able to land with landing craft on the island beaches.

The joint use of Zr. Ms. KAREL DOORMAN is also a good option for both navies. In 2018, a large-scale evacuation exercise was conducted (under German direction) aboard this ship in Rostock. During the exercise "Schneller Adler" hundreds of German citizens were evacuated from "land to sea". The Seebataillon took care of the transport and security of these civilians and the Dutch Navy ship took care of processing them on board. In 2022 this exercise is planned again for both armed forces.

Mutual cooperation and integration is not only sought after within the Navy. Both the Army and Air Force are also intensively seeking partnerships. Several large projects have already been started for this purpose. Dutch soldiers of the Cavalry are now using German LEOPARD tanks and major steps towards integration are also being made in the area of air defence. For example, the German air defence unit "Flugabwehrraketengruppe 61" has been placed under the command of the Dutch DGLC [Note: Defensie Grondgebonden Luchtverdedigingscommando – Groundbased Air Defence]. Furthermore, intensive efforts are made within both MODs to replace Dutch-German military communication systems (Project FOXTROT/TEN) within the upcoming years.

To achieve more savings, it is cheaper to develop and purchase new navy ships together and to integrate maintenance plans after procurement. Our operational and material requirements should therefore match as much as possible. For example, we are now developing our future mine countermeasure vessels together with the Belgian Navy. These are based on the operational concept of investigating and neutralising mines and explosives from a distance by using motherships capable of deploying drones, unmanned vessels and divers. The German Navy is also in the process of replacing their mine clearing capabilities, but they might adopt a different operational concept for hunting and destroying mines. Therefore, it may become more difficult to integrate together in the future. Nevertheless, we still have plenty of opportunities for in-depth collaboration in the field of mine clearance and sharing knowledge and expertise within this domain. So, I think more steps can be made in terms of co-operation between our navies.

MSD: Last December, the two "Staatssekretäre" [Note: State Secretaries for Defence – in both nations a position subordinate to Minister of Defence] of both MODs, Mrs. B. Visser and Mr. B. Zimmer, signed a Letter of Intent concerning cooperation to replace the Dutch air defence and command frigates and their German F124 SACHSEN class equivalents. What are your expectations?

Kramer: For the replacement of both the Dutch LCF and German F124, the LoI creates a common German/Dutch environment in which both nations will closely cooperate in investigating common operational requirements and a common concept of operations, all based on a joint threat assessment, for the so-called Future Air Defence Frigates. Due to the variety and multiplicity inherent in the concept of operations, these may be better referred to as the Future Surface Combatant. I expect that the collaboration for this project will strengthen the existing bond between the two navies, both in terms of design now and operational use in the more distant future. For the design phase I expect a variety of common German Dutch studies, both from an operational and a materiel point of view. For the future frigate itself I expect a frigate that must be capable of conducting all types of maritime military operations,

worldwide. The future frigate, in service from the mid-2030s up to the 2060s, will be primarily deployed to provide and command Air & Missile Defence (AMD) for a maritime task group, integrated into the NATO Integrated Air and Missile Defence System (NATINAMDS). Due to the fact that the future frigate will operate up to the 2060s, I assume an enormous potential for innovation. This mostly applies to the fields of automation, artificial intelligence, and the use of unmanned vehicles, with a particular focus on reducing the use of ever-scarcer human resources.

MSD: The Royal Netherlands Navy is engaged in the European Mission "European-led Maritime Awareness Mission in the Strait of Hormuz", Operation Agenor. Could you share with us your major lessons learnt from this participation? Could you provide us the rationale for the Dutch participation?

Kramer: To answer the first part of your question: In a relatively small and complex deployment area, coordination among allies is essential. This allows for optimal deployment of assigned units. Diplomatic access to Gulf states requires a great deal of preparation time. Agreements on logistical support and medical provision with the various countries must be well established in advance. Maritime operations in the Persian Gulf are also very difficult without some form of tactical cooperation with the United States.
The rationale for Dutch participation has been the significant economic interests related to the transport of oil through the area and the presence of Dutch flagged merchant ships. The choice of participating in a French initiative was mainly dictated by the presence of a political track, in addition to the military commitment.

Photo: Dutch MoD

The four HOLLAND class OPVs, jointly built by the Damen shipyards in the Netherlands and Romania, have been in service to perform ocean-going patrol missions since 2012. Shown here is the first-of-class, HNLMS HOLAND.

MSD: HNLMS EVERTSEN is set to sail with the Carrier Strike Group of the Royal Navy on its maiden operational deployment. What are the motivations behind such a decision to which you certainly contributed?

Kramer: The decision to take part in the Royal Navy Carrier Strike Group (CSG) was driven by the intensification of long-standing bilateral cooperation between the UK and the Netherlands. Furthermore, it is a unique opportunity to practice air defence under the highest threat scenarios. CSG operations are one of the cornerstones of NATO. By integrating Zr. Ms. EVERTSEN into the UK CSG, the Netherlands Navy will develop important experience regarding this cornerstone capability.

Photo: Damen

Artist impression of the future HNLMS DEN HELDER Combat Support Ship (CSS)

MSD: Back to Dutch-German cooperation. Could you envisage further fields of collaboration? It might seem futuristic and provocative, but could one see an integrated Belgian-Dutch-German mine countermeasures force or a fully integrated Dutch/German Amphibious Corps with a combined toolbox?

Kramer: Finding ways to intensify German-Dutch naval cooperation is an ongoing process. In the future, it is especially interesting to seek more cohesion in the joint development of projects. One could think of the mutual replacement of naval ships, as well as in terms of related training and maintenance processes. Within the training domain, we can also start looking at "opening up our defence training facilities" to international partners. We also need to find more opportunities for Personnel Exchange Programmes (PEP). These programmes offer foreign naval personnel possibilities to gain experience within our navy. PEP can be conducted by the exchange of 'duty (watch) officers on the bridge', the offering of jobs to specialised German Navy personnel that are difficult to fill or the mutual filling of staff positions within our operational units. In this way we will learn from each other, which will allow us to work together even better in the future!

MSD: Threat perceptions based on the capabilities of the Russian Navy, particularly with respect to its submarines, have changed in the last years. What is your take? And what would be your military/

naval advice if you would have to provide it to the political leadership?

Kramer: Amongst other issues described in the Dutch Integrated Foreign and Security Strategy, the current Russian attitude poses a threat to Europe. Events in Crimea, airspace violations and expansion of the military arsenal are reasons to take our role very seriously. We must, in an international context, do our part in providing for the defence and deterrence of our own and allied territory. The hybrid, not directly military, activities by which Russia is expanding its influence are also of great concern.

Specifically in the maritime domain, we see large investments in the Russian fleet, with the Arctic and the Atlantic Ocean clearly being among Russia's areas of focus. The Dutch Navy also operates in these waters and we will therefore have to be prepared for possible deployment. We are already doing that through a number of important partnerships. The Dutch Marines form a close partnership with their US and British counterparts and the Norwegian land forces. Joint training and exercises ensure an almost permanent allied presence in northern Norway. Within NATO, the Netherlands contributes to the various maritime Standing Naval Groups and other reaction forces. But we also form alliances outside of NATO that allow for military intervention and diversion, such as the Joint Expeditionary Force (JEF).

Submarine warfare is an important capability of the Dutch Navy, and future materiel procurement projects will continue to contribute to this. Our next generation frigates and submarines will carry state-of-the-art Anti-Submarine Warfare (ASW) equipment. Here, too, we are working with partner nations to ensure that our capabilities can be effective against any opponent in various international contexts.

Given the increased Russian assertiveness in the maritime domain around Northern Europe, I believe that we need to further intensify cooperation and interoperability between the northern navies. Not only military-to-military, but also from a maritime military industrial complex perspective. This will enable us to build state-of-the-art, fully interoperable, maritime capabilities for dispersed maritime operations with sufficient combat power to deter aggression, defend the Euro-Atlantic region and, when necessary, win wars.

It has probably not escaped your notice that I, along with the commanders of other branches of the armed forces, recently expressed my concerns about the state of our navy in the media. Last year, the Dutch MOD published our Defence Vision 2035 (white paper) that stresses the need for additional investment in the armed forces. For the next cabinet period there is an urgent need for an additional €4Bn (annually) for our defence budget to grow to the average spent by other European NATO partners. This will enable us to invest in current and new capabilities as a first step towards a modern defence organisation, ready for current and future threats. The next step is for additional budget to grow towards the agreed NATO norm of 2% of GDP. Although defence spending is now on an upward trend, after decades of cuts, it is not keeping pace with the spending of major powers like Russia and China. Political leaders are becoming increasingly aware of this, but I still see it as a task to continue to call attention to it. We need to invest in defence and, therefore, the navy to keep deterrence sufficiently strong that deployment is not necessary. The current COVID crisis, of course, does not help and I hope that the bill for fighting it will not be passed on to defence budget.

Photo: Guy Toremans

The Anti-Air Warfare (AAW) system of the four DE ZEVEN PROVINCIËN class air defence and command frigates is subject to an upgrade with the objective to acquire a BMD sensor capability. Germany has similar plans for its fleet of three F124 SACHSEN class frigates.

MSD: According to the Dutch newspaper De Telegraaf, an internal memo that the newspaper has in its possession suggests that the Royal Netherlands Navy is deep in red. The budget deficit is just under €75 million. Without extra money or cutbacks, this will increase to just under €190 million by 2026. What is the true position?

Kramer: Although it is true that budgets for the Royal Netherlands Navy (RNLN) and the other service branches in the Netherlands are tight, fortunately the RNLN will not literally end up in the red. The internal memo in possession of the De Telegraaf newspaper, the contents of which are unfortunately a reality, is part of the annual budgetary cycle within the Netherlands MOD. The RNLN has had to take some drastic measures to stay within budget for 2021. We no longer could make do with rearranging the available budget to cover shortcomings. For example, we had to decide to keep one of our oceangoing patrol vessels and a minehunter in port for the whole year to free up budget and personnel. The bigger problem is an imbalance between resources such as budget and available personnel compared with the tasks appointed to the RNLN. This, together with the contents of the NATO Wales Summit declaration of 2014 (to spend 2% of our GNP on Defence by 2024), has meant that the Minister of Defence, Mrs. Bijleveld, has made it clear in Parliament and the media that we at least need an additional €4Bn annually to be able to sustain and modernise our forces and meet the average level of what our European partners within NATO spend on defence (about 1.7% of GDP). This would be the first significant step to reach the targeted 2%, which would need an additional €9Bn to €13Bn annually. This would then ensure the RNLN and other services are ready for possible future challenges, where "wars of choice" may be replaced by more violent "wars of necessity".

Questions by Captain (Navy) Hans Uwe Mergener (Ret.)

Marketing Report: Marine Alutech Oy AB

Naval Off-the-Shelf Landing Crafts

Marine Alutech Oy Ab is an international company specialising in designing and manufacturing state-of-the art aluminium and composite combat and fast patrol boats for government applications. Marine Alutech has extensive in-house design and engineering resources, modern production facilities and a service network. Marine Alutech is a supplying to partners in defence, law enforcement and emergency services all over the world with customised naval Off-the-Shelf (OTS) boats, providing low risk and cost, and a high level of interoperability and reliability.

Naval OTS – Requirements and Solutions

Currently several European Navies maintaining a capability for individual or joint waterborne operations have similar requirements, notably for high-speed combat boats and high-speed military landing craft.

Photos: Marine Alutech

The Marine Alutech solutions range from landing craft to boats to insert and retrieve SOF and amphibious units, coastal and harbour patrols and patrolling bustling port cities. Marine Alutech boats are force multipliers by their nature for armed and emergency response and can also operate from landing platform docks or other amphibious support ships.

Naval OTS as Combat Support Service Vessel (CSSV)

WATERCAT M18
Armoured Modular Craft (AMC)

- Versatile – Fulfils future combat support requirements for interdiction, ISR, escort, patrols, etc.;
- Modular – Interior standard set up for multiple configurations, troop transport, medevac, C2, etc.;
- Modern – Most advanced boat for the Finnish Marines & SOF – easy & low-cost MRO;
- Consistent – Same benefits as other WATERCATs in terms of propulsion, manoeuvrability, landing, craft, etc.;
- HSBO – Effective against sea or land borne assaults and aggressions, featuring ballistic protection and a bow ramp.

Advantages: Suitable for warfighting – performing multi-day missions – station & presence keeping.
Speed: >40 knots full load & >45 knots light load – stops a boat's length from full.
Landing: Beaches or unimproved areas – manual/hydraulic hatches & bow ramp.
Crew: 30 personnel on shock mitigating seats = cargo & fully equipped troops fore & wheelhouse aft, on engine.
Benefits: Effective HVAC for extreme climates – latest navigation, CMS & C4I – modular combat suite.
Combat: Small- to medium-calibre machine guns and RCW + light SSM/SAM, sea mines, torpedoes (LW), depth charges, VDS & UAVs.
Experience: 12 for Finnish Defence Forces during 2014–2016

WATERCAT M12
Type: Landing & coastal troop command craft
Draft: Low (~ 1 m)
Advantages: Highly manoeuvrable* – high-speed landing – easy & low-cost MRO.
Landing: Beaches or unimproved areas – manual/hydraulic hatches & bow ramp.
Hull: Marine grade aluminium – ballistic protection – detachable wheelhouse.
Propulsion: 2 diesel engines powered waterjets.
Speed: > 30 knots full load & >40 knots light load – Stops a boat's length from full.
Crew: 25 personnel on shock mitigating seats = cargo & troops fore; wheelhouse aft, on engine.
Combat: 7,62 mm or 12,7 mm machine guns, 40 mm grenade launcher, or Patria NEMO 120 mm mortar
Experience: > 30 boats for Finland incl. midlife upgrade – advanced navigation & compact C3 available

Naval OTS as Military Landing Craft

WATERCAT M8 / M9
Type: Fast landing craft
Draft: Very Low (~ 20–40 cm)
Advantages: Highly manoeuvrable* – easy & low-cost MRO
Landing: Beaches or unimproved areas
Hull: Marine grade aluminium, welded
Propulsion: 1 diesel powered waterjet
Service speed: > 30 knots with full load
Crew: 10 soldiers & equipment = 8 on shock-mitigating saddle seats, fore + 2 at the steering console, aft.
Experience: several armed forces; > 150 WATERCAT M8 & M9 vessels delivered. Advanced navigation & compact C3 available.

* riverine/estuarine, littoral, confined, or shallow waters

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The Critical Eye: The Polish Navy's Modernisation in Focus

Dr Robert Czulda

In recent years, both the Polish Army and the Polish Air Force were gradually upgraded. The same cannot yet be said about the Polish Navy, which remains underfunded and obsolete. Almost all modernisation programmes were either delayed or simply frozen indefinitely. Meanwhile, allies and adversaries in the region progress with the latest technologies and techniques to almost redefine the maritime ORBAT in the Baltic Sea region.

Socrates famously remarked that "The unexamined life is not worth living." Perhaps it can also be said that the unexamined navy is not worth sailing.
A "lack of vision" and a "lack of strategic goals" – these problems were repeatedly singled out by numerous Polish defence experts for years. The Polish Navy has not been a priority for any Warsaw-based government since 1989. None of the successive governments have had a clear vision as to what role the Polish Navy (est. 1918) should play in terms of Poland's defence doctrine and as a political tool supporting Warsaw's diplomacy. What was once a powerful navy that actively fought with the Allies against the Nazi Germany during World War II and was prepared to invade NATO alongside other Soviet forces during the Cold War is now obsolete and underfunded as a result of apathy. Without exaggeration and with much sadness it can be said that the Navy is an unwanted child of the Polish Armed Forces family.

Photo: Cdr. Radosław Pioch PIO

The rocket frigate ORP GEN. T. KOŸCIUSZKO juxtaposed with the training ship ORP ISKRA

Photo: Pioch

The KONTRADMIRAL XAWERY CZERNICKI class mine counter-measure forces command vessel, ORP CZERNICKI

Fleet Follows Function

Currently, Poland has dangerously modest aspirations in the Baltic Sea. This is partially a result of a common - yet false - belief that the Baltic Sea is too small for large vessels, therefore the Polish Navy should rely on smaller ships. However, this plan, just like any other half-backed naval strategy born in Poland, has not been truly pursued. It is no wonder that hapless Polish sailors are lost in a limbo. The fleet limits itself to the EEZ (22,500 km^2). Its main duties include protecting Poland's shore (770 km coastline, 440 km sea border); conducting SAR operations; and demining operations – the Baltic Sea remains one of the most mine-polluted sea reservoirs in the world, a veritable dumping ground of sea munitions from two World Wars and a 45-year Cold War.

Energy Security

It is expected that the role of the Baltic Sea in Poland's security and economic policy will inevitably grow. Warsaw has

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been trying to decrease its dependence on Russian natural gas (60.8% of import supply in 2020) and oil (70%). By 2022, Poland will halt all long-term import of Russian gas. In 2015, Poland opened a large LNG terminal at Świnoujście near a border with Germany (3Bn m^3 in 2019), while an oil terminal in Gdańsk (17M tonnes in 2019) became operational in 1975. By 2026-2027, the Gulf of Gdańsk is to host a Floating Storage and Regasification Unit.

An undersea bipolar high-voltage direct current cable between Poland and Sweden has been laid, while another one (Harmony Link) – connecting Poland and Darbėnai in Lithuania is planned to start in 2023 and finish in 2025. Another crucial energy initiative is the Baltic Pipe, which is to connect Norway and Poland. However, the Polish Navy is expected and required to protect these critical assets and infrastructures and any tankers visiting Polish ports with increasing frequency.

Allied Obligations

Poland remains active in international endeavours. While these are mainly efforts organised by NATO, Poland participates in various EU initiatives also. It is political dogma in Warsaw that 1) European security must be guaranteed by NATO; and, 2) any EU defence project must support NATO, not undermine its major position. Poland participates in numerous NATO activities, including the Standing NATO Mine Countermeasures Group. Since joining NATO in 1999, the Polish Navy has participated in more than 300 international exercises, including "Baltops" – the largest, multinational naval exercises carried out in the Baltic Sea. Poland was involved with naval operations, such as "Iraqi Freedom" and "Active Endeavour" and is currently participating in EUNAVFORMED Operation "Irini" – but insofar as it does not undermine NATO obligations.

Struggling to Swim in the Wake of Legacy Equipment

The main problem is that the main assets Poland relies upon for its defence and security are decades old and in need of extensive repair or replacement. There are only two exceptions whereby new equipment or assets are to be made available but, even this is not certain. Polish sailors are well trained, professionally mannered and honourably disciplined, but operate with an equipment from the Cold War era. Only few systems – several warships and the NSM anti-ship coastal-based missiles – are considered "modern". The Polish Navy has a low percentage of modern equipment and the average age of its naval ships is approaching 35 years. Taking stock of the major ships afloat is like "walking down Memory Lane" where one is confronted by reminders of how low-tech the cast-offs sold to Poland by other countries really are. Poland's outdated assets stand in stark contrast to how far the rest of the world's navies have advanced.

USN Frigates

The strength of the Polish Navy is comprised of two ageing OLIVER HAZARD PERRY class frigates with limited combat capabilities. They were launched in the United States in 1978 and 1979 and recommissioned in Poland between 2000 and 2002. It is reported that several systems on board are unfit, including the radars, Mk 92 guided missile fire control, and the HARPOON missile launchers.

Recently, the Polish Navy expressed strong interest in procuring two used ADELAIDE class guided missile frigates from Australia also based on the PERRY class. In the end, this plan did not get the required political support from the authorities in Warsaw. Australia sold those warships to Chile, which modernised them and has now placed them in deployment.

Soviet-Era Corvettes

Other major Polish Navy assets include one KASZUB class ASW corvette (Project 620, commissioned in 1987) and three small patrol vessels of the ORKAN class (Project 660). The latter were supposed to be modernised (includes engine replacements) but the plan was cancelled last year.

This is particularly worrying since the ORKAN class is equipped with highly advanced and highly capable Saab RBS1 Mk 3 missiles. Without them, Poland will lose a significant part of its hard-kill anti-ship capabilities. The ORKAN class was built locally in the early 1990s by using hulls originally manufactured by VEB Peenewerft in Eastern Germany.

Photo: Pioch

ORKAN Class, ORP PIORUN

Photo: Tomasz Grotnik

ORP KORMORANN (Project 601) the lead ship of Polish Navy's KORMORAN II class MCMVs

Photo: Pioch

Decommissioned KOBBEN-class submarine – ORP KONDOR

Soviet MCM

While Poland has the ORP XAWERY CZERNICKI mine-counter-measure forces command ship, it is so old that it was designed by Polish engineers and initially used as a degaussing ship for the Soviet Navy. Later and due to Moscow's changing priorities, it joined the Polish fleet in 2001. The same can be said for the Naval Aviation Brigade's (BLMW) aging stock in Gdynia. Although Poland has only four SH-2G SUPER SEASPRITE helicopters, they were delivered nearly two decades ago, are very old, and no longer supported by the producer.

