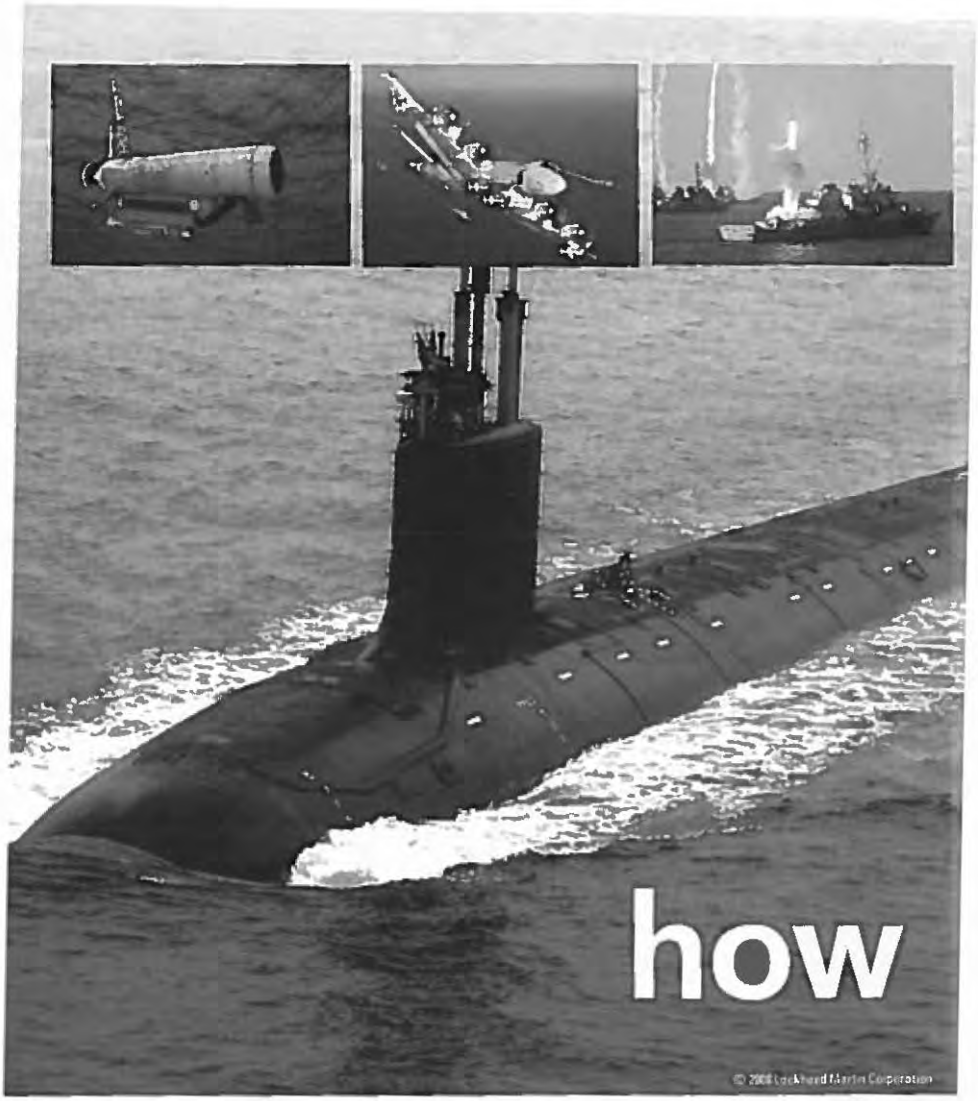
JULY 2009

PAGE



BETWEEN SMART SHIPS AND COMMAND DECISIONS, THERE IS ONE IMPORTANT WORD: HOW.

Flexible. Affordable. Intelligent. Open. Requirements to support today's naval demands. Words that define our C2 combat systems. Bringing battlespace management to the high seas is all a question of how. And it is the how that makes all the difference.

LOCKHEED MARTIN
We never forget who we're working for®

lockheedmartin.com/how

EDITOR'S COMMENTS

Our FEATURES in the July 2009 issue of THE SUBMARINE REVIEW all originated with this year's session of the Submarine Technology Symposium jointly sponsored by the Naval Submarine League and the Advanced Physics Laboratory of Johns Hopkins University and held at the Lab's facility in Laurel, Maryland on May 12th through 14th.

A special aspect of this Symposium was the devotion of an entire section of the program to the cooperation between the US Navy and Britain's Royal Navy in the construction of each nation's follow-on class of ballistic missile strategic submarines. In conjunction with that part of the agenda, the Banquet Address was given by Vice Admiral Mathews, the Royal Navy's Chief of Fleet Materiel. The Admiral's address most helpfully discussed the full history of US-UK cooperation, both the SKIPJACK/DREADNAUGHT link and the Submarine Launched Ballistic Missile cooperation. He then described the current state of joint work on the follow-on SSBNs.

Mr. Ron O'Rourke, of the Congressional Reference Service, again this year spoke of his personal perceptions of the future for submarine force levels in light of defense-wide budget outlooks. For a number of years, Mr. O'Rourke has spoken to this forum of the views from his distinct vantage point and, along with his recommendations based on those views, they have resounded with the submarine community. This year's version, reproduced in this issue, is particularly, and uniquely, insightful. It is highly recommended reading for all in the submarine community.

The third reproduction from this year's Submarine Technology Symposium is the opening address to the Symposium by Mr. Dan Tyler, Head of the National Security Technology Department at The Johns Hopkins University Applied Physics Laboratory. He is responsible for the Laboratory's support to the Navy's undersea warfare mission. He offered a *challenge* to the Symposium participants, and to the greater submarine community, to build on the promising potential of technology, in its broadest sense, to achieve the goals of the US security establishment in its undersea warfare efforts.

The lead article of this issue highlights the efforts, perhaps under recognized in the US, of Canadian submarines in Cold War operational surveillance of Soviet missile submarines in the northwestern Atlantic theater. Readers may couple this account of a Canadian SSK's patrol with the account in the April '09 issue of *THE SUBMARINE REVIEW* of HMS VALIANT's patrol in 1985 in the Shetland/Faroes Gap to assess the value of late Cold War open-ocean allied ASW surveillance. The importance to strategic ASW (vice *Strategic* ASW) of gathering and integrating **all** information is well known and the potential of coordinated operations to do so has been demonstrated.

To pursue a bit further the subject of *potential* in submarine operations, it is instructive to read Mr. John Merrill's researches into early discourses on the matter appearing in the Naval Institute's Proceedings of many years ago. Some of the factors which we feel to be obvious, but are not recognized as such by others, are very like those cited by submarine advocates 80 and 90 years ago. Perhaps one of our *lessons to be learned* is that we have not been getting our preaching out beyond our own choir.

On another note of history, Admirals Wertheim and Griffiths have dovetailing articles about the development of the SSBN force, and its early effectiveness in real-world deterrence. The lessons in both programmatics and national strategy are very obvious in these two tales from long ago (in this case only about 50 years). Let us all hope that they **are** well understood.

A final comment is warranted for the conclusion of VADM Jim Sagerholm's *big-picture* analysis of the German failure in the U-Boats' Battle of the Atlantic in WW II. We all have to remember that it is the big picture which really counts in the end. Admiral Dennis Wilkinson used to say that we have to guard against letting *the urgent get in the way of the important.*

Jim Hay
Editor

FROM THE PRESIDENT

The Naval Submarine League started the fiscal year on 1April 2009 with a huge success. VADM George Emery did another superb job as Chairman of the 2009 Submarine Technology Symposium (STS). The addition of the US/UK joint session on the OHIO Replacement and VANGUARD Successor Programs was well-received. VADM Andrew Matthews, RN, challenged and entertained as the speaker at a sellout banquet audience. Mr. Ron O'Rourke's thought-provoking analysis of the Navy's submarine program was a crowd pleaser at lunch. His remarks are in this issue. Commodore Robert Burke, COMSUBDEVRON 12, chaired the Fleet Needs session where three Commanding Officers reported on their unique operations. The Commanding Officer of the Submarine Learning Center reported on the status of submarine training.

I offered two challenges at STS; train on operating without dependence on satellites and examine the practice of one weapon for one target. The magnificent VIRGINIA Class submarines are limited by the number of targets it can attack with a full torpedo room and VLS tubes.

One of the technical papers discussed the development of a weapon system that never runs out of ammunition, is suitable for a number of different types of targets, and can easily fit into the footprint of an existing submarine. I applaud this type of thinking.

The Annual History Seminar was the eighth in the series and focused on a historical review of submarine launched missiles including Regulus and Tomahawk. The Seminar was Chaired by RADM Jerry Holland, USN (Ret) and focused on the importance of training and testing to establish the early Regulus patrols, the need for stability in Program Managers to develop a superior weapon system, and the influence the weapons have in strategic decisions affecting national security. Again Jerry did an excellent job pulling the seminar together.

The League's next major event is the Annual Symposium on 28-29 October 2009 at the Hilton McLean, Tysons Corner, Virginia. The Annual Symposium Submarine Force Cocktail Party will be held on Wednesday evening, 28 October. Please look for your registration package in late August. The package will include registration information, a draft agenda, and a ballot for the

election of NSL Board of Directors' members.

Last year I initiated a more aggressive campaign for annual donations and corporate sponsorships to the League. I am pleased to report that to date your response has been most encouraging. The Levering Smith Chapter provided the highest percentage of participation in the every-member canvas; and the League raised over $130K in Corporate Benefactor sponsorships to support the Annual Symposium and Corporate Benefactor Recognition Days.

As announced in the April 2009 President's letter, the Executive Committee completed an extensive analysis of the League's dues structure and determined that changes could be made to simplify the structure. Individual Membership rates will remain at $35 for one year and $90 for three years and applies for all categories. The Life Membership categories will be reduced to two tiers; Life Membership for Individuals age 59 and under at $750 and Life Membership for Individuals age 60 and over at $640. These rates will go into effect on 1 July 2009.

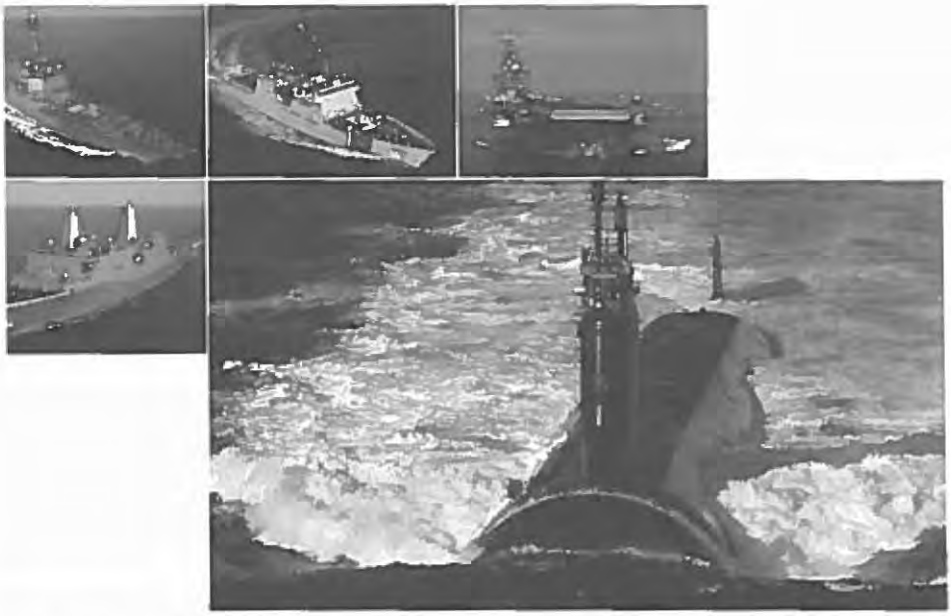
The League continues to address issues that are important to the Submarine Force. Your support of maintaining the build rate for VIRGINIA Class submarines at two submarines each year will be required. The Navy has funding in FY 2010 for the OHIO Replacement Program setting the course for maintaining the most effective leg of the nation's strategic deterrent triad until the end of this century. Let us all do our part to insure that submarines remain the "crown jewel of the defense arsenal."

I also ask you to encourage your friends and colleagues to join the League. Please refer them to the webpage and click on "Join NSL." Nobody will turn you down.

Please join Jan and me as we continue to pray for the safety of troops and submariners deployed around the world. I am honored to represent you as President of the Naval Submarine League. Enjoy your summer.

J. Guy Reynolds
President

NORTHROP GRUMMAN



Strength at sea, freedom ashore.

www.northropgrumman.com/shipbuilding

SHIPBUILDING

At Northrop Grumman, we take tremendous pride in designing, building, and maintaining the world's most complex and capable ships for the world's most powerful fleet. Working for the warfighter and the homeland defender, we're committed to strengthening a foundation at sea that's vital to safeguarding our democracy and our freedoms. Whether building a nuclear aircraft carrier or submarine, an amphibious assault ship or surface combatant, each and every one of our nearly 40,000 dedicated shipbuilders is focused on one purpose: advancing American sea power today for the security of tomorrow.

©2009 Northrop Grumman Corporation

THE SUBMARINE REVIEW IS A PUBLICATION OF THE NAVAL SUBMARINE LEAGUE
COPYRIGHT 2009

OFFICERS OF THE NAVAL SUBMARINE LEAGUE
President: VADM J.G. Reynolds, USN (Ret)
Vice President: RDML B.B. Engelhardt, USN (Ret)
Executive Director: CAPT C.M. Garverick, USN (Ret)
Secretary: CAPT C.J. Ihrig, USN (Ret)
Treasurer: CAPT R.C. Wagoner, USN (Ret)
Counsel: CAPT N.E. Griggs, USN (Ret)

BOARD OF DIRECTORS OF THE NAVAL SUBMARINE LEAGUE
Chairman: ADM R.W. Mies, USN (Ret)
Mr. J.P. Casey
ADM A.R. Clemins, USN (Ret)
VADM D.L. Cooper, USN (Ret) (Emeritus)
RADM J.P. Davis, USN (Ret)
ADM B. DeMars, USN (Ret) (Past Chairman)
VADM G.W. Emery, USN (Ret)
CAPT M.E. Feeley, USN (Ret)
RDML (Sel) J.G. Foggo, III, USN (Liaison)
Mr. J.P. Fox
FORCM (SS) J. Garrison, USN (Liaison)
RADM C.D. Haney, USN (Liaison)
RADM J.G. Henry, USN (Ret)
CAPT C.J. Ihrig, USN (Ret)
VADM B.M. Kauderer, USN (Ret) (Emeritus)
RADM A.L. Kelln, USN (Ret) (Emeritus)
Dr. E.G. Liszka
Mr. D.F. McCormack
Mr. W.D. Nash
Mr. J.W. O'Neill
Mr. D.T. Perry
Mr. C.M. Petters
VADM J.G. Reynolds, USN (Ret)
Mr. J.I. Rosenstock
Ms. M.P. Salomone
ADM W.D. Smith, USN (Ret) (Emeritus)
Dr. D.L. Stanford
VADM S.R. Szemborski, USN (Ret)
ADM C.A.H. Trost, USN (Ret) (Emeritus)
Mr. T. Vecchiolla

ADVISORY COUNCIL OF THE NAVAL SUBMARINE LEAGUE
Chairman: VADM N.R. Thunman, USN (Ret)
VADM R.F. Bacon, USN (Ret)
Dr. W.J. Browning
RADM R.A.Buchanan, USN (Ret)
RDML F. Byus, USN (Ret)
CAPT D.S. Cooper, USN (Ret)
Mr. J.P. Cottrell
Mr. R.L. Haver, Jr.
RADM R.G. Jones, Jr., USN (Ret)
Mr. P.E. Lantz
VADM J.W.Metzger, USN (Ret)
CAPT T.W. Oliver, USN (Ret)
RADM J.B. Padgett, III, USN (Ret)
CAPT J.H. Patton, USN (Ret)
Mr. R.N. Sexauer
Ms. R.A. Stewart
RADM C.B. Young, USN (Ret)

STAFF OF THE SUBMARINE REVIEW
Editor: CAPT J.C. Hay, USN (Ret)
Assistant Editor: Mrs. K.N. Bernacchi

EDITORIAL REVIEW COMMITTEE OF THE SUBMARINE REVIEW
Dr. W.J. Browning
RDML F. Byus, USN (Ret)
CAPT W.G. Clautice, USN (Ret)
CAPT J.E. Collins, USN (Ret)
VADM D.L. COOPER, USN (Ret)
CAPT C.M. Garverick, USN(Ret)
CAPT G.L. Graveson, Jr., USN(Ret)
VADM J.G. Reynolds, USN(Ret)

CORPORATE AFFAIRS: RADM R. Jones, USN (Ret)
GOVERNMENT AFFAIRS: Vacant
MEMBERSHIP CHAIRMAN: RADM B.B. Engelhardt, USN (Ret)
R&D CHAIRMAN: CAPT F.M. Pestorius, USN (Ret)
RESERVE AFFAIRS: RADM (Sel) J.G. Messerschmidt, USN
SUBTECH SYMPOSIUM CHAIRMAN: VADM G.W. Emery, USN (Ret)

CHAPTER PRESIDENTS OF THE NAVAL SUBMARINE LEAGUE
ALOHA: CAPT G.L. Hofwolt, USN (Ret)
ATLANTIC SOUTHEAST: CAPT M.R. Kevan, USN (Ret)
CAPITOL: CAPT T.W. Oliver, USN (Ret)
LEVERING SMITH: CAPT H.L. Sheffield, USN (Ret)
HAMPTON ROADS: CAPT B.C. O'Neill, USN (Ret)
NAUTILUS: CAPT R.D. Woolrich, USN (Ret)
NORTHERN CALIFORNIA: LT N. Meyers, USN
PACIFIC NORTHWEST: CAPT R.A. Aronson, USN (Ret)
PACIFIC SOUTHWEST: CAPT D.R. Mathiowetz, USN (Ret)
SOUTH CAROLINA: CAPT H.D. Hopkins, USN (Ret)

OFFICE STAFF
Executive Director: CAPT Michael Garverick, USN (Ret) **Operations Manager:** Vacant
Membership Records: Mrs. Debbie Del Russi
Symposia Coordinator: Mrs. Kathy Hargett **Administrative Asst.:** Mrs. Jodi DeLoach
NAVAL SUBMARINE LEAGUE P.O. Box 1146 Annandale, VA 22003-9146
PH:(703) 256-0891 Toll Free (877) 280-7827 Fax: (703) 642-5815 E-mail: subleague@cavtel.net
Web Page: www.navalsubleague.com

SUBMARINE TECHNOLOGY SYMPOSIUM BANQUET SPEECH

by VADM A.D.H. Mathews, CB, MCc, ECnG, MIMEchE
Chief of Materiel Fleet
Royal Navy

This is a huge honour to be invited to speak tonight at your symposium. This honour reflects the special relationship that endures between our two countries. At the political level many other European nations might claim to have a special relationship with you. Indeed, America must sometimes feel schizophrenic when talking to Europe these days, but as far as the submarine programme is concerned the Royal Navy knows it enjoys a very special relationship with the United States Navy. That is reflected tonight in the honour you pay me by listening to me and it is about that special relationship that I am going to speak.

I want to take this opportunity to look *back over the past 50 years of collaboration,* between the United States and the United Kingdom before looking forward to the next 50 years. Much of what I will say will help build a foundation for tomorrow's discussions, but before I do that I would just like to congratulate you on your future submarine programme. As you are all aware, the Virginia Class SSN is now growing rapidly, built by Electric Boat and Newport News, five already commissioned and the sixth christened in December. You are now in the enviable position of making the transition to building two per year–we look on jealously, but ASTUTE, our latest SSN, should go to sea this summer with six to follow. Having had a memorable day at sea on VIRGINIA, I can only say she is a remarkable advert for your submarine enterprise–and by enterprise I mean your Navy and your Industry.

Here I pause just to remind you that we share a common bond but we are divided by a common language, for example, the word availability to you means a maintenance opportunity, to us, it

means quite the opposite, that a submarine is available for operations. I will do my best tonight not to confuse, which reminds me of a plain English campaign which has been run by one of our broadsheet papers – labelling – packet of nuts .... Warning "this packet may contain nuts" – deodorant stick – instructions – remove lid, push up bottom.

I also need to congratulate you on Secretary Gates' announcement last month that "in Financial Year 10, we will begin the replacement programme for the Ohio Class Ballistic Missile Submarine". As we will discuss tomorrow this announcement is of equal importance to the UK, we announced our replacement SSBN programme in 2007 but we need your support in particular for the missile compartment, just as we have done in the past. And it is that *past* that I am now going to turn to.

As is so often the case, understanding the past *history* helps plan for the future and I can think of no better example than our joint submarine programme. I deliberately use the word joint because it is two way enduring and solid.

We can put a number of markers down to trace the long history of *cooperation* in our submarine programmes. More than 100 years ago we started our submarine programmes using the same design derived from HOLLAND's original work, although it has to be admitted that the Royal Navy contracted with the American Electric Boat Company to *build* their five Holland design submarines under licence at the Vickers Maxim shipyard in Barrow-in-Furness. These submarines cost £35,000 (or $50,000) each. Electric Boat supplied drawings and components for an improved design that was bigger and more powerful than the US Navy's first submarine, the Holland Type 6. They also agreed to send some experienced submariners to train the first British crew. Eight months later Britain's first submarine was pushed out of Yacht Shed No. 1 and down the slip way. And with it slipped a long-term opportunity to collaborate. So let's pick up the story just after the Second World War. The start of the Cold War was vividly portrayed by Churchill, here in the US, at Westminster College in Fulton, Missouri, in his famous Iron Curtain speech. Let us not forget he was very proud of his American mother, and thus his strong family links.

What Churchill said was:

> " From Stettin in the Baltic to Trieste in the Adriatic an "iron curtain" has descended across the Continent. Behind that line lie all the capitals of the ancient states of Central and Eastern Europe. Warsaw, Berlin, Prague, Vienna, Budapest, Belgrade, Bucharest and Sofia; all these famous cities and the populations around them lie in what I must call the Soviet sphere, and all are subject, *in one form or another*, not *only* to Soviet influence but to a *very high* and in *some cases increasing*, measure of control from Moscow."

At the heart of the Cold War was deterrence and thus the race to develop and deploy nuclear weapons. It also was the start of the nuclear submarine navy. But for the UK there were two absolutely key agreements forged with the US that would prove crucial to the UK's submarine programme. Called agreements, they were, in fact, international treaties and, of course, they still endure today.

The first was the imaginatively nick-named 1958 Agreement, to avoid having to use its proper title, the **Agreement Between The Government of the United States of America and the Government of the United Kingdom of Great Britain and Northern Ireland on the uses of Atomic Energy for Mutual Defense Purposes**. There were two key elements to this agreement, firstly it built on the Quebec Agreement of 1943, which made Britain a junior partner in the Manhattan project, recognising the UK's "Tube Alloys" programme that had been running since 1940. Forty UK scientists were assigned to the project and 18 of those were at Los Alamos. The 58 Agreement allowed British delivery systems to be fitted with warheads based on US designs. Quite the opposite to where we are today with the US designed Trident missile fitted with a UK designed warhead. The agreement also gave UK access to the Nevada Test Site and also enabled the transfer of the US Skipjack submarine design to the UK, lock, stock and reactor, to become HMS DREADNOUGHT our first nuclear powered submarine, launched on Trafalgar Day 1960. This Nuclear Propulsion element was the result of a prolonged negotiation essentially between Admirals Rickover and Lord Mountbatten, contrasting characters but they had mutual respect.