Submarines

Until recently, Poland had five operational submarines. Embarrassingly, this included the four KOBBEN class (Type 207) donated by Norway under an agreement signed in 2002. All were originally launched between 1964 and 1967 and entered service in the Polish Navy between 2002 and 2004.

They were deployed internationally from the North Sea to the Mediterranean Sea. However, due to their fatigue, Poland has already decommissioned two units and intends to phase out the two remaining submarines. Exact timelines are unclear / unknown and expected to be announced this year. However, Poland has no discernible plans for replacements.

It was expected that the KOBBEN class would be replaced by two commercially purchased ex-Swedish SÖDERMANLAND class (A17S class) submarines or perhaps two ex-Brazilian Type 209-1400 class submarines as an interim solution. Negotiations began and the Swedish authorities quickly approved the plan, but as of yet no deal has been concluded.

This means the Polish Navy has only one commissioned submarine available. However, it is not really a viable option: an ORP ORZEŁ of the KILO class (ex-Soviet Project 877E) launched in 1985 and which has been under repair since 2014 and remains unfit for sea duties.

Multi-Role Helicopters

The Polish Armament Inspectorate launched the KONDOR programme in late December 2019, to acquire between four and eight multi-role naval (sea-based) helicopters. Apart from ASW duties, they will detect and track targets for land-based NSM anti-ship missiles. These new aircraft will be a significant improvement over the current stock for SAR and ASW operations. Poland has W-3WARM ANAKONDA, Mi-14PŁ/Rs helicopters – which went out of production in 1986 – and, the M28B 1R BRYZA maritime patrol aircraft (the youngest was built in 2006), sometimes deployed in EU Operations "Sophia" and "Irini".

Mine Hunter

Poland has also one KORMORAN II mine hunter (Project 258), the youngest major warship in the Polish Navy. Initially, up to 14 units were planned but now only three are scheduled. The first ship of this class was commissioned in November 2017. Another new unit is the ORP ŚLĄZAK OPV (Project 621M, formerly a multi-role corvette). She was commissioned in November 2019. Meanwhile, Poland has cancelled projects such as CZAPLA (three patrol vessels with mine-hunting capabilities and UAVs) which were once expected to be delivered by 2026.

Modernisation Efforts

In December 2012, Poland adopted a modernisation plan for 2013-2022. It included 22 priorities to be achieved by 2030. However, this plan was significantly revised later. Some new programmes were added, while others were either cancelled or replaced. Currently, the Polish Navy has at least two major modernisation programmes ongoing – ORKA and MIECZNIK.

ORKA

Orka is critically delayed and only serves to illustrate the political decision-makers' horrendous level of impotence. The programme's goal is to procure a new genera-

tion of diesel submarines. A supplier was expected to be chosen in 2019, while deliveries were initially planned between 2024 and 2026. Poland received official offers from leading European shipbuilders:

- Naval Group proposed the SCORPÈNE/ BARRACUDA class
- TKMS the type 212CD
- Kockums the A26 class

Poland intended to equip the new submarines with cruise missiles. All contenders have assured that they can meet this requirement. No binding decisions have been made as of yet. Before ORKA is procured, Poland needs an interim solution. I think this needs to be deleted because it largely duplicates what has been said on page 33, col 1, para 4.

MIECZNIK

Miecznik is an initiative aimed at procuring two new multi-role frigates designed for littoral duties and long-range multinational operations. They will replace the PERRY class units and will be suitable for ASW, ASuW and air defence. This class is expected to become the backbone of the Polish Navy. Procurement is expected to be finally launched this year; the ships are to be built locally in cooperation with a foreign, more experienced partner. Initially, deliveries were planned by 2024 but according to plans for 2021-2035, two are to be handed over by 2035.

In February 2021, Poland completed a 22-month overhaul of the ORP KONTRADMIRAL XAWERY CZERNICKI. The vessel returned to the 8th Flotilla and became ready to participate in NATO's Response Force. Poland is overhauling two other vessels – the ORP KOSCIUZKO frigate and the ORP ARCTOWSKI survey ship; the latter was commissioned nearly 30 years ago. Both are planned to return to service in the Third Flotilla this year.

Are There Any Other Plans?

At the same time, the Polish Navy has been procuring, although also with delays, two additional KORMORAN II class mine hunters. ORP ALBATROS was launched in October 2019, and ORP MEWA in December 2020. Both are under construction at Remontowa Shipbuilding in Gdańsk. Both ships are expected to be handed over to the Polish Navy in late 2021 but most likely, the deliveries will be postponed.

The Polish Navy also wants to acquire two sets of maritime tactical drones (ALBATROS), which are to be used for surveillance and SAR operations. As mentioned previously, by 2022, the fleet is expected to get four AW101 helicopters for both SAR and ASW. This purchase will allow the Polish Navy to finally retire some Mi-14PŁs (ASW) and Mi-14PŁ/R (SAR) helicopters.

Photo: Pioch

H-13 PRZEMKO tugboat for the Polish Navy

In February 2021, rumours spread in Poland that the government was interested in procuring ex-Swedish GÖTEBORG class corvettes (commissioned between 1990 and1993) as a replacement for the ORKAN class corvettes. These reports were quickly dismissed by the Polish authorities. The same cannot be said about rumours which appeared in 2020, when the local press wrote that the US would offer Poland its decommissioned littoral combat ships. Interestingly, the government did not dismiss or deny these controversial rumours.

Plans Go Missing in Action

Many procurement initiatives released in recent years were ultimately delayed or the authorities simply have stopped releasing any information. A standard answer from the Armament Inspectorate is that "documents are still under evaluation" or "the analytical-conceptual phase is not yet complete".

For instance, under the supply ship programme the Polish Navy was to receive a new fuel tanker but ultimately, the programme was cancelled without any alternative plan. The new tanker is still very much necessary as the requirement has not dissipated but the plans have gone "missing in action". The same holds true for the cancelled DELFIN project (for two ELINT ships) or for frozen initiatives that include the TRANSHOL (auxiliary ship), BALTYK (logistic support ship) and MARLIN (joint operations support ship). Current plans no longer mention the RYBITWA programme. Its goal was to acquire three MPA aircraft for ASW duties. By now, it is presumed that RYBITWA is no longer required and ASW duties will be carried out by PLOMYKOWKA-class surveillance aircraft. However, this project seems to be stalled as well. Again, ASW capabilities are still in high demand because the requirement did not go away but yet again, the plans have gone "missing in action".

RATOWNIK is another worrisome project. Its goal was to procure two multirole SAR ships by 2024, as a replacement for two Project 570 class units that have been in service since 1974. However, a deal for the first unit was cancelled last year and since then no other contract has been signed. Under the MURENA programme, Poland wanted to procure six missile patrol boats but this project has also been suspended indefinitely.

Thank Heaven for Small Miracles

One of a few successful modernisation efforts still underway is the procurement of six locally-built B860-type tugs. Four of them were already commissioned (see the photo above). So, that is at least something… ■

Adriatic Security from the Croatian Perspective

Igor Tabak

The Adriatic, as an enclosed part of the Mediterranean, has a long tradition of maritime commerce, shipbuilding and – more lately – tourism. In recent years, it has been a relatively calm area on the very fringe of the major transport or migrant routes, with most coastal countries in NATO and many also either in the EU or on the path to membership. This tranquillity has also allowed the coastal countries, especially the smaller ones, to avoid devoting significant attention or resources to all but the most basic maritime security needs. As a result, over the last 30 years, the eastern shores of the Adriatic have been home only to minimal naval forces.

Of all the republics that formed the former socialist Yugoslavia, Croatia has the longest coastline; some 5,835km in total split between 1,777km relating to the mainland and a further 4,058km of islands, of which there are some 1,244 of various sizes. Around 1.2 million (out of a total of around four million) Croatian citizens live along Croatia's Adriatic coastline and the country earns almost 20 percent of its GDP from the tourism industry that is largely concentrated there. As this is an especially security-sensitive industry, Croatia has been fortunate to escape any major terrorist or ecological incidents in recent years. Also focused on the coast are several key industrial and infrastructural complexes that merit special attention, such as the new LNG terminal on Krk that became operational on 1 January 2021 and the EU-funded but Chinese-built built Pelješac Bridge that will connect the enclave of Dubrovnik to the rest of Croatia. This new infrastructure, as well as some of the more developed shipping port complexes, has attracted some interest from the likes of the United States, China and Russia but this has yet to translate into the achievement of any substantial influence.

Given the Adriatic is a relatively peaceful area, the most pressing maritime concerns are ensuring the security of shipping, commerce and tourism, including the critical infrastructure referred to above, offshore oil and gas platforms and port facilities. In order to meet its part of these naval security responsibilities, Croatia has established the Croatian Navy (the Hrvatska ratna mornarica or HRM) as a full branch of the Republic of Croatia Armed Forces. The Croatian Navy is small; out of total armed forces personnel of 15,605 the navy comprises just 1,534 (1,363 military and 171 civilian). Its main components are the fleet and the coast guard, whilst its main base and headquarters are located in Split, the largest city in the Croatian coastal part of Dalmatia. Operationally, the navy collaborates with both the Croatian Police and Croatian Ministry of Transport, both of which maintain around 50 smaller vessels in pursuit of maritime security within the waters bordered by country's 12 nautical mile limit.

Author

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Photos: Author

Split, second biggest city in Croatia and headquarters of the Croatian Navy

Daily Challenges

A major challenge facing the Croatian Navy is the fact that the attention of the Croatian populace – politicians and the general public alike – is largely focused inland, valuing the country's Central European identity more highly than its Mediterranean one. This results in a general lack of clarity with respect to the security situation in the Adriatic, most evidenced by the apparent absence of any publicly available analysis of the maritime security challenges and potential responses that would inform a national debate and lead to a focus on capability development plans. From a historical perspective, both during the period of the Austro-Hungarian Empire and also that of the socialist Yugoslavia, the focus was clearly on the defence of the coast and the possession of limited counterstrike capabilities. Subsequently, during the Croatian Homeland War, the emerging Croatian Navy focused on defeating its enemies and defending the emerging country from the sea. Afterwards, however, Croatia started on its journey towards NATO and EU membership and naval security disappeared from view amongst a general emphasis on military "streamlining". After NATO entry in 2009 and EU membership in 2013, no clear new goals were set and Croatia somehow became stuck in a naval "end of history" scenario.

The second major challenge facing the Croatian Navy, compounding the lack of strategic focus, is the state of Croatian defence spending. Croatia, as a NATO member, has committed itself to the alliance's goal of spending two percent of GDP on defence, as well as allocating 20 percent of that amount for investment in

modernisation, both by 2024. Whilst the national defence budget has fluctuated significantly over the last decade, the stagnation in the country's progress towards the two percent goal that is visible in recent NATO defence expenditure has only been achieved by an accounting trick, viz. the inclusion of veterans' pensions into the overall defence budget count. A truer reflection of the real state of things is provided by NATO data with respect to Croatian investment into defence modernisation, which has recently plummeted towards the bottom of the alliance (the figure was the second worst in 2020, with just 9.5% invested). The budget for 2021, passed in late November 2020, suggests a further stagnation in Croatian defence spending but even this projection looks dubious. Official statistics released in February 2021 indicated that Croatia's GDP fell 8.4 percent in 2020 as a result of the pandemic-induced economic shock. With such extreme pressures on the national economy, it is hard to expect that either the overall defence budget or its naval component will remain unscathed for long.

This state of affairs – a lack of both strategy and funds – is clearly visible in the current "Long term development plan for the Croatian Armed Forces 2015-2024". Perhaps unsurprisingly, the document's naval section is its least ambitious. Most of its stated strategic priority projects have either completely stalled or are severely delayed as the practical focus has shifted just to the retention of existing capabilities, with only cosmetic levels of modernisation achieved. A good example of the problem relates to the delayed but still ongoing attempts to reinvigorate domestic naval shipbuilding, which is currently focused on coast guard patrol vessels. With this effort moving at a painfully slow pace and most of the broader fleet modernisation programme seemingly stalled through lack of funding, much of the Croatian Navy is on the brink of block obsolescence and left to its best to utilise scarce resource against a backdrop of official neglect.

Boarding exercises on FAUST VRANČIĆ (BŠ-73) in the internal waters of the central Adriatic

Naval Resources

The mainstays of the HRM fleet are five Fast Attack Craft (FACs) primarily armed with SAAB RBS-15 Mk1 rockets; three produced in Croatia, and two acquired second-hand from Finland in 2008. In addition, the HRM has an amphibious squadron with two multipurpose transport vessels. In service since the early 1990s, they enjoyed their international premiere in October 2015 when they transported Croatian forces across the Mediterranean to participate in the "Trident Junction 15" exercise in Spain. After a pause of several years, a company of marines is being reformed as part of the HRM fleet in Ploče, whilst the fleet's naval divers platoon has also recently became more prominent due to their active cooperation with the US Navy.

The Croatian Coast Guard, an integral part of the Croatian Navy, was established in November 2007. It relies on nine ships for performing its duties in conjunction with four Mi-8 MTV1 helicopters and two PC-9 aircraft from the air force. Amongst these vessels are four patrol craft of the former Yugoslavian MIRNA class, the former hydrographic vessel ANDRIJA MOHOROVIČIĆ (BŠ-72), the old rescue vessel FAUST VRANČIĆ (BŠ-73) now used as an OPV and OMIŠ (OOB-31), the prototype for a new class of patrol vessels that are being built domestically by the Brodosplit shipyard in Split. OMIŠ was finally delivered in December 2015 after delays and modifications to the initial project. A contract for the four vessels that will comprise the rest of the class was signed in February

HRM explosive ordnance disposal divers at work

2020; two of these were laid down in September 2020 and the other pair in mid-November. The completion of the first of these is expected in March 2022, with the other vessels to be completed by September 2023. This construction programme ended a prolonged pause in domestic military shipbuilding stagnation, raising hopes that a class of bigger OPVs may be built in Croatia in future.

The Exclusive Economic Zone Conundrum

This regional security framework was seriously disrupted in late November 2020, when neighbouring Italy decided to change its views on the delicate topic of the proclamation of Exclusive Economic Zones (EEZs) in the Mediterranean (and the Adriatic). After spending years discouraging Croatia from adopting such a measure, it initiated the process for proclamation of an EEZ of its own. Consequently, on 18 December 2020, the Croatian Parliament (Sabor) gave the Croatian Government authority to reach a trilateral agreement – with Italy and Slovenia – on the implementation of a Croatian EEZ in the Adriatic in the course of 2021.

The prototype patrol vessel OMIŠ (OOB-31) during its maiden cruise on 8 December 2018

This new legal regime in the Adriatic will upgrade the existing rights and duties enjoyed by Croatia under the existing Ecological and Fisheries Protection Zone proclaimed in 2004. Moreover, the new legal regime will place new emphasis on the naval resources and capabilities required to police the Croatian side of the Adriatic, with potential benefit for the Croatian Navy in general and the Croatian Coast Guard in particular. Given the limited current resources and capabilities referenced above, this new limelight – and the additional funding that might come with it – could be a most welcome boost to Croatian maritime capabilities. ■

Is "DEU MARFOR" German for "NAVAL READINESS"?

An Exclusive Interview with Deputy Cdr DEU MARFOR, RAdm (LH) Stephan Haisch by Capt (Ret) Hans Uwe Mergener

Despite COVID Lockdown measures across northern Europe, Maritime Security & Defence (MSD) magazine spoke exclusively with Deputy Commander DEU MARFOR, Rear Admiral (LH) Stephan Haisch about compelling matters for maritime security such as Germany's increased level of regional commitment, NATO's 360° readiness requirements and Baltic Sea concerns.

MSD: What is the background for setting up DEU MARFOR, as per Germany's commitment to take on more responsibility within NATO?

Rear Admiral (LH) Stephan Haisch (Haisch): To answer this question, we have to go back in time to 2014. At the NATO summit held in Wales at that time, the participating heads of state and government decided, in view of the changing security situation, to focus more strongly again on national and Alliance defence. And so, the Very High Readiness Joint Task Force (VJTF), known as the "spearhead", was created at this time, which is perceived by many primarily as a deployment in the Baltic States and Poland - but which, by the way, also includes NATO's four Maritime Task Forces.

Two years later, at the NATO summit in Warsaw, Germany agreed to establish a multinational headquarters to command maritime operations, the so-called Baltic Maritime Component Command (BMCC). Germany therefore assumes visible supra-regional responsibility for Alliance defence with maritime forces, but at the same time also contributes regional competence for the Baltic Sea and the North Flank area to NATO's operational planning and command and control.

The practical realisation took place through the establishment of the German Maritime Forces Staff with the official designation DEU MARFOR. In developing the conceptual basis and the structure of the staff, we were guided by similar, already existing operational staffs in other navies. In January 2019, DEU MARFOR was formally commissioned in Rostock.

MSD: How does DEU MARFOR structurally fit into the German Navy - and its role within NATO?

Haisch: The staff of DEU MARFOR is part of the Naval Command in Rostock and is organisationally assigned to the Operations Division. The special feature, however, is that DEU MARFOR with its internal structure can be detached and relocated from the Naval Command Headquarters at any time and then become part of a maritime command structure, for example NATO.

Another feature of DEU MARFOR is that the staff is not only deployable but also capable of growing in number. Normally, we are in the so-called "peacetime establishment" (PE) as a permanently available "core staff". From this PE, DEU MARFOR can take on command and control tasks at the level of a Maritime Task Force "ad-hoc" and without further augmentation, but with the existing national and multinational personnel.

If required, these capabilities are expanded into the so-called "Crisis Establishment" (CE) after augmentation. DEU MARFOR is then able to operate at the level of a Maritime Component Command (MCC) or as a High Readiness Forces (Maritime) Headquarters (HRF (M) HQ) as part of the NATO Response Force (NRF).

And this is where the link to NATO comes in. The maritime operations of the transatlantic alliance are coordinated and controlled in the so-called "Baseline Activities and Current Operations" (BACO) via the Allied Maritime Command (MARCOM) in its function as Maritime Domain Advisor of NATO and as Maritime Component Command (MCC) in Northwood/ UK. However, in the event of a deterioration of the security situation or a crisis, the tasks of the MCC are transferred to an HRF (M) HQ. Currently, the United Kingdom (UKSTRKFOR), France (FRMARFOR), Italy (ITMARFOR), Spain (SPMARFOR) and Turkey (TURMARFOR) offer NATO such an HRF (M) HQ.

The German Navy is pursuing the goal of having DEU MARFOR certified as an HRF (M) HQ according to NATO standards. The application to include DEU MARFOR

Masthead

Maritime Security & Defence
Volume 2
Issue 02/21 (May 2021)
ISSN 1617-7983

Published by

Mittler Report Verlag GmbH
A company of the TAMM Media Group

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Layout:
CREATIV.CONSULTING GmbH, Meckenheim, Germany

Production:
Lehmann Offsetdruck GmbH, Norderstedt, Germany
Emirates Printing Press, Dubai, UAE

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Cover photo: Royal Navy

Annual subscription (from 09/21, 4 issues): €25,00 incl. postage

in the Long Term Commitment Plan (LTCP) has already been submitted to NATO.

MSD: Why is DEU MARFOR in Rostock?
Haisch: Rostock can certainly be called the "Capital of the Navy" for some years now. With the founding of the Naval Command Headquarters in 2012, the leadership of the Navy is based in Rostock. As I mentioned before, the new Command Centre building will soon also be handed over to the Navy. This excellent infrastructure and the associated short, direct decision-making channels were the decisive factors for choosing the Hanseatic city of Rostock as the headquarters of DEU MARFOR.

MSD: What are DEU MARFOR's future objectives?
Haisch: The core mission of DEU MARFOR is to plan and lead maritime operations at the higher tactical level. This can be done under the operational command of NATO, the EU or the UN.
In addition, national or multinational exercises can be planned and conducted by the staff of DEU MARFOR in a maritime and/or joint force framework. This also means that we can support the management of an exercise (as a so-called, Exercise Control) and be available for other headquarters in their exercises as a "Maritime Response Cell".
At the moment, however, we are still in the setting-up phase. Our goal is to achieve Full Operational Capability by 2025 at the latest and to be able to offer the full range of tasks outlined above by then. This will also then include the capabilities of an HRF (M) HQ according to NATO standards.
These capabilities are clearly defined. They include both the classic fields of naval warfare, such as submarine or amphibious operations, mine warfare, as well as, within an extended framework, the fields of information or cyber operations. And it is also clearly stated that such an HRF (M) HQ must be taken with a 360° approach.

MSD: What is behind the "360° approach" exactly?
Haisch: The ability to be deployed unrestricted within NATO's entire geographic area of responsibility is an essential requirement for an HRF (M) HQ in the role as MCC. In order to be assigned command and control responsibility for maritime operations, DEU MARFOR must meet this requirement to conduct maritime operations not limited to the Baltic Sea region, but within all other NATO's areas of operations.

MSD: What does DEU MARFOR have as a special unique selling point in the Baltic Sea region – with the 360° approach in mind – due to its high level of regional expertise?
Haisch: The Baltic Sea has regained importance in recent years. As part of the northern flank, it forms a strategic unit with the North Sea and the Norwegian Sea, which must therefore be regarded as a quasi "continuum". Russia's militarily flanked superpower politics has made the Baltic Sea a vulnerable umbilical cord to our allies in the Baltic. Against this background, NATO must position itself accordingly in the Baltic Sea region and develop appropriate responses. In the area of land forces, it has already done so with Enhanced Forward Presence.
From a maritime point of view, the "Baltic Sea area of operations" is very challenging: shallow and narrow waters characterise most of the Baltic Sea and, given the comparatively small geographical extent, any position at sea can be influenced upon from land. Special skills are needed to operate here. The German Navy is at home here and has precisely these capabili-

ties, due to its many years of experience and the expertise it has acquired.
At DEU MARFOR, these capabilities are brought together in one staff and are significantly expanded by the additional expertise of our multinational staff members. DEU MARFOR's regional relevance is therefore undoubtedly given and it would be obvious, following the basic idea of the Baltic Maritime Component Command (BMCC), to assign DEU MARFOR with the performance of MCC tasks in the Baltic Sea region.
In contrast to this, however, is the 360° approach outlined above: no regional limitation of an HRF (M) HQ in the role of an MCC! And it follows logically from this that DEU MARFOR, although based in the Baltic Sea, is by no means limited to the Baltic Sea region.

MSD: How does DEU MARFOR cooperate with partners in the Baltic Sea region?
Haisch: There is already long-term multinational participation in DEU MARFOR by personnel from Denmark, Finland and Lithuania, as well as from the non-Baltic Sea countries France and the United Kingdom at our headquarters in Rostock. This ensures a close connection to these countries, but also shows to me the great interest in our task.
The focus of cooperation is currently on participation in exercises of our partners. Even though our plans could not be realised in their entirety due to the effects of the COVID-19 pandemic, DEU MARFOR personnel were and are still numerous and visibly on the move. We are, therefore, appreciated in the multinational maritime community and increasingly accepted as a new "player".
Particularly worth mentioning for me in this context is the close cooperation with the Multi National Corps Northeast (MNC NE) in Szczecin, Poland. Here, the focus is on the interaction of land and naval forces, and I am pleased that DEU MARFOR can support the MNC NE in their next staff exercise in the role of a "Maritime Response Cell".

MSD: How is DEU MARFOR - and its activities within the German Armed Forces - unique? Are there ways the German Navy benefits from DEU MARFOR?
Haisch: Germany is already regularly involved in the LTCP, for example, the 1 (German/Netherlands) Corps in Münster is already regularly involved in NATO's LTCP in various functions. In addition, the multinational Joint Support and Enabling Command (JSEC) in Ulm has been established in the NATO Command Structure.
Within the German Navy, however, DEU MARFOR is unique, and the German Navy is also entering completely new territory here. With the establishment of DEU MARFOR, the German Navy is, for the first time, creating the prerequisites to be able to take on planning and command and control tasks in a multinational framework at the level of an MCC. This is an ambitious, but worthwhile, step: in future, DEU MARFOR will pool multinational planning and leadership competencies, be available as a staff for command and control tasks at various levels, offer technical expertise in all warfare areas and establish a reliable and trusting network with our partners through the firm integration of our multinational staff members. In my opinion, this is a real added value for the German Navy.

MSD: What are DEU MARFOR's milestones to achieving operational readiness?
Haisch: The first big step will be the move here in Rostock, in late summer this year, to the newly constructed building for the Naval Command and Control Centre. DEU MARFOR will be the "first occupant" there, and at a later date other parts of the Naval Command Headquarters currently still stationed in Glücksburg, such as the Maritime Operation Centre (MOC), will be added. This move will bring us enormous improvements in terms of infrastructure and IT, and I am very much looking forward to it.
Next year, we will then conduct a "virtual" staff exercise called "GRIFFIN MARKER 2022" in Rostock. Over a period of ten days, the planning and command and control process, associated internal staff procedures, the IT infrastructure and the increase in personnel in the "Crisis Establishment" will be tested at the level of an MCC. "Virtual" means that all scenarios are purely computer-based. Even if no ships, no aircraft and no troops will actually move during this exercise - it is one of the most important exercise projects of the German Navy in 2022, and I am confident that after an intensive analysis and evaluation, we will be able to declare an Initial Operational Capability as MCC in 2023 at the latest.
Subsequently, we will have to implement the lessons learned and prove our Full Operational Capability by participating in high-quality multinational exercises. We want to achieve this goal by 2025 at the latest.

MSD: What are your impressions since assuming command of DCOM DEU MARFOR two years ago?
Haisch: With the establishment of DEU MARFOR, the German Navy is sailing in uncharted waters. I am proud to be able to play a formative role in this important project for the future. The cooperation with our multinational partners is extremely productive and brings a lot of expertise to our team. My goal is that in the future, the German Navy will once again be able to offer a flexibly deployable command and control element with the highest level of expertise in a multinational framework with DEU MARFOR.

Ballistic Missile Defence at Sea

Bob Nugent

Ballistic missile threats have increased over the past 30 years since the end of the Cold War. Increased numbers and types of short and intermediate range missiles are operated by nations increasingly willing to employ them.

The proliferation of missile propulsion, guidance and warhead technologies, coupled with more mobile launch platforms, add to the offensive potential of ballistic missiles in local and regional conflicts. And the adaptation of ballistic missiles to anti-ship missions in global peer-peer naval conflict scenarios also expands and complicates the existing challenges of strategic ballistic missile defence.

In the naval domain, advances in ship combat system, sensor and weapons technologies have enabled naval platforms to respond to this growing threat. Naval platforms bring inherent qualities of mobility and flexibility that enhance national and ballistic missile defence systems. The evolution of the AEGIS combat system is one example of this naval flexibility, as the system nears its 50th year of operational service. Naval platforms make valuable contributions in dealing with complex operational and technical challenges of defending against long range missile attacks.

This article reviews developments in naval BMD, including combat systems, sensor and weapons developments, drawing on open source reporting and naval market intelligence provided by AMI International. It provides information on new naval construction and modernisation programmes related to ballistic missile defence. Organisation and mission context and operational impacts of naval BMD are also considered. In sum, the scale and scope of BMD at sea confirm its growing importance, although questions remain about how sustainable current programmes and investments will be over the coming two decades.

Author

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Photo: US Navy

The AEGIS class destroyer USS HOPPER launches a standard missile (SM) 3 Blk IA, successfully intercepting a sub-scale short range ballistic missile.

Capability

Most current naval BMD capability is found on ships equipped with the combination of the Lockheed Martin AEGIS combat system and Raytheon Standard Missile family of missile weapons fired from vertical launch systems. Initial sales of the Lockheed Martin AEGIS system to international navies started in the late 1980s. Countries that now operate AEGIS-equipped ships include Japan, South Korea, Australia, Spain, and Norway.

Based on its origins as a fleet air defence system, earlier versions of the AEGIS BMD provided capability to engage theatre-range ballistic missiles (SRBM, MRBM, and IRBM) in their terminal phases of trajectory. The long-range radar of the system could also contribute launch detection and target track data to land-based BMD systems defending against ICBMs.

As the table below (Source: GAO Report 19-387) details, AEGIS 5.0 and later variants reflect advances in sensor and missile systems related to BMD. These US AEGIS upgrades also provide international navies with a path toward adding naval BMD capability, especially in the Asia-Pacific region.

The Raytheon Standard Missile Family

Several variants of the naval Standard Missile have BMD capability: SM-3, SM-2 Block IV, and the SM-6. The widely-deployed SM-2 is assessed by the US Missile Defence Agency as capable of engaging SRBMs in the terminal phase. The SM-3 can operate against SRBM and IRBM with both single and multiple warheads in the missiles' mid-course phase. Japan and the US are jointly developing a 21-inch diameter variant of the SM-3 missile, SM-3 Block IIA, to defeat longer range ballistic missiles. In November 2020 the US successfully tested the capability of the ship-based SM-3 Block IIa missile to engage

Aegis Ballistic Missile Defense (BMD) spirals with associated Aegis Weapons System Baselines and capabilities.

Aegis BMD spirals	Associated integrated Aegis Weapon System Baselines (BL)	Key Ballistic Missile Defense Capabilities	Delivery date
BMD 5.0 Capability Upgrade (CU)	BL 9.C1	• Addition of Standard Missile-3 (SM-3) Block IB Threat Upgrade interceptor • Launch on Remote[a] • Improved discrimination using infrared and radio wave data • Capability against more advanced threats • Ship battle group defense capability using Standard Missile (SM-6) Dual I[b]	2015
	BL 9.B1	• BMD 5.0 CU capabilities for Aegis Ashore in Romania without Standard Missile (SM-6) Dual I	2015
BMD 5.1	BL 9.C2	• Addition of SM-3 Block IIA • Engage on Remote[c] • Ship battle group defense capability using Standard Missile (SM-6) Dual II[b] •	2019
	BL 9.B2	• BMD 5.1 capabilities for Aegis Ashore in Romania and Poland	2019
BMD 4.1	BL 5.4	• Similar capabilities to BMD 5.0 CU capabilities, installed on legacy hardware	2020
BMD 4.2	BL 5.X	• Aegis SPY-1 radar refurbishment for improved tracking capability	2023
BMD 6.0	BL 10.0	• New SPY-6 radar with increased radar capacity and discrimination • Performance against additional threats and larger raids • Improved missile communications	2023

Source: GAO analysis of MDA data | GAO-19-387

an ICBM. The SM-6 was first deployed in 2013 as fitted in the Mk41 VLS. An upgraded version of the missile, the SM-6 "Dual -1," has been tested for BMD as part of the Missile Defence Agency's Sea-Based Terminal programme and combines both anti-air warfare and sea-based BMD terminal capabilities as a successor to the SM-2 Block IV missile. In 2017 the US approved export of the SM-6 missile. Of the five international navies that operate ships with the AEGIS combat systems, Japan, Korea and Australia are expected to be the initial customers for the SM-6.

The AEGIS/Standard Missile combination is not the only BMD capability operating at sea. European combat systems suppliers such as Thales, MBDA and Naval Group are also responding to growing requirements for naval ballistic missile defence.

ASTER 30 Block 1

This missile equips a number of NATO navies, including France, Italy and the UK. The missile's Ku-band seeker enables it to engage SCUD-type SRBM threats. The Block 1 NT upgrade under development for the French and Italian ground forces will expand capability against SRBM and MRBM threats with ranges up to 1,500 KM, including missiles with multiple warheads. Modernisation of naval platforms with the ASTER 30 Block 1 NT would provide them with BMD capability.

Platforms

Large surface combatants (destroyers and frigates) are the platform types that provide most BMD capability. These ships, ranging in size from 4000 to 9000 tonnes

Photo: Lockheed Martin

Over time, AEGIS has evolved new capabilities to counter emerging threats and take advantage of new technologies. The latest AEGIS configuration, called BASELINE 9, presents an open architecture framework to allow flexibility.

full load displacement, have the power generation systems needed for advanced radar and communications. Additionally, the above deck structures are big enough to mount the radar and sensor surfaces of phased array systems, driving the choice of larger hulls for BMD. These ships' hulls provide enough volume to accommodate vertical launch systems with enough cells to hold missiles optimised for BMD, as well as the broader range of short and medium anti-air and anti-ship missiles needed to fulfil multi-mission responsibilities. These requirements result in fleet force structures that generally concentrate BMD among a small number of larger surface combatants.

Several of the new construction programmes detailed below have BMD as a specified mission in the programme requirements, and combat systems and weapons dedicated to that mission. Others are included as having the potential to contribute to BMD, based on combat systems, sensor systems and weapons fit. Modernisation for BMD is an equally important area of naval BMD development for two reasons. First, among most navies, major surface combatants representing the ships most able to contribute to the BMD mission have already been built for general purpose requirements where BMD was not the primary (or even a secondary) task when the ships were designed and built. Secondly, while the technologies needed for BMD are among the most complex, the states of the art in sensor, power, communications and weapons technologies are rapidly evolving. This translates into the need for continuous innovation and frequent modernisation programmes. The development of the AEGIS combat system described above is one example of this trend.

Photo: US Navy

An Evolved SEA SPARROW Block 2 missile is launched from the aircraft carrier USS CARL VINSON.

New Shipbuilding Programmes

US: The continuing construction of the DDG-51, and future building of the Large Surface Combatant (LSC) programme are the core of the US Navy's future sea-based BMD capability. As noted by the Congressional Research Service in December 2020, In the FY2021 budget submission, the number of BMD-capable Navy Aegis ships is projected to increase from 48 at the end of FY2021 to 65 at the end of FY2025. The portion of the force equipped with earlier Aegis variants is decreasing, and the number equipped with later variants is increasing. With the planned start of construction of the first LSC now estimated to be 2026, DDG-51 AEGIS destroyers will continue to make up the largest component of the U.S. sea-based BMD. The DDG-1000 does not have BMD capability, and the Navy's 22 TICONDEROGA class cruisers are expected to begin leaving service within the next 2-3 years.

Japan: In July 2019, Maya class DDG-180 HAGURO was launched as the eighth AEGIS-equipped Japan Maritime Self-Defence Force (JMSDF) ship. The ship commenced seat rials in 2020 and is expected to be commissioned with the JMSDF in 2021. The first ship of the class, MAYA, was commissioned in to service in 2020. Both ships are equipped with AEGIS Baseline J7 with Ballistic Missile Defence (BMD) upgrades. The ships' Mk 41 VLS with 96 cells is expected to be configured with a mix of Evolved SEA SPARROW (ESSM), SM-2 Block IIIB, SM-3 Blk IIA and SM-6.

South Korea: In May 2019, South Korea announced approval of plans to build an additional 3 KDX-3 class 7,600-tonnes AEGIS destroyers by 2028. The KDX-3 Batch 2 will have a mix of VLS-mounted SM-2, SM3 and SM-6 missiles, with the latter two providing BMD capabilities. This represents an improvement in capability over the initial 3 ships in the class that have SM-2 only.

Australia: The HUNTER class frigate, based on the BAE Type 26, will have Raytheon Standard Missile 2 (SM2) and Evolved SEA SPARROW Missile (ESSM) in the Lockheed Martin Mk 41 vertical launch system (VLS), with 48 cells total (16 cells for 64 ESSM). While the ship is not currently assessed as BMD capable,

it will have the Lockheed Martin AEGIS combat management system with the Saab 9LV CMS used as the tactical interface. Upgrades of missiles and the AEGIS combat system similar to those explored by the Australian government for the HOBART class could equip the HUNTER class to contribute to the BMD mission. With only 3 HOBARTs in service, only one of the destroyers would likely be available at any given time, so additional BMD capability on the HUNTERs would help the RAN respond to what is increasing viewed in professional military circles as a potent Chinese ballistic missile capability.

Spain: The new F110 class frigate programme reportedly began construction in May 2019. The five ships in the class will be equipped with the AEGIS combat systems and the SM-2 Block IIIB missile in a Mk 41 VLS. The first ship is scheduled to be delivered in 2026. To date there are no reports indicating the F110 class will have BMD capability.

Italy: The PPA (Pattugliatori Polivalenti d'Altura) class frigate programme includes three (of ten) hulls equipped with two 8-cell A50 SYLVER Vertical Launch Systems (VLS) capable of launching the MBDA ASTER 15 and ASTER 30 missiles. Missile detection and tracking for the frigates is provided by the Leonardo/Selex AESA C, X and L-band (8 panels) radar system. The Italian Navy has selected the ASTER 30 Block 1NT for the ships, which will provide them with BMD capability. The first PPA is scheduled to be commissioned in 2024.

Modernisations

Japan: The ATAGO class DDG has seen a number of AEGIS combat systems upgrades as part of the country's goal to make all eight of its AEGIS ships BMD capable. This involves going from AEGIS BMD 3.0 (tracking) to AEGIS BMD 3.6.1. This upgrade will permit engagement of missiles from the ship. As noted above, Japan is also involved in a bilateral programme with the US to develop the SM-3 Block IIA, and has requested up to seventy-three of the missiles, which would be expected to equip the ATAGO and MAYA class of destroyers.

South Korea: The acquisition of the three KDX-3 Block 2 ships with upgraded missile capabilities is also expected to influence the South Korean government to modernise the three older Block 1 ships with the newer missiles. An upgraded AEGIS baseline will also enable those ships to contribute to the BMD mission.

Photo: MBDA

The navies of France, Italy and UK operate the PAAMS/SEA VIPER air defence systems with MBDA`s ASTER 30 missile.

UK, France and Italy: All three navies operate the PAAMS/SEA VIPER air defence systems with the ASTER 30 missile. As noted above the ASTER 30 Block 1 NT, modified for shipboard use, would be an option to enhance capability against ASBM (Anti -Ship Ballistic Missile) threat such as that posed by China's DF-31. The French 2019-2025 Defence Planning programme authorises studies to integrate the missile on the French HORIZON (FORBIN) class frigate to provide BMD capability.

Netherlands: In 2019 the lead ship of the Royal Netherlands Navy LCF class (HNLMS DE ZEVEN PROVINCIËN) completed an upgrade to the SMART-L MM radar. The remaining three ships in the class are scheduled to get the new radar. This AESA radar is reportedly capable of surveillance and tracking of ballistic missiles at ranges up to 2000 km, while also maintaining a conventional air defence picture and ability to engage conventional air and missile threats. With the new radar the Dutch ships can integrate more fully into the larger NATO BMD infrastructure.

Germany: The German Navy is also seeking to upgrade the SMART-L search radars fitted to the three SACHSEN class (F 124) class air-defence frigates in service. As part of the request for proposals for the modernisation released in January 2019, the upgrade will seek an expanded BMD capability during the refit. A contract award is expected by the middle of 2020.

Australia: Reports since 2017 suggest the Australian government is actively assessing modernisation of the HOBART class (AWD) destroyer with the SM-6 missile. The Australian Defence Department's Integrated Investment Plan (IIP) provides for AWD combat system upgrades through 2028, although it does not specify which systems will be upgraded. By October 2018, the ships were scheduled to be upgraded to AEGIS Baseline 9, which would accommodate future retrofits to the SM-6. Government plans released earlier in 2009 and 2012 both envisioned the AWDs would eventually be upgraded to the SM-6. Another modernisation option would be to upgrade the HOBART class to use the new SM-3 Block IIA missile to engage IRBMs in midcourse engagement scenarios.

Organisations and Structures

The European Phased Adaptive Approach (EPAA) is the programme under which the US contributes capability to NATO's missile defence system. EPAA is designed to protect Europe against short-, medium-, and intermediate-range ballistic missile launches from Iran and is a system of voluntary national contributions of sea- and land-based systems. The NATO BMD programme provides the command and control backbone for the Alliance's BMD capability and is the only element of the system funding through alliance mechanisms. As part of Phase 1 of EPAA, Spain since 2014 has hosted four US Navy BMD-capable DDG-51 class ships in Rota. Those ships are scheduled to be replaced by another 4 US Navy ships in 2020. The next group of EPAA forward deployed USN combatants are expected to be equipped with the AEGIS Baseline 9 variant which provides enhanced BMD. European observers have noted the current BMD system in Europe leaves the region dependent mainly on US systems and resources. This is especially true of effector systems, weapons able to engage incoming ballistic at extended ranges (exoatmospheric) such as the SM-6. Yet European navies have not been idle in the BMD area. Germany has taken several initiatives to emphasise the potential for NATO navies to increase their BMD contributions. The October 2015 "At Sea Demo" exercise, following a German-Dutch operational concept, saw units from eight nations test coordinated air and ballistic missile defence against tar-

Photo: US Navy

An SM-3 missile is launched from the Japan Maritime Self-Defense Force destroyer JS KIRISHIMA, successfully intercepting a ballistic missile target. Japan is involved in a bilateral programme with the US to develop the SM-3 Block IIA.

gets in the upper layer. The German Navy was the lead for the October 2017 sea-based BMD exercise (Formidable Shield) which saw ships from Canada, France, Germany, Italy, the Netherlands, Spain, the United Kingdom, and the United States conduct a live-fire integrated air and missile defence (IAMD) scenario defending against a ballistic missile and anti-ship cruise missiles.

The Asia-Pacific region lacks a multi-lateral architecture like the EPAA which brings together national-level capabilities into a regional system. As a result, naval contributions to BMD are made within the context of national BMD systems.