But as ever with Rickover, things were not simple. He believed that the UK had to own its design. That the British must understand it and be able to stand on their own two feet. So in 1958, UK received the design, we also received training for our nuclear plant operators and that was essentially the end. He was absolutely right–whilst it might seem hard-nosed, we recognised we could not be like Oliver and ask for more. We became self sufficient–and learnt quickly. To ensure we really did stand on our own two feet Rickover tried to insist that all UK officers attending US training were to be interviewed by him to consider their suitability. Mountbatten refused, stating it was for the Royal Navy to decide. For once, Rickover, conceded. The 1958 Agreement prevented foreign nationals, and this included USN personnel, from visiting the reactor or propulsion compartments. We were conjoined twins, separated at birth not to be fully reunited until 2000. It is only under Bowman's and Donald's leadership that the technical exchanges between our nuclear propulsion teams have approached the breadth and depth of those within the weapons programme. Just returning to DREADNOUGHT there were, of course, many parallels with the building of Dreadnought and that of Holland. Both US Electric Boat designs, both built in Barrow and both genuine firsts for the UK.

Exchanges on weapons design principles went forward apace under Joint Working Groups (or JOWOGs), many of which still exist today.

One of the earliest fruits of the weapons collaboration was the ability to adapt the US W28 warhead design to fit in the UK's Blue Steel standoff bomb, but even the 100-mile range of that weapon was hardly sufficient to protect the aircrew from their own weapons. The UK Air Staff really had their eye on an upcoming US system, Skybolt. With its range of more than 1000 miles, this nuclear cruise missile would fit the UK's V-bomber force. So in May 1960 Prime Minister Macmillan and President Eisenhower signed a deal for the UK to buy 144 Skybolt missiles. A little publicised *quid pro quo* was that the US could base a Polaris tender in UK waters so that they could patrol in the western Atlantic without having to return to the continental USA between each patrol. The US had a tender in Holy Loch from 1 November 1960 to 1 June 1992. The greater range and endurance of Trident

submarines and missiles rendered the forward basing unnecessary. And Dunoon slipped back to being a sleepy town with a golf course.

But only 2 years later, in 1962, the engineering challenges of the Skybolt programme became insuperable and the programme was cancelled. The UK was left in a difficult position. It had planned for Skybolt to provide the delivery vehicle for a continuing airborne deterrent and now did not have a fallback. Britain quickly realised it could not go it alone. However, the only alternative seemed to be Polaris and this led to some major internal conflict between the Navy and the Air Force. However, these internal rivalries were pushed aside and Britain sought an opportunity for discussions at the highest level. This came with a planned summit in Nassau in late 1962. This just two months after the end of the Cuban Missile crisis and the discussions between these great statesmen covered:

- Aftermath of Cuba
- East-West relations including the status of Berlin, one year after the erection of the Wall
- Test ban treaty negotiations
- Chinese invasion of India and the continuing tension between India and Pakistan.
- The Congo
- UK membership of the Common Market
- Nuclear Defence Systems

Many of these are still very much alive.

Importantly for us the offer of Polaris was made on the condition that it contributed to the Atlantic Alliance. The same generous offer was made to the French in December 1962 but was characteristically rejected by General de Gaulle during a press conference in January 1963 when he also rejected the UK's application to join the Common Market. To quote Julia Roberts in Pretty Woman, "Big mistake, huge mistake!"

There are many indications that the final agreement between Prime Minister Macmillan and President Kennedy was achieved during a classic *walk in the woods* with no officials or advisers present. This agreement marks the start of our hugely successful co-operative deterrent programme that of course still endures

today. With the signature of the Polaris Sales Agreement in 1963, an agreement that has remained remarkably little changed for 46 years. We have steadfastly maintained a submarine deterrent force. But, having got the Nassau Agreement, matters moved swiftly.

- In Jan 1963 a very senior group was sent to Washington to open negotiations.
- The lead negotiator and author of the Polaris Sales Agreement was J M MacKay, a high civilian in the Admiralty.

They were not authorised to enter into any long-term financial or contractual commitments but had £2M in their back pocket to show good faith and to commission any urgent studies. Now remember this was 1963 and there was no Satellite Communication (Telstar had actually failed terminally on February 21 1963 after only a few months service use), e-mail had not been invented and fax, although earlier patented as a concept, did not become commercially viable until the mid-70s. The only secure system was by telegrams through the embassy.

By the 6th of March an impasse had been reached relating largely to the R&D levy that the US Sec Def Robert MacNamara insisted on. MacKay got revised instructions from the Prime Minister 1 week later.

Here I pause for a second on our joint history, just to contrast what it was like in the 1960s with today. Having been informed of his new role by the First Sea Lord on Boxing Day 1962 Admiral Rufus Mackenzie, the then Flag Officer, Submarines, was appointed project leader for Polaris and given an office in Whitehall and told he can have the pick of the Navy and to get on with it. No budget is set, timescale five years to get a submarine to sea. So he stands his team up in January 1963. By February, they are thinking about needing a naval base to operate these new submarines from. Recognising this would be a critical path, two Commanders were tasked on a Monday to write a paper for the Admiralty Board on where to site the new base. So armed with nothing more than an AA road atlas, a free road atlas given to members of an automobile breakdown recovery organisation (large scale maps only), they set off to drive around the UK to visit all potential deep water ports. They conclude, based on very little

apart from it had a Submarine Tender there already, that Faslane, in the West of Scotland, is the place and start writing a paper over the following weekend. Mackenzie approved it and it went to the Admiralty Board and was approved. Two weeks to approval and funding. E-mail and other technology may have speeded communications but the human processes have become more labyrinthine and almost terminally slow. We would take at least 5 years to do this now with public enquiries, economic and environmental assessments and much more. Who had it right?

Work on the programme proceeded apace and RESOLUTION conducted its first DASO on 15 February 1968 (less than 5 years from the signing of the PSA). She sailed on its first patrol in April 1968 from the new Faslane Naval Base. She was joined a year later by HMS Repulse and the Royal Navy has maintained Continuous At Sea Deterrence (CASD) since then, celebrating 40 years only last month.

Whilst the US will undoubtedly have at least one SSBN in each of the Pacific and the Atlantic oceans you also have the land and air based components of the TRIAD contributing to the deterrent posture. The SSBN-borne Trident system is UK's only nuclear deterrent force and maintaining Continuous At Sea Deterrent [one submarine always at sea at the required state of readiness to fire] and we do this with a minimum practical number of boats and that is a significant challenge, and motivator, to our people. Who would want to be the first man or woman to break CASD, especially after 40 years.

But time marched on and although the UK had a shiny new outfit of Polaris missiles on her submarines, production had ceased in 1968 and you were deep in the Poseidon development programme. It became apparent that the Soviets were developing a serious ABM system to protect Moscow and there were real fears in the UK that our Polaris force would be insufficient to penetrate those defences and would lose its deterrent value. Whole books have been written on the indecision and politics of whether the UK should seek to buy Poseidon but suffice it to say now that we adopted, typically, a different British approach, still with US roots in their Antelope programme. We developed a very complex system of penetration aids and hardened warheads to fit to our Polaris missiles. But that programme could not have gone forward,

UK-unique though it was, without the concentrated and deeply professional assistance from the US programme office. Having got this Chevaline system into service we soon realised that the main rocket motors were rapidly running out of life and although Margaret Thatcher and Ronald Reagan had *by then agreed* to the sale of Trident II, a very expensive re-motoring programme was needed to bridge the gap from the mid '80s to the mid '90s. That programme required all the skills the US could muster to re-commission production lines that had been dormant for almost 20 years.

But the decisions on Trident meant a very different relationship had to emerge. The UK bought a design for a missile compartment that was identical in all significant respects to the one built by the US. The only differences detectable being that we have 16 tubes in our boats and a paint scheme to which we are enduringly attached. We were to operate a mingled stockpile of missiles (and certain other related components) and a single base, Kings Bay, would support it. So we contributed to the capital cost of Kings Bay *and* we continue to pay a proportion of its operating costs. But we estimate that saved us a huge amount of money, at least £3Bn. We signed up to the Life Cycle Cost Control programme to ensure we remained in step with the equipment and software updates that SP were fielding in the US fleet. Our financiers objected to the short-term costs of keeping in-step but were soon put back in their boxes when we rehearsed the costs of UK-uniqueness over the life cycle (as represented by Chevaline and re-motoring).

Of course both Margaret Thatcher and Ronald Reagan must be given immense credit for driving and overseeing an end to the Cold War. The mid-80s were tense times with the tussle over medium range weapons in Europe, Land-based Cruise missiles, Pershing, SS20s all were well fixed in our minds. But the focus in the UK was much more mundane. Having signed up to Trident, Margaret Thatcher was keen to see it deployed *on* time and *to* cost. She had regular reviews with senior staff and any sign of deviation was rewarded with a serious reminder of one's incompetence. One of her fellow Tories[1] (but one to whom power was elusive) coined

[1] She cannot see an institution without hitting it with her handbag. Julian Critchley MP

the phrase handbagging for this ordeal, in deference to the size and sturdy nature of her handbags. And that phrase has passed firmly into the English language, if not the American variant, where I understand it has a rather different meaning in popular culture, and another sign of our division by a common language.

So, with some bruises, my predecessors ensured Trident entered service in late 1994 and since then we have seen closer and closer working between our operational navies and between the government offices that support those navies. And of course this led to a great number of transatlantic flights.

So what have we achieved in that 50 years of co-operation under the 1958 Agreement, the 47 years of the PSA and the 40th year of CASD – Firstly the end of the Cold War – Secondly an enduring, hugely successful deterrent programme – highly visible when it needs to be – 126 consecutive US and UK successful flights of Trident D5 missiles does that. And we look forward to the 127 UK flight very soon. But the quiet, but slow ticking pulse of SSBNs sailing on patrol to continue to sustain the UK's Continual At Sea Deterrent operational profile and the USN deterrent patrols also act as a genuine reminder. Pivotal to this has of course been the role of the Director SM and his team.

Common interest and reducing resources have stimulated increased levels of cooperation on a wide range of important topics between our weapons labs, the NNSA and the UK MoD And since 2000 we have revitalised our exchange on nuclear propulsion under the auspices of the 58MDA, underpinned by the exchange of letters between Prime Minister Blair and President Bush. With great personal support from Admiral Donald we now have a vibrant two-way exchange programme. There are 36 US engineers from the *naval reactors programme in UK*, supporting our design team for our next generation nuclear propulsion plant, which will power our new deterrent submarines and almost certainly our next class of Attack submarines. So many parallels with our acquisition of Dreadnought back in 1958, but the difference is that we now have our first RN officer to pass the Donald interview – Admiral Donald has declared Lt Ralph Coffey RN suitable for nuclear power training through the US programme and he started last month, and he'd better pass.

We have shared two SSBN missile compartment designs, we

are now working on our third (our means joint US / UK) – much more of that tomorrow.

There are real opportunities to expand that joint working and to expand the opportunities for Industry – again more tomorrow – I am just whetting your appetite. And of course there are a number of things we still do differently. Hull designs for one, where we design to withstand collisions with the French. But to be serious, ladies and gentlemen the US has been a truly outstanding ally and partner. You have been instrumental in helping the UK sustain its nuclear submarine and deterrent programme – and we hope that in a small but important way we have helped you.

And finally, to quote Admiral Steve Johnson 'We have already entered the second half of a century of co-operation with certain partners in an uncertain world'.■

SUBMARINE TECHNOLOGY SYMPOSIUM
REMARKS BY
MR. RONALD O'ROURKE
MAY 12, 2009

Thank you for the introduction. And thank you for inviting me back for this year's symposium. It's a privilege to be here, and a pleasure, and I appreciate your willingness to listen to my comments.

As always, I need to issue the standard disclaimer that these views are my own and don't necessarily reflect those of my employer.

I want to make some comments today about where things stand today with submarine acquisition, where they might be headed, and what that might mean in terms of some potential acquisition and force-management initiatives the submarine community might want to consider. I want to do this first with attack submarines, and then finish with some comments along these lines about the next-generation SSBN.

FY10 Budget Submission

As you know, the FY10 budget was submitted last week, and it was a single-year budget submission, without an accompanying FYDP or 30-year shipbuilding plan. This isn't the first time we've had a single-year budget with no FYDP—it happened, for example, eight years ago, in the first year of the George W. Bush administration, when the detailed FY02 budget was submitted without a FYDP. And that submission was made in June, according to my records. So by that standard, the Obama administration is running a little ahead of where the Bush administration was eight years ago.

Without a FYDP, it's difficult to know exactly where a lot of acquisition programs might be headed over the next few years. That's particularly the case in light of the stated desire of DOD leaders to use the QDR to reshape the defense portfolio toward new priorities like irregular warfare. So FY10 has turned into yet another one of those budget cycles where the answers about a lot of things are not supposed to become clear until next year's

submission. I've lost count of how many times we've been in that situation over the last 10 or 20 years.

Attack Submarines

Clarity through FY13

The Virginia-class program, however, is a partial exception to this situation of not knowing right now where certain procurement programs are headed. As a result of the new multiyear for the Virginia class, we can know with a fairly high degree of confidence what the attack submarine procurement profile will look like from FY10 through FY13.

It's possible, of course, that DOD could decide to break the multiyear contract, but the cost penalties associated with doing that are so great that such a decision appears very unlikely — which is a big part of the reason those penalties are there to begin with.

So we can be fairly certain that the Virginia-class program will include one boat in FY10 and two boats per year in FY11, 12, and 13. That's more than a lot of other program managers can say about their own programs right now.

So if the attack submarine procurement profile through FY13 seems fairly clear, the question then becomes, what happens after that? This, I think, is a question the submarine community needs to focus on.

Some indications of the period beyond FY13

In my address here last year, I said I didn't think it likely that the date for getting to two per year would slip from FY11 to some later year, but that I did think there was a strong possibility that the procurement rate in subsequent years might drop to something less than a solid two boats per year.

Since I made those remarks last year, my view concerning the possible downstream procurement rate has been reinforced, for three reasons.

The first concerns the financial crisis and sharp economic downturn that began last fall, the federal spending enacted to deal with the situation, and the resulting projected effect on the nation's finances over the next several years. These developments, it seems to me, will likely serve to constrain DOD spending in coming

years more strongly than what people were generally anticipating prior to last fall.

The second reason concerns some indications about where the shipbuilding plan may be headed in coming years. One of those indications came in a white paper on defense issues that the Obama campaign organization released last year during the election. That white paper stated quite explicitly that in an Obama administration, the shipbuilding investment balance would be tilted toward smaller combatants.

And indeed, the FY10 budget submission seems to reflect such a direction. Of the eight new Navy ships included in the FY10 budget, six are relatively inexpensive ships—specifically, three LCSs, two TAKEs, and one JHSV for the Navy. The remaining two new ships are the next Virginia-class boat and a DDG-51.

To be sure, the budget also includes continued procurement funding for the next aircraft carrier, as well as funding needed to complete the cost of the DDG-1000 and the LPD-17 that were authorized but not fully funded last year.

But of the eight ships that are included as new efforts in this year's budget, three-quarters are relatively inexpensive ships.

A second indication of where the shipbuilding plan might be headed came in February, when Defense News published an article about a draft version of the FY10 30-year shipbuilding plan that apparently dated to December of last year. This was a draft plan only, and apparently only one of several planning excursions that were being studied at the time.

Even so, the draft plan was of interest, because it included a reduction in plans for procuring larger and more expensive ships and an increased emphasis on procurement in the near term of relatively inexpensive ships like the LCS and JHSV. These proposals, if implemented, would shift the balance of the shipbuilding account toward smaller and less expensive ships, consistent with the statement in the Obama campaign white paper. As some of you may have noticed, the draft shipbuilding plan that was reported in February would reduce planned procurement of attack submarines over 30 years from a total of 53 boats to a total of 40 boats—a reduction of 13 boats, or about 25%.

If you take the attack submarine procurement profile in that draft plan and put it into a simple force-level model, what you get is an attack Submarine Force that drops to the low-to mid-40s, and then stays there indefinitely. So the attack submarine shortfall, which has long been understood as a bathtub that would eventually turn upward, would instead become something like a permanent shortfall.

This situation, in fact, leads me to wonder whether there will be discussion in the QDR of the option of reducing the attack Submarine Force-level goal from 48 to some number in the mid- to low-40s.

And the third reason that my view regarding the potential downstream attack submarine procurement rate has been reinforced since last year is the stated OSD emphasis on shifting the balance of the defense portfolio more strongly toward things like irregular warfare. The general view is that such a shift will lead to reductions in programs for procuring expensive, highly capable platforms that are intended primarily for conventional interstate conflict.

All this causes me to wonder what will happen to the attack submarine procurement rate after the end of the current multiyear in FY13.

Now it's possible, of course, that there could be a change of administrations four years from now, and that a new administration might reverse the shift toward irregular warfare, and the shift toward a greater emphasis on relatively inexpensive ships. Even if that were to occur, however, that new administration would still need to address a federal budget deficit situation that has been changed by last Fall's economic crisis and the spending initiatives enacted in response to it.

Program execution

So if these are some indications of where things might be headed, then what might all this mean for the submarine community?

First, I think it places an increased importance on maintaining good program execution. The new DOD acquisition executive, Ashton Carter, reportedly said the other day that program terminations can be viewed as a component of acquisition reform

— the phrase used was acquisition reform "at the back end," as opposed to acquisition reform that affects the early stages of weapon acquisition programs.

Now, program execution is an area where the submarine community has been getting good marks in recent years, particularly in terms of reducing the procurement cost and construction time of the Virginia class while introducing new technologies that actually improve the boat's capabilities.

And this situation of getting good marks could be reinforced by the community's follow-on initiatives to reduce Virginia-class life cycle costs while perhaps also increasing the number of deployments that Virginia-class boats make during their 33-year lives.

Beyond that, the submarine community's long-range plan for block procurements of Virginia-class submarines, the next-generation SSBN, and the attack submarine that comes after the Virginia-class might come to be viewed as a model for others to follow. Indeed, it might be a harbinger of a more structured and more engineered approach to all Navy shipbuilding that may be required to maintain the Navy in future years at its desired size within available resources.

So in terms of program execution, the submarine community appears to be in a strong position.

Submarines and irregular warfare

But there's at least one other area where the submarine community might need to put more emphasis, and that is the link between attack submarines and irregular warfare. Currently, that link is not at all clear to people who don't closely follow submarine-related issues. As possible ways of strengthening this link, there are three potential acquisition initiatives that come to mind.

The first would be to put into place a firm program for procuring some ASDSs as follow-ons to the one ASDS that has been produced to date. The argument about the submarine community being connected to irregular warfare through its support of covert operations by Navy SEALS is weakened by not being able to point to a firm program for procuring the multiple ASDSs that the Navy had earlier argued would be necessary in

future years to properly support those SEAL operations. I just learned at the lunch table a few minutes ago that the FY10 budget contains funding for additional ASDSs.

A second initiative would be to put into place a firm program for equipping submarines with UAVs. Improved ISR is viewed as part of getting better on irregular warfare, and while the attack submarine offers advantages as an ISR platform in terms of covertness and persistence, the addition of UAVs would improve the ISR capabilities of submarines by giving them a capability for overhead and deep-inland observation that they currently lack.

At a meeting I spoke at a few weeks ago at Carderock, the topic of UAVs on submarines came up, and during the discussion, one of the conference attendees said that the Navy's activities in this area could be summed up with the phrase "a demo and you're done."

From where I view things, I'd have to agree with that characterization. For years now, it seems, the pattern I have noticed is that there would be a couple of trade press articles about a UAV being operated by a submarine on a test basis. I file the articles, and then nothing happens—until maybe a year later, when I see another couple of articles, broadly similar to the ones from the year before, which I again file, followed again by nothing. There doesn't seem to be any clear momentum toward a real acquisition program and planned deployments.

I understand that the submarine community has some work underway regarding submarine hardware for handling UAVs. But with the Secretary of Defense practically popping his veins over the UAV issue for more than a year now, it seems that a firm, high-profile, initiative to acquire and deploy UAVs aboard attack submarines by a date certain is something the submarine community should consider.

And a third potential initiative for strengthening the link between submarines and irregular warfare would be to begin a firm program for developing a large-diameter UUV oriented toward irregular warfare that can be put into the large-diameter tubes on the SSGNs and future Virginia-class boats. Introducing the large-diameter tubes on non-strategic submarines is something that the submarine community deserves credit for, but we're

getting to the point where observers might begin to ask what the value of the tubes is, if the submarine community doesn't have anything new to put in them.

The last large-diameter UUV I heard of was Seahorse, and that was years ago. The submarine community may be working on new large diameter payloads, but if it is, it might help to make that effort better known, or accelerate it, or ensure that it has some applicability to irregular warfare.

I understand that all these potential acquisition initiatives require money. You'd need some pretty substantial funding to procure additional ASDSs, to get UAVs on submarines in a concerted manner, and to acquire large-diameter UUVs. Making the case for that funding is going to be a challenge.

But it's not just a challenge. Making the case for this funding also provides an opportunity for explaining to others the attack submarine's link to irregular warfare, and how the submarine community is responding to leadership direction by initiating high-priority programs to significantly strengthen that link.

Additional options in a world of reduced procurement

But there's one more thing I think the submarine community may want to consider, which is the possibility that, even if the submarine community does everything that I have just talked about, the fiscal situation in coming years may be such that the attack submarine procurement rate will still drop below two boats per year.

Last year, I suggested that it was possible for the rate to drop to as low as 1.5 boats per year. This year, in part because of the change over the last several months in the country's finances looking forward, I'm not sure I would consider that as the lowest possible level. The 40 boats over 30 years in the reported draft 30-year shipbuilding plan from last December work out to an average rate of one and a third boats per year. And I'm not sure even that figure represents the minimum possible rate.

If that's the case, then I think that the submarine community should look at two more options for dealing with where things might be heading.

One of these is multiple crewing. The submarine community looked at this a few years ago, and then put the option on the shelf. It might become necessary to take it off the shelf and examine it as part of a larger strategy for dealing with the reduced force size that would eventually result from a constrained procurement rate. And the other option would be to extend the lives of new attack submarines from 33 years to some higher figure — to 40 years, if possible, or even 45. A 40-year life and a build rate of one and a third boats per year over the long run would support a force of 52 boats.

I understand that extending service life to the figures I just mentioned might not be feasible, and if feasible, would raise a number of issues. Among other things, it might require a return to mid-life refuelings, with everything that entails for the ship's design, and for life-cycle O&S costs. And it might require making the ship more expensive to procure, because of the need to build certain parts of the submarine rugged enough to last over a longer life.

I don't know what's possible in terms of extending attack submarine life beyond 33 years, or how cost effective it would be relative to the current approach of building boats with 33-year lives.

But I think it's something the submarine community should examine, if only to be able to understand what the numbers look like, and to be ready to show them to others.

Now, when I've mentioned the idea of a longer service life in the past, more often than not, the response I've gotten has been a sort of silence. Which might mean one of two things. One is that the person I'm talking to is thinking, "Oh, that's just Ron throwing-out some crazy idea, and we'll just wait until he forgets about it and moves on to something else." Well, if that's what's going on, then I guess I have to thank you for being polite enough to not say that to my face. And it's not such a bad strategy, really, because I long ago reached the age where I can't even remember what I had for dinner last night.

But on the other hand, if someone had come to you about 20 years ago and told you that the submarine procurement rate would soon fall to zero, that the rate would average less than one boat per year for more than a decade, and that there would be studies for

reducing the attack Submarine Force to as few as 37 boats, you would have said that's crazy too.

The other possibility is that the submarine community doesn't see this idea as crazy at all, but would prefer not to mention its work on this issue to others, because doing so might risk converting a possible low submarine procurement rate into a planned one. Well, if that's the case, I guess I understand that, but I hope you're examining the idea all the same.

Next-generation SSBN

In the last few minutes I have here, I want to shift to the next-generation SSBN. Secretary Gates endorsed the start of this effort in his April 6 news conference, and the proposed FY10 budget contains a substantial amount of funding for it.

I want to make four points about this program.

Accelerated start

The first concerns the question of whether to describe the start of this program as having been accelerated, or as having occurred when it normally would have.