Japan has made the biggest investment in BMD defence in the region to date, with programs that began in 2004 to establish a multi-tiered system of land and sea-based systems. Most recently, Tokyo has committed to acquiring two AEGIS ashore installations that will be designed only for BMD, rather than a more expensive approach (the AEGIS Cooperative Engagement Capability) that would defend against manned aircraft and cruise missiles. Japan's eight AEGIS combatants represent the sea-based elements of Japan's BMD system. Five US Navy AEGIS ships are also forward deployed to bases in Japan, representing almost one third (5 of 17) of all USN BMD ships in the Pacific region.

Korea also has a multi-tiered national air and missile defence system, with substantial capability provided by US forces on the Peninsula. A US-operated THAAD battery and several US and South Korean-operated PATRIOT batteries are operational now. The Korean Air and Missile Defence (KAMD) programme includes the three new AEGIS-equipped destroyers detailed above as well as land-based sensor and weapons systems.

Conclusion and Outlook

Naval BMD is another illustration of a verity of military art – that the balance between offense and defence is always shifting and demands constant attention from military planners and leadership alike. The scope and depth of naval BMD investments described in this article show that the US, NATO and Asian-Pacific region increasingly see BMD as a mission where naval forces can make uniquely valuable contributions, offsetting the offensive advantage of such systems.

Yet senior officers also lament the loss of operational flexibility that comes with advances in naval BMD capability. In June 2018, US CNO Admiral Richardson noted how the current state of the balance between offensive and defensive with respect to ballistic missiles kept US Navy BMD ships on geographically restricted tethers in order to be able to counter the most likely missile threats along the most likely threat vectors. Those limits, and the force demands for BMD ships – already a low-density high demand resource – will continue to strain availability of the select platforms and crews able to contribute to that mission.

Recent attacks on Saudi Arabian oil facilities, most likely by a combination of cruise missiles and long-range UAVs, also illustrate that potential aggressors have options beyond ballistic missiles to pose existential threats to nations. BMD advances, and increased naval BMD capability may be triggering another asymmetric response on the offense side of the balance in the form of more non-ballistic strike weapons. Such a response will aim to render much of the naval BMD capability available now and building over the next 10-20 years both less effective and too expensive, in resources and operational freedom, to sustain.

Which ensures BMD at sea, like the systems that drive it, will remain a complex moving target, difficult to identify, track and engage consistently, but continuing to demand serious attention. ■

MCMV Survey

European and Middle Eastern Navies

Guy Toremans

Sea mines remain one of the most attractive and leathal weapons available to any combatant due to their low cost, significant potential for disruption and ease of deployment – even from non-specialist craft. Consequently, naval mine countermeasures (MCM) remain a key enabler for maritime forces. As the Minefield is inherently high-risk to both personnel and mine countermeasures vessels (MCMVs), there is a broad trend amongst navies to expand the acquisition of unmanned and remotely-controlled systems.

The European NATO Navies

Belgium and the Netherlands

The Belgian Navy and the Royal Netherlands Navy, two of world's leading practitioners of naval mine warfare, are to give up the use of traditional mine countermeasures vessels in favour of a stand-off MCM capability based on "motherships" employing a "toolbox" of unmanned autonomous systems. This will allow mastery of a full "detect-to-engage" cycle at stand-off ranges of 12 nautical miles and more beyond the mothership. On 23 May 2019, a contract worth c. €1.9Bn was signed with Belgium Naval & Robotics – a consortium made up of Naval Group and ECA Group – to supply 12 motherships (six for each navy to replace existing "Tripartite" class vessels on a one-for-one basis) and their associated toolboxes to meet the requirements of the BE-NL rMCM Capability Replacement Programme. Deliveries are expected to commence from September 2024, with all the ships expected to be fully operational by 2030. Further details of this significant programme are provided in the following chapter.

Bulgaria

The Bulgarian Navy currently operates three "Tripartite" type MCMVS as the focal point of its MCM Capabilities. BNs TSIBAR (the former Belgian MYOSOTIS) was transferred in 2009 whilst two former Dutch members of the class – MESTA (the former MAASSLUIS) and STRUMA (previously HELLEVOETSLUIS) – withdrawn from the Royal Netherlands Navy in 2011- were inducted into the Bulgarian fleet on 14 October 2020.

Photo: author

An MCM Denmark Minor Standard Vessel (MSF) and a HOLM class multi-role craft (MSD)

Croatia

The Croatian Navy currently operates one KORCULA class minehunter which was commissioned into the fleet in 2007. Under longer term plans, the Croatian Navy envisages the acquisition of up to four new MCMVs but a lack of finding suggests that the start of the programme us not anticipated until 2028. Unconfirmed reports indicate that, as an interim solution, negotiations with the German Navy are underway for the possible transfer of two KULMBACH class (Type 333) units.

Denmark

The Royal Danish Navy was the first navy to give up the use of traditional MCMVs in favour of a modular mine countermeasure concept, the "MCM Denmark", introduced in 2011. The MCM Denmark toolbox is made up of two 29m HOLM class multi-role craft (MSDs), four optionally manned 26m Minor Standard Vessels (MSFs), C³ containers, diver containers, administrative containers and additional containers for ammunition and/or stores and spare parts. The system can be put on-board the navy's ABSALON, IVER HUITFELDT and KNUD RASMUSSEN class units, any other military or merchant vessel that is fitted with container positions or even mounted on trucks for operation from the shore.

Author

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Photo: author

The Estonian Navy's minehunter ENS ADMIRAL COWAN (the former HMS SANDOWN) has recently completed modernisation.

The MSDs embark a Thales/Saab Mine Warfare Tactical Data System, an In-Snec/Infocom combat data system, a Furuno FAR-2117 (I-band) navigation radar and the Saab Seaeye DOUBLE EAGLE Mk II S ROV, while the MSFs mount a Thales TSM 2054 side-scan sonar (SSS), a Furuno FAR-2117 navigation radar and an In-Snec combat data system. On 23 April 2020, a contract with signed with Saab to upgrade the DOUBLE EAGLE Mk II ROVs with new sonar, cameras, GPS, and inertial navigation systems. Subsequently, in July 2020, the Danish Acquisition and Logistics Organisation selected Kraken Robotics of Canada's KATFISH towed synthetic aperture sonar system to replace legacy technology on the MSFs.

Estonia

The Estonian Navy's three SANDOWN class minehunters – ENS ADMIRAL COWAN (The former Royal Navy SANDOWN), SAKALA (ex-INVERNESS) and UGANDI (previously BRIDPORT) – underwent an upgrade package at the Babcock International Group's shipyard in Rosyth from 2018 onwards that included the fitting of a Thales Sonar 2193 hull-mounted minehunting sonar, the Thales M-CUBE command-and-control system and an upgraded navigation system. This modernisation should allow the MCMVs to remain in service until at least 2030, by which time new units are expected. The navy also operates one minelayer; the former Danish LINDORMEN transferred in 2006 and now named WAMBOLA.

France & the United Kingdom

The French Navy and the Royal Navy are both taking a similar approach to that adopted by the Belgian and the Netherlands navies in terms of emphasising a mine countermeasures capability delivered by off board systems operating remotely from either onboard a ship or from ashore. Indeed, the two countries have been working jointly on an Anglo-French Maritime Mine Counter Measures (MMCM) programme since 2012. Drones developed under the MMCM initiative will form a central part of both countries MCM capabilities.

The French Navy's future mine countermeasures system – named SLAM-F (Système de Lutte Anti-Mines Future) – was formally approved in October 2020. It will comprise between four and six motherships known as Batiments de Guerre De Mines (BGDMs); eight suites of unmanned drone systems, five Bâtiments Base Plongeurs Démineurs Nouvelle Génération (BBPD NG) diving support vessels and a mine warfare data command system. Replacing the current ten ERIDAN ("Tripartite") class minehunters; three ANTARES class route survey vessels and four VULCAIN class diving tenders, SLAM-F is expected to achieve Initial Operating Capability (IOC) around 2023 and be complete by 2030.

Meanwhile the Royal Navy has completed Service Life Extension Programmes (SLEPs) on its remaining six HUNT and seven SANDOWN class MCMVs to allow them to remain operational during the current decade pending replacement by new autonomous minehunting systems under what is known as Project Wilton. In November 2020, a GBP184M contract for three systems – each comprising an autonomous vessel, a towed sonar and mine neutralization equipment – was placed under the auspices of the MMCM.

Subsequently, in January 2021, a separate contract for three autonomous minesweeping systems based on Atlas Elektronik's ARCIMS modular USV system was placed with the group's UK subsidiary for delivery from 2022 onwards. As of yet, it is unclear whether the UK will follow other countries in acquiring dedicated motherships or rely on craft of opportunity for system deployment.

Germany

The German Navy is to replace its entire MCMV fleet – currently made up if eight Type 332 FRANKENTHAL class minehunters, two Type 322B mine clearance diving vessels and 12 SEEHUND drones – from 2027 onwards, with a combination of dedicated platforms and organic MCM modules, the latter being suitable for deployment larger surface combatants should the need require. In the meantime, three members of the Type 332 class have been upgraded with the Atlas Elektronik Integrated Mine Counter Measure System (IMCMS) to form the MJ 332Cl variant. [1]

Greece

The Hellenic Navy's inventory encompasses two EVNIKI class (former US Navy OSPREY class) minehunters and one remaining former Royal Navy HUNT class minehunter HS EVROPI (the former BICESTER). The second unit, KALLISTO (previously HMS BERKELEY), was cut in half as a result of a collision with the Portuguese-flagged container ship MAERSK LAUNCESTON outside the Port of Piraeus in October 2020. There seem no plans to replace or modernise these remaining platforms in the near future.

Photo: author

The Italian Navy's eight GAETA class MCMVs – TERMOLI is seen here – completed midlife modernisation at the end of 2017.

[1] Two additional Type 352 ENSDORF class units remain in service as training ships

Italy
By the end of 2019, the Italian Navy's eight GAETA class MCMVs had completed a modernisation programme that encompassed the installation of a Selex SSN-714(V)4 combat management system, a Thales 2093 VDS, the Gaymarine PLUTO PLUS and PLUTO GIGAS ROVs and a modular hyperbaric chamber. The Italian Navy's fleet renewal programme calls for the replacement of the class by up to 12 new minehunters under the Cacciamine Oceanico Veloce (COV) Programme: four Cacciamine Nuova Generazione-Altura (ocean going minehunters) and up to eight Cacciamine Nuova Generazione-Costieri (coastal minehunters). A construction contract is expected to be in place by 2025, allowing the first of the new MCMVs to enter the fleet by2028 and all 12 units to be operational by 2033.

Latvia
The Latvian Naval Forces operate five IMANTA class (former Dutch "Tripartite") minehunters that entered service between 2007 and 2011, supported by the MCM command and support ship VIRSAITIS (the former Norwegian VALE) transferred in 2003. In September 2020, ECA Group was awarded a contract for the modernisation of three of the five units. They will be upgraded with a compact version of ECA's Unmanned Mine Countermeasures Integrated System (UMCM IS), including A18-M drones for the detection of mines and the SEASCAN Mk 2 and K-STER C systems for the identification and clearance of mines. The programme is to be completed by 2024. The service also operates five SKRUNDA class SWATH (Small Waterplane Twin Hull) patrol vessels commissioned into service in between 2011 and 2014. These units can embark a MCM mission module in their standard 20ft ISO container position.

Lithuania
The Lithuanian Naval Force's inventory includes LVS SUDVUIS (the former German LINDAU class MCMV KOBLENZ) transferred in 1999 and two former Royal Navy HUNT class minehunters SKALVIS (ex-COTTESMORE) and KURŠIS (ex-DULVERTON) acquired in 2011. A third HUNT, the former QUORN is scheduled to be delivered in 2022 following an upgrade which is expected to include the Thales UK M-Cube MCM command and control system. The navy also operates the MCM command and support ship LVS JOTVINGIS (previously the Norwegian VIDAR) transferred in 2006.

Norway
The Royal Norwegian Navy's MCM portfolio is currently made up of two OKSØY class minehunters, two ALTA class minesweepers and the Mine Diver Command (MDK). Although a full service life extension programme was cancelled in 2014, the MCMVs have received incremental upgrades, with another upgrade scheduled for 2021-2023. In the longer term, the navy is also focusing on a transition from the 'traditional' platform-centric approach to one that embraces the employment of unmanned autonomous systems. Key to the fleet's MCM fleet renewal planning is the "Future Norwegian Maritime MCM Capability" (Project 6359). This project, to be fully operational by 2028, is based on the use of two motherships and three MCM toolboxes.

Poland
Today's Polish Navy's MCMV fleet includes one surviving KROGULEC class unit and 13 GOPLO and four MAMRY class coastal vessels. The navy is currently replacing the 1960-vintage KROGULEC class with three new, indigenously designed KORMORAN II class (Project 257) MCMVs. The first of class, OPR KORMORAN was commissioned on 28 November 2017; the second, ALBATROS, joined the fleet in early 2020 and the final MCMV, MEWA was launched on 12 December 2020 and is anticipated to follow in 2022. A comprehensive range of mine hunting and disposal equipment includes Saab's latest DOUBLE EAGLE Mk III ROV and Kraken Robotics' KATFISH towed synthetic aperture sonar.

Romania
It is believed that the Romanian Navy is looking to acquire four new MCMVs to replace its four 1980-vintage MUSEA class minesweepers. However, with a construction contract not expected before 2029, the lead ship is not anticipated to join the fleet by 2031 and all four vessels only in 2034. To bridge this gap the navy could be looking into procurement through the second-hand European ship market. In this regard, the Belgian, French and Netherlands "Tripartite" class minehunters becoming available from 2025 onwards may prove an attractive interim option.

Spain
The Spanish Navy currently operates six SEGURA class MCMVs (derived from the Royal Navy SANDOWN class), which joined the fleet between 1999 and 2005. The units are to be fitted with an integrated platform control system – the Sistema Integrado de Control de la Plataforma (SICP) – similar to those installed onboard the navy's larger surface combatants. The Spanish government has also approved the repair of the minehunter TURIA, estimated to cost €25M, after she ran onto submerged rocks while searching for the wreckage of a Spanish Air Force CASA C-101 in August 2019. The work is expected to take around two years to complete.


Photo: Abeking & Rasmussen

The Turkish Navy's AYDIN class MCMVs were built jointly by Abeking & Rasmussen and Lürssen, providing increased protection and state-of-the-art technologies.

Turkey
The Turkish Navy's current MCM capabilities are focused on six AYDIN class minehunters – based on the German Type 332 FRANKENTHAL class – that entered service between 2005 and 2009, and five ENGIN (former CIRCÉ) class minehunters acquired from France in 1997. Turkey is considering a new class of MCM to replace the latter units and a Request for Information (RfI) for the mine clearance system was released in January 2018. Although this programme was expected to start in the near term, economic conditions and competing priorities have resulted in subsequent delay.

TURSO MM30: A MODERN NAVAL INFLUENCE MINE

The MCMV programmes described in this article are, in part, being driven by an increased understanding of the threat posed by modern naval mines. Sea mines – and naval minelaying – have not been a priority for many countries over recent decades. This trend has sometimes been driven by views that mines are dangerous and uncontrollable weapons, posing a threat to civilians. This, however, is not really the case for modern influence mines, which are extremely safe.

The recognition algorithms used by modern naval mines mean they can accurately detect, recognise and identify individual vessels: mines detonate only on hostile targets. In addition, moored and bottom mines do not "creep"; so you know exactly where they are. Moreover, mines are set to self-neutralise after a given operational period and are then safely redeployable. In short, modern naval mines can provide an efficient and secure means of self-defence, offering an effective anti-access/area denial (A2/AD) capability.

Finland, with its long coastline and archipelagic waters typified by narrow fairways, is one country that has continuously focused on developing mines and naval minelaying capabilities. The country's DA-Group has consequently become one of the leaders in this specialised area, recently announcing its latest TURSO MM30 sea mine. This incorporates the group's TURSO TDS Target Detection System, which is based on multi-sensor technology to combine safe and effective operation with high resistance against countermeasures. DA-Group describes TURSO TDS as "…a compact, modular system using sensors and control electronics for target detection and detonator ignition". User-programmable algorithms are run both to detect and distinguish potential targets. After activation, TDS becomes fully operational without any sensor stabilisation delays on a 24/7 basis.

Photo: DA Group

DA-Group states that the modular nature of TURSO mines enables easy customisation, for example with respect to the nature of the explosive material used and in terms of the physical interface with mine rails and hauling equipment. The group also offers its patented SUMICO Modular Minelaying System for a fully integrated and reliable minelaying system built around containerised technology.

In a case of "poacher turned gamekeeper", DA-Group is also using its knowledge of influence mines and vessel signatures to develop mine countermeasures technologies. The considerable global effort being put into minehunting and minesweeping capabilities reflects that this is a costly, dangerous and resource-intensive process. For example, a modern sea mine can recognise the signature of a sweep, a robot or a diver and decide whether to detonate or not. The cost of an underwater vehicle – or a diver – is much higher than that of a single mine.

NATO Partner Navies

Finland

The Finnish Navy has recently completed a substantial upgrade of its MCM assets with the induction of three Italian-built KATANPÄÄ class minehunters into the fleet between 2012 and 2016. Their toolbox of systems includes hull-mounted echo sounders and sonar, towed side-scanning sonar and a range of deployable systems including Kongsberg HUGIN and REMUS autonomous underwater vehicles, Saab's multi-functional DOUBLE EAGLE Mk III ROV and Atlas Elektronik's SEAFOX combat and identification variants. Other mine warfare assets include the remaining elderly KUHA and KIISKI class minesweepers whose residual capability might be replaced by a remotely controlled minesweeping system. The navy also deploys significant dedicated minelaying assets in form of the two HÄMEENMAA class minelayers that were modernized between 2006 and 2008 and the three smaller PANSIO LCU-type minelayers that completed an extensive midlife overhaul during 2015-17.

Sweden

The Royal Swedish Navy currently operates five upgraded KOSTER and two SPÅRÖ class MCMVs, the latter as diving support vessels. The KOSTER class minehunters will remain in service until the early 2030s by which time new MCMVs, most likely Saab's MCMV52 design (improved KOSTER class), will be acquired. The navy's five VISBY class corvettes are also able to provide supplemental MCM capabilities.

Ukraine

The Ukrainian Naval Forces are looking to rejuvenate their MCM capability after losses of vessels as a result of Russia's annexation of the Crimea left just one YEVGENYA class coastal vessel in its inventory. The navy seems to be interested in the Polish KORMORAN II class but is also looking at other western shipbuilders for potential candidates

Russia

The Russian Navy is in the midst of replacing an ageing MCM flotilla that is largely comprised of elderly GORYA, LIDA, NATYA and SONYA class vessels with its new Project 12700 ALEXANDRIT class. Orders for at least 10 of the vessels have been placed to date and it is possible that construction will extend to as many as 30 units. First of class ALEXANDER OBUKHOV, laid down in September 2011, was inducted into the fleet in 2016 and a further four vessels either have been or are close to completion.

Photo: author

Five upgraded KOSTER class MCMVs – ULVÖN is pictured here – currently form the core of the Royal Swedish Navy's MCM capabilities.

MIDDLE EASTERN NAVIES

Algeria
The Algerian National Navy has one of the most advanced MCM programmes in the Middle East, placing an order for three EL KASSEH class MCMVs from Italy's Intermarine in 2014. The lead vessel was delivered in 2017 and a second in mid-2020. It is possible the contract encompasses additional optional vessels. Similar to Finland's KATANPÄÄ class, the new MCMVs are believed to incorporate a range of fixed and deployable systems, including an Atlas Elektronik hull-mounted sonar, a Klein Marine towed side scab sonar and Gaymarine PLUTO type ROVs.

Egypt
Although the Egyptian Navy nominally has a large MCM force, its main capabilities are focused on two former US Navy OSPREY class vessels transferred in 2007 and upgraded during 2017-19, supplemented by three 1990s-era Switftships type coastal minehunters and two of the company's route survey vessels. The remaining vessels acquired from the Soviet Union in the 1970s are likely to be decommissioned and replaced by new units.

Kuwait
The Kuwait Naval Force is one of a number of Gulf navies looking to establish a MCM component, which could be comprised of either new or used MCMVs. Some reports suggest a priority is the acquisition of an autonomous USV-based sweep package.

Libya
The Libyan Navy is believed to retain two former Soviet NATYA class units in semi-operational condition. The acquisition of more effective units on the used international market is a possibility should political stability be restored.

Oman
Although Oman has long had plans for the procurement of MCMVs, no formal programme has been launched to date.

Qatar
Given the ongoing threat from mine warfare in the Persian Gulf, the Qatar Emiri Navy is reportedly another regional fleet looking at an inaugural MCMV acquisition.