It might be the case that the answer is both—that the program's start was accelerated originally as part of a strategy for supporting the submarine design and engineering base, but that the Navy subsequently discovered that it needed to start the program this year anyway, given the time the Navy now thinks will be needed to design the boat.

Those on the Hill who have been following submarine acquisition are familiar with the issue from a couple of years ago about the need to find a way to support the design and engineering base, and how accelerating the start of the SSBN effort was going to be a big part of the strategy for doing that. In that context, I think it would confuse people to be told now that the effort has not been accelerated. And noting that the start of the program was accelerated to help sustain the design and engineering base doesn't preclude the Navy from saying that it subsequently determined that this was the best approach for the program for other reasons as well.

Minimizing cost

The second point I'd like to make about the SSBN program is that, in light of the coming fiscal situation I've discussed, minimizing the cost of this ship might not be simply one goal for the program, but a top goal. That would suggest conceiving of the boat as a very basic platform—as a boat with the features needed to perform its mission cost-effectively over its entire life cycle, to be sure, but with no extra bells and whistles. Save your money for the attack submarines.

A possible exception regarding bells and whistles might be some new technologies that might not be needed strictly for the SSBN itself, but which, if developed for the SSBN, could help reduce the cost of future attack submarines. But be careful with that rationale, because it's ripe for abuse.

Number of boats in program

The third point I want to make about the SSBN program concerns the number of boats in the program. The current understanding, based on the Navy's prior 30-year shipbuilding plans, is that the program will include 12 boats, and that the number is 12 rather than 14 because the life-of-the-ship core on the boat will eliminate the need for a mid-life nuclear refueling, and thus for needing two additional boats in the force to maintain deployments during the middle years of the class's life-cycle.

I understand that not everyone agrees with that explanation, in part because, when it comes to mid-life refueling overhauls, getting rid of the refueling doesn't mean you're getting rid of the overhaul.

If the explanation about needing 12 rather than 14 due to life-of-the-ship cores doesn't hold up under inspection, then now's the time for the Navy to come clean on this. Incorporating a fib or a sloppy argument into the start of a program can weaken the foundation for that program.

Beyond the issue of core life and how it might or might not affect required numbers, the submarine community may need to consider the possibility that fiscal limits, perhaps combined with possible arms control agreements, may reduce the number of boats in the program to fewer than the submarine community or the Navy might prefer. If the preferred number is 14, these factors

might reduce it to 12 or 10. And if the preferred number is 12, these factors might reduce it to 10, or even 8. The Navy's analysis might show a higher number being needed to perform the mission at a certain level, but that might not be enough to prevent a decision in favor of a lower number.

If a reduction in total numbers is a possibility, then the submarine community might wish to consider whether and how that could affect the design of the boat, or other aspects of the program.

Service life

And the fourth point I want to make about the next-generation SSBN is that—along the same lines of what I said earlier about attack submarines—the submarine community might want to consider planning the next-generation SSBN as a boat with a service life that is longer than the Ohio-class's 42-year life - perhaps as much as 50 years. Again, I understand what this might mean in terms of life-of-the-ship cores vs. mid-life refuelings and life-cycle costs. And I understand that this idea is in tension with my earlier point about minimizing the cost of the ship.

But again, the Navy might want to run the numbers to ensure that it understands the possible barriers or tradeoffs and can explain them to others.

Conclusion

In summary, the point I want to leave you with is this: The Virginia-class multiyear and the budget support for the start of the next-generation SSBN effort give the submarine community some clarity and confidence about where submarine acquisition is headed for the next few years.

But it's only for the next few years. After that, things are less certain, and preparing for that uncertainty may require consideration of some of the options I've outlined here.

Purchases of large numbers of relatively inexpensive LCSs and JHSVs will permit the number of ships in the Navy to be propped up over the next several years at relatively little cost, even while existing higher-capability ships begin to retire in larger numbers. Within a certain number of years, however, deliveries of

LCSs and JHSVs will wind down, and the retirements of the higher-capability ships will continue.

At that point, the full dimensions of the Navy's shipbuilding affordability challenge will be unmasked, and the numbers are going to look very daunting indeed. That's the situation the submarine community should be planning toward today, and I hope my remarks today will prove useful in that task.■

Thank you.

THE CHALLENGE TO BUILD ON OUR STORIED LEGACY

Remarks from the 2009 Submarine Technology Symposium

by Mr. G. Daniel Tyler

Dan Tyler is Head of the National Security Technology Department at The Johns Hopkins University Applied Physics Laboratory, and is responsible for the Laboratory's support to the Navy's undersea warfare mission. He holds a bachelor's degree from the Massachusetts Institute of Technology, a master's degree from the Johns Hopkins University, and participated in the Executive Program at the Stanford Graduate School of Business.

Our adversaries–conventional nation-states, insurgents, terrorists–look for ways to weaken the resolve of the American people. They may try to instill a false sense of security by convincing us that they're our friends, trading partners, even religious groups–there's no threat! At the other extreme, they point out that there's more than a billion Chinese, and a billion Muslims between Egypt and Indonesia, and they invoke images of unstoppable social, religious, cultural, and national change. For the American way of life there's no hope! Fortunately, we're too smart for the former, and too proud to succumb to the latter. But, there's a more insidious and potentially defeating psychology we may be inflicting on ourselves. It's not that there's no threat. It's not that there's no hope. It's that there's no hurry. We're the world's only superpower, with the largest economy, the most powerful military, and a wealth of technology. So why worry? We should have plenty of time to deal with our challenges. Jack Welch, former CEO of GE, gave us something to think about when he said "If change is happening on the outside faster than on the inside, then the end is in sight."

Let's take a quick and sobering look at the challenges facing the Nation today – they're staggering. The Under Secretary of Defense for Policy, Michele Flournoy, detailed the framework and priorities for the upcoming Quadrennial Defense Review[2]:

> "I don't think I am exaggerating when I say that we face the most daunting inheritance in generations ... Most obviously, we are involved in two ongoing wars (in) Iraq and Afghanistan ... Yet these two ongoing conflicts only form part of the picture. Everywhere we look, we face emerging new security challenges–the rise of violent extremist movements ... the spread of weapons of mass destruction...rising powers with sophisticated weapons...failing or failed states...and increasing tensions in the global commons. Many of these emerging challenges are fueled and complicated by a series of powerful trends that are fundamentally reshaping the international landscape. These trends include the global economic downturn ... climate change ...cultural and demographic shifts ... growing resource scarcity ... and the spread of potentially destabilizing technologies."

Ms. Flournoy observed that all these new challenges and ongoing trends necessarily shape the U.S. military's operating environment, and will require us to adapt and change, adding: "Adapting quickly is a necessity, not a choice."

What can be done within the technology community to step up to these challenges? In a recent meeting,[3] Alan Shaffer, Principal Deputy Director Defense Research and Engineering, outlined DOD's enabling technology priorities for supporting the "strategic outcomes" of the Quadrennial Defense Review:

Technology Focus Areas:

Human, Social, Cultural, and Behavioral Modeling

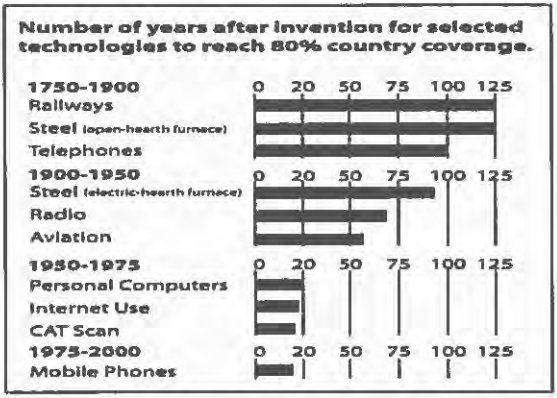
[2] From a speech given at the Center for Strategic and International Studies; April 29, 2009

[3] "Strategic Imperatives for the DOD Science & Technology Program"; CENTCOM S&T/JCTD Conference; April 28, 2009.

Biometrics and Biological Exploitation
Information Technology and Applications
Persistent Surveillance Technologies
Networks and Communication
Language Translation Technologies
Manufacturing Technologies
Cognitive Enhancement
Directed Energy Technologies
Autonomous Systems Technologies
Hyperspectral Sensors
Nanotechnology
Advanced Materials
Energy and Power Technologies
Organization, Fusion, & Mining Data
Combating WMD Technologies
Energetic Materials

This list of technology focus areas contains new technologies that one would expect, like Nanotechnology and Advanced Materials. But there are also unexpected areas like Human, Social, Cultural, and Behavioral Modeling, and Cognitive Enhancement. DOD has come to recognize, as has the rest of the world, the need to go beyond hard physics and engineering into multidisciplinary and non-kinetic solutions.

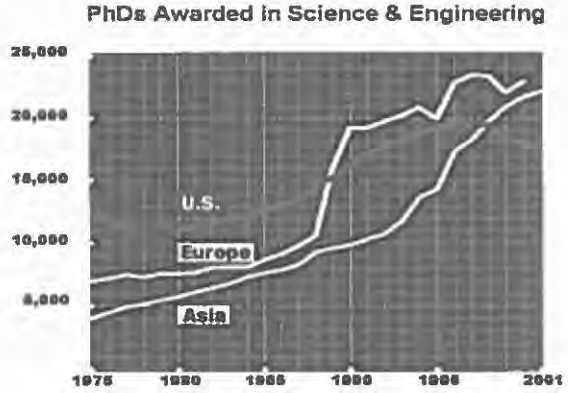
Importantly, Mr. Shaffer then talked about the pace at which technology is being developed and introduced. He described how the time from invention to market penetration is shrinking dramatically. Railroads, steel, and the telephone took 100 years from invention to market penetration. The radio and airplane took 50 to 75 years. Personal computers and CAT scans took 20 years. Cell phones took about 15 years. It was 23 years from the discovery of the semiconductor effect in 1931 until the first commercial transistor radio, but only 9 years from discovery of the carbon nanotube in 1991 until that invention made its way into a commercial product – the Jumbotron lamp.



SOURCE: The Economist, Feb 9, 2008

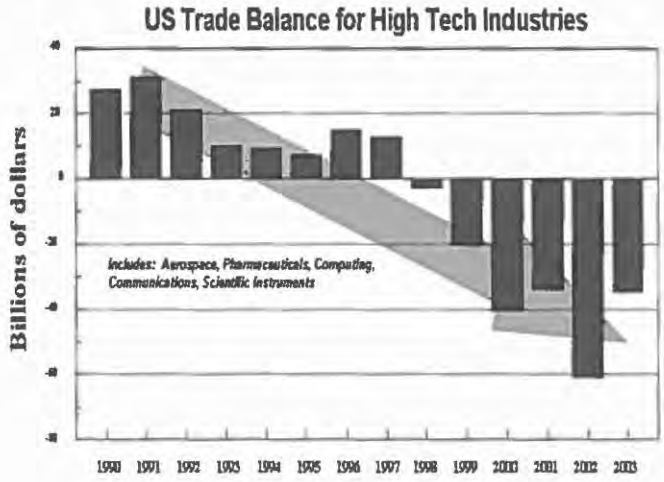
The pace of technology invention, development, and market penetration is increasing – and the US is challenged to keep up with the rest of the world.

You've probably seen the report cards. We've lost the lead in the number of PhDs awarded in science and engineering.



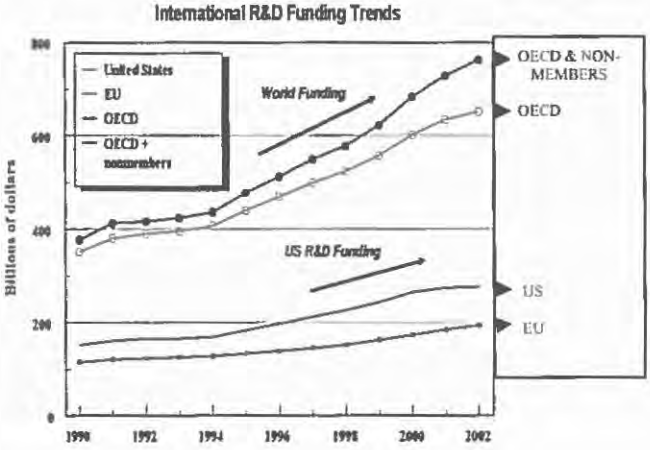
SOURCE: Money Magazine, 2005

Our high tech balance of trade went negative a decade ago, with the serious implication that we're now importing critical technology from abroad.



SOURCE: Global Insight and S&E Indicators, 2006

And finally, while one could argue that the rest of the world is bigger than us, so maybe their collective spending on R&D should be bigger, the rate of growth of R&D funding for the rest of the world is three times that of the United States.



SOURCE: OECD, Main Science & Technology Indicators database, Nov 2004

Not surprisingly, we're seeing the impact of these trends on national security. Consider the rate at which we're transforming the Army's ability to handle non-traditional threats. In developing approaches and systems for dealing with terrorists and insurgents, the Army continues to rely on traditional disciplines such as physics and engineering, but importantly, now recognizes the need for multi-disciplinary and non-kinetic approaches as well. Over most of this decade, successive Chiefs of Staff of the Army have painted a picture for a transformed Army that is, among other things, light and agile (e.g., deployable), flat and distributed (e.g., decentralized), and networked.[4] The issue is how well the Army is doing in pacing the threat. Let's look at where the Army is today.

[4] "Defense Transformation" as articulated in the 2001 QDR; *2003 Army Transformation Roadmap*, Peter Schoomaker, Army Chief of Staff.

Light and agile–we're reliant on massive offensive firepower and heavy armor for defense (69 ton Abrams tanks, 19 ton MRAPs). Flat and distributed–while the Army is moving to reorganize from a Division-based force to one based on modular Brigades ("closer to the way it fights"), the political realities of current conflicts result in a vertical command structure that often stretches to the Pentagon and the White House. Networked–we're at least ten years from being net-centric on the battlefield, and recent cuts in the Army's Future Combat System may jeopardize even that timetable.

Now look at the enemy. Light and agile? A hand carried RPG launcher can blow away the 69 ton tank. Flat and distributed? "Transnational terrorists have created dispersed and flat organizations ... (they've) learned from global business entities such as McDonalds and Starbucks the value of franchising ...".[5] Networked? With technology as simple as cell phones. Today's terrorists and insurgents are living the Army's future vision, and having significant successes with it.

In conventional warfare there's a common belief that no nation dare challenge the United States. So, let's look at a conventional nation-state threat through the eyes of the Pacific Fleet. The Chinese now have their own operationally deployed versions of 2 AEGIS Class destroyers–the Lanzhou (DDG 170) nd

[5] "Transnational Terrorism"; Michael D. Intriligator, Copenhagen Consensus 2008 Perspective Paper.




the Haikou (DDG 171). These platforms have phased array radars, vertical launch systems, long range missiles, formidable C^2, and daunting close-in weapons systems. The Chinese have their own version of Harpoon, and a high hypersonic land-based anti-ship ballistic missile–the Dong Feng 21–"with a range in excess of 1500 km ... to provide the PLA the capability to attack ships at sea, including aircraft carriers, from great distances."[6] In addition, the Chinese have demonstrated the abilities to shoot down as well as to jam satellites, potentially robbing the US of both communications and navigation during a conflict.[7] And lastly, the Chinese are building a formidable submarine force. Contrary to what some might still believe, the Chinese are not a technologically

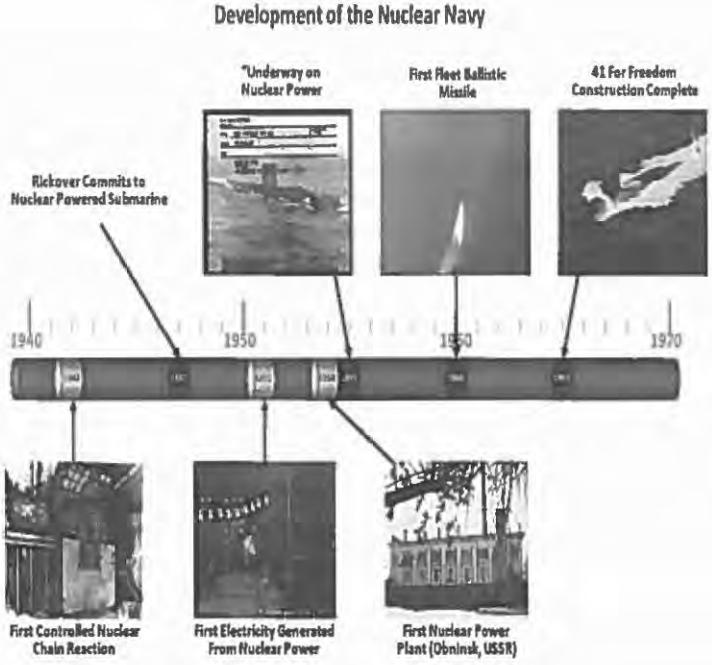
[6] Annual Report to Congress, Military Power of the People's Republic of China, 2008; Office of the Secretary of Defense.

[7] "China Poses Threat to GPS," Allan Holmes; Government Executive, May 31, 2007.

disadvantaged threat, and they could pose a challenge to the US Navy for maintaining maritime superiority in WESTPAC. "The pace and scope of China's military transformation have increased in recent years, fueled by acquisition of advanced foreign weapons, continued high rates of investment in its domestic defense and science and technology industries, and far reaching organizational and doctrinal reforms of the armed forces."[8]

But, we've been here before. America has been repeatedly challenged and risen to the occasion–the preeminent example occurring during the period following World War II, when the US faced the formidable and growing Soviet threat. Immediately following the end of the war, the Soviets recognized the need to compete with the West at all costs. The Russians had been attempting to develop a nuclear weapon while simultaneously acquiring US designs through espionage. At the same time, the Soviet Navy embarked upon a program to quickly catch up with their western counterparts. At this same time, the US submarine force was composed of a fleet of diesel electric submarines basically equipped to do ASuW. To be a player in the evolving Cold War, it became obvious that the US Submarine Force would need increased endurance, speed, and firepower. It is instructive to examine the response of the submarine community to this discontinuity in the strategic environment, the critical role played by technology, and the rapid pace with which operational capabilities were developed and deployed.

[8] "Military Power of the People's Republic of China 2009", *Annual Report to Congress*, Office of the Secretary of Defense.



The first controlled nuclear chain reaction occurred in 1942 in a squash court at the University of Chicago. Electricity was first generated by nuclear power in 1951. And, the world's first operational nuclear power plant went on-line outside Moscow in 1954. What seems incredible is that Hyman Rickover began planning for a nuclear powered submarine in 1947, before it had been demonstrated that you could get useable power out of nuclear fission. So that just 7 months after the first nuclear power plant went operational, the Nautilus radioed "Underway on nuclear power." And if that weren't enough, with the Nation facing a missile gap, the first FBM was fired from the George Washington in 1960 – 2 years ahead of schedule. As for "market penetration", we had "41 For Freedom" constructed by 1965. The submarine community set the standard for how to develop technology,

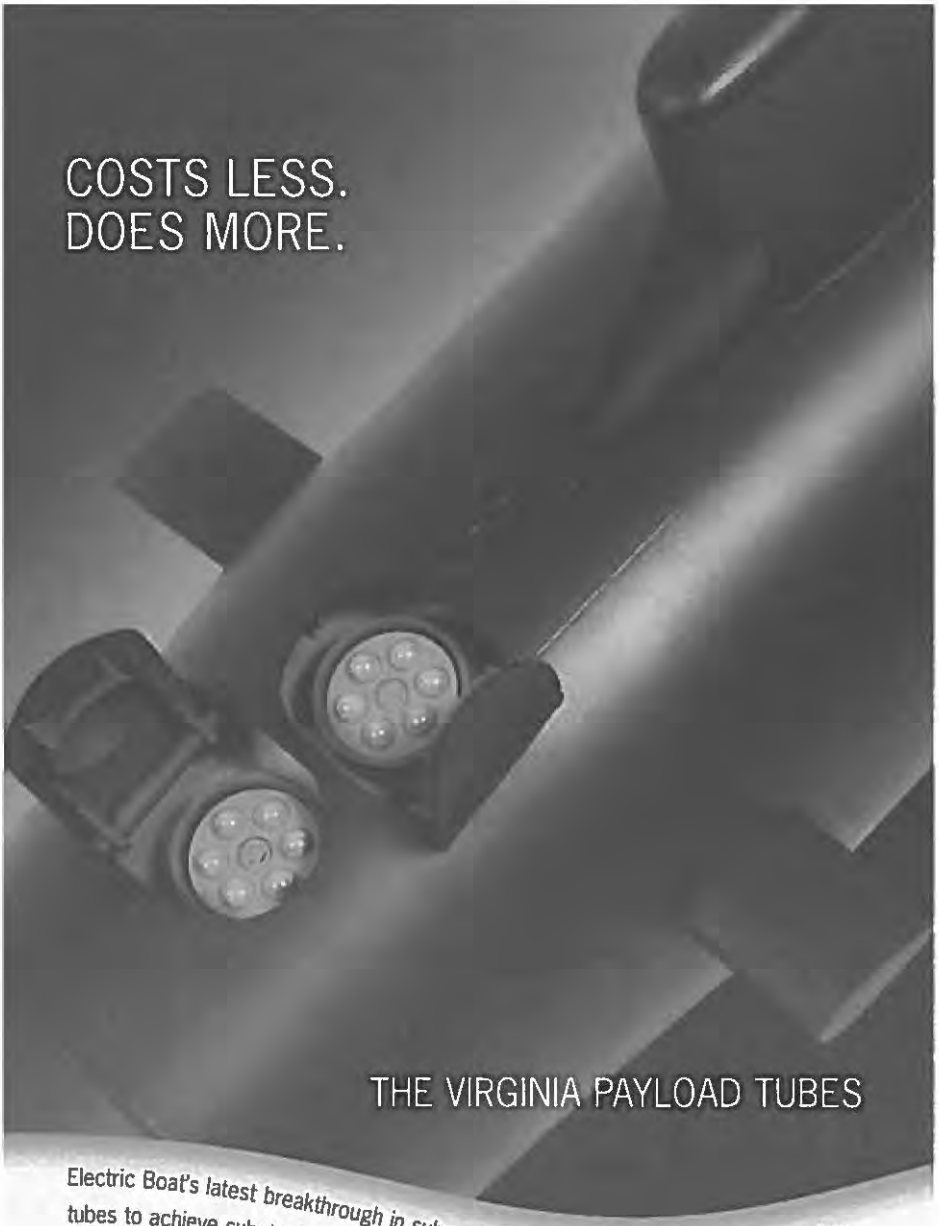
rapidly implement it, and the nuclear submarine became the premier contributor to the Nation's security during the Cold War.

What are the requirements today? From the perspective of the Pacific Fleet the Navy needs:

- A platform invulnerable to ballistic, cruise, and guided missiles;
- A platform that can operate in a denied/degraded navigation and communications environment;
- A platform not at risk to threat submarines;
- And a platform with a weapon that is oblivious to SAM defenses, that can penetrate threat "Aegis" systems, and with enough warhead to guarantee mission kill.

The submarine's stealth, endurance, speed, and firepower are relevant to today's problems. To guarantee that the submarine is the Nation's premier platform for tomorrow's problems requires investment in future-focused research, development, and experimentation that produces game changing technologies–a hallmark of the submarine force - for dealing with the evolving nature of conventional and irregular warfare. Our job is to provide more than technology–it's to provide technology leadership.

As recently articulated by Under Secretary of Defense for Intelligence, Dr. Stephen Cambone, on the 103rd anniversary of the Submarine Service's founding, "The nation needs such an effort from the Submarine Force again because we are a nation at war. It is up to you to build on your storied legacy, your unequaled success, and encourage the coming generation to reach for greatness by upholding the finest traditions of the 'Silent Service'."■



Electric Boat's latest breakthrough in submarine design adds larger and less complex tubes to achieve substantial savings on Virginia-class attack submarines while increasing their capability. The boat can deploy a wider range of payloads than ever before and the cost is $40 million less per ship. That gives the Navy a fleet with the flexibility it needs for tomorrow at a price it can afford today.