Saudi Arabia
The Royal Saudi Navy operates three Al JAWF (SANDOWN) class MCMVs delivered in the 1990s, the four older AD-DRIYAH class vessels being largely used as patrol vessels. Preliminary steps have been taken to find replacements but no tangible progress has been reported.

Syria
The Syrian Navy has a handful of former Soviet-built MCMVs in its inventory but the operational status of these units is doubtful.

The United Arab Emirates (UAE)
The UAE Navy's two AL MURJAN (former German FRANKENTHAL) class MCMVs were acquired in 2096 and upgraded in 2011. One was seriously damaged in 2017 during operations against Yemen's rebel forces. It is understood the procurement of four new vessels us under consideration, although the project is unlikely to be realized before the second half of the decade at the earliest. Given the UAE's experience with German designs, either Abeking & Rasmussen or Lürssen would appear to be leading contenders for any contract. ■

Photo: Russian Navy

The Russian Navy is replacing much of its ageing MCM flotilla with the new Project 12700 ALEXANDRIT class.

The BE-NL rMCM Replacement Mine Countermeasures Capability Programme

Guy Toremans

The Belgian Navy and Royal Netherlands Navy have aligned the replacement of their ageing TRIPARTITE class minehunters through the joint procurement of 12 new mine countermeasure vessels (MCMVs) under a project designated the "BE-NL rMCM Capability Replacement Programme". Both navies have agreed to give up the use of dedicated MCMVs in favour of a stand-off MCM capability based on "motherships" employing a "toolbox" of unmanned autonomous systems.

On 22 May 2019, the Belgium Naval & Robotics (BNR) consortium comprising the French-headquartered Naval Group and ECA Group was awarded a €1.92Bn contract to implement the programme, which encompasses the completion of six "motherships" for each navy. Of this amount, approximately €450M relates to the acquisition of toolbox systems. Having successfully completed a "Systems Functional Review" on 23 May 2020, BNR commenced a "Critical Design Review" phase that is anticipated to be validated on later than May 2021. This will allow first steel cutting to take place in June 2021.

Photos: Naval Group

A current graphic of the BE-NL rMCM "mothership" design. The precise design and systems shown may change prior to the building phase.

Motherships

The motherships are based on the Naval Group's Bâtiment de Guerre de Mines (BGDM) design. They will have a length of 82.6 m, a width of 17 m, a draft of 3.8 m and a displacement of some 2,830 tonnes. The platforms will have growth potential, with sufficient flexibility for incremental improvements. Amidships the motherships feature a mission bay to accommodate the toolbox systems and associated technical workshops. Naval Group's innovative Launch and Recovery System (LARS) is fitted both to port and starboard to handle the unmanned surface vehicles (USVs), providing the required level of redundancy. The platforms have a 200 m² flight deck and a hangar that can store up to two UAVs and the spare parts needed for maintenance purposes, while the aft deck can accommodate up to three TEU 20 ft. containers.

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For protection against Chemical, Biological, Radiation and Nuclear (CBRN) agents, the ships will have a CBRN citadel and a prewetting system. The ships are also to be fitted with two Marine Evacuation Systems (MES) inflatable slide-ways, two 7 metre rigid hull inflatable boats (RHIBs) and two Replenishment-At-Sea (RAS) stations. The specification of NATO Role 1 medical facilities is another important requirement.

Extensive automation will allow the ships to be operated by a core crew of 30, but there will sufficient accommodation for an additional 33 personnel, such as the crews for the modular unmanned systems. As the Belgian Navy has decided not to replace its 55-year old command and support ship BNS GODETIA, each MCMV will be capable of embarking a mine countermeasures command staff. A planning/briefing room equipped with a large screen display and a multifunctional console will be provided to support this capability.

Whereas in the past MCMVs had only limited self-defence capabilities, the new platforms will be comparatively well-armed. The principal armament will be a BAE Systems Bofors 40mm Mk4 gun capable of firing 300 rounds per minute. This will be supplemented by two FN Herstal 12.7mm Sea deFNder® remotely controlled weapon stations with a firing rate of 1,100 rounds per minute and four 7.6mm machine guns. An additional "non-lethal" armament suite will comprise two water cannons and up to two Long Range Acoustic Devices (LRADs).

In terms of power supply, the ships will be powered by an Anglo Belgian Corporation (ABC) generator suite made up of two 6DZC (1,260 kW) generator sets and a single 12VDZC (2,520 kW) generator. Propulsion will be by means of two electric motors driving shaft lines fitted with fixed pitch propellers. The shafts and propellers will be supplied by Spain's Baliño, the latter to a design from fellow Emenasa Group company, Vicus DT. Operational range has been set at 3,500 nautical miles at 15 knots. Two bow thruster and one stern thruster will considerably facilitate the ships' manoeuvrability and position-keeping capabilities. Much of the deck equipment, such as the electrically driven anchor and mooring winches, will be supplied by the Belgian company Brusselle Carral.

The motherships are to be fitted with advanced sense-making and decision support functions to allow an increased level of au-

Amidships the MCM motherships are equipped with a large mission bay and Naval Group's Launch and Recovery System (LARS).

tomation. The Integrated Platform Management System (IPMS) encompasses a comprehensive range of user interfaces and a digital Closed Circuit Television (CCTV) system to monitor power generation, propulsion, ship services, the fight deck, and other vital locations. IPMS data will be made available to a shore support team located in the Belgian naval base at Zeebrugge, facilitating diagnostics advice and planning for condition-based maintenance. The integrated battle damage control system incorporates ship-wide monitoring and control functionality to provide a fully automatic malfunction and damage analysis. An integrated bridge system will be equipped with a Warship Electronic Chart Display Information System (WECDIS), a bridge alert management system, a global navigation satellite system, military GPS as well as other networked functions.

Naval Group is to supply its POLARIS combat management system and Saab its TactiCall integrated communication system. The sensor suite will include an advanced Thales NS50 4D multi-function Active Electronically Scanned Array (AESA) air/surface surveillance radar and a Thales IFF Mode 5 system. On 26 February 2021, Danish aerospace and defence company Terma announced that its SCANTER 6000 radar system – optimised for the detection of small surface and low flying targets – would also form part of the sensor suite. Other systems encompass a mine avoidance sonar and two Chess Dynamics SEA EAGLE electro-optical fire control systems.

Construction of the motherships will be entrusted to the Kership joint venture formed between Naval Group and Piriou. According to information available as of March 2021, both the lead ship and third unit will be built at Piriou's yard in Concarneau, Brittany whilst the second ship – and first for the Royal Netherlands Navy – will be fabricated at the group's Lanester, Brittany facility, Kership Lorient. Some of the follow-on units will be built at a European shipyard that has yet to be selected, with final outfitting carried out in Brittany. Steel cutting of the "first-of-class" is set for June 2021, with the launch anticipated in June 2022 and the delivery contractually set for 23 September 2024. The second ship is scheduled to join the Royal Netherlands Navy in May 2025. The ten follow-on units will be delivered at six-month intervals, alternating between both navies. All the motherships are expected to be fully operational by 2030.

Toolbox Systems

ECA Robotics Belgium, part of Belgium Naval & Robotics, will provide the MCM toolbox systems. These are based on ECA Group's Unmanned MCM Integrated System. ECA will also supply its Unmanned MCM Integrated System (UMISOFT) software for the toolbox's mission management and data analysis functions. The key components of the toolbox include the INSPECTOR 125-M USV, the SeaScan ROV, the 4.3m long A18-M AUV, the T-18M towed synthetic aperture sonar, the, the K-STER C Expendable Mine Disposal System (EMDS), and the UMS-SKELDAR supplied SKELDAR V-200 unmanned aerial vehicle. ECA has also contracted iXblue for the delivery and integration of the FLS 150 forward looking sonar, the GAPS M7 USBL positioning and communication system and the PHINS COMPACT inertial navigation system. Many of the drones will be manufactured in a new assembly hall to be built in Ostend. The construction of this new site will start early 2021 in order to allow production to commence in 2022 and have the first batch of drones available by the end of September 2023.

The motherships are sized to accommodate up to two INSPECTOR 125 USVs, two TI8-M towed sonars, three A18-M AUVs, three SeaScan ROVs, 40 K-STER C drones, a mine sweeping module, two REMUS AUVs, and two SKELDAR V200 UAVs. In turn, each INSPECTOR 125-S will be able to deploy a T18-M towed sonar, an A18-M AUV or various mine identification and disposal configurations that might encompass either two SeaScan ROVs and four K-Ster C EMDS or six K-Ster C EMDS. A specifically configured INSPECTOR 125-S with a different propulsion system will be used to tow an Influence Mine Sweep (IMS). Possible options for the IMS include a Polish R&D Marine Technology Centre (CTM) system. Research is also being carried out to deal with buried and drifting mines.

The MCM toolboxes can also be put on board other surface combatants, commercial vessels or Craft-of-Opportunity (COOP) and, in a containerised configuration, can even operate independently from ashore to conduct coastal mine warfare operations or the clearance of inland waterways and rivers. They are even capable of being airlifted to the theatre of operations.

Included within in the rMCM contract is the installation of a tactical simulator at the École de Guerre de Mines (EGUERMIN) in Ostend. The simulator, to be developed by Naval Group in cooperation with Belgian partner CMI Défence, will consist of an instructor room, a briefing room and three cubicles. Each of these will encompass a replica of a mothership's operations room and a "Ship Explorer" VR-zone representing a digital mock-up of the ship's interior on large 3D high definition displays. The simulator is scheduled to be operational by the middle of 2023 in order to commence the training of the lead ship's crew by that year's second trimester.

The Project Team is also preparing operational concepts for other USV payloads, such as diving and force projection. As EOD diver teams will continue to be used in future MCM operations, the potential to stow diving equipment and provide seating facilities on the INSPECTOR USVs is anticipated, as is the ability to mount a .50 calibre machine gun. ■

The motherships feature a 200m² flight deck to operate the SKELDAR V-200 UAV and the aft deck, fitted with a crane, can accommodate up to three TEU 20 ft. containers.

Modernisation of the SPY Radar Family

Tom Withington

The US Navy is on the cusp of an overarching overhaul of the naval surveillance radars used across the fleet via the advent of the AN/SPY-6(V) Air and Missile Defence radar family.

Raytheon achieved a major milestone on 2 June when the firm announced it had completed testing of its first production AN/SPY-6(V)1 S-band (2.3 gigahertz/GHz to 2.5GHz/2.7GHz to 3.7GHz) naval surveillance radar for the US Navy. The radar is now being shipped to Ingalls Shipyard in Pascagoula, Mississippi to equip the first ARLEIGH BURKE/Flight-III class destroyer, the USS JACK H. LUCAS which is under construction by Huntington Ingalls Industries. She is expected to commission in 2023.

"The AN/SPY-6(V)1 Air and Missile Defence Radar is the navy's next-generation radar system that will address Ballistic Missile Defence (BMD) and air defence capability gaps" identified by the US Department of Defence, Raytheon said in a written statement. It continued that the "AN/SPY-6(V)1 is an integrated air and missile defence radar providing sensitivity for long range detection and engagement of advanced threats." While the radar will be at the forefront of efforts to protect US Navy vessels, task groups and allied navies against air and missile attack, its baseline architecture is scalable across a wide array of ship classes performing an equally wide array of missions.

The S-band radar will be employed for volume search and will work closely with Northrop Grumman's AN/SPQ-9B X-band (8.5 GHz to 10.68 GHz) surface search and fire control radar. With a reported instrumented range of between ten nautical miles/nm (11.6 km) and 20 nm (37 km), this radar detects and tracks low-altitude targets flying below 2,000 feet (610 metres) altitude. Nonetheless, the AN/SPQ-9B is not intended to for the detection and tracking of higher altitude targets, this role instead being the responsibility of the AN/SPY-6(V)1. For all intents and purposes, the AN/SPQ-9B's primary role is ship defence.

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Photo: US Navy

The AN/SPY-1B/D series of naval surveillance radar has given sterling service during its long career. It will be succeeded by Raytheon's AN/SPY-6(V) family.

Gallium Nitride (GaN) is used in the Transmit/Receive (T/R) modules equipping the AN/SPY-6(V) series. The ability of this material to tolerate higher temperatures compared to the Gallium Arsenide (GaS) T/R modules used in legacy active electronically scanned array radars translates into more power being sent through the T/R modules resulting in higher detection ranges compared to systems like the Lockheed Martin AN/SPY-1B/D S-band naval surveillance radar family that the AN/SPY-6(V) will replace. The AN/SPY-6(V)1 will use a similar physical infrastructure to the AN/SPY-1B/D with four arrays positioned around the ship's infrastructure to provide 360 degrees of surveillance. Each array is 18.2 square metres (196 square feet) in size; roughly comparable to the size of the arrays used by the AN/SPY-1B/D family.

Capabilities

From the outset, the AN/SPY-6(V)1 has been optimised to detect and track ballistic missiles, performing its first live ballistic missile flight test at the US Department of Defence's Pacific Missile Range Facility in Hawaii in March 2017. Official US Navy documents in the public domain give an insight regarding just how much better this radar's performance will be vis-à-vis the AN/SPY-1B/D: The AN/SPY-6(V)1 has 15 times the sensitivity of the AN/SPY-1B/D, which translates into the radar's ability to detect and track a target half the size of the minimum detectable with the AN/SPY-1B/D at twice that radar's range. As a means of comparison the AN/SPY-1B/D can detect a golf-ball sized target at a range of 89 nm (165 km).

CMS

The AN/APY-6(V)1 will be integrated with the baseline-10 standard of Lockheed Martin's AEGIS Combat Management System (CMS). The US Navy periodically upgrades the overall AEGIS CMS architecture. Navy documents state that this is done through three Advanced Capability Build (ACB) standards, namely ACB-12, ACB-16 and ACB-20. ACB-12 encompasses the Baseline-9A0 and Baseline-9C1 standard for the Navy's respective TICONDEROGA class destroyers and ARLEIGH BURKE/Flight-1 class destroyers, chiefly the first 21 ships. However, as will be shown, the TICONDEROGA class ships have now transitioned to an updated baseline. ACB-12 Baseline-9C1/9A2A also covers the 37 ARLEIGH

BURKE/Flight-IIA class destroyers. Meanwhile, the ACB-12 Baseline-9C2 standard outfits the AEGIS CMSs used by the nine ARLEIGH BURKE/Flight-IIA Technology Insertion class destroyers and on all TICONDEROGA class cruisers equipped with the Lockheed Martin AN/SPY-1A variant of the AN/SPY-1 series radar. This comprises the first twelve ships in the class, five of which have now been decommissioned. A 2020 report from the US Congressional Research Service (CRS) stated that the ACB-20 Baseline-10 AEGIS CMS standard equipping the ARLEIGH BURKE/Flight-III class ships allows the combat management system to prosecute a larger number of more complex engagements, compared to legacy versions, together with an improved missile radio frequency datalink.

Weaponry

The AN/SPY-6(V)1 is designed to work with all variants of Raytheon's RIM-161 Standard Missile-3 Semi-Active Radar Homing (SARH)/long wave infrared-guided, long-range/high-altitude Surface-to-Air Missiles (SAMs) and RIM-174 Standard Missile-6 Active Radar Homing/SARH guided long-range/high-altitude SAMs. This will include the RIM-161 SM-3 Block-IIA SAM currently under development. Compared to legacy versions of the RIM-161 series this weapon has an improved discrimination seeker helping the missile distinguish between a ballistic missile's warheads and decoys, and a high divert kinetic warhead which could give the missile the ability to intercept Intercontinental Ballistic Missiles (ICBMs).

The rationale behind this development is to provide an additional capability to intercept ICBMs beyond the US Army's Ground-Based Interceptor (GBI) ballistic missile defence system located at Fort Greely and Vandenburg airbases in Alaska and California respectively. The asset of having such a capability based at sea is that it could be deployed either to enhance the GBI when needed, or to provide counter-ICBM BMD coverage over areas not covered by the GBI. Media reports stated that a live test of the RIM-161 SM-3 Block-IIA had been planned for the third quarter of 2020 to take place in the Pacific Test Range, although whether this timetable remains fixed in light of the ongoing Covid-19 pandemic remains to be seen. The test was planned to use Northrop Grumman's representative T2 ICBM target.

The RIM-174 SM-6, meanwhile, will be the successor to Raytheon's RIM-66 Standard Missile-2 IR/SARH guided long-range/high-altitude SAM. As well as engaging aircraft, cruise missiles and ballistic missiles the RIM-174 can be used as an anti-ship weapon. Cleverly, it uses the ARH seeker of Raytheon's AIM-120C AMRAAM (Advanced Medium Range Air-to-Air missile) and the airframe of the RIM-156A Standard Missile-2ER Block-IV weapon. The RIM-174 achieved an initial operating capability in November 2013. As well as being deployed by the US Navy, the missile has been exported to the Royal Australian Navy, Japan Maritime Self Defence Force and the Republic of Korea Navy.

Production

The overall AN/SPY-6(V) programme commenced in September 2010 when the Navy defined its concept for the radar. System development began in September 2013 with an Engineering, Manufacturing and Development (EMD) contract awarded to Raytheon on 10 October 2013. A hardware Critical Design Review (CDR) was completed in early December 2015, with a system CDR concluding in late April 2015. Two years later in May 2017, the Navy took the decision to move into low-rate production. The EMD contract included the provision for production of nine radars.

In March 2019 the US Navy's Naval Sea Systems Command awarded Raytheon a contract worth US$402.7M for the production of three AN/SPY-6(V)1 radars to equip the first three ARLEIGH BURKE/Flight-III class ships. Alongside the USS JACK H. LUCAS this will include the USS LOUIS H. WILSON, expected to commission in 2024. Although the first production radar is expected to be delivered for installation in August 2020, Covid-19 restrictions permitting, this will not mean the end of the radar's development. According to the 2020 Defence Acquisitions Annual Assessment published by the US public spending watchdog the Government Accountability Office (GAO), operational tests of the AN/SPY-6(V)1 will commence in May 2023, with an expected conclusion in August 2024.

The GAO report provides a useful snapshot of the programme's progress to date: The radar's development costs were estimated as just over US$2Bn in October 2013. As of July 2019, this had risen to US$2.1Bn, an increase of 3.3%. Despite these increases, there is good news. Procurement costs for the radar had originally been estimated at US$4.3Bn in 2013 and as of July 2019 these

Photo: US Navy

Like its AN/SPY-1B/D predecessor the AN/SPY-6(V)1 will use fixed panel arrays to provide up 360 degrees of azimuth detection around the forthcoming ARLEIGH BURKE/Flight-III class frigates.

had reduced to US$3.7Bn. This is a 15% reduction and, despite the increase of the development costs, this represents a cost saving of US$500M; hardly small change.
Likewise, the unit cost of the radar has been reduced. In October 2013, each radar was expected to cost the US taxpayer US$292.7M. This has since seen a 9% reduction to US$266.4M. That said acquisition cycles for the radar increased from 156 months to 161 months. With an initial 20 radars to be procured to cover eleven ARLEIGH BURKE/Flight-III class destroyers, five GERALD R. FORD class aircraft carriers, two SAN ANTONIO/Flight-I class and the same number of SAN ANTONIO/Flight-II class amphibious assault ships, even taking increases in development costs into account, American taxpayers will still enjoy savings.
Cost estimates by the GAO in October 2013 mooted that the programme would have an all up cost of US$6.4Bn when combining the unit costs for the radars with its development and procurement costs. However, as of July 2019, these all up costs are calculated as US$5.8Bn; a saving of US$600M. These savings are all the more commendable given that 100% of the AN/SPY-6's software is custom made. Writing software from scratch traditionally adds significant costs to military systems.

Photo: US Navy

The US Navy's new GERALD R. FORD class aircraft carriers are being outfitted with the AN/SPY-6(V)3 radar. Several of the US Navy's legacy aircraft carriers and amphibious assault ships may follow suit.

Photo: Raytheon

The AN/SPY-6(V) promises a quantum leap for US Navy anti-air warfare and BMD capabilities, thanks to its performance vis-à-vis the AN/SPY-1B/D series.

Nonetheless, the GAO did express some concerns regarding the overall programme. The GAO report stated that the navy believes the radar has "mature critical technologies, a stable design and production processes in control." The GAO says that disagrees "that the technologies are fully mature" adding that it does not believe the radar can be considered fully mature until "the navy integrates (the radar) and AEGIS on the lead 'ARLEIGH BURKE/Flight-III class) shup in 2022" in spite of navy plans to perform a land-based integration of the radar with the AEGIS CMS.
The report continued that the GAO believes that this course of action adds risk to the programme because the navy plans to procure circa 15 of these radars before all of the AN/SPY-6(V)'s operational testing is complete in 2024. The report warns that "(a)ny deficiencies the navy discovers during at-sea testing could require revisions to existing design drawings or retrofitting to already built radars, which would likely increase costs of delayed radar deliveries." The GAO report also flagged concerns regarding the software development for the AN/SPY-6(V). It stated that the navy had performed some initial cyber security testing but that full tests of the radar's cyber capabilities are not expected until at least 2023. The report said that some cost increases germane to the programme had been noted as a result of implementing cyber security controls, warning that "if cyber security issues arise during testing, additional software development may cause further cost growth or disrupt operational testing."