GENERAL DYNAMICS
Electric Boat
Delivering Undersea Superiority

THE ENEMY IS INCOMPATIBILITY.

Legacy systems. Open source software. Older hardware. Future naval architectures. Communications. Many legacy systems aren't forward compatible. So DRS helps to overcome this common enemy with technology that allows maximum interoperability. From nearly anywhere onboard. Stem to stern.

Systems vital to a ship's operation don't always work together. Recognizing this, DRS develops systems that employ open system architectures with commercial-off-the-shelf hardware. The result? Greater information sharing, greatly improved productivity, crisper decision making today, and a clearer path to the future. Bring us your toughest challenges. We're always looking for new enemies to conquer.

DRS TECHNOLOGIES

A Finmeccanica Company

www.drs.com

ARTICLES

HMCS OJIBWA'S PATROL vs A SOVIET DELTA

by Captain Phil Webster, CF
Canadian Navy
Director Undersea Warfare

This article is extracted with permission from the 2008 issue of the Maritime Warfare Bulletin of the Canadian Forces Maritime Warfare Center, of Halifax, Nova Scotia.

Editor's Note: The author has provided the following context for the longer article in this issue of the Maritime Warfare Bulletin from which this piece is extracted:

"This article is a result of declassification of Canadian Navy Cold War submarine operations in support of CTF 84 ASW missions against Soviet SSBNs in the Canadian Atlantic Area of Responsibility (AOR). The article is part of the fourth volume of the official history of the Royal Canadian Navy, to be published in 2010 as part of the 100th Anniversary of the Canadian Navy. The fourth volume covers from 1967 to first Gulf War (1991). Although our three Oberon class SSKs were only a small part of our Fleet during this time frame, we did have some success detecting and tracking Soviet submarines. In particular, the patrol HMCS OJIBWA conducted against a Delta 2 SSBN with Victor 3 delousing was quite noteworthy. I have found no other record of a NATO SSK prosecuting a SSBN for the length of time OJIBWA remained in trail, although I presume some of these ops are still classified.

"As we bring our four Victoria SSKs (ex-RN Upholders) into operational service, we continue to build on the history of the important contributions that the Canadian Oberons have made to support of our NATO, CAN-US and national commitments."

Summarizing the heavy load of exercising and training serials OJIBWA had borne in 1984, her commanding officer, Lieutenant Commander Phil Webster–*Ace* to his colleagues–repeated the hoary adage that operations at sea are typically 99 per cent boredom, one per cent wild excitement. Although complete patrol records are unavailable, there is enough evidence to apply that

maxim to OSP 1/85. After the last minute loading of torpedoes and other supplies, OJIBWA departed Halifax on the afternoon of 25 February 1985. Despite the confidence accrued through outstanding performance in NATO exercises in 1984, Webster lamented that OJIBWA's crew did not have the benefit of a dedicated training period prior to the patrol to shake off the rust that had accumulated over a maintenance and leave period. This was an old lesson, and senior officers subsequently acknowledged, "that rigorous equipment *shakedown* and significant preparation must precede all patrols of this nature."

OJIBWA was headed to a patrol area in the Labrador Sea southwest of Greenland where Soviet Delta SSBNs regularly occupied firing positions. It was a long transit. Typical for the time of year, the weather was poor and a following sea made snorting difficult. The intelligence Webster received during the initial part of the trip also was not promising and with the prospect of a long boring patrol ahead he tried to catch up on his reading. One of the first books he cracked was Lothar-Günter Buchhiem's Das Boot, and he recalls the environment described in the classic novel of U-boat warfare was not all that different from what OJIBWA was enduring. Despite the routine nature of the transit there was still work to do. The command team practiced BINT procedures and the torpedo crew conducted maintenance checks on the Mk 37s. OJIBWA also carried out noise radiation checks with CP-140s *(Editor's Note: Canadian Maritime Patrol Aircraft)* that indicated that the boat was running "incredibly quiet." Despite that, Webster had concerns that poor communications discipline ashore and from an MPA may have compromised their location.

After a nine-day transit OJIBWA reached her patrol area on 6 March 1985. Although they obtained a number of inconclusive long-range sonar hits there were no other signs of activity, and Webster worried OJIBWA might come up empty. The picture improved on 10 March when they received information that a Soviet SSBN, designated LD-010, had been detected moving into the CANLANT zone. As OJIBWA awaited cueing, CP-140 Auroras, guided by information from SOSUS, flew constantly, sewing sonarbuoy patterns in an attempt to find the boomer. In waters notoriously bad for sonar and with the SSBN likely running deep and slow to reduce its signature, this was an exceedingly

difficult task: as one submarine recalled, "it was a very hard place to find a quiet submarine." After four days, however, MPAs localized the contact, classified it as a Delta class SSBN, and controllers sent OJIBWA north to intercept.

Since the 1970s American attack boats had attempted to shadow all Soviet SSBNs, throughout their patrol. The rationale was brutally simple. In 1985 Secretary of the Navy John Lehman announced that American SSNs intended to attack Soviet missile boats "in the first five minutes of the war." Although this was the first public declaration of the strategy, the Soviets had been aware of it for some time–probably from information provided by the Walker spy ring. In an attempt to preserve their first strike capability, the Northern Fleet began to use its own attack boats to screen their SSBNs. This practice–used by both sides during the Cold War–was known as *delousing*, and in the early 1980s the Soviets introduced the new Project 671RTM Victor III class SSN into this high-stakes strategic waltz. Victor IIIs were the most advanced submarine yet produced by the Soviets and they quickly assumed almost mythical status within the NATO ASW community. They could be tracked with great difficulty through the GIUK Gap and other choke points, but once they were in the open Atlantic, as OJIBWA discovered, they were extremely elusive.

On 16 March, while OJIBWA searched for the Delta, controllers informed Webster that a VICTOR III was in the immediate area, and, worse still, might be trailing him. The hunter had become the hunted. Webster immediately took his boat deep into the sound convergence layers where sonar achieved best results and, sure enough, soon picked-up a contact. Although initially classified as biological, further investigation indicated it might be a submarine, and this was suddenly substantiated by an active sonar transmission from down the same bearing. Since Soviet submariners often *banged away* on active sonar, this was probably confirmation of their presence. It also signified that OJIBWA might have been counter-detected. The next time he went to periscope depth to check communications, Webster received a sitrep based on MPA tracking that suggested OJIBWA had passed close to the DELTA and probably the VICTOR III as well. At the same time, MARCOM ordered Webster to head south along the

projected course of the SSBN. Unsure if they were themselves being followed, OJIBWA crept away as quietly as possible.

The next 72 hours brimmed with tension. As OJIBWA moved south, Auroras put up a maximum effort, flying around the clock to track the DELTA. With SOSUS support they managed to localize the contact, and on St. Patrick's Day afternoon, Webster received the go-ahead to close the Delta for the purpose of gathering acoustic intelligence. It was a long, challenging search. Biological contacts fouled broadband and the SSBN used the standard Soviet tactic of keeping close to the North Atlantic Ridge to mask its signature: like all O-boat crews involved in Operational Surveillance Patrols (OSPs) OJIBWA's attack team lamented the lack of sophisticated narrowband equipment. Teamwork between the SSK and MPAs remained almost seamless. When OJIBWA had to snort, MPAs cued her back to a promising area upon completion.

Finally, OJIBWA hit the jackpot. At 0102Z on 19 March - the day before she was to begin her return passage to Halifax - the sonar crew gained hits with both 2007 and 187. A firing solution was immediately input into the fire control system, and Target Motion Analysis tracked the DELTA as it conducted a routine turn to clear its stern arc. The big missile boat kept coming and passed so close down the starboard side - Webster estimated under 800 yards - the crew could hear the quiet thumping of machinery as the SSBN slunk by. Webster recalls no real excitement in the boat; the crew just went about their business, quietly and professionally. OJIBWA stuck with the DELTA throughout the 20th, tailing her from about 2000 yards, and maintaining a firing solution. Each time they went to snort MPAs brought them back into contact. All the while OJIBWA gathered a treasure trove of acoustic intelligence.

After hours of what now seemed like routine shadowing, the situation suddenly became exceedingly tense. When the delta turned to clear its baffles in the late hours of 20 March, a second contact popped up on sonar, heading the other direction. Webster immediately classified it as the VICTOR III he had been warned about four days earlier. The *delouser* did its job. Breaking towards the Canadian boat it lit up OJIBWA with active sonar. The effect was dramatic. Soviet SSNs used high frequency active sonar that

NATO codenamed *Blocks of Wood*; the sound it made on the hull of its target was precisely that of a pair of two-by-fours being slapped crisply together. Now certain he had been detected, Webster faced a difficult situation. His primary responsibility had to be the safety of his boat and he was far from port, so far in fact that if something went wrong his nearest refuge was the UK, not Halifax. Moreover, he was manoeuvring in extremely close proximity to two adversaries, one of which was trying to drive him away. Rumours of collisions between NATO and Soviet submarines abounded–current unofficial estimates put the number at as many as 40 incidents–and Webster was determined that OJIBWA not join that company. Due to begin his homeward passage within hours anyways, and already possessing acoustic data from both contacts, at 2300 20 March Webster broke off contact. Summarizing the drama in his patrol report, he ruefully noted, "...was counter-detected...and actively prosecuted.... The second submarine was successful in riding off the patrolling unit."

Despite the fact that Webster broke off the operation, OJIBWA had conducted the most successful surveillance patrol mounted by an O-boat in Canadian waters. It certainly achieved Commander Nesbit's objective to demonstrate to the Americans that we could look after our own backyard. On her way back to Halifax, COMSUBLANT notified MARCOM and OJIBWA, "Your recent ASW prosecutions most impressive and productive. Your efforts have contributed significantly to the LANTFLT ASW picture and have not gone unnoticed." That was about as wide as the celebration got, as OSP 1/85 remained cloaked in secrecy. When OJIBWA reached home, the squadron commander mustered the crew–Webster had kept them in the picture–and threatened if anybody uttered a word about the patrol he would cut off a vital part of their anatomy. Likewise, when Vice-Admiral J. Wood, the Commander MARCOM, reviewed the patrol with Nesbit and Webster, he said they had better keep the information to themselves.■

ITT Acoustic Sensors stands side by side with the U.S. and allied Navies, providing sonar systems and sensors for undersea warfare. Our systems touch virtually every active submarine in the U.S. fleet. We demonstrate, to our customers, our dedication to quality and long term commitment on legacy programs such as the Lightweight Wide Aperture Array and the AN/BQN-17A Secure Fathometer. To learn more please visit www.es.itt.com

We stand side by side for quality and service.

ITT

Engineered for life

Communications • Sensing & Surveillance • Space • Advanced Engineering & Integrated Services

ITT, the Engineered Block logo, and ENGINEERED FOR LIFE are registered trademarks of ITT Manufacturing Enterprises, Inc., and are used under license ©2008 ITT Corporation

U.S. Navy photo by Paul [illegible]

GROWING PAINS IN SUBMARINE DIESEL ENGINE DESIGN

by Dr. Edward Monroe-Jones and Mr. Lyle Cummins

Dr. Edward Monroe-Jones is the Director of the Submarine Research Center (SRC). he holds a bachelor's degree from Occidental College and a doctorate from University of Southern California. He qualified as an enlisted man on STERLET (SS-392) and as an officer on SIRAGO (SS-485) and served on the SubPac staff and WAHOO (SS-565).

Lyle Cummins has a long history of work with diesel engines and holds several patents related to diesel fuel systems. He has written several books on engine history, including the recent Diesels for the First Stealth Weapon: Submarine Power 1902-1995.

In 1920 The Navy Department's General Board urged an examination of its submarines because of serious problems it was having with new engines for S-Class submarines authorized in 1916 which were then entering service. Only two companies, Electric Boat's subsidiary, the New London Shipbuilding and Engine Company (Nelseco) and the Busch-Sulzer Company were building submarine diesels. New, 8 cylinder, 600 hp Nelsecos (based on the previous 6 cylinder, 500 hp models in the O, L and R Classes) and 6 cylinder, 900 hp Swiss-based Busch-Sulzers went in these early S-Boats.[1]

The General Board's concern also arose from the inability to replicate the much higher output and more reliable German submarine diesels.[2] In frustration the Bureau of Engineering reverse-engineered two German engines, the M.A.N. (Maschinenfabrik-Augsburg-Nuernberg), 6 cylinder, 1,750 hp, and the M.A.N. 10 cylinder 3,000 hp engines. In 1922 the Navy began building a *Bureau* clone of the 6 cylinder model to replace Nelsecos in some of the S-Boats. By 1924 the Lake Torpedo Boat Company had failed and the Busch-Sulzer Company stopped producing diesel engines for use in submarines. This left Nelseco as the sole private company to build submarine engines.

At the same time, the Navy moved ahead under a 1914 Congressional authorization to build *fleet submarines* which were intended to have surface speeds equivalent to that of cruisers and battleships. The gap between maximum submarine surface speed with Nelseco engines and battle group surface speeds rendered the term, *fleet submarine,* meaningless. Nevertheless, Electric Boat forged ahead to produce an advanced submarine design. These new boats were to have Nelseco, 6 cylinder engines that were designed to produce1000 hp at 375 rpm.

Test stand troubles encountered are not known, but they began in earnest when installed. With 4 engines driving two screws, two engines were paired longitudinally with a clutch inserted between them. Between the after two engines and their propellers were another pair of clutches and the motor/generators to make a total twin drive shaft length of almost 100 feet. Little thought had been given to torsional vibrations inherent with this arrangement.

The first American T Class submarine, the T-1, (SS-52), was launched with high expectations. Trials at sea immediately revealed serious vibration problems resulting from drive shaft length and coupling of engine crankshafts. At rated speed on all four engines, torsional vibrations were so severe, linkages snapped and piston cooling piping parted. These problems were in addition to high pressure injection air compressor failures. The diesel engineers did what they could to redeem their design, but in the end, the operation of the Nelseco diesels in the T Class boats could only be accomplished by either taking the forward two engines off line by declutching them or by reducing the RPM of the coupled engines to an insufficient power level. This rendered the surface speed of the T Class boats far below the minimums for fleet operations. The maximum surface speed using just the two aft engines was about 15 knots.

Three T Class submarines were built and during the 1920s the three boats struggled to improve their performance. T-1 was decommissioned after only 20 months of service, during which time it failed to join the fleet. The T-2 lasted 18 months until July of 1923 when it too was decommissioned. The T-3 was similarly fated but was resurrected with *Bureau* 10 cylinder diesels based on the M.A.N. diesels, but she too was finally decommissioned in July of 1927.[3]

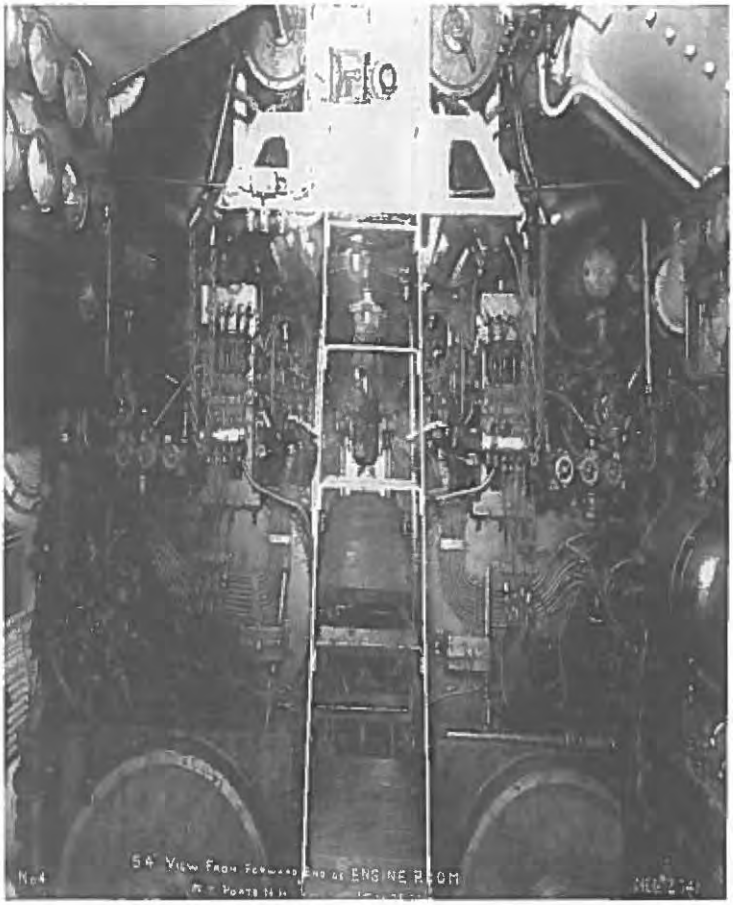


Figure 1 Engine room of S-4 looking aft with Nelseco 8-EB-16 engines. From Diesels for the First Stealth Weapon

Although these submarines and their ill-fated diesels enjoyed short life spans, they and the large, interim V Class boats pioneered what became the American fleet submarine of the Second World War. Even so, the old S Boats with their less than satisfactory engines would be forced to serve on war patrols or as training boats until they could be replaced. Thirty-one of these remained in commission at the outbreak of war.

The first of the ocean spanning fleet submarines with General Motors (Cleveland/Winton) V-16 diesels was commissioned in 1935. This evolving design, along with the Fairbanks-Morse 8, 9 and 10 cylinder in-line, opposed piston, twin crankshaft engines (built under a Junkers license) both went through their own growing pains which have been well documented.[4]

A third engine also powered early Second World War submarines. It was the Hooven-Owens-Rentschler, or H.O.R, 8 cylinder engine, the first of which went into the Salmon (SS-188) in 1938.[5] Ensuing engines were 9 cylinder models of 1535 hp at 700 rpm. The H.O.R was two stroke, like the GM and FM submarine engines, but the H.O.R engine was distinctive in being double acting. This engine's power to weight ratio was the best by far of the three authorized designs, but this advantage was bought at a price. Having a combustion chamber on both the top and bottom of the pistons meant every stroke was a power stroke. A piston rod rigidly attached to the piston passed through a sliding seal at the lower end of the cylinder. The rod's lower end was attached to a vertically sliding *crosshead* which anchored the top end of a conventional connecting rod. This design had long been used on large steam and diesel engines. Unfortunately, it was not yet a suitable submarine engine. Twenty boats had these, and their record was dismal with mechanical, sealing and heat related problems.

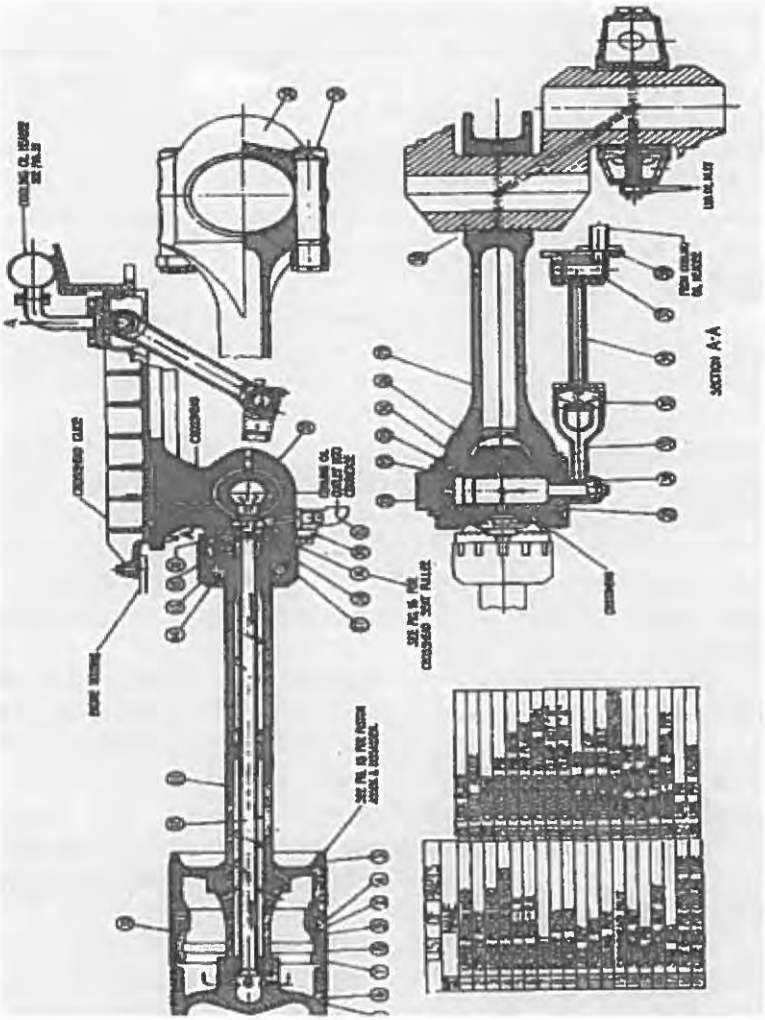


Figure 2 Diagram of the H.O.R. double-acting piston and rod with crosshead and its guide.
From Diesels for the First Stealth Weapon

Enginemen and Machinist Mates had their hands full in making repairs to engines and in particular to the internal gearing. A case in point was the experience of USS GUNNEL (SS-253).

In November of 1942 the boat was underway to its destination in England. The journey was characterized by the enginemen's frustration in trying to keep the H.O.R. engines running. The name of the engine lent itself favorably to the profanity of those in the engine rooms. The following was taken from, "USS GUNNEL (SS-253) First War Patrol" by RADM Joe Vassey and Mr. Jim Lavelle which appeared in the July, 2007 issue of THE SUBMARINE REVIEW.

"The engine casualty became apparent when an unusual noise was heard in the after part of No. 1 engine. It was immediately secured by the engine room watch. The control room crew was alerted to the seriousness of the problem when Chief Motor Machinist Mate E. W. Murphy passed through their station on his way to see the Captain. It was clear from Murphy's grim expression and lack of his usual banter that whatever he was holding in his hands, cupped together in front of him, represented some major casualty in the engine room. It would soon be learned that Murphy was carrying pulverized metal from Number 1 main engine."

All four of Gunnel's H.O.R. main engines suffered casualties that could not be repaired while at sea. The worst of these was the stripping of gear teeth which was later attributed to micro-cracks in the casting of the gears. Gunnel made its way to England making 2.5 knots on the surface using its auxiliary engine. Upon reaching port the crew made extensive repairs using parts flown to England. It then made its way back to an American port where more extensive repairs were affected.

The Gunnel story was typical of those Fleet Type submarines equipped with H.O.R. engines. Although Commanding Officers complained bitterly of their poor performance, the last engines remained in service until 1944.

America was not alone in experiencing diesel engine teething problems. In Great Britain the Admiralty grew increasingly concerned by 1913 over serious delays in Vickers releasing its new diesel for the Royal Navy's more modern E Class boats. It sent Engr.Lt. William F. Rabbage to work for Vickers to help

solve the engine delivery problem.[6]

There he found that the smoke/power troubles were mainly in the injector nozzle design for its new common rail fuel system. His trial and error solution was then used in all of the Vickers diesels. The ensuing 12 cylinder, 100 hp/cylinder engines would become the backbone of the British submarine fleet.

That same year, Vickers lost its contract with the Admiralty as the sole supplier of submarines to the Royal Navy. Until then, it had controlled both the hull and engine designs. Ongoing disputes grew between Vickers and the Admiralty over differing design philosophies. One involved the hull's engine bed rigidity. Vickers had designed the engine and its hull mounting as a unit, but the Admiralty's L Class boat engine bed stiffness was greatly reduced without consideration of the Vickers engine demand for greater longitudinal strength. Rabbage later referred to the 12 cylinder engines in these L boats as the Vickers' *Underslungs*, meaning that they were hung by their exhaust manifolds.[7]

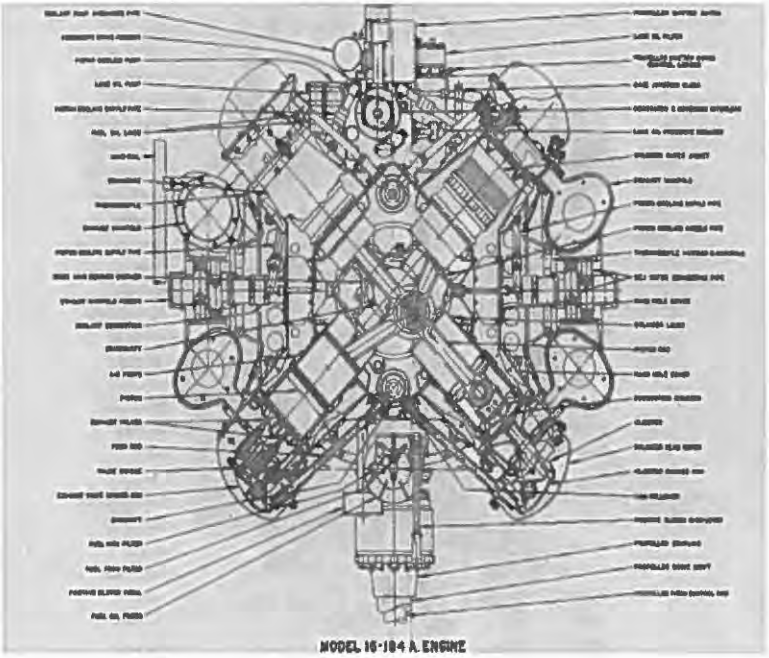
One outcome of these quarrels was the transfer of all submarine engine developments to the Admiralty Engineering Laboratory (A.E.L.). This resulted in a long series of designs having inherent structural and dynamic weaknesses. The A.E.L. also abandoned the common rail fuel system where fuel was hydraulically injected. It instead reverted to the earlier air injection method where high pressure air blasted vaporized fuel into cylinders. While this system reduced exhaust smoke, the Admiralty complained that the Vickers engine would require a problem-prone, multi-stage air compressor. Meanwhile, those not so constrained were working on hydraulic injection systems to eliminate the troublesome compressor. Vickers continued using the improved common rail system on engines being sold to foreign navies.

The Vickers-A.E.L. conflict continued up to the doorsteps of the Second World War. By that time the Admiralty had designed and was building its T Class ocean going submarines still without a reliable A.E.L. diesel which was still undergoing tests at its Chatham Naval Dockyard. Vickers, also building T boats, was by necessity authorized to install its proven engine with a common rail system based on experience gained on those used by the numerous foreign navies. Even so, the Admiralty continued

proposing other designs. Shortly before war broke out, it bought Sulzer and M.A.N. licenses and assigned British companies to make the engines. The M.A.N. engines, built by Scott Shipbuilding were failures in the three T boats receiving them. The Sulzer engines likewise suffered from builder inexperience and A.E.L. design changes, although they did gain a credible service performance by war's end.[8]

The Royal Navy faced a spare parts problem during much of the war because of a plethora of engine types. With four different designs in the T boats alone, plus the engines for older as well as smaller submarines, spares for 14 makes and models were needed.[9]

At war's end, the Type XXI German submarines captured by America were so remarkably superior to the Fleet Type submarine, the Navy immediately set about to build an attack class boat that would incorporate many of the German innovations. Once again, the designers sought a light-weight, high-output diesel engine. The Tang class submarine was to be considerably shorter than the Fleet Type boats and the single engine room had to accommodate both engines and generators. While the Guppies of the time had 53 feet of hull length devoted to main propulsion, the Tang class boat was to have almost the same total horsepower output in 22 feet of hull length. To accomplish this, the Navy centered its attention on a radial diesel engine. The GM 16-338 (surface ship model number 16-184A) had four decks of four horizontally arranged cylinders. These 16 cylinders turned a vertical crankshaft that drove a generator below the engine. Four of these engines with generators were crammed into the 22 foot compartment.[10]



The GM radial diesel. From the Lyle Cummins collection.

Engineers of Cleveland Diesel Engine Corporation, a division of General Motors hadn't sufficient time to test the new type of engine in a submarine. Navy 110 foot submarine- chasers used these vertical crankshaft engines which were geared with right angle drives to the propeller shafts. These proved to be passably reliable, but the demands of a submarine were much more severe. The Navy had a shipyard schedule to keep and the result was the installation of an engine of unproven quality.

Diesel engines run at specified speeds. The opposed-piston, twin-crankshaft Fairbanks-Morse ran at 720 rpm and the General Motors at 750 rpm. The GM 16-338, *Pancake* engine ran at 1600 rpm, approximately twice the speed of the earlier Fairbanks-Morse 1,600 hp, 38D 8 1/8 engine and General Motors 1,600 hp 16-278A engine. Engine room noise was likewise excruciatingly increased.[11]

A sweat-soaked engineman on USS WAHOO (SS-565) poses next to his engine. From Submarine Research Center collection

USS TANG (SS-563) and USS WAHOO (SS-565) were the first boats completed. WAHOO's engines experienced some difficulties on the way from mainland USA to Pearl Harbor. TANG's engines were so severely damaged during the trip its WesPac tour had to be canceled and the boat went into the shipyard for repairs. The Tang class boats were to suffer from the age-old desire to get more power from less weight. In the cramped space, enginemen and electricians, struggled to keep some of the engines going. Soon torpedomen and auxiliarymen were pitching in. It was a twenty-four hour, non-stop effort. The engines vibrated from their light weight and rubber sound mountings, causing parts to fail. Lines ruptured and gaskets leaked. Oil and cooling water dripped down into the generators causing grounds and shorts.

The GM 16-338 engine was also used in USS ALBACORE (SS-569). One of its executive officers, Lou Urbanczyk, listed the engine's weaknesses, ". . .weak retainers for piston rods. . .the spherical thrust bearing at the bottom of the engine wiped. . .the expansion joint for the exhaust kept breaking, not flexible enough. . .etc."[12]

Commander David A. Kratch, commanding ALBACORE, later wrote, "Their unreliable operation is well documented in the annals of naval history. . .The number of overhauls have precipitated the following operating restriction; if one engine fails, immediately return to port."[13]

ComSubLant, Admiral E. W. Grenfell noted that the unreliability of the pancake diesels required that a surface vessel accompany the ALBACORE or that the boat could not operate beyond sight of land.[14]

The Navy gave up on the GM 16-338 *pancake* engine. It extended the Tang Class hull length to accommodate well-proven Fairbanks-Morse engines. With the advent of nuclear propulsion the problems involving submarine diesel engine design faded into obscurity.

ENDNOTES

1. Lyle Cummins, *Diesels for the First Stealth Weapon, Submarine Power 1902 - 1945*, Carnot Press, Wilsonville, Oregon, 2007, p. 234, 239
2. Ibid. p. 350
3. Ibid. p. 234
4. Ibid. p. 665 – 700, 709 - 724
5. Ibid. p. 188
6. Ibid. p. 206
7. Ibid. p. 562
8. Ibid. p. 410
9. Ibid. p. 564
10. Norman Friedman, *US Submarines Since 1945*, Naval Institute Press, Annapolis, Maryland, 1994, p. 27
11. Cummins, p. 736 and Friedman, p. 27.
12. Robert P. Largess and James L. Madelblatt, "USS Albacore, Forerunner of the Future", *Portsmouth Marine Society Publication 25*, Portsmouth, New Hampshire, 1986, p. 89
13. Ibid. p. 134
14. Ibid. p. 137

THE DEVELOPMENT AND EVOLUTION OF THE FBM SYSTEM
A CLASS OF 1946 COLD WAR STORY

by RADM Robert H. Wertheim, USN (Ret)

The Cold War spanned the entire period of our years of service--from the end of WW II to the dissolution of the Soviet Union. What follows is an account of the part we played in creating and maintaining a sea-based strategic nuclear deterrent that for over 50 years helped keep the Cold War cold and allowed it to die in a whimper, not a blast.

In the winter of 1947, three classmates, Jack Fagan, George Foglesong and Bob Wertheim, received secret orders to report to Sandia Base for duties in connection with the "military applications of atomic energy". We later learned that we had been selected by the Assistant Chief of the Bureau of Ordnance, RADM William S. Parsons, to be members of the Navy's first nuclear bomb assembly team. RADM Parsons, who had been Dr. Robert Oppenheimer's deputy at Los Alamos during the Manhattan Project, wanted to include three young officers who might build their future careers in nuclear weaponry.

As it turned out, each of us did just that. All three of us went on to take ordnance engineering postgraduate degrees in nuclear physics at MIT. Jack's later career as a submariner led him to command two nuclear submarines: the attack sub USS SHARK, and POLARIS armed SSBN USS LEWIS and CLARK. George left the Navy after graduating MIT, but spent much of his later career designing nuclear weapons at Los Alamos. As an Ordnance ED, I was shanghaied very early on into the new Special Projects Office (SP) and its Fleet Ballistic Missile (FBM) program. Most of the remainder of my Navy career was spent at various levels of responsibility for the FBM systems described below.

First, let's set the stage: In 1955 U. S. intelligence reported rapid Soviet progress in their nuclear program and there was grave concern that the U. S. might find itself facing a nuclear ICBM threat with no comparable capability to counter it.

A presidential commission under MIT's James R. Killian Jr. recommended that the ongoing Air Force ICBM development

program risks be hedged by deploying the Army's 1500 nm JUPITER IRBM at sea in order to bring Soviet targets within missile range as soon as possible. In response to this charge, the CNO, Arleigh Burke, created the Navy Special Projects Office in December 1955, and named a newly selected Rear Admiral (later Vice Admiral) Red Raborn to carry out the Navy's role in this shotgun wedding with the Army. SP was less than 6 months old when I reported for duty in June of 1956, with the joint Army-Navy program by then well underway.

A moment to describe the Army's JUPITER missile: A large, single stage, liquid propellant rocket, carrying a 3500 pound payload to ranges of up to 1500 nm. It was being developed under the technical direction of the German rocket scientist Dr. Werner von Braun and his team who had developed the V-2 during WW II.

The Army Ballistic Missile Agency in Huntsville was responsible for modifying their land based JUPITER, working with the Navy's SP who had responsibility for developing launching and handling, navigation, fire control, test instrumentation and other ship systems necessary to adapt Mariner class merchant ships to take this weapon to sea. The system was to be available for operational evaluation in 1960.

Once into the program however, the Navy set its sights on ultimate replacement of the liquid missile with a solid propellant version of JUPITER that would be suitable for submarine deployment. The solid propellant would alleviate the serious handling and storage problems associated with liquids at sea. The goal was to have such a system ready for evaluation by 1965.

The JUPITER (S) would have been huge: over 41 feet tall, 10 feet in diameter and weighing over 80 tons. A specially designed submarine carrying four of these monsters would have been the largest in the world to that date. It would have had to come to the surface to elevate and launch missiles--a hairy proposition, at best.

Meanwhile, during that summer of 1956, the Office of Naval Research sponsored a study on undersea warfare. It was at that meeting that Dr. Edward Teller asked a provocative question: "Why is the Navy designing a 1965 weapon system with 1958 technology? He then went on to project dramatic improvements in the yield-to-weight ratios of nuclear weapons that would permit

reduction in the weight of a megaton warhead by almost a factor of three. If Teller's prediction could be realized, the potential implications for making a dramatically smaller solid propellant missile were electrifying.

Admiral Burke asked Raborn to provide an independent assessment as quickly as possible. To perform the trade off studies and to define the envelope parameters of a new system, teams were assembled for each of the weapon subsystems, including the missile, its launching and handling system, fire control and guidance, navigation, test instrumentation and the submarine itself. My responsibility was to lead the re-entry body team doing the studies of missile payload size and performance factors, including weight, accuracy and warhead yield.

In three months of intensive work, SP with its supporting contractors and government agencies defined a completely new system concept we called *Polaris*. The payload my reentry team proposed was reduced from the Jupiter's 3,500 pounds to less than 850 pounds. Along with the promise of a smaller and lighter guidance system by MIT's Charles Stark Draper and by applying new high energy solid propellant motor technology, the overall missile size and weight was projected to come down by more than a factor of four. Such a missile would be small enough to be carried vertically within the pressure hull of existing nuclear attack submarines. (As it turned out, the first SSBN, USS GEORGE WASHINGTON was originally laid down as an SSN, USS SCORPION which had a 133 foot hull section inserted for the POLARIS launchers and missiles.) We considered conceptual submarine designs with as many as 128 missiles. The final choice of 16 was a compromise between cost effectiveness which argued for more, and operational flexibility and construction risks which argued for fewer missiles per submarine.

In December 1956, the Secretary of Defense authorized the Navy to proceed with *Polaris* and terminated the joint Army-Navy program for *Jupiter*.

Program success would require breakthroughs in a number of technical areas including: development of a small, proven thermonuclear warhead, high-energy solid missile propulsion, underwater missile launch, and precision navigation, fire control and guidance to accurately strike strategic targets at ranges up to

1500 nautical miles from a moving platform at sea.

Each of these and many more were successfully achieved, and on November 15, 1960, GEORGE WASHINGTON, the first of the 41 for freedom, departed Charleston on operational patrol with 16 nuclear armed POLARIS A-1 missiles--just under 4 years after the program was authorized.

To give you a feel for the kind of support this project had from on high, this is a quote from a 1955 letter, then classified Top Secret, that Admiral Burke wrote to Raborn:

> "If Rear Admiral Raborn runs into any difficulty with which I can help, I will want to know about it at once along with his recommended course of action for me to take. If more money is needed, we will get it. If he needs more people, those people will be ordered in. If there is anything that slows this project up beyond the capacity of the Navy Department we will immediately take it to the highest level and not work our way up through several days. In taking this type of action we must be reasonably sure we are right and at least know the possible consequences of being wrong because we will be disrupting many other programs in order to make achievement in this one if we are not careful. That is all right if we really make an achievement.
>
> "The Air Force has got a tremendous amount of enthusiasm which they demonstrate behind their project and we must have even more. The awards should be made to companies as soon as possible and our major contract awards, I think, should be made by the 15th of December."

The letter was dated 2 December 1955.

Suffice it to say that the project was conducted under intense schedule pressure. The initial operational availability date for the system was advanced from 1965 to 1960 in the wake of the Soviet launch of SPUTNIK in October of 1957; a year before the first flight test of a U.S. ICBM.

The only way to make such a compressed schedule was by doing everything in parallel, including pursuing alternative technical approaches and releasing designs to production long

before development testing was complete. (Such concurrency is all but forbidden under today's government procurement regulations.)

In any event, as our early test missiles were raining from the sky over Cape Canaveral, we learned to use a new code. For example: *Successful launch* could mean "didn't blow up until after leaving the launch pad" *Successful first stage flight* might mean "went out of control and was destroyed during second stage flight" and so on and on.

We had six such flight tests before the first one flew far enough to get out of sight of the launch area. Of the first 17 POLARIS flights, only 5 flew as planned. (The program would probably have been cancelled if today's policies and regulations had applied. So far as I know, this was never even considered.)

Of absolutely central importance to FBM program success was the relationship that SP was able to establish with its contractors. The notion of a government-industry/civilian-military team was for real, not just lip service. SP was allowed to use cost plus fixed fee, level of effort contracts; we pioneered automated planning tools; we focused on exception reporting--never shooting the messenger but rather encouraging the bearers of bad news (in Raborn's words these were always *challenges*, never "problems"); and we had the support of everyone from the President and the Congress to the media and on down to the most junior military and civilian employee in the field.

Like ADM Rickover's Naval Reactors, Special Projects retained cradle-to-grave responsibility for each of its successive generations of FBM systems. POLARIS A-1, A-2 and A-3, POSEIDON C-3, and TRIDENT C-4 and D-5 provided increased reliability, range, payload and accuracy in response to perceived Cold War Soviet ASW and ballistic missile defense (BMD) threats and to meet new targeting requirements. For the initial operational missile, POLARIS A-1, schedule had overriding priority when making trade-offs with system performance. As a consequence, the missile deployed on GEORGE WASHINGTON in 1960 was less reliable, had a shorter range and a lower warhead yield than the goals that had initially been set for a 1965 IOC. Those performance compromises were all recovered in the 1500 nm POLARIS A-2 which commenced deployment on ETHAN ALLEN 18 months later.

Desire for increased operational flexibility and hedging against postulated Soviet ASW and BMD threats were reflected in the 2500 nm range and the multiple warhead payload of POLARIS A-3, first deployed in DANIEL WEBSTER (SSBN 626) in September of 1964. The A-3 was also made available to the United Kingdom under the terms of the US-UK Polaris Sales Agreement and was deployed in the 4 Resolution class SSBNs.

When in 1964 the Soviets unveiled their ABM system for the defense of Moscow, we were alarmed to find that the system could be vastly more capable than had been postulated. Because of the combination of radar frequencies, interceptor warhead size and engagement altitude, all existing U.S. missile penetration aids would have been ineffective. This led to the development and in March 1971 the first deployment on JAMES MADISON of POSEIDON C-3. POSEIDON had improved accuracy and double the payload of A-3, and with multiple independently guided reentry vehicle (MIRV) capability, it provided unprecedented flexibility to trade off range for payload as needed to assure penetration of potential defense systems.

The genesis of TRIDENT was the 1966-67 OSD-sponsored "Strat X" study of alternative future strategic missile basing systems. The measure of effectiveness used was life cycle costs for a given amount of surviving effective payload on target in a worst case second strike scenario. The clear winner in that contest was a large, very stealthy new submarine carrying many large missiles with intercontinental range.

Such range capabilities were first provided in October 1979 by deployment of TRIDENT C-4 in existing SSBN's (starting with FRANCIS SCOTT KEY and later in the new OHIO class TRIDENT subs) that eliminated the need for tenders overseas and made vast new ocean areas available for alert patrols.

The C-4 was followed in 1989 by the large new Trident D-5 which could only be carried by Ohio class Trident SSBNs. With a combination of greater range, accuracy and payload, the Trident D-5 weapon system can hold at risk the full spectrum of strategic targets.

So this is the end of my Cold War story.

The original 41 POLARIS submarines have now all been retired--replaced by a numerically smaller, but far more cost-

effective force of 14 Tridents.

What was once an "oh, by the way" Navy hedge against delays in ICBM development, has become the dominant leg of our strategic triad, and now constitutes over 50% of the U.S. nuclear deterrent force. The consequent deterrence of major warfare between advanced states has been a crucial 20th century success story, and members of the class of 1946 were important contributors to it.

As for the future, I quote from the year 2000 congressional testimony of Admiral Rich Mies, Commander in Chief, U.S.Strategic Command before the Senate Armed Services Committee:

> "Ballistic missile submarines will continue to carry the largest portion of our strategic forces ... With approximately two-thirds of the force at sea at any one time, the SSBN force is the most survivable leg of the triad, providing the United States with a powerful assured retaliatory capability against any adversary ..."■

P.S. Here is a list of my1946 classmates who played significant roles is this story:
Dixon Lademan, who served tours in SP in POLARIS missile technical plans and later in POSEIDON test operations.
Sam Anders, who served both at sea and at SP headquarters.
Jack Fagan, mentioned earlier as LEWIS AND CLARK (SSBN 644) Commanding Officer.
Jim Burrill, who served in SP headquarters test operations and later as CO of the Naval Ordnance Test Unit at Cape Canaveral.
Al Whittle, ANDREW JACKSON (SSBN 619) CO and later as Chief of Naval Material was the reporting senior for the Director, Strategic System Programs (SSP).
Harvey Lyon, CO of USS ALEXANDER HAMILTON (SSBN 617) and later as Director, PM-2 responsible for coordinating TRIDENT SSBN construction and weapon system development.
Chuck Griffiths served as XO and CO of ROBERT E. LEE (SSBN 601), CO of SIMON BOLIVAR (SSBN 641), and Commander Submarine Squadron 15.
Joe Russel who served at sea as an SSBN CO and in SP headquarters responsible both to the Director and to COMSUBLANT for FBM weapon system test and evaluation.
George Dickey served as Navy SP representative to Air Force Advanced Ballistic Reentry Systems project office at Norton Air Force Base.

Chuck Grojean was XO of PATRICK HENRY (SSBN 599) and CO of THOMAS JEFFERSON (SSBN 601).
Bernie Heesacker, ComOpTevFor representative at SP headquarters and Weapons Officer on FBM test ship OBSERVATION ISLAND (EAG 154).
Bob (Yogi) Kaufman, ComSubRon 14 staff planner in OpNav, CO of WILL ROGERS (SSBN 659), and OpNav Director of Strategic Submarine Development
Al Kulik, XO of HUNLEY (AS 31) in Holy Loch, Scotland, and later tours in OpNav for POLARIS plans and as Director, Navy Strategic Command and Control Division.
Saul Levine, served on technical staff in SP headquarters.
Mitch Mitchell, as civilian engineer worked on POLARIS solid motor development at Aerojet General and later at Vitro Laboratories in SSBN configuration management.
Sandy Sandford, CO, JAMES MONROE (SSBN 622) and later as CO of FBM Training Center, Charleston.
Joe Skoog, CO of JAMES MADISON (SSBN 627) and later SubPac Assistant Chief of Staff for POLARIS.
Stan Smith, CO of DANIEL WEBSTER (SSBN 626) of FBMTraining Center.
Larry Stahl, SSBN CO and XO of POLARIS submarine tender.
Jack Walsh, CO of THOMAS JEFFERSON (SSBN 618).
Backie Yerbury, SP headquarters staff responsible for developing POLARIS long range R&D concepts.


MAST 2009 KISTAMÄSSAN, STOCKHOLM, SWEDEN 21-23 OCTOBER 2009
The Fourth Annual MAST will take place in Stockholm Sweden between 21–23 October 2009 with the official endorsement of:
FMV
FOI
Swedish Defense Materiel Administration (FMV)
Swedish Armed Forces
Swedish Defence Research Agency (FOI)
Swedish Coast Guard
Norwegian Armed Forces
Finnish Defence Forces
SAAB
LOCKHEED MARTIN
OES
OMG
TNC
IEEE
SUT
NURC
DGA
ADSO
NAVAL SUBMARINE LEAGUE

ROLE OF POLARIS SUBMARINES IN THE CUBAN MISSILE CRISIS

by VADM Charles Griffiths, USN(Ret)

My classmate Bob Wertheim has written a superb Sea Story entitled THE DEVELOPMENT AND EVOLUTION OF THE FBM SYSTEM which describes in detail the significance and scope of the tremendous National effort in progress at the time of the Cuban Missile Crisis to achieve dominance over similar efforts in the Soviet Union. Actually only five of the forty one planned Polaris submarines were deployed at the time of crisis with several others in various stages of construction and preparation for deployment. The deployment site was at Holy Loch, Scotland, the homeport where the families lived was New London, CT

USS ROBERT E. LEE (SSBN 601) was one of the three SSBNs on patrol in October, 1962 at the time of The Cuban Missile Crisis and I was in Command. It was my first patrol as CO although I had been the XO for the previous three Blue Crew patrols. The XO, Pete Cady, had been the Blue Crew Engineer since pre-commissioning. We both knew our ship and crew very well and the ship's company knew us as well. This was to be a short thirty day patrol followed by a return to the Holy Loch to exchange exercise heads for warheads on six of our missiles. This was to be followed by proceeding to the South Atlantic to fire the exercise missiles into the Atlantic Instrumented Range from simulated patrol status. This would have been the second Follow on Test (FOT) of the Polaris A1 System; USS GEORGE WASHINGTON having recently fired the first.

We were excited about being chosen to fire the FOT and were thoroughly checking out the entire System to ensure we would experience no surprises that could hamper the FOT.