Beyond Flight III

Although the radar has yet to enter service, plans are afoot to increase its performance via the Advanced Distributed Radar (ADR) programme. Details are vague on exactly what the ADR will entail beyond it being an enhancement for the radar's ballistic missile detection performance. Official navy documents in the public domain have stated that this will form a software enhancement and allow the radar to operate in a "receive only" mode in cooperation with other radars.
From a BMD perspective, this means that several AN/SPY-6(V) radars can be networked to deepen target tracking when performing BMD engagements. This may enable several radars to illuminate and track the same target, possibly from ships in different locations but with a line-of-sight range to the target. This could provide highly detailed imagery of the target thus improving the chances of a successful detection. Such a capability could see radar imagery being shared across the US Navy's fledgling Cooperative Engagement Capability (CEC).
The receive only mode will allow a radar to illuminate a target from one location and for another radar to receive echoes reflected by this target to enable tracking without having to transmit. This greatly reduces the chances of the non-radiating radar being detected and jammed by an electronic countermeasure. The CEC heralds a quantum leap in US Navy abilities to share not only radar track data, but actual radar imagery across platforms using secure V/UHF (30 megahertz/MHz to three giga-

hertz) wideband line-of-sight datalinks. The cooperative engagement capability is now entering US Navy service and promises to vastly improve the situational awareness and command and control of a task group, particularly as far as anti-air warfare and BMD engagements are concerned.

In 2019, it was reported that Raytheon was working on a variant of the AN/SPY-6(V) which could equip legacy ARLEIGH BURKE/Flight-IIA destroyers, a total of nine ships, two of which have been commissioned. This version would be the same as that outfitting the ARLEIGH BURKE/Flight-III class ships, but optimised to the available power, weight and size restrictions of the former. The version of the radar for the ARLEIGH BURKE/Flight-IIA ships will be designated as the AN/SPY-6(V)4.

Meanwhile, the AN/SPY-6(V)2 which will use a rotating antenna, as opposed to fixed arrays, is equipping the SAN ANTONIO class landing platforms docks, with the AN/SPY-6(V)3 outfitting the US Navy's GERALD R. FORD class aircraft carriers. Five ships are planned for this class, one of which, the eponymous ship, was commissioned in July 2017, with the USS JOHN F. KENNEDY scheduled to commission in 2022. The AN/SPY-6(V)3 uses three fixed arrays to provide 360 degrees surveillance. Both the AN/SPY-6(V)2/3 will be integrated with Raytheon's Ship Self-Defence System Mk.2 (SSDS Mk.2) architecture equipping these ships. The SSDS Mk.2 is a CMS providing air and surface protection for non-AEGIS equipped ships.

Beyond these vessels the AN/SPY-6(V)2 could equip the WASP and AMERICA class amphibious assault ships and the NIMITZ class aircraft carriers via a retrofit. As far as the WASP class is concerned, the AN/SPY-6(V)2 could replace these vessels' Raytheon AN/SPS-49 L-band (1.215GHz to 1.4GHz) and ITT Exelis/L3Harris AN/SPS-48 S-band (2.3GHz to 2.5GHz/2.7GHz to 3.7GHz) air search radars. These radars also equip the AMERICA and NIMITZ classes. Currently, there appears to be no formal US Navy programme to equip these vessels thus in the future. Should such a decision be made this could see Raytheon winning up to US$6.6Bn of orders should all 14 ships in the NIMITZ class, all eight WASP class vessels and the three AMERICA class ships receive the upgrade. Raytheon's written statement stated that the AN/SPY-6(V)3 will equip the US Navy's new FFG(X) frigates expected to enter service over the next ten years. A total of 20 ships are planned which, like the AN/SPY-6(V)3 acquisition for the flattops, could generate up to US$5.3Bn in sales for the company.

Examining Raytheon's figures shows that total demand for this radar could result in the total procurement of up to 76 radars across all these classes including the ARLEIGH BURKE/Flight-III class and SAN ANTONIO class. Raytheon says that this could see the company receiving contracts for up to 17 radars annually, although it adds that the actual frequency of these awards "will depend on navy installation schedules and funding."

Commonality

The US Navy has taken an ambitious step with the AN/SPY-6(V) family. It has developed a single, modular radar design which can equip a wide array of current and future vessels. While the potential rewards for Raytheon are obvious, slimming down the number of disparate radars in US Navy service offers potential economies of scale as spare parts inventories and logistical demands can be streamlined. The AN/SPY-6(V)'s predecessor, the AN/SPY-1B/D series has enjoyed a long, illustrious service in the US Navy, and has set a high bar as regards the specification and performance of its replacement.

Time will tell the extent to which Raytheon has met this challenge and produced a radar which can vastly eclipse the capabilities of the AN/SPY-1B/D. Assuming that the AN/SPY-6(V) delivers operationally then Raytheon and the US Navy can probably expect to see international interest in acquiring the AN/SPY-6(V). It is noteworthy that the AN/SPY-1B/D series also equips the Australian, Japanese, Norwegian, Republic of Korea and Spanish navies. Similar sales of the AN/SPY-6(V) to US allies will not only bring economies of scale, but levels of interoperability which will prove essential given that the only predictable aspect of the conflicts at sea in the future will be the overarching requirement for coalition operations to meet the challenges posed by near-peer adversaries like the People's Republic of China and Russia.

Image: US Navy

On 30 April, Fincantieri announced that it had won the contract to develop the US Navy's new FFG(X) frigates. These ships are expected to be outfitted with the AN/SPY-6(V)3 variant of the radar.

Fire Suppression & Containment

Edward Lundquist

While major shipboard fires remain a danger, new technologies and concepts help to fight and prevent fires on board

The Current Challenge

"Every fire is an opportunity to gain some important lessons," according to Mary Hunstad, the US Navy's technical warrant holder for fire protection systems. In trying to make ships safer and more survivable, there is always something be learned from actual incidents. In looking at shipboard fires in recent years, Hunstad said there are four common threads.

"Some of the issues that we see repeated over time include:

- Issues with hot work, welding and cutting
- How we stow flammables and combustible materials such as cardboard packaging; where they are stowed and the quantities can be a factor
- The industrial environment; where you have a ship in various states of maintenance and repair and the systems may not be fully operational
- The fact that detecting and locating a fire can be a challenge in any of these environments."

Fortunately, new technologies and concepts have been developed to prevent and fight fires on ships.

There is a distinction between firefighting and fire protection. "Firefighting is something that is done by the person fighting the fire, while fire protection refers to the equipment and systems," Hunstad said. "They go hand in hand."

Today, industry has made much safer building and infrastructure fire protection systems possible. While that technology is also being used in maritime environments, naval shipboard systems must meet stricter shock and vibration standards. As explained by Hunstad, "You don't just walk into (a home improvement shop) and buy a fire detector that will go aboard a Navy ship."

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Photos: US Navy

Sailors aboard the forward-deployed amphibious assault ship AMERICA (LHA-6) respond to a simulated fire during a general quarters drill.

Although newer ships are being designed and built with better detection and suppression systems, many older ships have not been upgraded with the newest available technology. Ships have some automatic systems that can indicate or automatically activate sprinkler systems, such as in ammunition magazines. But in most cases, crews have relied on watch-standers to report a fire because they see, smell or feel it, and the ship's damage control parties get their gear at their repair locker and methodically proceed to put out and the conflagration and then dewater the space.

Adopting Industry Standards

Hunstad said the US Navy looks to industry for guidance. The National Fire Protection Association (NFPA) issues codes and standards, and the standard for fire alarms and signalling (NFPA 72) informs the design and installation of systems. "The standards are primarily focused on industrial and residential structures, but we adopt those parts where we think they apply to our shipboard use."

The International Maritime Organization (IMO) has also established standards and specifications. The IMO's International Convention for the Safety of Life at Sea (SOLAS) specifies regulations to help prevent fires from occurring; to better detect fires; and to rapidly contain and extinguish them. In addition to SOLAS, there are commercial classification standards for steel vessels, and National Fire Protection Association (NFPA) codes. "We look at all of that, and pick what is appropriate for navy ships," Hunstad said.

One comparatively recent development has been the introduction of water mist fire suppression technology. The US Navy introduced the implementation of water mist systems with the SAN ANTONIO LPD- 17) class of amphibious ships, with the lead ship being commissioned in 2006. The LCS-1 and LCS-2 littoral combat ship variants and ZUMWALT (DDG-1000) class of guided missile destroyers were also designed to have water mist systems.[1]

"Water mist is used in places where we used to have gaseous systems such as Halon 1301 and FM 200," Hunstad said. Ozone depleting Halon 1301 (bromotrifluoromethane) is no longer produced, although the US Navy does still use it. Hunstad said the navy has stockpiles of Halon 1301 for the ships which were built with the relevant systems, although the fleet has been transitioning to safer, cleaner FM 200 (heptafluoropropane). However, water

mist provides cooling capabilities that the gaseous systems can't offer.

On the passive side, Hunstad said the Navy has also developed a system of fire-resistant bulkheads and decks that can help prevent fires from spreading that requires no crew intervention or electrical power. N class divisions, a system of fire-resistant, insulated bulkheads and decks, are similar to the A class divisions that are proscribed by classification societies such as the American Bureau of Shipping for ships built to commercial standards. "We've tested a lot of different fire insulations and approved them for use so that we have a fire-resistant boundary at various points in the ship that can stop and hold a fire for a period of time."

Without getting into specifics, Hunstad said some recent fires have demonstrated how well these insulations have performed.

The US Navy has adopted another concept taken from the commercial world that is as effective as it is simple. "Most fire hoses on our ships are 1.5 inch diameter collapsible hoses, with 1.5 inch couplings and nozzles. When you look at the civilian firefighting world, they are using 1¾ inch hoses with 1.5 inch couplings. When you have that larger hose coupled to a smaller nozzle, there is a phenomenal saving in pressure drop. That can make a difference in a damage scenario where you may have lost power or a few fire pumps and you don't have as much pressure, that saving in pressure can be dramatic. It's the same nozzle and coupling, but a slightly larger hose. It's a fairly simple remedy that saves pressure. We've been implementing that on new ships, and when our older ships need to replace hoses, we're replacing them with the larger diameter."

A traditional tool that is still in use is the ubiquitous red portable fire extinguisher. For small fires, they are one of the quickest things you can grab and utilise to extinguish a fire before it gets bigger. "We still use those portable extinguishers as the first response, especially when there is a minor incident," she said. "We wouldn't want to actuate the full-space water mist system if a portable extinguisher or a fire hose could address the problem".

Under Control through Automation

However, warships today have smaller crews than in years past. With a limited manned response, it is necessary to secure damage to the fire main, get pressure back up, and get water onto the vertical and horizontal boundaries adjacent to the primary fire spaces to limit the spread of fire. Once a fire spreads, the fire volume gets larger, and more people are needed to contain it and extinguish a fire.

Many fire suppression systems are not activated automatically by a sensor that detects a fire in a space. Rather there are sensors that can provide an alarm at the engineering control station, and the operator can then activate the system. This method is much faster than the more traditional way of reporting a fire and calling away the damage control parties, who then work their way to the fire. However, automation is steadily increasing all the time.

Sailors simulate firefighting in the ship's laundry during a damage control drill.

The fire that destroyed the BONHOMME RICHARD (LHD-6) provides important lessons for preventing similar disasters.

Brian Callahan, General Manager & Technical Director at Fairmont Automation, has been heavily involved in developing the software for the DDG-1000 class's autonomic fire suppression system (AFSS) engineering design module, including the AFSS land-based and live fire testing. A peacetime scenario and a wartime fire and damage control situation are two very different events, Callahan said. "The weapons effects test allows us to study a combat damage event, simulating a weapon detonating inside the skin of the ship and taking out sections of the fire suppression system."

Live testing of the fire main SMART valve system, which automatically detects and isolates ruptures in the fire main system and reconfigures the system to re-establish pressure in intact sections, was conducted during a weapons effect test (WET) sea aboard the former destroyer PETERSON (DD-969) in the Gulf of Mexico in 2004. The decommissioned ship was outfitted in Philadelphia and then towed to Pensacola for the testing.

The test was successful. "In some real-world incidents, it has taken hours if not days to re-establish fire main pressure," said Callahan. "The autonomic fire suppression system could re-establish fire main pressure in a matter of minutes without any human intervention." Following further trials of the technology, SMART technology systems were ordered for the DDG-1000 class in 2010.

Civilian and naval personnel train together at a naval air station to maximise joint ops effectiveness.

A High Pressure Response

If the control system is the brain, then the pumps are the heart of any water-based suppression system. John Buck, Director of Technical Engineering Applications at Leonardo DRS Marlo Heat Transfer Solutions is well aware if this fact. His company manufactures freshwater pumps for the water mist systems on the DDG-1000, LPD-17, LHA-6, LHD-8 and DDG-51 Flight III classes. He stated, "Our pumps are part of a larger system. Instead of the traditional shipboard fire main system, which uses a piping system of pressurised seawater throughout the ship, water mist systems draw fresh water from the ships dedicated water tanks, with pumps that pressurise the water in the system to 950 psi."

Buck said there are different configurations. Each instance is slightly different in terms of pump volume and pump pressure. "Our fire suppression pumps provide between 260 to 400 gallons per minute. Our pumps are very special because they operate at such a high pressure. They are not used for any other purpose."

According to Buck, there's a big difference between a deluge system, which is what you will find in a building, where you have nozzles on the overheads, and the system is mechanically or electrically triggered. That method just dumps water onto the space where there is a fire. The reason a water mist system is so effective is because it creates an extremely fine atomised mist that can put out a fire in a space without direct line of sight, or applying the water directly onto the fire. By filling the space with mist, it displaces the oxygen, and the latent heat of evaporation of water, which is the physical conversion of water to steam, takes out a great deal of energy from the fire. It cools the air and the space.

The system can be activated remotely from the engineering control station. Fire parties don't need to respond, dress out and proceed to the fire. No hoses need to be rigged and brought into the space to activate the system because it's already plumbed into the area where it will be used.

Buck said the system has margin built into it, so that there is adequate pressure all the way to the last nozzle at the end of the longest pipe run.

The ZUMWALT (DDG-1000) and Littoral Combat Ship classes – LCS-2 variants TULSA (LCS-16), MANCHESTER (LCS-14) and INDEPENDENCE (LCS-2) are pictured here – are amongst US Navy warships benefitting from the installation of modern fire suppression equipment such as water mist systems.

A Vital Insurance Policy

"We think of fire protection systems and equipment as an insurance policy," Hunstad concluded. Unlike systems such as propulsion, which are constantly being "tested" when the ship is underway, fire protection systems don't get actuated every day. "We pay for them up front when we design them and put them on ships; and we pay premiums when we test them regularly. We hope we never have to use them. But they have to work the day that fire happens. They need to do their job effectively."

Perhaps reflecting a number of high profile fires aboard ships in naval dockyards and bases, processes for safeguarding ships alongside are also receiving attention. According to Hunstad, the US Navy has created new procedures for ships that are pier-side or in dry-dock, especially where sailors will be working with the federal firefighters (civilian employees who staff the fire stations on most naval facilities) as well as with municipal firefighters in the communities where the bases are located. "We've initiated an integrated command structure so the three pieces work seamlessly together."

Piracy Re-Emerges

Michael Meyer

Serious kidnapping cases are increasing in the Gulf of Guinea. Battle-hardened pirates are becoming more professional. Politicians and regulators are lagging behind these developments.

Pirates and shipping have formed an indissoluble relationship for centuries, imposed by one side but chained together by inseparable bonds. The number of cases fluctuates and the so-called "hotspots" shift but the problem remains an immediate one. While the predominantly Somali-based piracy off East Africa has, at least temporarily, been almost eradicated thanks to the international military presence and private armed security forces, the focus has shifted to the Gulf of Guinea. Here, Nigerian attackers are considered a scourge of the shipping industry. To the chagrin of seafarers, many say they have changed their approach to focus more on kidnapping and the extortion of ransoms.

But is it really like that? Although security experts paint a differentiated picture, what is certain is that crew members have been kidnapped time and time again off West Africa. With the 2019 and 2020 incidents involving the MAR MALAITA and the TOMMI RITSCHER, German owned-ships have been amongst those affected. The latter vessel, a container freighter of the shipping company Gerd Ritscher, was attacked off the coast of Benin last May and eight seamen were dragged ashore. It is not altogether clear whether a ransom was paid or if the men were forcibly freed by security forces. The German Federal Police responsible for the case have not yet revealed any details due to ongoing investigations.

68 Per Cent More Hostages

Data from different observers fluctuate, counting methods differ, and the number of unreported cases is an additional complication. It is therefore difficult to get an exact picture. However, it is clear that the total number of piracy cases worldwide has been falling: with 193 incidents – a decrease of 14% - 2019 was the quietest" year since 1996, according to the International Maritime Organization (IMO). At the same time – counting and interpretational differences accepted – one has to acknowledge that the risk of being kidnapped in the Gulf of Guinea has increased.

Graphic: International Maritime Organisation

The steep increase in crew abductions / hostage events in the Gulf of Guinea underscore the rise in risk and costs of conducting business in the vicinity of this sea route.

Munro Anderson, partner at the security service consultancy Dryad Global, emphasised this in an interview with HANSA, "The figures tell us that there is generally a slight decline in piracy off West Africa. The figures also tell us that there is an increase in serious incidents involving kidnappings and ransom extortions." His team counted 105 kidnappings in 2016, 111 in 2017, 156 one year later and as many as 177 in 2019. At the end of that year, the cases of the NAVE CONSTELLATION and DUKE, in particular caused a sensation when, respectively, 19 and 20 crew members were abducted. This trend continued into 2020, when there were 50 kidnapping victims in seven attacks during the first few months of the year alone.

Anderson confirms this impression: "In West Africa, pirates have long been concentrated on stealing cargo, especially from tankers. Now there is a swing to 'human cargo'."

Not a Drastic Change

The attackers benefit from years of experience: in the Niger Delta and Nigeria, kidnappings have long been part of the repertoire of militants and criminal groups involved in drug or smuggling business. They fight against each other, against government agencies and against international oil companies, which they accuse of corruption and enrichment at the expense of the population. So far, these activities have only been "maritime" in so far as they have taken place in a region intersected by many rivers, with the kidnappers running hostage camps in the mangrove forests of the delta. Now, seafarers are being dragged there as well.

In fact, there are currently more incidents beyond the "traditional core area" of the pirates, the Nigerian Exclusive Economic Zone (EEZ). This is due to the lack of effective security structures. 2019 saw a sharp increase near the joint development zone of Nigeria and Sao Tome, 13 raids in the waters off Togo and Benin, and an 83 percent increase off Cameroon. However, experts do not see a drastic change. Dryad Global's Anderson says, "It has always been a problem. Where you have little resistance, you will always have an exponential increase." On the other hand, it is true that West African piracy has become stronger and cases on the high seas are increasing.

Dirk Siebels from the security service consultancy Risk Intelligence emphasises that the situation has never been static: "The oil theft is almost over. Other things, especially kidnappings, have increased. The change in the attack areas has always been a problem for shipping companies: Those who send their ships to the region have to be up to date. "

At the same time, there has always been a great deal of overlap between piracy and other criminal machinations; the groups were and are often the same. "There aren't necessarily more kidnapping attacks. What has changed, however, is that, on average,

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Photo: HANSA International archives

A criminal forensic team gathers evidence from an on-board crime scene.

more hostages are taken per attack." Four or five years ago it was the captain or the chief, because they get the most ransom money. In 2016 there were an average of four hostages, in 2018/19 there were eight.

US$50,000 to U$80,000 per Capita

The reason for this: it is worth it. However, that is not the only cause. "The business model is so well established that the hostages can now be kept safe, both from the police and the military as well as from rival groups," says Siebels. The sums extorted are lower than in Somali piracy cases. There it was about whole ships and cargoes, whilst in West Africa it is "only" about seamen, as callous as that may sound. It makes negotiations easier. And it's a business model that has been established on land over a long period of time, producing experienced negotiators. Between US$50,000 and US$80,000 per capita is a relatively realistic demand for foreign hostages, depending on nationality. You try to get it done well and quickly. The hostages are treated relatively well, even if a hostage camp always remains a hostage camp.

When asked "More piracy or not?" Siebels refers to the greater public attention the subject currently attracts. "One shouldn't simply analyse everything as piracy. The connection to other things is important. If you take that into account, piracy hasn't increased significantly over the past 5-10 years, but it hasn't decreased significantly either. It's just partly more visible. That will be the case over the next few months."