Meanwhile we were kept advised by our Operational Authority (CINCLANT) on the startling news that intelligence was showing the Soviets to be installing medium range ballistic missiles in Cuba. I kept the ship's company apprised of the news

while discussions in the wardroom and crews' mess switched from FOT to more somber considerations of what the news might mean for us. Our suspicion that FOT would be cancelled and our patrol extended shortly came to pass and we proceeded to the highest state of readiness. The President announced words to the effect that any missiles fired from Cuba would be considered as fired from the Soviet Union. We understood we might well be called upon to fire our sixteen Polaris A1 missiles at targets in the USSR and we were fully ready to do so. It was up to the President and God to avoid Armageddon.

We were all mindful that our loved ones were in imminent danger and that we could be facing an unbelievable future. Yet we would have fired as ordered and no one on board would have tried to prevent it.

Simultaneous with going to the highest Defcon the Navy urgently worked to get the two submarines alongside PROTEUS ready and out to sea. Both were undergoing repairs to pumps, motors, electronics and weapons as well as loading of supplies. In the case of USS ABRAHAM LINCOLN (SSBN 602) a load-out of several torpedoes was involved. Incredible as it may seem both ships were underway and clear of The Holy Loch within a span of 24 hours. Understandably many repairs had to be completed while enroute to their patrol areas in the Norwegian Sea.

The Soviets kept a trawler (AGI), equipped for electronics and communications surveillance, stationed close enough to the Holy Loch to keep track of traffic in and out of the port. Most certainly the Soviet High Command knew there were five SSBNs within range of targets in the Soviet Union with 80 nuclear weapons on board. This must have given the Soviet leadership food for thought. To add to their concerns the AGI would have reported that Holy Loch was now empty since PROTEUS, tender to the submarines, was also at sea.

We will probably never know what really caused the Soviet leadership to back down and announce they would remove the missiles from Cuba. I believe at least one cause must have been those 80 nuclear warheads aimed at Soviet targets from unknown locations in the nearby sea. The destruction would be more than 40 times that at Hiroshima and Nagasaki!

Our patrol lasted 68 days. It was supposed to be a short patrol

before returning to the Holy Loch to exchange exercise heads for warheads. So the Squadron Catholic Chaplain joined us from his office in Groton, CT. There he might better understand what it was like to experience a Polaris Patrol.

He ran out of wine for communion after 40 days, but learned what it was like to experience a fully active patrol. Our leading cook got into a bit of trouble with his shipmates for running out of sugar several days before completion of the patrol.

The ship ended the patrol in good condition, ready for the turnover to the Gold Crew. We conducted a second Polaris A1 FOT after our next patrol, but that's another story.■

REUNIONS

USS PIPER SS-409 Aug 14-16, 2009 Groton, CT
POC: Frank Whitty e-mail Whitty409@aol.com
Web Site: http://webpages.charter.net/usspiper/index.html

USS ALEXANDER HAMILTON SSBN-617 Sep 2-6, 2009
San Diego, CA
POC: Prank Bonafede, 157 Via Montisi, Santee, CA 92071
Phone 619-306-0324 E-mail: SSBN-617@HullNumber.com

USS JAMES MONROE SSBN-622 Sep 7-11, 2009
San Diego, CA
LOC: own & Country Resort, San Diego
POC: Robert J. Miller, 1021 Glenmere RD, Vista, CA 92084
Phone: 760-519-7730 E-mail: BobM593@gmail.com

USS VOLADOR SS-490 Sep 7-13, 2009 San Diego, CA
POC: Andrew Steiner 5475 Topaz Street, Fort Mohave, AZ 86426
Phone: 928-234-0858 E-mail SS-490@HullNumber.com

USS SCORPION SSN-589 Sep 8-12, 2009 San Diego, CA
Loc: Crown Plaza POC: Len Reneau E-mail: laddreneau@hotmail.com

USS DOGFISH SS-350 Sep 9-13, 2009 Mt. Pleasant, SC
Loc: Quality Inn & Suites at Patriots Point
POC: Frank Young Phone: 843-553-5593 E-mail: fiysky@yahoo.com
Web Site: http://www.ussdogfish.com

USS POGY SSN-647 Sep 10-11, 2009 San Diego, CA
POC: Jack Burdick E-mail: jackburdick@cableone.net

SUBMARINES IN EARLY U.S. NAVAL INSTITUTE PROCEEDINGS PART II

by Mr. John Merrill

Mr. Merrill is a frequent contributor to THE SUBMARINE REVIEW and is a published author of several books on the history of undersea technology. He is a retired engineer with lengthy experience at the New London lab of the Naval Undersea Warfare Center. He currently lives in Waterford, CT.

Part I appeared in the April 2009 issue of THE SUBMARINE REVIEW.

Introduction

From 1874, Naval Institute Proceedings, the journal of the Naval Institute, has provided an independent window dedicated to Navy matters with articles from military professionals and civilian experts. Through the years and especially after the Navy's April 1900 purchase of HOLLAND submarine, commentaries directed to submarines have appeared in the Proceedings. A bibliography of submarine commentary in the Proceedings from 1903 to 1992 that appeared in the January and April 1994 issues of THE SUBMARINE REVIEW reveal more than 200 hundred articles, most with the word *submarine* in the title. The intention is to look again at some representative articles of how the submarine was perceived in the pre-WWII period by Navy officers and others.

The Value of the Submarine in Naval Warfare *

Proceedings, May 1926

Rear Admiral Arno Spindler, German Navy

Like other submarine-related Proceedings articles in the middle and late 1920s, Spindler's essay immediately addresses the issue of "... the extension of the restriction of naval armaments to the submarine."[1] Other aspects of the significance of the

* Commander W. P. Beehler, U. S. Navy, retired, translated the 21-page article.

submarine are supported by data and observations about the wartime activities of the German submarines. Comments regarding the future of the submarines are based on careful examination of the wartime experience. The article stresses the strength of the submarine in the military role. It does not address the interrupted use of the submarine in the intense commerce raiding that began in 1917.

During WWI, Spindler was assigned to the German Ministry of Marine in the section charged with construction and development of submarines. He was considered a leading authority on submarine warfare and published four of the official histories of the First World War U-boat campaign. In 1929, Spindler became head of German anti-submarine warfare.

An appropriate comment made by the author sets up the value criteria for the submarine. "In the same sense that we speak of a 'fleet in being,' a fleet which exerts its *effectiveness merely by its presence*, ... we can apply this idea to the submarine weapon.[2] This view is supported in many ways but the vast antisubmarine effort taken in both world wars is an example of the response to the *fleet in being*.

The essay establishes that prior to the war in 1914 no preparations were made by the German Navy for the employment of submarines against enemy commerce. The number of submarines available at the beginning of the war was in agreement with the military estimate of the number required as auxiliaries in naval warfare, not commerce raiding.

As Spindler's careful analysis of German WWI submarine strategy against England points out, it was heavily driven by the geography of the primary areas of operation. The German Bight, located in a small triangle of the North Sea with the submarine bases close together, was much easier to blockade with mine fields than a long coastline with scattered harbors. The narrow channel between Dover and Calais and the stretch of water between Norway and Scotland allowed blocking of submarine routes. German submarines found it further time consuming to go on station west of England to interdict overseas trade. A Heligoland-based submarine needed about two weeks of a three-or four-week operation to go and return from station. With 60 submarines in service at the North Sea bases during the summer of 1917, there

were on the average only 23 at sea at one time.[3]

Perhaps the crucial importance of adapting submarine strategies and needs to the geography of where some future unknown encounter might possibly occur is Spindler's mid-1920s gift to the reader in the 21st Century.

The September 1914 German submarine antiwar ship success demonstrated to the Germans the Allies' lack of suitable means for combating the submarines. According to Spindler "...the complete discontinuation of the submarine warfare from the summer of 1915 to the beginning of 1917 which gave the allied nations the time to develop and organize their anti-submarine offensive on a large scale after the short flare-up of the submarine warfare 1915 had made them aware of the danger."[4] In this period, mines and depth charges became effective enemy antisubmarine measures. Of the 166 German submarines destroyed, 37 were lost due to mines and 33 by depth charges. The effectiveness of the English convoy system was recognized as an exceedingly great obstacle to the German submarine.5 The end of the war saw Germany balancing the monthly loss of seven submarines per month with new construction.

Spindler observes that submarine warfare in the Atlantic and Pacific Oceans in addition to bases needed would require larger submarines with increased radius of action and good sea-keeping qualities. This view coincided at the time with current views held by some in the United States. His understanding of the submarine's military and non-military values provides guidance appropriate to today as well. This summarization and comment of his essay suggest that reading of the entire article may be valuable.

Throughout the article, the unique and exacting demands of submarine service, the technical needs of the boat, its complement and command are stressed. The importance of communications with the submarine is cited with examples given of its lack.

Sunderland Operation August 16-19, 1916

In this sea battle not long after Jutland, the German goal for the operation was to find some way to isolate and bring portions of the British Grand Fleet to battle. With few German at sea military operations during the war, Spindler uses this operation in the North Sea off England's east coast to present an early example of

a modern, but primitive, naval operations integrating air, surface, and sub-surface platforms, a step toward developing submarine operations in conjunction with the fleet.

A 2005 essay commented about the Sunderland engagement. "Understanding how the German High Seas Fleet dealt with the complexities of integrating these assets may help the U. S. Navy today learn important lessons as it tries to integrate network centric concepts into its operational doctrine."[6]

The German entourage moving toward Sunderland, in addition to battle cruisers and dreadnaughts, included screening support from eight zeppelins and 24 submarines. Moving lines of submarines were deployed so that British forces standing out from the north or south would have to pass over one of the lines of submarines. Although British forewarned by German activity sailed to encounter the German forces on the 19th of August there was no fleet encounter.

With the German commander of Submarine Forces embarked on one of the High Seas Fleet battleships, reports from the zeppelins and some of the submarines enabled the line of the submarines to be in the direction of the main enemy body. Six boats were stationed initially in the latitude of Sunderland another four boats directly across the mouth of the Humber. Six submarines sighted the enemy and five were enabled to fire torpedoes. Of the twenty torpedoes fired on the 19th and 20th by submarines, eight were hits. Cruisers Nottingham and Falmouth and one destroyer were sunk.

Admiral Jellicoe later emphasized the value of the submarine in a book. His comments noted the extensive submarine trap, submarines causing large alterations of course to avoid them, and light cruisers at highest speeds needing screening by destroyers even when proceeding at highest speed. "...Representations were made to the Admiralty to the effect that it was considered that in the future light cruisers should be screened by at least one destroyer per ship..." The submarine showed value when engaged in strictly military operations in naval warfare.[7]

Spindler's 1926 concluding remarks emphasize the future from technical and military standpoints. The submarine's field of activity would be increased, and it would become a more effective weapon in naval warfare, as would the methods of conducting

naval warfare to meet the submarine threat. The burden of future submarines cited included double machinery requirement (surface and submerged), speed, and radius of action and range of visibility. Finally, the submarine would increase in value for naval warfare "if its further development is not forcibly stopped by other means."[8]

Submarine Will Last Despite All its Foes Proceedings
December 1926
Professional Notes, Hector C. Bywater*
Baltimore Sun October 7, 1926

This pro-submarine article brings attention to the submarine's demonstrated success during WWI by both the Allies and Germans. Attention is directed to the U-boat operations not related to merchant ship sinking. At the time the essay was written, the author notes that the British were embarking on the construction of 24 submarines, and he contrasts this with the negative position of complete abolition or restricting submarines taken by the British at the Washington Conference several years earlier, (1921-22), and unsuccessfully again in 1930 at the London Naval Treaty sessions.

The Admiralty's long-lasting diffident view of submarines was first noted in 1804. Robert Fulton proposed building a submarine to the Admiralty. Prime Minister, William Pitt (the younger) was favorable. The First Lord of the Admiralty was opposed and, referring to Pitt, said, "was the greatest fool that ever existed to encourage a mode of war which those who commanded the sea did not want, and which if successful would deprive them of it."[9]

Bywater points out that in addition to the widely-publicized sinking of merchant ships, the U-boats took a heavy toll of Allied warship tonnage and that their presence in the various war zones was a source of grave embarrassment to the Allied naval plans all

* Hector C. Bywater (1884-1940), British naval correspondent for The New York Times and the Baltimore Sun, wrote a series of brilliant books and articles during the 1920s and 30s. He prophetically outlined naval strategies that would read like a blueprint for the Pacific Theater during WWII and establish his reputation as the successor to the great naval authority Alfred Thayer Mahan. (Reference, Visions of Infamy by William H. Honan)

through the war. The deterrent effect of submarines, present or not, forced the battleships that put to sea to steam at high speed and pursue a zigzag course that impacted fuel consumption with a consequent restriction of cruising endurance, a serious military disadvantage.

Bywater further highlights submarine effectiveness. German U-boats sank two British battleships in quick succession during a critical period of the Dardanelles campaign, causing the whole Allied fleet to withdraw to a fortified anchorage. Troops ashore were without the support of naval artillery. Two British battleships lost in the Dardanelles campaign were the IRRESISTIBLE and OCEAN. This could not be confirmed as a U-boat victory. Various historical sources indicate loss due to mines. The density of the watercraft limited U-boat operations in the Dardanelles.

The author suggests, "It is still a moot point whether Germany, by concentrating her submarines against the British fleet instead of using them as commerce destroyers would not have achieved more decisive results. There is scarcely any doubt that the former course of action, by rendering the North Sea untenable for Allied warships, would have made the British blockade exceedingly precarious and might even have reduced it to a farce. It was well for us that the German high command became obsessed with the idea of wholesale commerce destruction as a short cut to victory."[10]

Again addressing the British dichotomy of *in* or *not* in favor of submarines, the observation that the unending construction of 157 new British submarines built or ordered during the WWI years, even in 1917 when the popular cry was for mercantile tonnage and destroyers, points out that the War had shown the submarine to be absolutely indispensable. The laying down of 140 new submarines by the six leading powers during past few years is proffered to indicate the submarine has come to stay and will last.

A Brief for the Submarine * Proceedings, August 1928 Midshipman (now Ensign) Albert C. Burrows USN

* This article was adjudged the winner for 1928 of the gold watch presented by Dr. Henry van Dyke to the member of the graduating class submitting the best original article or theme on any naval or equally patriotic subject.

As a midshipman, Burrow's essay surprisingly brings out the importance of the submarine as a formidable naval weapon demonstrated during WWI, then ten years past. His defense of the submarine as an important component of the Navy's fleet is cleverly supported in several interesting and logical viewpoints.

With his strong pro-submarine brief, he mentions the persistent attempt by some to abolish submarines. It is surprising that eight years after the failed attempt at the 1921-22 International Washington Naval Conference to abolish submarines, this was still a topic to be considered. The earlier antisubmarine argument was the danger of the submarine to non-combatants. In contrast, the essay points out the broad support for airplanes that could also be used against non-combatants.

Submarine merits in the essay include a quote from the submarine designer Marley F. Hay. "It may be surprising to learn that in point of armament, radius of action and seaworthiness, a modern submarine already considerably surpasses any destroyer of equal size."[11]

A case for the submarine, even in its infancy of development, presents a proven record of its operational versatility. Scouting, advance guard, protection of trade routes and naval bases, and unsupported attacks on moving fleets and convoys are offered as examples.

Burrows points out the submarine's scouting role in the build-up to the First Battle of Heligoland Bight (August 28, 1914) during the early weeks of WWI. Heligoland is a small island in the North Sea off the German coast, sometimes referred to as Germany's Gibraltar of the North Sea. In the battle, the Royal Navy sank three cruisers and a destroyer with no loss. British submarines brought back valuable intelligence about German patrols that supported the British to plan and attack German patrols off the northwest German coast. Burrows notes in support of submarines as a deterrent that following the British triumph, pursuing the enemy was curtailed because of the presence of a flotilla of U-boats covering the German squadron, as well as mines.

The main impact of the British success confirmed the Kaiser in his determination not to risk the High Seas Fleet in any major encounters, and thus to confirm British control of the North Sea,

and the security of the blockade of Germany. The effect upon the German government and in particular the Kaiser was to restrict the freedom of action of the German Fleet, instructing it to remain in port and avoid any contact with superior forces.

In January 1915, the Battle of Dogger Bank, half way across the North Sea, was scene of a stern chase clash by British Grand Fleet ships with the German High Seas Fleet. Again a British win, the ubiquitous but not always present submarine impacted the actions. There were no submarines in the area. Acting Vice Admiral Beatty the leader of the British forces did not know this. This time it was a false submarine periscope sighting, fog, and poor communications that limited a greater victory by the British. Towing the damaged battle cruisers the British flagship Lion and Indomitable during their slow return to England demonstrates the strong influence of a potential U-boat attack. Under this threat, a screen of over 50 ships was assigned to guard the heavily damaged cruisers. The defeat at Dogger Bank brought a further pronouncement by the German Kaiser ordering fewer risks at sea.

Burrows supports the value of submarines during WW1: "For proof of the efficacy of the submarine, one need only recall that nearly 1500 armed vessels were required to patrol the largest mine field ever laid down in naval warfare to limit the activities of 100 to 150 U-boats issuing from their only bases on the German and Flanders coasts."[12]

The author comments that the best defense against submarines was found to be submarines. A strong summarization in the essay regarding the effectiveness of submarines states "Admiral Sims in *The Victory at Sea* points out that in proportion to the number of antisubmarine craft employed the Allied submarines destroyed three times as many German subsurface craft as Allied destroyers and twenty times as many as auxiliary patrol craft." Burrows in his concluding remarks consider submarines as underwater cruisers and points to the direction of submarine technology toward significant operational enhancement and performance. "The submarine is an American invention. It belongs to America along with the airplane, the steamship, and the telegraph. It is ours to keep, to improve, to perfect to use-but not to misuse."[13]

Career Note: A. C. Burrows (USNA Class 1928)
Member of 4th Command Class Submarine Base,
New London, CT February 1942
Commanding Officer
USS SWORDFISH SS 193, 5th War Patrol February-July 1942
USS WHALE SS 239, 3rd 4th ,5th ,6th
War Patrols Feb. 1943-Feb. 1944
USS SHENANDOAH AD-26, August 1945

The Effect of Depth Charges on Submarines Proceedings
March 1935
Lieutenant Commander Leonard Doughty, Jr., U. S. Navy

This essay, written eighteen years after the end of WWI, examines the effectiveness of the submarine countermeasure, the depth charge introduced during the War. The first reported depth charge attack on a U-boat was made July 20, 1915 in unsuccessful attempts by two British armed cruisers. Ten wartime depth charge sinkings or related to the sinking of U-boats are analyzed to support the essay title. Depth charge, deterring an enemy submarine from pressing home an attack, and the success of the Allied convoy system after April 1917 using depth charges against submarines are acknowledged as examples submarine counter measure.

Regarding submarine vulnerability Doughty draws on Admiral Jellicoe's 1920 *The Crisis of the Naval War*, citing a submarine danger ranges from depth charges exploded within 14 feet (destruction), within 28 feet (submarine disability), and within 60 feet (a demoralizing effect). Statistics on numbers of depth charges expended during the war by the Allies place the number at more than 38,000. With a total of 38 German U-boats sunk by this means, the average number of depth charges for each submarine sunk would be in the vicinity of 1,000.

Considering the submarine to be an important factor in any naval war of the future and the depth charge to again be the principal weapon in antisubmarine warfare, the author points to the need to study the effect of the depth charge on the submarine to determine the actual damage done and what measures might be

taken to reduce the submarine's vulnerability. Measures included "Greater ruggedness and resistance to shock in the depth-regulating mechanism, protection of the batteries and motors from entering water, and protection of personnel from gas."

Based on the accounts of the sinking or damage of various submarines given by the interrogations of survivors or by submarines' war diaries, it was found that in some instances repair of the damage from the depth charge was possible but that due to the frequent circumstance of enemy surface ships on the surface, the opportunity for repair was not present.

In all but one of the 1917-8 U-boat case histories examined in the essay, the submarines were sunk as a result of depth charges, ramming, gunfire, or in some combination of these. In three situations after extensive damage attacks on certain occasions lasted for more than a day. Three sinkings were the result of demolition by the crew of the submarine. Analysis attributes resilience for both the U-boats and the crews.

Summary of Lt. Doughty's Analysis
UC-26 (mine layer), July 9, 1917, English Channel, rammed by destroyer forward of conning tower, **depth charged**, bottomed at 150 feet; Internal pressure allowed hatch to be opened, two survivors.
U-58 November 17, 1917, south coast Ireland, **depth charged** (near stern) by USS FANNING, further depth charges and gun fire upon surfacing, U-boat crew placed explosive charges and open hatches sunk the U-boat; crew rescued.
UC-38 (mine layer), December 14,1917, Aegean Sea Gulf of Corinth, **depth charged** by two destroyers; Due to significant water leakage boat dead slow on one motor and down by the stern at steep angle. On surfacing boat was fired on by the destroyers and sank while crew abandoning ship.

U-110 March 15, 1918, northeast coast of Ireland, destroyer **depth charges** put the diving rudder motor out of commission. Boat dived to 334 feet, with increasing leakage. Boat surfaced under additional gun firing; crew jumped overboard. Although crew arrangements were made to sink the submarine, gunfire was used.

U-104 April 25, 1918, southeast coast of Ireland, upon sighting destroyer, dived to 98 feet. Second **depth charge** forced the stern down and admitted water into the motor room. Men in forward compartment attempted escape; one escaped, submarine sunk.

U-108 April 28, 1918, western approaches English Channel, USS PORTER convoy escort destroyer periscope sighting released two **depth charges** from stern at point of submarine's submergence, 6 seconds later 2 more from throwers, and additional 19 single **charges**. Post WWI U-108, assigned to France.

UB-72 May 12, 1918, English Channel, May 7 and 8, a total of 51 **depth charges** dropped on UB-72. First three from a dirigible (no damage), next a destroyer dropped 23 **depth charges**, May 9 destroyer dropped 20 **depth charges**, and a patrol boat dropped 5 more **charges**. UB-72 proceeded and patrolled without incident until she was torpedoed and sunk by British submarine D-4 at a range of 600 yards on May 12.

U-64 June 17, 1918, off Tunis in the Mediterranean, first **depth charge** jammed the vertical rudder, and probably the after vertical rudder, due to leakage the boat was down by the stern, trying to dive to 100 feet. The boat cycled through, breaking the surface and submerging. On the surface gunfire from three ships sank the submarine, there were five survivors.

UB-110 (mine layer) July 10, 1918, off the east coast of England, first **depth charge** exploded underneath the submarine, forcing her up, and jamming the forward diving rudder in the up position, another **depth charge** exploded aft, short circuited the port main motor and damaged a fuel tank, The submarine came to the

surface in spite of efforts to dive and was rammed, fired on, and rammed again, sinking the submarine.
UB-124 (mine layer) northeast coast of Ireland, breaking surface after a torpedoing was attacked with **depth charges** losing trim. Boat dived to the bottom at 282 feet; 50 **depth charges** were dropped during the next hour and a half, one hour later 5 more **charges.** Four hours later surfacing was risked, but as a result of the damage acid from the batteries generated gas. All hands were ordered on deck and the boat was sunk with demolition charges.

Conclusion

Of the ten U-boats encounters analyzed, nine were commissioned in 1917 and 1918. Between July 9, 1917 and July 26, 1918, all except one were sunk with the depth charge playing a significant role.

In the August 1936 issue of the Proceedings comment regarding Doughty's essay addressed future antisubmarine progress in areas such as placing depth charges with better precision and greater explosive power and better underwater detection of submarines. The article summarized the impact on the submarine; "The attack will be concentrated and not diffused, and the underwater vessel of the future, no matter how robust her construction is, may find herself has as bad and even a worse time of it from the depth charges than did the U-boats in the World War of 1914-18."[14]

Endnotes

[1] Rear Admiral Spindler, German Navy, The Value of the Submarine, United States Naval Institute *Proceedings*, May 1926, p. 835.
[2] *Ibid*, p. 850.
[3] *Ibid*, p. 840.
[4] *Ibid*, p. 839.
[5] *Ibid*, p. 839.

[6] Mike Edinger, "German Use of Composite Naval Force Operations in World War One", 2005, www.gwpda.org/naval/igncompf.htm
[7] Spindler, *op. cit.*, p. 849.
[8] Spindler, *op. cit.*, p. 854
[9] Thomas Parrish, *The Submarine,* Viking Penguin Group, New York, 2004, p. 173.
[10] Hector C. Bywater, Submarine Will Last Despite, All its Foes, *Proceedings*,
Professional Notes, December 1926, p. 2452.
[11] Ensign Albert C. Burrows, A Brief for the Submarine, *Proceedings*, August 1928, p. 644.
[12] *Ibid*, p. 645.
[13] *Ibid,* p. 646
[14] Maurice Prendergast, *Proceedings,* Discussions, August 1935, The Effect of Depth Charges on Submarines (see page 353, March 1935, *Proceedings*), p.1158.

ACCIDENT ON THE NEWEST RUSSIAN NUCLEAR ATTACK SUBMARINE NERPA

by Dr. George Sviatov
Captain 1 Rank (Ret. Russian Navy)

The K-152 sub's accident was an incident that occurred aboard the new Russian nuclear attack submarine NERPA, which was built for the Indian Navy, on November 8, 2008. It resulted in the death of 20 people and injuries to 41 more. Three of the dead were military personnel and the rest were civilians from the Vostok, Zvezda, Era and Amur shipbuilding yards, who were members of the acceptance team. The deaths and injuries were caused by unsanctioned release of fire suppressant gas during a submerged test run in process of the sub's sea trials in the Sea of Japan. The sub itself was not damaged by the incident, which was the worst Russian submarine disaster since KURSK sank in 2000.

At the time of the accident NERPA was undergoing sea trials at the Russian Pacific Fleet's test range in Peter the Great Gulf, an inlet of the Sea of Japan adjoining the coast of Russia's Primorsky Krai Province. The submarine had not yet been accepted by the Russian Navy but was undergoing complex tests under the supervision of a team from the Amursky and other shipbuilding plants. For this reason it had a much larger complement aboard, totaling 208 people, 81 military personnel and 127 civilian specialists from the production enterprises.

The accident occurred at 8:30 p.m. local time, during the submarine's first underwater test run. The submarine fire extinguishing system was triggered, sealing two forward compartments and filling them with freon R-114B2 gas (dibromo-tetrafluoroethane, known as khladon in Russian). The gas, a hydrobromofluorocarbon refrigerant, is used in the Russian Navy's LOKh (Iodochnaya obyemnaya khimitsceskaya - "submarine volumetric chemical") fire suppressant system. Each compartment of such a Russian submarine contains a LOKh station, from which freon can be delivered into that or adjacent compartment. Freon

displaces oxygen, enabling it to extinguish fires rapidly in enclosed spaces. In high concentrations it is narcotic, which progresses by stages into excitation, mental confusion, lethargy and ultimately asphyxiation.

The Governor of Russia's Chabarovsk Region, Viktor Ishaev, rejected the human factor as a possible reason for the breakdown on board the nuclear submarine. The introductory investigation shows that there were no wrong actions taken by the crew. "The so called human factor has not been discovered," Interfax quoted the governor as saying.

An official version of the tragedy says that it happened because of inadvertent occurrence of function of the fire-extinguishing system, which released freon gas into two front compartments of the submarine. Twenty people - three servicemen and 17 civilian individuals - died as a result of gas poisoning.

Experts, however, believe that the accident occurred because of the human factor and not the technical malfunction. Everything on board the sub, that can be tested, is tested at the factory, at first at the pier, above the water surface. Afterwards, they say, submarines are tested for their performance under the water.

"There were many outsiders on board to conduct all the tests. As a rule, these people do not know how to behave on board the submarine. They only know how to fix a device, which they made at their enterprises. Almost none of them has ever been on a submarine before, but they want to be there, because of financial reasons", said an expert.

"Contractors drink a lot during tests, they do it all the time. Someone could simply light up a cigarette in a compartment, which activated the fire extinguishing system. Someone else was probably sleeping in the compartment and was unable to understand what was going on there," the expert added.

The NERPA submarine was outfitted with an up to date automatic fire extinguishing system on the insistence of the Indian customers. All the instructions for the system were written in English.

Freon is used, if fire breaks out on board, but the source of it remains unknown. Only the Commanding Officer has the right to order freon release. However, experts say, that the system on NERPA was activated automatically.

All is OK, but there is a question: Where at the time of the accident was the Sub's Commanding and Engineering Officers, what were they doing and what are their names? Why is it a secret and why were their names not mentioned in any of the publications?

It is relevant to provide for a reader the tactical-technological characteristics of the Russian attack nuclear submarines NERPA (Project 971) type *(Editor's Note: NATO designation: AKULA)*, which was first designed in 1980s under the direction of Saint-Petersburg Number 143 Design Bureau Chief Designer Georgy Tchernishev and Chief Navy Supervisor Captain First Rank Igor Bogatchenko (the first SSN of that project was built on the Komsomolsk-on-Amur Shipyard and delivered to the Pacific Fleet in 1984):

Surface displacement, t	8,470
Submerged displacement, t	13,800
Length, beam, draft, m	113.0x13.8x9.6
Number of torpedo and	
Cruise missiles tubes:	4 of 650 mm and 4 of 533 mm

Number of torpedoes (missiles) - 40
Underwater speed - 35 knots
Power of one reactor, one turbine power plant - 60,000 h.p.
Diving depth - 600 meters
Complement - 80 (20 officers and 60 warrant officers and enlisted men)
Cost - 500 million dollars, 15,000 million rubles.

In the Russian Navy there are now 10 submarines of that project.

In conclusion, it is reasonable to propose some changes in the practice of Russian new nuclear submarines post construction sea trials.

First, the conclusive sea trials of nuclear submarines must be accomplished by a team of professionals like in aviation is done by test pilots. After finishing those tests they will transfer a submarine to a regular crew. The test submariners must teach a regular crew to control a new tested sub.

Of course, such practice will be most expensive but advan-

tages in safety and quality of testing and crew education would be much more important.

A new nuclear submarine is not a *Noev Covtcheg* for newcomers but an extremely dangerous and expensive weapon system, and testing of such extremely dangerous machine must be trusted to only very highly qualified test submariners.■

NEW SUBMARINE COMMS AT SPEED AND DEPTH DEVICES: SOME OPERATIONAL CONCEPTS FOR THEIR EMPLOYMENT

by CAPT James Patton, USN(Ret)

Captain Patton commanded PARGO (SSN650) and is now President of Submarine Tactics and Technology of North Stonington, CT.

Background

With the recent awarding of Increment One to the Submarine Comms at Speed and Depth (CSD) program, three devices are now being developed, built and fielded. These are:

- A three-inch fiber optic-tethered expendable that will provide two-way UHF/SATCOM (line-of-sight) comms for submarines.
- A three-inch fiber optic-tethered expendable that will provide two-way IRIDIUM satellite comms for submarines.
- An expendable Acoustics to Radio Frequency (A2RF) buoy deployable from submarines or Maritime Patrol Aircraft (MPA) that serves to modulate acoustic to radio communications (and vice versa) to enable connectivity between the two platforms while the submarine is below periscope depth. Conceptually, this could also be deployed by surface ships.

Because there is some time before these devices are in the fleet, it is appropriate that some thought be given early as to not only the capabilities they will provide, but also their limitations. Although it is a near certainty that such matters are currently being provided the necessary intellectual entrepreneurialism of organizations such as Submarine Development Squadron TWELVE, it still seems appropriate that the large body of corporate submarine expertise embodied in such as the Naval

Submarine League feel free to offer hopefully redundant (at the risk of perhaps being even erroneous) opinions as to the Concept of Operations (CONOPS) for the employment of these devices. Also, it is clear to everyone that CSD Increment One is not the ultimate answer to submarine connectivity, and that subsequent increments over the next decade or more could likely include such as the air or space-based blue-green laser option unsuccessfully attempted during the late 80s with SLCSAT (Submarine Laser Communications Satellite). Increment One is what will be available in the near term, however, and it is imperative that it be employed to maximum effect.

Discussion

One of the first *realities* of either the three-inch comms buoys or the A2RF buoys is that for both fiscal and physical storage reasons, there will not be an infinite number of such devices available for use, and some degree of *circuit discipline* will have to be ingrained in any OPCON–particularly concerning unrealistic connectivity expectations by non-submariners. In the continuing quest for the *silver bullet* that will provide submarines *persistent*, high data rate connectivity at operationally significant depth and speed, these devices are not it – but *are* a valuable addition to the ever expanding CSD *toolbox* of partial solutions, *if* their particular capabilities and limitations are understood and exploited by all concerned. Another critical property sought after in submarine comms is *latency* – best envisioned by the difference in the time domain of when a particular idea or information set is established, and when it *clears* the initiating entity and arrives at the intended recipient.

UHF/SATCOM Buoy

The period of connectivity that this buoy will provide is, of course, dependent upon the amount of fiber optic contained within, and thus varies as a function of ship's speed. Not so intuitive is the fact that the *rise rate* of the buoy is a finite value, and although capable of being used from very deep depths, it must be kept in mind that fiber will be consumed as the device rises and the ship moves away from the launch point that will not be available for connectivity once the buoy breaks the surface. This

will be in addition to the extra fiber just attributable to the deeper depth per se. Persistency will be poor in that each buoy will provide connectivity for only tens of minutes, and latency will be fair to good in that information could be loaded into a buoy *standing by* in a 3-inch ejector, and connectivity established in a few minutes–an order of magnitude more quickly than if the submarine came to periscope depth (P/D) for transmission with a hull-mounted antenna. *As an entering tactical CONOP assumption then, if length of connectivity is important, more time will be provided if the buoy is deployed at shallower or moderate depths.*

Since connectivity to a geosynchronous UHF satellite involves an information transit path of nearly 25,000 miles – unlike what is commonly called "Line Of Sight" (LOS) connectivity with nearby manned or unmanned platforms tens of miles for ships, 100-300 miles for aircraft at altitude) – transmit power requirements are much greater than for shorter range applications. Because of the large electrical demands when supporting high power transmissions, the effective period of connectivity for these buoys *could* be controlled by battery capacity rather than tether length when using a high active (transmitting) duty cycle at low submarine speeds. Also, since the UHF transmissions are interceptable and DF-able (susceptible to direction finding equipment), it must be kept in mind that if an accurate buoy position is established by an opponent, that position is conceptually exploitable as an aim point for homing weapons. *As entering tactical CONOP assumptions then, if length of connectivity is important, more time will be provided if the active (transmitting) mode of the buoy is minimized in favor of a passive (listen only) mode, and care must be exercised as regards the length of time transmissions are conducted and how long one remains in the vicinity of a transmission.*

IRIDIUM Buoy

The *Iridium* buoy has three significant advantages. Having to reach a satellite constellation at only some 500 miles altitude versus nearly 25,000 for the UHF satellite, it will do so with far less instantaneous power, which translates into significantly longer battery life. Also, since the 66 satellites of the *Iridium* constella-

tion are in polar orbit, performance of the system is virtually independent of ship's latitude – dramatically different than UHF satellite connectivity, which is very poor at the high latitudes at which submarines frequently operate. The third consideration is that Iridium is a commercial service, and as such, its presence is not prima facie evidence of the presence of a warship or submarine. Persistency and latency will be essentially the same as the UHF buoy. *As an entering tactical CONOP assumption then, if operations at high latitudes are envisioned, pre-deployment loadouts of 3-inch devices should probably be skewed towards Iridium versus UHF buoys.*

A2RF Buoy

This device is significantly larger than the 3 inch devices, and is deployed from the submarine by using the Trash Disposal Unit (TDU) – a vertical 12 inch diameter, up to two-stories tall *torpedo tube-like* device whose primary purpose is to eject weighted garbage bags. From MPA, the unit is deployed from the same internal launch tube used to eject certain special sonobuoys from within the airframe. After deployment, the device floats, subject to winds and current, and will operate as a connectivity *gateway* for at least three days. With its significantly longer *lifetime*, the A2RF buoy provides more of the desired *persistency* per unit than its two 3-inch CSD cousins. However, the downside is the very constraining data rate limitations of acoustic-based connectivity, which also drops markedly with range between the buoy and the submarine. In practice, meaningful data rates can be maintained within a few hundred square miles of the buoy's location – a limitation acceptable in some instances, but not in many others. There is also the consideration that acoustic energy injected into the ocean environment is the bane of submarine operations whenever the possibility exists of the presence of an opponent's submarines or other passive acoustic listening devices. Furthermore, there are very significant limitations on MPA being able to safely operate in contested littoral areas where such a persistent connectivity *pipe* would be very useful. *As entering tactical CONOP assumptions, if acoustic stealth is appropriate, usage of A2RF buoys must be carefully weighed against other means of connectivity, and the safety of any manned aircraft must be*

considered when operated in contested areas.

A positive consideration of A2RF buoys as compared to the 3-inch CSD devices is that it is unique in *initiating* connectivity by other than the submarine, although it does require the MPA to have reasonably accurate knowledge of the submarine's present or predictable future location. Also, for the submarine-deployed case, it is unlikely that an A2RF would be kept *loaded* in the TDU, and its deployment from a dead start might easily take 30-60 minutes – resulting in poor latency. A conceivable operational construct would involve the MPA to establish connectivity as described above, then, if a high data rate exchange of limited duration is desired, direct the submarine to launch an expendable 3-inch UHF or *Iridium* device. *As an entering tactical CONOP assumption, the A2RF buoy is more likely to be deployed from aircraft than by submarines if the tactical situation permits the safe operation of aircraft in the airspace above the submarine. If not, than the submarine may have to be the platform which deploys the buoy to provide a link to the Iridium constellation or to an aircraft operating at a safer standoff distance.*

Future CSD Developments

Several recent and not so recent submarine incidents, including collisions, highlight the need for above air-water interface *situational awareness* – particularly when in shallow waters or when coming to periscope depth. In many cases, entirely doable derivatives of the 3-inch CSD devices could offer this through optronics, Automatic Information System (AIS), Electronic Support Measures (ESM), Global Positioning System (GPS) and other *payloads*. In fact, the extent to which modern electronics have reduced size and expense of such capabilities would permit more than one of these features to *affordably* be incorporated in a single device.

Also, a concept worth further CONOP investigation is a feature on 3-inch CSD buoys to load a preset message, use the tether link only to assure connectivity with the intended recipient of the information package, then cut the tether and leave the buoy datum; the buoy going active and transmitting the package after some preset time delay.

Since persistence and latency are such important characteris-

tics of any FORCEnet submarine solution, both of these features need to be continuously improved upon. With the two recent disappointing failures of the much anticipated joint US-UK Recoverable Towed Optical Fiber (RTOF) buoy, it is perhaps time to reconsider the towed buoy option – reminiscent of the underdeployed AN/BSQ-5 installed on two 637-class SSNs in the mid-70s whose erectable mast provided two way HF/VHF/UHF connectivity at speeds of up to 15 knots. Of course, it is only fair to add that in the mid-70s, the ability to chat with one's shoreside bosses was not a highly sought after capability by submariners.

Conclusions

The present CSD program is a first and vital step towards more flexible, persistent and short latency submarine connectivity. It is, however, only a first step – the "...quick 75% solution for current problems" type referred to by Secretary of Defense Robert M. Gates at a National Defense University speech in September 2008. The submarine's CSD "toolbox" has been virtually empty, and these three devices of Increment One will be much appreciated, once their optimum modes of employment are established. Much more remains to be accomplished, however – the "...99% solution for future problems" also referred to in the same SECDEF speech – especially with the new missions SSNs, and particularly SSGNs are being tasked.

Expendables are a fertile and relatively unexploited field, and *will* provide not only situationally appropriate *tactical* options, but will probably also contribute to *safety of ship* issues through such as a photonics-capable fiber optic tethered 3-inch buoy launched immediately prior to a quarterly test of the Emergency Main Ballast Tank blow system to check for *range clear* of surface traffic, or an AIS-equipped buoy launched if circumstances require coming to P/D while transiting a crowded international strait.

There is a compelling argument that due to both fiscal and onboard stowage limitations, that submarine CSD expendables will never be able to provide the aggregate time-bandwidth product required to fully support a nominal deployment comprising of several different types of missions with widely variant persistency and latency requirements. If this is the case, which it almost certainly is, then these expendables would best be

complemented with a towed, retrievable buoy of some sort which featured an antenna and other sensor-studded erectable mast which, as directed, could penetrate the air water interface. When this feature was not needed, the buoy could be at several tens of feet depth to provide persistent, passive VLF connectivity – much as the SSBN community has relied upon for a half century, or be completely stowed to permit very high speed transits. In any case, the series of submarine CSD increments will remain a dynamic endeavor for the foreseeable future and could eventually achieve high persistency, low latency and high data rate connectivity through such as space-based blue-green lasers.■

REUNIONS (continued)
USS NARWHAL SSN-671 Sep 10-12, 2009 San Diego, CA
LOC: Town & Country Resort
POC: Buck Crouch Phone: 520-668-7095 E-mail: buck7@cox.net
APOC: Jon Cox e-mail 671plankowner@comcast.net
Website: http://www.ssn671.org/

USS SPINAX SSR/SS 489 Sep 14-18, 2009 Seattle, WA
POC: CDR Jay K. Davis Phone: 425-269-6565 Web Site: http://www.spinax.com

USS LAPON SSN-661 Sep 24-27, 2009 Myrtle Beach, SC
POC: Raymond Zieverink 3003 Lakeland Drive, Rock Hill, SC 29730-9560
Phone: 803-324-1414 E-mail: SSN-661@HullNumber.com

USS TUSK SS-426 Sep 24-27, 2009 Groton, CT
POC: Dexter Holaday, 59 Sylvan St., Noank, CT 06340
Phone: 860-536-6586 E-mail: dahmarine@aol.com

MAINTAINING THE SUBMARINE "CONNECTIVITY ADVANTAGE"

by CAPT James Patton, USN(Ret)

Captain Patton is a retired submarine officer who is a frequent contributor to THE SUBMARINE REVIEW.

Background

The good news is that with the awarding of a major *Comms at Speed and Depth* program, there seems to be imminent progress towards significantly improving connectivity to U.S. submarines throughout more of their speed-depth envelope. The bad news is that similar programs are underway in many other nations, and it is rare that technological developments in the defense industry don't, fairly quickly, proliferate to potentially hostile entities. Slowing or withholding from use such developments is *not* a viable option. For example, during WWII, both Allied forces and the Germans independently developed the concept of anti-radar *chaff* (or *window*, as it was called by the British), but neither deployed it for an extended period of time for fear that the opponent would copy it and adversely impact aircraft raid detection and tracking. As a result, many more aircraft and crews were lost than would have, with the balance being decidedly against the Allies because of the far greater number of sorties being flown by them at the time.

Discussion

Strangely enough, another interesting analogue exists in the Cold War competition between U.S. and Soviet submarines in the area of quieting. Figure (1) is a very simplified graphic based on one in a 1987 book by Tom Stefanick–*Strategic Antisubmarine Warfare and Naval Strategy*–that shows what the author alleges is a historical *race* between superpowers as regards technological advances in support of submarine quieting. To put things in perspective, the difference between the loudest and quietest groups indicated is about 80 dB – a factor of 100 million, and the approximately 20 dB (factor of 100) sudden drop in Soviet

submarines between the *Alfa* and the *Victor III* classes was due to the proliferation of technologies associated with propeller design and fabrication. This *breakout* capability of Soviet submarines would have disastrously affected the Cold War strategic balance if the U.S. had opted to rest on the significant acoustic laurels of the SSN 637 *Sturgeon* class.

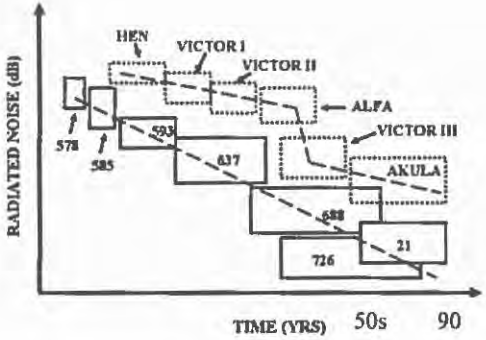


Figure (1): U.S. vs. Soviet Cold War Acoustic Advantage

There is no less sense of urgency now to not only achieve a significant degree of U.S. submarine *Connectivity Advantage*, but to also assure a continuing edge as other entities improve their capabilities. This is particularly true when it come to potential adversaries who are less than *peer competitors*, since, as Figure (2) implies, submarines at the low end of the mobility and endurance spectrum, especially those who are armed with good Anti-Ship Cruise Missiles (ASCMs) but have none of the stealth, mobility, endurance, sensors and processing power to do their own detection and targeting of High Value Units, benefit far more from improved connectivity than those such as U.S. assets at the high end do.

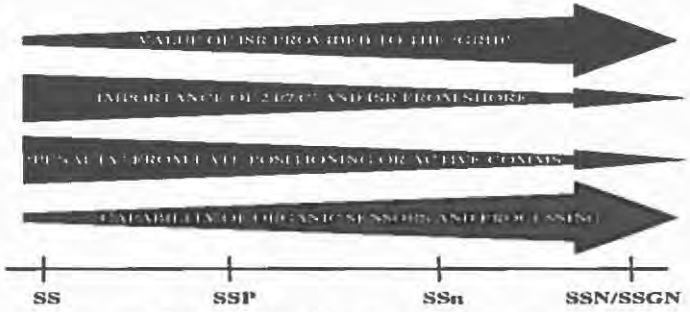


Figure (2): Relative Gains From Improved Connectivity

The currently planned *Comms at Speed and Depth* connectivity initiatives will increase a submarine's ability to quickly initiate non-persistent global connectivity from operationally significant speeds and depths and will also enable better coordination with nearby air and surface units. However, there are several goals needed to be pursued beyond these initial capabilities. They include the ability to quickly acquire above-surface visual, RF and Automated Information System (AIS) situational awareness from operationally significant speeds and depths and to acquire means through which *persistent* passive and (as required) active connectivity at speed and depth at data rates commensurate with the situational mission needs. In addition to these continuing improvements, significant intellectual capital needs to be invested into how to deny the employment of an opponent's better means and methods of submarine connectivity.

Conclusions

The U.S. currently has superior connectivity with its deployed submarines, and this connectivity will get even better as recently approved developments are introduced to the fleet. However, as our experience in the area of submarine quieting has demonstrated, those faint noises heard in our baffles are potential adversaries, with far more to gain from an operational sense, improving *their* connectivity. As with the quieting analogue, our *glide slope* of continued improvement must be great enough to absorb and contain any sudden technological *breakout* by a potential adversary.■

ɪREE **POWERFUL** REASONS TO ATTEND WEST 2010:

- **HEAR** top-notch speakers in your field
- **PARTICIPATE** in panel sessions on timely issues in today's military
- **PREVIEW** hundreds of state-of-the-art technologies at the West 2010 Exposition

West 2010 is the largest event on the West Coast for communications, electronics, intelligence, information systems, imaging, military weapon systems, aviation, shipbuilding, and more. This is a one-of-a-kind forum featuring the people you need to hear from, the products and services you need to do your job, and informed discussion of the critical issues of today and tomorrow!

FREE! Registration
www.west2010.org

SUBMARINE NEWS FROM AROUND THE WORLD

Reprinted with permission from AMI HOT NEWS; an internet publication of AMI International, PO Box 40, Bremerton, Washington, 98337.

From the January 2009 Issue

BRAZIL–DCNS Design Chosen for Future Submarine Programs

In late December 2008, AMI International received information that DCNS of France had been awarded a contract by the Brazilian Navy (BN) to form a joint venture (JV) to build the Scorpene submarine design in Brazil. DCNS (prime contractor) with its JV Brazilian partner, Norberto Odebrecht Construction Company, will construct four conventionally powered submarines at the JV, set up by DCNS and Odebrecht. DCNS will produce key advanced-technology equipment in its own plants. The submarines will be designed in cooperation with the Brazilian teams under DCNS design authority to meet the BN's specific need to protect and defend the country's coast. The first submarine is scheduled to enter active service in 2015.