There will always be a myriad of causes for piracy, often with hidden intentions. Both analysts see bureaucracy and corruption as one of the main evils in the region. Political action is a crucial factor. Politics is not inactive. Smuggling and cargo theft are still a major problem in Cameroon, Gabon and Equatorial Guinea. "But that's the smaller part. Yes, the majority of offshore crime is the result of criminal activity – there will always be complex cases – but the majority of incidents today are quite simply the result of piracy", said Anderson.

Last but not least, the case of TOMMI RITSCHER showed that Benin is increasingly developing into another hotspot. According to Dryad, it was the second incident within the Cotonou anchorage in 2020 and the fifth in twelve months. At the same time, it is an example of cooperation: within a few hours, the Nigerian Navy was informed and deployed – but the pirates and their hostages had already disappeared. According to Siebels, a central difficulty in the trend towards hostage-taking is that it actually requires even more from the security services, because the pirates are able to disembark much faster than is the case with tanker captures and cargo theft. There is less time to intervene and more personnel and equipment are needed to control the relevant waters effectively.

Battle-Hardened Pirates

Nigeria still does not allow private armed security guards on board in its waters. For Siebels, the question arises as to whether or not that makes sense. In Nigeria, in particular, attackers were often not deterred by this, not even by warning shots as often helped off Somalia: "Here the attackers are better equipped and more battle-tested." On occasions, security personnel on board engaged in an exchange of fire with the pirates, and there were deaths among the guards.

Meanwhile, regional developments have led to some changes in the insurance market. In September 2020, the Joint War Committee of the Lloyd's Market Association and International Underwriting Association in London expanded its Gulf of Guinea listed area – first deemed a high risk area in August 2011 – further south and east due to the continuing and expanding range of attacks. Ships attempting to sail the Gulf of

Guinea must notify their insurers and may need to take additional safety precautions and pay additional premiums in order to obtain coverage.

Illegal Refineries Destroyed

The World Economic Forum still sees weak governments and poor conditions as the main reason for piracy. "Criminals, insurgents and other groups see opportunities to raise money for their fighting on land by sucking oil from tankers and selling it on the black market," says an analysis. At least this problem is somewhat contained. According to the Nigerian authorities, almost 2,300 illegal refineries were destroyed between 2015 and 2019.

At this time, as with almost all assessments, it is necessary to consider the Covid-19 crisis, which has resulted in many policy measures being suspended. The World Economic Forum sees a risk that, as a result of the pandemic, countries with fewer resources will find it difficult to monitor their territorial waters: "As hospitals fill up with patients, governments will turn their efforts away from piracy and towards shift more immediate worries ashore."

Marine risk analyst Siebels, on the other hand, does not believe that there will be a noticeable reduction in cooperation at sea – but he does not expect an expansion either. Munro Anderson from Dryad says: "As a result of Covid-19, uncertainty should theoretically increase, there are delays in the port, more ships in the roadstead - so more targets for pirates. I would be surprised if the numbers don't rise". Currently, the waiting time for ships in the port of Lagos alone is around 50 days ...

German Findings

In 2019, Germany's Federal Police's Piracy Prevention Centre collected information on 96 incidents in the Gulf of Guinea. Among them were 52 robberies - six of them with a "German connection" – and 21 kidnappings, one of them with a German connection. In 2020 (as of early June) there had already been 24 raids – two of them with a German connection – and twelve kidnappings. The number of cases is "almost at a consistently high level," it says. The approach to prevention and investigation work by the German police is identical to that for cases of Somali piracy.

Politics vs. Pirates

"On the one hand, it has become much more difficult for pirates since the Buhari government came to power in Nigeria in 2015. There were reforms in the oil sector, now it is no longer so easy to sell stolen oil," says Dirk Siebels from Risk Intelligence. On the other hand, not all measures have been shown to be effective. But at least there are political initiatives, such as the first real anti-piracy legislation in West Africa and the plan for special courts in the country.

Cameroon and Benin have also become more active, requiring guards when calling at ports. At the regional level, initiatives such as the Djibouti Code of Conduct, the Yaoundé Code of Conduct and the Lomé Charter of the African Union should help in ensuring exchange and cooperation. There is now a regional coordination centre in the Cameroonian city of Yaoundé and many countries encompassed by the region's main two economic groupings – the Economic Community of West African States (ECOWAS) and the Economic Community of Central African States (ECCAS) – are working more closely together. "The cooperation between neighbours is now much better. But the basic problem remains, there are too few boats and trained security guards", says Siebels.

The Buhari government also has the €180 million "Deep Blue" integrated maritime security project in train. Its start, delayed due to the Corona crisis, is anticipated in the first half of 2021. It is intended to expand the use of ships and helicopters to help the authorities to know more precisely what is happening across Nigeria's EEZ and not just in the territorial waters. Siebels rates the initiative as "great progress". Piracy, however, was not the driver of the plans. Deep Blue is actually designed to combat oil theft and smuggling, which is the bigger problem from the government's point of view.

Sovereignty vs. International Intervention

International security operations in the Gulf of Guinea are unlikely. Recently, there have been repeated calls, including from German ship-owners, for more action, not least from countries in the region. However, the use of warships or an international military alliance, such as the one that was and is very successful in the fight against pirates before Somalia, is considered unrealistic for many reasons.

In contrast to Somalia, the West African countries are not so-called "failed states". There are functioning state structures. Even if they are too often overwhelmed and the sometimes subject to rampant corruption that only serves to fuel piracy, these are sovereign states. Deployment

of foreign naval units to the region would be perceived as interference in internal affairs and is therefore rejected. "In this structure it is far more difficult to find an agreement," says Munro Anderson of Dryad, who only observes support measures such as training and the exchange of information between countries such as the United States, France and Portugal with the navies of Ghana or Nigeria.

In his opinion, an important aspect is a lack of will in the international community: Nigeria and the delta are of far less importance for world trade than the Strait of Hormuz or the Suez Canal. The geopolitical interest is correspondingly smaller. The nationality of the seafarers also plays a role in Anderson's eyes: "Realistically, if we had seen 177 hostages taken from Europe or America, naval coalitions would very quickly be present in these waters." Dirk Siebels from Risk Intelligence also doesn't believe that it will come to that. A lack of naval capacity is one reason. He also notes that, "Navies would not be particularly well suited to combatting this whole mix of piracy and other illegal activities such as smuggling." But most importantly, regional countries do not want it. ■

MSD Technology Profile: VIDAR for Counter Piracy

Challenge

Piracy continues to threaten seafarers in strategic waters and EEZs worldwide. Vigilance, preparation, early detection and rapid response remain the best means to counter pirate tactics since the earliest days of armed robbery on the high-seas. However, these are difficult to achieve because pirate vessels range in size from high speed skiffs to watercraft disguised as fishing boats attempting to get close to a target ship and attack.

Photos: Sentient Vision Systems

Pirates intercepted and arrested as a result of Sentient Vision Systems.

Solution

Visual Detection and Ranging – ViDAR – developed by Sentient Vision Systems is the world's first optical radar system. It consists of multiple fixed, high-resolution cameras with a combined Field of View of 180 degrees. Mounted in an external pod or internally aboard an aircraft or UAV, ViDAR can passively find an object in the water as small as a human head.
ViDAR makes counter-piracy tasks much easier for patrolling forces and the transport-logistic ships they might escort. ViDAR demonstrated its ability to automatically find fast boats at ranges of 9.1 to 17 nm and fishing boats at ranges from 17 to 25 nm in various sea trials around the world.

Sentient builds surveillance architectures with capabilities that deliver airborne Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) capabilities.

VIDAR

Core Capabilities:

- Target discovery at significant safe and discreet distances
- …from 10 to 30nm depending on vessel size
- Real time identification, classification and
  categorisation of targets
- >300x greater ocean coverage than conventional
  visual search techniques
- Collates simultaneous inputs from ViDAR,
  AIS transponders and other sensors.
- High probability of detection at 96%
- Proven effective in rough waters up to Sea State 6
- Identifies targets with a small or non-existent
  radar cross-section

Benefits:

- Low SWaP addition to any airframe
- Quick and effective ISTAR and SAR tool
- Allows an armed maritime force to respond appropriately and proportionately
- Significantly reduces loss of life and property
- Lower cost than re-installing an entirely new system
  of sensors, etc.
- Easy integration with legacy manned / unmanned airframes and sensor packages
- Proven effective in multiple continent deployments
- Mission recording for analysis, court evidence, documentation and training

Insight

"ViDAR was designed to enhance detection & tracking capabilities to deliver whatever effect the situation demands. The Royal Australian Navy is typical of modern maritime forces in exploring this elegant and economical response to common maritime security challenges", Dr Paul Boxer, founder of Sentient.

Flexibility

Sentient Vision Systems has integrated ViDAR with multiple different airborne mission systems and platforms ranging from a UAV such as the Insitu Scan Eagle® to helicopters such as the AW139 and fixed-wing aircraft including the Beechcraft KINGAIR 350, Viking TWIN OTTER , Dash 8 and the Bombardier CHALLENGER 604 jet.

Detection & tracking activity on a map

Conclusion

ViDAR's AI-enabled signal processing capability enables it to detect miniscule targets against an extremely cluttered background. Data fusion and machine learning over multiple manned and unmanned missions enables faster, less-fatiguing aerial searches in all sea conditions. Sentient provides a unique, cost-effective and quicker response to maritime threats and emergencies.

German-Dutch Cooperation in Naval Shipbuilding: Charting a New Course

Christian Freiherr von Oldershausen and Marcel Hendriks

Last summer, the German Ministry of Defence signed a contract for the construction of four class F126 (formerly MKS 180) surface combatants with Damen Schelde Naval Shipbuilding and Thales. The fact that the programme, which was subject to a Europe-wide tender, is to be executed under Dutch management at Blohm + Voss in Hamburg caused much controversy in political and business circles. This is understandable. In addition to a possible effect on national pride, there was concern that German know-how and added value could be at risk. The unease was intensified by the fact that, on 12 February 2020, the German Government's cabinet adopted a new strategy paper on strengthening the security and defence industry. It defines naval shipbuilding as a key technology for Germany, as is also the case in the Netherlands. The possession of such technology is inherently linked to the ability to equip one's own armed forces with the best available military equipment.

Continued Bilateral Cooperation

However, according to a decision published on 13 January 2020, the German Ministry of Defence was of the opinion that the pan-European procurement process and the award of the F126 contract to Damen Schelde Naval Shipyards, was the right choice. Following the implementation of a transparent award procedure by the Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw), the award provided the German Navy with the best ships at an appropriate price. At the signing of the contract, the Dutch Minister of Defence, Barbara Visser, and Germany's National Armament Director, Benedikt Zimmer, agreed on further consultations relating to mutual collaboration. This intention was implemented quickly, as the two countries signed an agreement for further cooperation on 17 December 2020. The intention is to cooperate in the research, development and procurement required to replace the Dutch DE ZEVEN PROVINCIËN air defence and command (LCF) frigates and their German SACHSEN (F124) class counterparts. The two countries will also work on common operational requirements.

In the military arena, Germany and the Netherlands have been working together for a long time. This is particularly evident in the cooperation between the German and Dutch armies. There are integrated and composite units, such as the joint headquarters of the German-Dutch Army Corps in Münster. In addition, the Royal Netherlands Army makes extensive use of German or German-Dutch equipment, such as the LEOPARD 2, the self-propelled Howitzer 2000, and the BOXER and FENNEK armoured vehicles. Both navies have also increased their operational cooperation in recent years. For example, the Sea Battalion and the Corps Marineers have been jointly deploying aboard the Royal Netherlands Navy's amphibious ships since 2018. In the area of equipment the cooperation is even older. The BREMEN (F122) class frigates are largely based on the design of the Dutch KORTENAER class. The last unit of the BREMEN class, FGS LÜBECK, is still in commission after almost 32 years of service. Moreover, the SACHSEN and DE ZEVEN

Photo: US Navy

The RNLN's KORTENAER class frigates and...

Photo: Marine Nationale

...their German counterparts of the BREMEN class

Authors

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Image: Damen

The Dutch Damen Shipyard is under contract to build the class F126 surface combatants.

PROVINCIËN classes share a unique, German-Dutch air defence system. Based on the "Naval Ship Cooperation" agreement, the two ministries have been meeting regularly since 1990 to exchange knowledge and experience. The German and Dutch navies often use the same test sites and have a joint knowledge centre: the "Centre of Ship Signature Management" in Kiel.

Industrial Consolidation

The European tender for the F126 frigates and the new German-Dutch agreement on cooperation in the construction of the new ships are part of a much broader European effort to strengthen Europe's military capability and make its defence industry more effective. The need is felt by all but must always compete with the immediate reflex to support traditionally nationally-oriented defence industries under the exception to European Union competition law provided by EU Article 346. Whilst Europe and its individual member states have sometimes proved reluctant to shape a more effective defence industry, industry itself has often taken the initiative on its own. Step by step, national companies are transforming themselves into European defence corporations. Airbus, MBDA, Nexter, Thales and Rheinmetall/BAE Land Systems have all integrated a large number of British, Dutch, French, German, Italian and Spanish defence companies. These steps support the transition of different weapon systems to a European main battle tank, a common fighter jet and a shared refuelling aircraft design; just to name prominent examples. They also help the European defence industry to become more powerful in the export market.

Even though this development has gained momentum in army and air force systems, naval shipbuilding remains nationally oriented for the time being. It is limited at most to occasional partnerships, such as the development of the Franco-Italian FREMM frigates. Currently, France, Greece, Italy and Spain are developing a "European Patrol Corvette" with the support of the Permanent Structured Cooperation (PESCO), the part of the European security and defence policy aimed at enhancing defence and aiming for the structural integration of defence incentives. The emerging cooperation could ultimately lead to separate Northern European-orientated and Southern European-oriented naval shipbuilding efforts.

A Joint Approach

Although the requirement to achieve greater European cooperation in naval shipbuilding is widely recognised, this will not happen in the short term for various reasons. In their recent agreement, Germany and the Netherlands do not focus on the construction of a single type of ship. This would be a step too far, as Germany and the Netherlands apply different standards in naval shipbuilding. A good example is the standards applied to crew accommodation. For German naval vessels, the result is significantly larger longitudinal passageways and more spacious living and recreational facilities than those found in Dutch ships. This is one of the reasons why a German frigate is larger than a Dutch counterpart of similar combat power. But the combat power of a warship is not determined by accommodation standards. Instead, combat power is based on seaworthiness, weapon effects, propulsion and survivability. In these aspects, in particular, the German Navy and the Koninklijke Marine can work together, as they know each other well and largely follow the same NATO procedures and rules. Industry, which is organised in the Netherlands Industrial Foundation for Defence and Security (NIDV) and the German Security and Defence Industry Association (BDSV), has also proven in practice that they can agree on common denominators. The German and Dutch industries are highly complementary and would be able to build new frigates equipped with major components that could be largely supplied by companies from the two countries. A smart German-Dutch selection of the main components in command and control and weapon systems, as well as platform systems, is certainly not easy but it is well within the realm of possibility. A joint approach on as broad a basis as possible would be of greatest benefit to both navies and industry.

Despite the recent agreement between the Dutch and German ministries of defence and all the good intentions that this is based on, such cooperation cannot be taken for granted. Both countries and their respective maritime industries are traditionally used to building their own naval vessels. Both have shipyards and technology companies with long traditions and familiar procedures, all established with the aim of not disappointing their customers. However, cooperation would be greatly supported by the involvement of companies that are already organised across borders and can con-

tribute additional knowledge without displacing traditional and trusted national partners.

The DNV Perspective

DNV is an international company with offices in Norway, Germany and the Netherlands. Traditionally active in the maritime sector as a leading classification society, it is also as a global player when it comes to advising the energy sector, corporate assurance, logistics chains and product assurance and digital solutions. These are all areas of knowledge and expertise that will become more important in the coming years because, among other things, the need to switch from fossil fuels to alternative fuels and technologies is inevitable. This is a major challenge where all available intellectual capacities need to be mobilised, both at national and international levels. DNV has already gained a lot of experience in this regard through the Norwegian Green Coastal Shipping Program project and is happy to share this experience with the German and Dutch navies and the supporting maritime sector.

Incidentally, DNV is no stranger to the Koninklijke Marine. For example, the HOLLAND class OPVs and the Joint Logistic Support Ship KAREL DOORMAN were built according to DNV classification. The new supply vessel DEN HELDER will also be built according to DNV's classification scheme. In 2016, DNV Energy Systems, based in Arnhem, carried out the damage survey of one of the defective main engines of the KAREL DOORMAN, resulting in the removal, repair, modification and installation of the two 85 t electric motors. DNV has also been contracted time and again by the German Navy as a testing organisation for the implementation of major surface combatant projects, including the F123, F124 and F125 frigates, the combat support ships of the BERLIN class and the K130 1st and 2nd batch corvettes. In the case of the latter, the DNV Naval Rules were used instead of the BV1040 naval construction regulations for the design of the hull strength. DNV also expects to be involved in the F126/MKS 180 frigate programme as a testing organisation.

Conclusion

What is at stake? Taking into account current geopolitical developments, Europe will soon need to have armed forces capable of successfully countering threats that are becoming more complex as well as being able to play a role on the world stage that matches its economic importance. In addition to far-reaching military cooperation, a consolidation of its defence industry is also necessary. Matters are going in the right direction for army and air force systems but naval shipbuilding is lagging behind. For this reason, the agreement between the Netherlands and Germany regarding cooperation in the replacement of frigates is of great importance. Both countries already have the necessary experience and have proven that they can achieve results. However, major challenges persist given that the industry is traditionally seen as an instrument of national sovereignty. In this regard, companies that already operate across borders in Germany and the Netherlands can provide important added value in creating a "Northern European" naval shipbuilding industry.

The Vision of the Fuel Cell Becomes Reality

Felix Selzer

Recently, MSD's sister publication HANSA International examined the recent growth in fuel cell technologies for (very nearly) all electric ships. We revisit this article and raise some additional suppositions to make this discussion more lively and relevant for the maritime security & defence arena.

With shipping responsible for about 2.5 percent of the world's total greenhouse gas emissions, there is an increased pressure for the maritime industry to transition to more sustainable power sources. The International Maritime Organization, a United Nations agency responsible for regulating shipping, has set a global target to reduce GHG emissions from international shipping and phase them out as soon as possible. The aim is to reduce average carbon intensity (CO2 per tonne-mile) by at least 40% by 2030 and by 70 % in 2050, as well as to cut total emissions by at least half by 2050 compared with 2008. Within the EU, this is recognised by the Fuel EU Maritime initiative.

Beyond Theory

For perhaps more than a decade, the all-electric warship has been more than just a concept or dream for navies worldwide. It was and still is viewed as something attainable and of a panacea, addressing challenges of lean-manning, increased efficiencies, silent running, extended deployments, signature management, cleaner energy, safer operations…the list goes on. Sustainable electricity generation becomes a strategic capability when considering the sharp uptake of power-hungry rail guns, direct energy weapons and lasers.
Alongside the many successful developments in civilian sector applications of fuel cells for maritime vessels, we can review these advancements with the intention of invigorating debate about their use in modern warships as an electrical ecosystem.
Energy technology is at the point where we can safely say that fuel cells are a promising technology that are market ready for maritime applications. This is evidenced by several "actors" working on concrete projects and systems in the power range of several megawatts. Some of them have already proceeded past the study and planning phase and are capable of delivering systems that are able to deliver several megawatts of power to provide large ocean going ships with clean, efficient and reliable energy.

Graphic: ABB

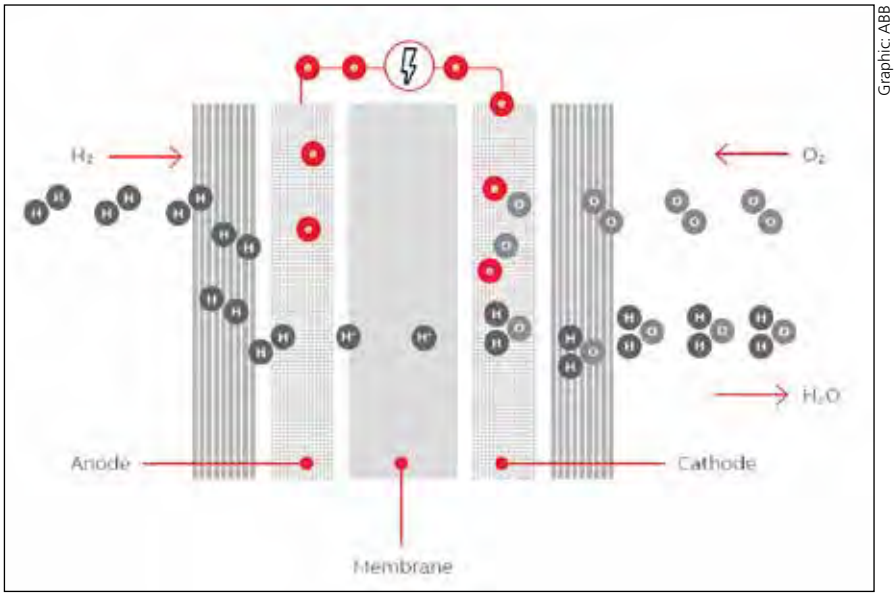
Concept illustration of a large vessel powered by fuel cells

Author

Felix Selzer Editor, HANSA International, with contributions from Stephen Elliott, Publisher, Maritime Security & Defence

Fuel Cell Drivers

ABB and Hydrogène de France (HDF) jointly produce fuel cell systems in the megawatt range that can power large ocean-going ships. ABB is already a renowned naval supplier of what it describes as "future-proof the electrical power generation, distribution and propulsion systems" on modern combatant vessels with its On-board DC Grid and power take off / power take in (PTO/PTI) tool will enable more fuel efficiency and reduced environmental impact. ABB describes its naval offering as being "highly configurable" and a resilient solution that provides "increased operational flexibility and mission support", citing advantages that include: smaller installation space; longer operational ranges; highly robust and redundant designs to keep systems running; global service capabilities (serviceable wherever ABB is in port); and fit for future power sources and loads that modern warships (logistic / supply ships to surface combatants).
ABB and HDF intend to build on an existing collaboration with Ballard Power Systems, the world's leading provider of proton exchange membrane (PEM) fuel cell solutions, to increase and optimise their fuel cell manufacturing capabilities. The new system will be based on the megawatt-scale fuel cell power plant jointly developed by ABB and Ballard and will be manufactured at HDF's new facility in Bordeaux, France. ABB is developing a fuel cell-based power and propulsion system for a new build



Graphic: ABB

Fuel cell illustration

Graphic: PowerCell

Conceptual layout of MW fuel cell system and hydrogen storage

push boat. Due for delivery in 2021, the vessel will operate along France's Rhône river, meaning its environmental impact will need to be minimal. With the hydrogen for the 400-kilowatt fuel cell sourced from shore-based renewables, the entire energy chain will be emissions free.

The Swedish producer of fuel cell modules PowerCell AB is currently developing a 3 MW-solution for a marine customer to be delivered in 2022. The pioneering installation opens up for more MW-solutions, based on megawatt building blocks. In the partnership of PowerCell with Siemens, an energy supply system for vessels based on fuel cells is proceeding. Siemens will supply the SISHIP BlueDrive integrated energy and propulsion system into which PowerCell will install its fuel cell modules. Possible joint projects could include energy supply systems for ferries, yachts, cruise ships and research vessels powered by the integration of fuel cell modules. Only a few weeks ago it became known that the Italian shipbuilding group Fincantieri had ordered a fuel cell from PowerCell. However, this request may be in the context of the new submarine project of the Italian Navy.

Multi-modal operator Samskip is leading the Seashuttle project to develop two autonomous container ships for short-sea routes between Oslo, Poland and the western coast of Sweden. The ships will be entirely electric and will be powered by hydrogen fuel cells. The team includes technology supplier Kongsberg, hydrogen specialist Hyon and Massterly, the autonomous vessel solutions joint venture between Kongsberg Maritime and Wilhelmsen.

Hydrogen Hybrid PCC

Japanese Mitsui O.S.K. Lines (MOL) and e5 Lab are collaborating on a joint study for a hybrid powered 'pure car carrier' (PCC) vessel equipped with a hydrogen fuel cell system and large-capacity batteries. The partners are striving to develop a propulsion system that does not emit carbon dioxide, sulphur oxides, nitrogen oxides or fine dust particles when the vessel navigates in coastal waters and during port calls. In these cases, the ship will get its propulsion power solely from the electricity supplied by the hydrogen fuel cell system and the batteries. When in open seas, energy would be delivered by an LNG-powered generator and the batteries, leading to significantly lower emissions than with today's ships with diesel engines. As a sort of bycatch, with reduced emissions power efficiency will be increased and the ship's signature reduced.

Learning from Others

Ship fuel cells used in the former Toyota racing catamaran "Energy Observer" is the first of its kind to be solely energy self-sufficient. Toyota's catamaran attracted attention with a six-year odyssey around the world by operating with a mix of renewable energies and an on-board system, including carbon-free hydrogen, generated from sea water.

Graphic: Samskip

Samskip's SEASHUTTLE project is to cultivate a short distance container ship using hydrogen fuel cells.

While Toyota initially introduced the fuel cell system in world's first mass-produced hydrogen fuel cell electric vehicle, the Mirai, its drive system for automobiles proved the cells to be useful for maritime applications in the catamaran. Before that, Toyota's was researching the use of its fuel cell system in other applications such as buses and trucks that require a significant amount of horsepower and torque.

The maritime specific fuel cell system was developed by the Toyota Technical Centre Europe in just seven months. It required a redesign of the system, followed by the construction and installation of the compact fuel cell module achieved through the use of components first introduced in the Toyota Mirai and built into a more compact module suitable for marine applications.

Fixing Limitations

Ulstein Design & Solutions and the Dutch fuel cell manufacturer Nedstack developed the Ulstein SX190 Zero Emission DP2 Construction Support Vessel, the first hydrogen-powered offshore ship, at the end of 2019. The concept ship could operate in zero emissions mode for four days. But it would take up to two weeks to reach a destination, meaning the ship could benefit by using a diesel-electric system for such extended missions, and the low emissions mode when in port or replenishing a warship.

The design is based on the existing SX190 platform and has a total power of 7.5MW, of which 2MW are to be generated by a fuel cell propulsion system. Typically provided by the Nedstack Proton Exchange Membrane (PEM) fuel cells, which are housed in a separate, second 'engine' compartment. PEM fuel cells run on hydrogen operated from pressure vessels in containers, thus eliminating the need for a cost- and space-intensive bunker infrastructure.

Vikings, Ammonia and Upgrades

Under the "ShipFC" research project, Norway will start the first ammonia fuel cell tests in 2024. The Norwegian energy company Equinor signed a contract with the offshore shipping company Eidesvik to upgrade the supplier Viking Energy. It will be the first ship that runs completely with ammonia fuel cells and will operate emission-free. Wärtsilä is providing the technical equipment. In 2003, the Viking Energy was the world's first LNG-powered ocean-going ship. Eidesvik and Wärtsilä also worked together on the 2009 Viking Lady, which was a milestone when it comes to fuel cells in a larger ship.At the end of 2023, Viking Energy will have a 2MW ammonia fuel cell permitting to operate 3,000 hours and more a year exclusively with renewable fuel made from sun, air, and water. According to project plans, over a one-year test period ammonia will cover 60–70% of the electricity demand on board. The remaining demand is to be covered with LNG in the future. This first high-performance fuel cell to be operated with "green" ammonia is being funded with € 10 million from the EU research programme Horizon 2020. Under the auspices of its roadmap to decarbonizing European shipping, the EU is sponsoring other green propulsion projects. ■

Sea Blind – Pacing Cyber-Security's Evolving Impact on Maritime Operations

Mark McIntyre and Joe DiPietro

Technology Disruption

Just as the sextant enabled celestial navigation of ships far from shore, and signal flags and lights allowed ships to communicate with one another more effectively, the adoption of digital technology has allowed sailors to shoot, move, and communicate even more rapidly. While this technology allows seafarers to navigate more precisely and communicate and coordinate with others more easily, it introduces new vulnerabilities to modern warships. Just as these systems assist personnel onboard ships, they potentially offer nefarious actors an attack vector to introduce malicious code into these systems.

Cyber is the ultimate domain for threat actors, providing strategic and regional adversaries alike with an effective way to target otherwise formidable platforms. We should expect to see more activity in the coming years from aspiring regional actors who aspire to project power, elevate their geopolitical stature – and perhaps make some money while they are at it – without incurring the major expenses of maintaining or surging military forces and materiel.

Advanced threat actors have proven their ability to take advantage of domestic and international supply chain complexities and dependencies, exploiting governments' troubling dependencies on legacy information technology infrastructure and bureaucratic inefficiencies. In short, attackers will remain quicker and more adaptable than defenders for the foreseeable future. While we have traditionally envisioned naval engagements with ships, planes, and missiles interacting with one another, we need to expand our aperture to anticipate adversary efforts to attack our shipboard systems through cyber operations.

Photo: US Cyber Command

US service members and civilians train alongside international counterparts to improve cyber skills during US Cyber Command's annual exercise.

Data Explosion and the Future of IoT

A core mission of most western navies is to protect shipping lanes for energy and commerce. Given global commerce's increasing reliance on digital technology, then surely navies will see their mission set expand to include protecting – or exploiting – global digital transmissions and understanding what all that data means. Further, with information and operational technologies converging rapidly, the United States and its allies must rethink traditional mind-sets that separate investments in physical infrastructure and fleets from the underlying technologies that will increasingly power and manage them, and the associated mission systems on board. With the need to forward-deploy computing power and infrastructure around the world, often on short notice, vessels may in the future be better characterised as floating data-centres that happen to hold traditional weapons systems. As maritime operations evolve around technology futures that increasingly rely on computing systems and data, and as long as data remains attractive to adversaries, the need for cyber-security defenders will only grow.

Data, as we hear, is the "new oil". Over 90 per cent of the world's data has been created in the last five years. We are using terms like "zettabytes" now, and organisations are creating "chief data officer" roles and data-specific enterprise strategies. Depending on the specific study, the growth rate for Internet of Things (IoT) devices is far exceeding that of traditional

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laptops, cell phones, and tablets. Over 30 bn devices are projected to be deployed by the end of 2021. IoT devices are used for specific applications that span many industry segments. As we look for the public sector application, a vast majority are in the "Industrial IoT" device segment below. There are many reasons for this growth, but the cloud increases application-specific value at a tremendous rate.
There are other terms like "Digitalisation", "Industry 4.0", and the "Fourth Industrial Revolution", but they all embody the following characteristics that digitalisation is creating:

- More complex systems to support the growing efficiencies needed to protect critical infrastructure through automation; and,
- The ability to respond much quicker, and with greater accuracy, to operational threats.

We are already seeing the introduction of autonomous drones, body-worn devices such as HoloLens augmented reality headsets, predictive maintenance sensors on engines or manufacturing devices, physical security and life control devices, and even connected installations. It is not Science Fiction to envision an operating environment where everything is connected and where all data contains hidden meaning that, left uncollected, constitutes an intelligence or mission failure. It is already happening.

The Cyber Workforce

Success or failure in leveraging data and devices will depend upon humans, especially our information technology and cyber-security defender teams. Because humans maintain and interact with these systems, we will long remain the primary target of adversaries. It is imperative that future technology adoption begins with recognizing the foundational importance of workforce readiness.
Commercial enterprises and governments alike are struggling to properly prepare their cyber defender workforce to adapt to new threats and take advantage of new security technologies. Many cyber defence teams grew up in an exclusively on-premises environment and are only now developing the beginnings of a cloud-native skillset. In addition, and of greater concern, we are not positioned to close the talent shortage in cyber-security which some analysts estimate to be between two and three million unfilled positions. Technology providers are making impressive advances in creating cyber tools and solutions, but in doing so we have created what Gartner calls a "digital dexterity gap" where we are innovating at a much faster rate than customers – especially governments and war-fighters – can absorb.
There is also an inverse relationship in play, according to one global CISO (Chief Information Security Officer) survey, where humans account for 95 per cent of data loss incidents, while only around 1.5 per cent of CIO (Chief Information Office) budgets is allocated to workforce cyber-security readiness. We simply are not investing enough in teaching the workforce – from leadership to the newest recruit – how to operate safely online. Role-based readiness is critical to help users fully understand the risks of phishing and other attacker activities.
We are also dealing with the troubling signs of analyst fatigue where cyber defenders are simply burning out. If we see the future of maritime operations and cyber-security as built around cloud-powered big-data systems and ubiquitous computing, then we must do better at providing the right proactive learning and "on-boarding" experiences to give our people, especially cyber defenders, a fighting chance.
The future of maritime operations, much like other public sector and commercial endeavours, is where information technology, data, and devices converge. We should expect continued cyber-attacks against national infrastructure and military platforms. This will be happening amidst continual technological innovation designed to capture and make use of massive amounts of data, which will be protected by outnumbered and beleaguered security practitioners who will often not be properly trained to employ emerging technologies to counter threats.

Photo: US Cyber Command

Sailors work together at a joint cyber training centre during an exercise at US Fleet Cyber Command / US 10th Fleet, Fort Meade Maryland.

Gamified Learning

Due to a variety of factors, including perceptions of slow technology adoption and the Spartan demands of military service, defence ecosystems are particularly vulnerable to the cyber workforce talent shortage and readiness challenge. Building tomorrow's cyber workforce is a fundamental societal challenge that requires governments, industry, academia, and communities to work together to attract and prepare individuals for cyber-security careers.
One potential solution to this challenge lies in taking advantage of cloud-hosted cyber ranges. Providers in this sector are currently ahead of the market, but they are on to something that will be increasingly critical for military cyber defenders: force-on-force training in a gamified learning environment.
A cloud-based cyber-range provides an immersive, scenario-driven training environment that mimics real-life threats, responses and has proven applicability to Red and Blue team training, security awareness training, certification-path training, and proficiency examination. This learn-by-

doing approach offers students a realistic experience to think like attackers while competing against one another in a gamified cyberspace environment. Simulated breach environments, sandboxed from operational enclaves but modelled to resemble real environments, help prepare an enterprise's workforce for the stress, panic, and communication barriers they will face during a real cyberattack.

This sort of gamified learning introduces interactive, video game-like experiences that naturally attract younger talent and competitive personalities, and this approach has already been shown to improve student retention compared to traditional classroom learning. Intuitively, this is obvious: we must make learning fun and competitive. Independent studies reveal that students retain only around 10 per cent of what they learn in a traditional classroom. After one month, by contrast, gamified learning flips that number, with retention at around 80-90 per cent.

For defence organisations that might struggle to attract and retain talent, these cyber ranges demonstrate a commitment to investing in employee education and career advancement and meeting younger people where they live – online, using devices. Since future force development will require some level of IT acumen, this is an excellent chance to address hiring profiles and optimise recruitment pipelines. Cloud-based cyber range platforms are also highly scalable and will allow defence organisations to reach many more personnel globally than what can be done with traditional learning programs and exercises.

Workforce Readiness for Tomorrow's Defenders

Modern cyber-range platforms are designed to support a broad range of scenarios that might range in user experience from a walkthrough, "choose your own adventure" scenario to "open world" exploration. Naval organisations can create and map skills development themes to operational and IT focus areas to nurture employee interest, gauge readiness, and advance career paths in areas with critical skillset shortages such as:

- Threat hunting
- Capture-the-flag
- Incident investigation
- "Live" incident response and containment
- Failure analysis and cloud trouble-shooting
- Malware and memory forensics
- Red-teaming and penetration testing

In addition to practical cyber-security learning, cloud-based gamified learning can also address more specific naval warfighting and maritime use-cases:

War-gaming and engagement simulation – run through many different variables and scenarios at much quicker speeds and with more predictive capabilities based on data inputs;

Combat Information Centre drills – improve analysis of incoming data points and communications;

Systems deployment and maintenance – allowing technicians and other personnel to learn and practice tasks with equipment before actual installation and servicing; and,

Virtual technology evaluation – accelerating product security evaluations and efficacy for IT and operational teams.

Gamified learning can just as easily be tailored to general IT users and leadership teams, for example with phishing, online safety, and command and control exercises. Everyone can find a role to play.

Some cyber-range companies are developing very promising avatar or concierge features where advances in ML (Machine Learning) and AI (Artificial Intelligence) provide new employees and seasoned veterans alike with a virtual assistant to help personnel make the right decisions.

Cloud computing offers significant cost and performance advantages for gamified learning. Currently, most training environments are on-premises, requiring significant up-front capital investments in infrastructure and servicing, sometimes over $500,000 each month for an exercise; and, they do not easily scale. Moving range infrastructure to the cloud will allow range providers to focus less on maintaining IT systems and more on providing the actual cyber learning, flipping training budgets from capital investments toward operational investments. Range providers need to get out of managing training infrastructure and environments and focus on providing high-quality, dynamic simulations.

Cloud-based cyber range technology platforms bring scenario-based immersive training and skills development experiences. Developer and IT teams will be able to focus on creating actual learning scenarios that are specific to attacker activities or user-defined use-cases and advance employees' professional development.

Tomorrow's Security Operations

The Department of Defense has spent the better part of the last year endorsing and directing components to start adopting Zero Trust architectures as part of a larger fundamental redesign of its networks to better handle modern collaboration demands, such as SaaS applications. This welcome development implicitly acknowledges a pragmatic "assume compromise" posture that managing the usage of technology is inherently a risk management exercise. Zero Trust architecture allows an organisation to implement proactive and centralised controls over users, devices, applications, infrastructure, and networks, all with the goal of protecting the most critical asset – data.

When incidents occur, Zero Trust helps minimise the "blast radius" by containing attackers before they can compromise more of the environment. This topology is like a naval vessel, where one will house specific operations in certain compartments and limit access to those by role. Conversely, one can limit the spread of damage to other parts of the ship by sealing access to compartments during emergencies.

Due to the central role that IT will continue to play in a modern warfighting or workplace environment, staying offline is not tenable. In fact, the trends are clearly moving in the opposite direction: more devices, more data, more flexibility, particularly for younger individuals whom constant access to technology is an expectation and therefore a recruitment and retention issue. This is particularly relevant when some analysts suggest that 99 per cent of usable intelligence collection will be OSINT, coming from commercial providers.

Cloud-First Platforms

The US Navy's rapid move toward adapting Zero Trust architecture is encouraging, particularly as it may serve as sort of a reference architecture for maritime partners and allies. It is even more opportune when we factor in the convergence of IT and operational technologies. Most net-new devices that will be deployed in the coming years will not be personal or organisational cell phones or other hand-held devices: they will be operational devices, part of the larger internet of things ecosystem, which will expand into billions of connected devices, all constituting points of intelligence and vulnerability.

From a cyber-security perspective these devices must be protected, and we must control how we interact with these devices and how they interact with each other. These are already forcing a modernisation of traditional security, incident, and event management (SIEM) and security orches-

tration, automation, and response (SOAR) platforms. Traditional on-premises SIEM/SOAR systems will not be fast or flexible enough to process and analyse incoming data with the exponential increase of data that is already occurring, and which will only accelerate. Technology providers are already moving security appliances to the cloud, and companies like ours – Microsoft – are rapidly deploying cloud-first SIEM/SOAR capabilities. The sooner a user adopts these, the better able they will be to get ahead of the curve on securing and monitoring their data estate. The ML/AI-backed automation built into these platforms will be a huge force multiplier for cyber defenders, taking more mundane tasks off their hands, and allowing analysts to focus more on the alerts and events that really matter.

Supply Chain Futures and Vulnerabilities

The Solorigate incident is a reminder that we as an ecosystem are collectively vulnerable to supply chain compromises. Defense organisations are at particular risk due to the vast networks of suppliers and subcontractors, and because of the long development and operational lifecycles of weapons and other systems, including fleet assets. While we are seeing promising investments in this area, for example around rapid development lifecycles such as "comply to connect" and steady adoption of Platform-as-a-Service software-defined weapons system development, addressing and remediating supply chain dependencies will take years, and will require more flexible attitudes from procurement and contracting.

From a cyber-security perspective, CISOs are increasingly focused on reducing complexity within their environments, for example by making specific commitments to corporate boards or management committees to standardise more of their security budgets around a core set of (cloud-native) technologies. Complexity is inimical to cyber-security, meaning legacy and one-off cyber-security providers will better serve their customers by aligning to large cloud providers' multi-billion dollar investment strategies. Standardising around these platforms and deprecating older and more customised tools will also ease the burden on cyber defenders.

Conclusions

Technology and data are agnostic: we use technology to advance mission objectives and we find meaning in ones and zeroes to advance our missions. We are already experiencing fundamental change in how we interact with data and devices, with existential implications for global security and international commerce. We in industry must and will continue to "shift left" and build more cloud-powered and automated cyber-security capabilities into our larger platforms and ensure that they are interoperable so that allied forces can properly communicate globally. These technologies must also be intuitive and usable so that they enable security operations and not add to the workload. At the same time, we must work harder and more creatively to attract tomorrow's cyber-security talent who we will ultimately rely on to protect the confidentiality, integrity, and availability of national security systems and data. Fortunately, we can harness the same technologies that we will rely on to advance our missions to create more experiential learning that we will need to prepare tomorrow's cyber workforce. ■

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