As part of this contract, DCNS will also provide design assistance, under the BN's design authority, for the non-nuclear part of the Navy's first nuclear submarine which also will be built by the JV. The Brazilian nuclear submarine program, known as SNAC-2, has been progressing at an extremely slow pace since 1979. However, in 2008, the sea service publicly announced that it was rededicating its efforts in order to get the program moving forward. It appears that the design assistance in the non-nuclear portion of the program may be the first step in an attempt to make headway in the stalled program. Additionally, DCNS will provide prime contractor assistance to Odebrecht for the construction of the naval shipyard that will build the five submarines and a naval base for the BN.

The strategic partnership between Brazil and France will result in a high degree of technology transfer, which will increase the level of national content and create jobs as well as advance the

country's shipbuilding infrastructure. With the selection of the DCNS Scorpene design in Brazil as well as in Chile in 1998, it appears that France is beginning to make significant inroads into the South American market that was once dominated by ThyssenKrupp Marine and its Type 209 design.

UNITED STATES–Eight Additional Virginia Submarines Contracted

In late December 2008, AMI received information that General Dynamics Electric Boat Corporation has been awarded a US$14B fixed price incentive multi-year contract for the construction of eight Virginia class submarines. The eight units will begin construction from 2009 through 2013 at Electric Boat in Groton and North Grumman Newport News Shipbuilding Operations in Newport News with delivery of all eight units by 2020. This contract covers units 11 through 18 of the planned class of 30.

The contract for the third (Block III) variant calls for one unit per year in 2009 and 2010 followed by two units per year in 2011, 2012 and 2013. This schedule follows the US Navy's latest 30-year shipbuilding plan that calls for two units per year beginning in 2012. The increase to two units in 2012 is a result of the 2005 mandate by then Chief of Naval Operations (CNO) Admiral Mike Mullen and PEO Submarines Rear Admiral William Hilarides to cut up to 20% in acquisition costs by 2012 in order to begin the two per year build rate.

The initial success of cutting acquisition costs will allow the US Navy to achieve its two per year build rate in 2012. However, its sustainability through end of class at 30 units will likely be determined by future ship construction costs as well as changes that may be directed by the Obama administration.

The increase in the Virginia program confirms that the US is currently committed to maintaining two yards that can build nuclear submarines. It appears that this capability will be maintained, and similar to the aircraft carrier, may be protected when considering future budgets regardless of the price per unit for the submarines.

Various Did You Know?

BULGARIA: On 06 January 2009,the Bulgarian Navy Romeo class submarine, NADEZHDA, was decommissioned. The NADEZHDA will become a museum in Varna.

UNITED STATES: On 10 January 2009, the US Navy (USN) commissioned the last Nimitz class aircraft carrier, USS GEORGE H. W. BUSH at Newport News Shipbuilding in Virginia.

From the March 2009 Issue

AUSTRALIA–AWD and New Submarine Developements

A. Hobart Class Destroyer (AWD): In late March 2009, AMI received information that the 4th unit (option) of the Hobart Class Destroyer Program has not been officially *cancelled* or *terminated* as has been reported in many circles. In fact, being an option, the 4th unit was never officially ordered. The 4th Hobart is still officially an option for the Royal Australian Navy (RAN) with the decision now scheduled for June 2009.

AMI's sources do however indicate that there are several schools of thought concerning the fourth unit. The first is that a new defense whitepaper due out in May 2009 will not justify the fourth AWD as needed for the Defense of Australia. Apparently, the whitepaper suggests a more expeditionary style force that gives added emphasis on submarines, which will be addressed under SEA 1000 program.

However, a major sticking point for the defense industry and more specifically ASC, is that the third Hobart class destroyer will be launched by 2014 and the first SEA 1000 submarine will not start construction until around 2018 or 2019 leaving a four to five year window with ASC having no major new construction programs; only the modernization of the Collins class submarines.

With ASC being the last remaining Australian-owned prime defense contractor, it would make sense for the DoD to authorize and build the fourth AWD soley based on economic and industrial infrastructure reasons. A fourth AWD would ensure a seamless work load at ASC through at least 2030 (considering the option AWD and submarine program) and the survivability of the last remaining Australian-owned defense contractor. A fourth AWD would surely signal the government's commitment to its

shipbuilding infrastructure and its highly skilled work force. Another, although probably not a preferred option of the RAN, would be to slow down the construction of the first three units to close the 4-5 year window without ordering a fourth unit.

B. Future Submarine Program (SEA 1000): On 23 February 2009, the Australian Department of Defense (DoD) announced that Rear Admiral (RADM) Rowan Moffitt would head the Future Submarine Program at the Defence Material Organization (DMO). RADM Moffitt reports to the Chief Executive Officer of DMO and leads the Royal Australian Navy (RAN), DMO and Capability Development Group Future Submarine Project Office.

The Future Submarine Program began in 2008 when the first US$4.67M was authorized for the RAN to begin its initial studies for the project. The studies are currently being conducted by the Defense Science and Technology Organization (DSTO), and other organizations such as ASC, under the Capability Development Group. These studies will be complete by 2009 in order to start the concept design phase in 2010. First pass approval for the design phase by the National Security Committee is scheduled for 2011.

On 29 December 2007, the Australian Defense Ministry gave the go ahead to begin planning for an AUD25B (US$22.9B) program for the acquisition of up to twelve new submarines to replace the six units of the Collins class when they reach the end of their effective service life around 2025. A construction contract can be expected around 2020 in order to have the first unit in service by 2025.

AUSTRALIA--ASC Sale Delayed Due to Financial Crisis

In late February 2009, AMI received information that the Australian Government decided not to proceed with the sale of ASC due to the current economic uncertainties. The government felt that the current state of the global financial markets presented significant risks to the successful sale to a private company at this time.

ASC, wholly owned by the Australian Government since November 2000, has been preparing itself for sale over the past several years. With the sale being temporarily delayed, ASC can now better position itself for the future as it is on the threshold of

beginning construction of three Hobart class destroyers and will also be the builder of the next generation submarines to replace the Collins class. ASC is also involved in the through life support and modernization effort for the Collins class that will remain in service until replaced.

ASC, as the last remaining Australian-owned prime defense contractor, is now in the driver's seat in regards to major surface combatant and submarine construction for the Royal Australian Navy (RAN). The delay in the sale of ASC could very well be a blessing in disguise as the yard now has the commitment for two major naval programs over the long-term while at the same time waiting for the global financial crisis to end. This will equate to a much better scenario in regards to the terms of agreement and financing with the future buyer as well as increased value of the company itself. The Australian Government, as owner, would also surely like to recoup its original investment when it procured ASC in 2000 for around US$80M.

CHINA--Defense Budget Continues to Soar

On 04 March 2009, AMI International received information that in 2009, China will once again see a double digit increase in defense spending despite the world-wide economic downturn.

In 2008, the Chinese defense budget rose an estimated 17.9% to approximately 418.2B Yuan (US$61.1B). With the projected increase of 14.9%, the 2009 defense budget will rise to 480.7B Yuan (US$70.2B). In comparison, the expected increase for the US defense budget for 2009 will be around 4%. With this increase in the 2009 defense budget, Chinese defense spending will have doubled since 2006.

This increase in defense spending is remarkable because of the extreme slowdown in the Chinese economy due to the world-wide financial crisis. The increase will allow the People's Liberation Army - Navy (PLAN) to continue with all of its current programs as well as proceed with its plans for an indigenously produced aircraft carrier.

In addition to continuing planned projects, a defense spokesman stated that much of the added budget will go to quality of life additions for the PLA's over two-million service members as well as rebuilding factories and facilities damaged by the May 2008,

8.0 magnitude earthquake in Sichuan.

For many years, it has been wide-spread knowledge that China's "stated" and "actual" defense budgets vary by as much as 100 percent (some estimates put it at 400 percent) and contain funding from various sources including international weapon sales and other industries with ties to the defense industry.

GREECE–Hellenic Shipyard for Sale

On 22 March 2009, AMI received information that Thyssen-Krupp Marine Systems (TKMS) still intended to sell Hellenic Shipyards (HS) in Greece once the final Type 214 submarine is delivered to the Hellenic Navy (HN) around 2011.

AMI's source stated that due to lack of upcoming work at Hellenic, it is in TKMS's best interest to sell the company and reduce overall costs for the German company. Once the final Type 214 delivers, the only near-term work that is likely to happen is the upgrade of the existing Type 209s or the possible replacement of them with a new AIP equipped class.

Information received by AMI has stated that there are currently three interested parties for the purchase of HS:

- Elefsis Shipyards
- A Greek Banking Group
- Unnamed French Shipbuilding Company

Sources in Greece have told AMI that it was well known that TKMS would sell the yard as soon as the 214 program was complete. Additionally, AMI sources indicated that TKMS is contractually obligated to maintain the yard until the last Type 214 was delivered to the HN, currently scheduled for 2011 or 2012.

One major question that must be answered is when the yard is sold; does Greece have the ability to maintain the HN's existing force of Type 209 and Type 214 submarines without any outside expertise? This may weigh heavily on who the yard is sold to.

Although there is already a memorandum of understanding (MOU) between DCNS and Elefsis Shipyards, there is the possibility that they may be interested in acquiring HS in order to give them a submarine building capability in Greece as well as helping the HN in maintaining its current Submarine Force.

Additionally, if DCNS were to acquire HS, they would be in a position to displace TKMS for the replacement of the Type 209s with Scorpene or a different design if and when the time comes.

As for the Germans, the main consideration now is reputation regarding the Type 214 and their ability to deliver the four units within specification as well as who will provide the through life support for the program. This surely would put a submarine building yard such as DCNS in the driver's seat if HS has its choice.

Various Did You Know?

Spain: On 07 March 2009, first steel was cut at Navantia's Cartagena facility for the third Spanish Navy S-80A submarine.

From the April 2009 Issue

UNITED STATES - Naval Priorities in 2010

In early April 2009, AMI began receiving early information concerning the Fiscal Year (FY) 2010 defense budget. Additionally, some of the highlights of the upcoming defense budget request have been released by the US Secretary of Defense, Robert M. Gates, through various press channels. The 2010 defense budget request is scheduled to be submitted to Congress in mid-May 2009. Proposals by Secretary Gates are just that: proposals that have not been approved by the US Congress.

Press releases indicate that the 2010 defense budget will be around US$533.7B with a supplemental budget addition of US$130B for a total of US$663.7B an increase of 1.4% over 2009 levels. The 1.4% increase of 2009 levels includes the 2009 defense budget of US$655B enacted plus President Obama's proposal for a second US$75.5B supplemental for 2009.

Highlights presented by Secretary Gates appear to be in line with the recommendations of the 2006 Quadrennial Defense Review (QDR), that were in the National Defense Strategy of 2008 and will most assuredly be included in the 2010 QDR, scheduled to be finalized in early 2010.

In regards to the US Navy, the Secretary has taken the following positions on major procurement programs:

- Shift the CVN-21 aircraft carrier program to a five-year build cycle with the second unit of class, CVN-79, beginning around 2013
- Delay the CG(X) Future Cruiser program and revisit the requirements and acquisition strategy.
- Limit the Zumwalt class destroyer (DDG-1000) program to just three hulls with all three built at General Dynamics Bath Iron Works (BIW). The agreement to build all three units at BIW (rather than split with Ingalls) was completed on 17 April.
- Reopen the Arleigh Burke class destroyer (DDG-51) production by adding 12 new units to the class. The initial two units will be built at Northrop Grumman Ship Systems (NGSS) in Pascagoula. the additional ten units could be split between the yards although it has not been determined at this time.
- Build all 55 Littoral Combat Ships (LCS) increasing the buy in 2010 from 2 to 3 units. No information on which LCS variant (Lockheed Martin or General Dynamics) will be built in 2010.
- Delay the 11th San Antonio class LPD and the first Mobile Landing Platform (MLP) until 2011 in order to assess costs and the capabilities that will be provided.
- Increase the number of Aegis ship modernization for ballistic missile defense (BMD) to 6 in 2010.
- Begin the replacement program for the Ohio class ballistic missile submarines in 2010.
- Although not mentioned by Secretary Gates, it appears that the Virginia class submarine program will remain on track with one unit in 2010, ramping up to two units per year beginning in 2011.

As mentioned earlier, this plan is far from being finalized as it is not yet official or approved by the US Congress. However, it is evident that Secretary Gates carefully evaluated the industrial shipbuilding base prior to announcing these recommendations. Adding one Zumwalt class destroyer beyond the Navy's recommendation of two units and building all three units at BIW will stabilize the workload there. Reopening the Arleigh Burke

line at NGSS stabilizes their workload while giving the Navy more time to examine the CG(X) cruiser or whatever major combatant succeeds the Zumwalt and Arleigh Burke classes.

Work will remain steady at Newport News with aircraft carrier starts approximately every five years as well as splitting Virginia class SSNs with GDEB. Three LCSs planned for 2010 and a ramp-up beginning in 2011 will stabilize Marinette Marine and/or Austal through around 2020.

WORLD - Economic Downturn - Impact on World Navies

The rise and fall of Naval and Defense budgets closely mirror that of each nation's Gross Domestic Product (GDP). The world economic downturn that began in late 2007 has created a general downward trend for GDPs worldwide and correspondingly for defense budgets. This downward trend began in mid-2008, has stretched into 2009, and will probably continue well into 2010.

As of this writing, there appear to be two courses of action that are now occurring as procurement budgets continue to subside. One has been for some new construction programs brought forward to serve as an economic stimulus measure and the second has been a cut in procurement monies with a corresponding uptick in modernization efforts.

ECONOMIC STIMULUS: In an economic decline, governments will reduce their defense spending. Generally this is accomplished in the short term through cuts in new procurements. As in the past two major recession cycles, these defense budget cuts are again appearing in procurement accounts, where the cuts will have an immediate effect. However, because of the scope of the worldwide recession, some nations are actually using major defense procurements as an economic stimulus.

AMI has noticed several cases in which programs have begun to be brought forward to support the shipbuilding industry during the economic downturn. Over the last two years France slowed defense expenditures by reducing the FREMM frigate program by six units and delaying the PA2 aircraft carrier by at least several years. However, due to the economic recession, France has brought forward an order for the second batch of Mistral class

LHDs (an order to start unit three immediately) in order to keep the shipbuilding industry employed during the economic slowdown.

Additionally, Italy is now considering moving forward an amphibious ship program in order to fill the order books of Fincantieri's commercial shipbuilding units that are facing declining orders in the cruise ship and merchant ship businesses. The Ministry of Industry is now considering using its funds to build two 18-20,000 ton LHDs for the Italian Navy in order to shore up the commercial shipbuilding base at Fincantieri.

There are also signs that Germany could move up its F125 frigate program in order to shore up jobs at ThyssenKrupp as the shipbuilding sector continues to falter as well.

FLEET MODERNIZATION: As mentioned earlier, in an economic decline, governments will reduce their defense spending and generally this is accomplished in the short term through cuts in new procurements. As new naval ship procurements are being stopped or slowed, modernization of the existing force becomes a priority. AMI's outlook for the next two years is that navies will look at modernizing their fleets in addition to selling or decommissioning older, more costly to operate vessels.

The long term impact on fleet operations will be a reduction in new vessels over a three year period 5 to 8 years from now. AMI anticipates an increase in modernization funds for naval ships in the next two years to ensure their life expectancy and their ability to pace the changes in anticipated threats over the next 5 years.

We are already seeing signs of these changes and want our clients to begin looking for opportunities in the modernization/refit market. Some of the most recent examples are:

1. United States
    a. Aegis modernization conversions beginning in 2012.
    b. Establishment of a Surface Ship Maintenance Organization in Norfolk, Virginia.
2. United Kingdom
    a. Continued modernization of the Duke (Type 23) frigates, Broadsword (Type 22) class frigates, Type 42s and support vessels.

3. Thailand
    a. Modernization of the Naresuan class frigates with addition of an air defense suite and modernization of major gun and anti-submarine warfare systems (ASW).
4. Canada
    a. Decision to modernize the Protecteur class fleet replenishment ships.
5. Romania
    a. Phase II modernization of the Type 22 frigates and the possible modernization of the Marseti class destroyer and the Tetal class corvettes.

As mentioned above, these modernization programs are just an example of some that are developing as of this writing. AMI estimates that there may be many more that are still being considered as the defense budgets continue to shrink over the next several years. And in the case of modernization versus stimulus; modernization numbers will probably far outnumber stimulus programs.

BRAZIL - National Strategy Outlines Future Naval Capabilities

The recent discovery of large oil reserves offshore has increased the need to modernize Brazil's naval forces. Analysis of the newest Brazilian whitepaper, *National Strategy of Defense*, dated 18 December 2008, along with the need to protect the vast oil reserves, has brought to light specifics of the Brazilian Navy's (BN) recapitalization plans.

The most notable long-term objective is the sea service's plan to move forward with their Submarine Forces, both conventional and nuclear powered. The BN has signed a contract with DCNS of France for the construction of three units of the Scorpene class that is to begin by the end of 2009 and will be built in Brazil with French assistance at Arsenal de Marinha in Rio de Janeiro. Sources indicate that 70% of the commercial bank financing by France's BNP Paribas has already occurred (with guarantees by France's export credit agency) for the program. Brazil will finance the remaining 30%. The first unit will likely enter service by 2015, followed by the other two submarines in 2016 and 2017.

The BN is also moving forward with its plans for a new class of frigates to follow the single unit of the Barroso class. With financing for the Scorpene submarine program now nearing completion; the frigates will be the next major naval procurement. AMI's sources indicate that the BN is evaluating several options including a Korean hull (possibly KDX 3) with Lockheed Martin combat systems, and a version of the Northrop Grumman patrol frigate design, similar to the US Coast Guard National Security Cutter. Other designs such as the French FREMM are also in the running. Up to four new frigates could be procured under this program.

Assuming that the Scorpene submarine program stays on schedule with the launching of the final hull in 2014; the first unit of the nuclear powered submarine (SSN) SNAC-2 program will probably begin construction soon thereafter. The hull design is from DCNS and has been called an *enlarged Scorpene*. AMI believes that the Scorpene design may be too small to be used as a nuclear powered boat so it is likely that the hull is similar to the Rubis-Amethyste class. The BN plans to have the first unit of the class in service by 2020.

In addition to the submarine and frigate programs, the Brazilian Ministry of Defense (MoD) stated that the Navy will pay special attention to the design and manufacturing of multi-purpose vessels that could also serve as aircraft carriers with "preference given to conventional aircraft carriers" probably referring to a full length flight deck capability found in an LHD. AMI believes that multi-purpose ships could possibly be large-deck amphibious vessels such as an LHD that will be able to participate in humanitarian operations. Should the BN want to move along more rapidly with this program, one or both units of the class may be built in a foreign shipyard.

The LHD could indeed be the stepping-off point toward an indigenously built aircraft carrier. Depending on the outcome of the SSN program, it is possible that Brazil would consider a nuclear-powered aircraft carrier (CVN). Brazil fully realizes the impact of the cost of oil over the long-term and undoubtedly consider these costs when considering the nuclear option. The BN also understands the operational benefits of nuclear power such as extended cruising in addition to the international status that comes

with having a CVN. If the BN is to proceed this way, the CVN program will likely not begin before 2025 with commissioning occurring around 2033.

Increased funding for the Brazilian armed forces since 2006 has allowed the MoD to move forward with their plans for modernizing. The sea service has been able to finally complete its Barroso class corvette and is currently in the process of building six additional patrol vessels in addition to the planned programs as mentioned above.

TAIWAN - Indigenous Submarines The Only Option Left

As of late April 2009, AMI continues to receive information that Taiwan is still considering its options for the procurement of a new class of submarines to replace the Guppy II class commissioned in the 1940s and the Hai Lung class commissioned in the 1980s. Both classes were built in foreign yards: the GUPPY in the US and the Hai Lung in the Netherlands. The latest option appears to be indigenous construction as Taiwan has not been able to move this program forward through an international supplier since 2001.

With the economy in Taiwan (as well as rest the world) slowing, President Ma Ying-jeou is trying to resurrect Project Sea Dragon (Kwang Hua 8) in an effort to create more job opportunities within the country's shipbuilding industry. AMI believes that Taiwan is slowly coming to the realization that if it wants new submarines, it will have to build them in Taiwan.

Project Sea Dragon (Kwang Hua 8) officially began in 2001 following then US President George W. Bush's announcement that the US would sell a large defense package to Taiwan, including eight diesel-electric submarines. The submarines were part of a larger package that includes P-3 maritime patrol aircraft (MPA), anti-mine MH-53 helicopters, Apache Longbow attack helicopters, Harpoon missiles, Patriot missiles and spare parts. Since 2001, most of these programs have moved forward with the exception of the submarine procurement.

With many program and policy changes, and many negative Taiwanese Legislative Yuan funding votes over the past eight years, the ROCN is no closer to a new submarine than it was in 2001 when President Bush made the announcement. In general, the program has not moved forward due to the extreme cost of

international construction (if built in the US around US$1.2B per unit) and the lack of credible design assistance from any foreign submarine designer. The Legislative Yuan since 2001 (even though there have been several elections and various factions have come to power) has argued that the price has been too high and has partially argued for indigenous construction.

In regard to design assistance, the US has not built diesel-electric submarines in decades. Almost certainly, the US Navy does not want to see diesel submarines built in US yards for export, which is consistent with long-standing USN policy of preventing the loss of US submarine technology through exported hulls. In regard to other foreign designers, there have been no legitimate offers for design or construction assistance due to the fear of political backlash from the Chinese mainland.

In regard to negotiations with the US; in mid-2007, the Legislative Yuan and US Government agreed to split the submarine program into two parts, Phase 1 for concept definition and design and Phase 2 for actual construction. US$375M was authorized to begin Phase 1 in late 2007. However, the US has not responded to Taiwan's Letter of Request (LoR) (prior to President Ma Ying-jeou taking office) to officially begin the program. With a new administration in Washington since January 2009, it appears less likely that the submarine program will move forward in any shape or form with US assistance.

With that said, AMI believes that Taiwan is pretty much on its own in regard to Project Sea Dragon. An indigenous submarine program in Taiwan would surely help President Ma Ying-jeou in creating jobs at the China Shipbuilding Corporation (CSBC). However, designing and building a submarine from scratch without outside assistance will be very expensive and frought with danger, although CSBS is currently moving forward with its own plan to do just that. CSBC believes that it is fully equipped to build submarines to international standards in the 2000-3000 ton range.

AMI believes that if the ROCN wishes to modernize its Submarine Force in the near term; it will have to rely on CSBC to do it. And realistically, it is probably the only option left if Taiwan wants to invest in a project of this magnitude.

RUSSIA - Naval Force Right Sizing, Two Decades Later

Information received by AMI in April 2009 indicates that as part of the planned Russian military draw-downs, the Russian Navy (Rosiyskiy Voennomorsky Flot - RVF) will be required to reduce the number of vessels to nearly half by 2016, or around 120 units.

With budget constraints, requirements for reducing personnel and a large number of obsolete vessels, the RVF will have a daunting task in the next seven years. Additionally with new construction units entering service albeit extremely slowly, the RVF will have to decommission around 140 units to meet the goal of 123 by 2016.

Many of the vessels in the RVF inventory are already beyond their effective service lives and in need of replacement. These classes of vessels are the most probable candidates for decommissioning immediately without replacement:

- Six Delta III class SSBNs
- One Kashin class DDG
- One Kara class DDG
- Four Krivak class FFG
- Three Grisha III class corvettes
- Four Alligator class LST
- One Polnochny class LSM
- Eleven Natya class MSO
- Twenty-four Sonya class MHC
- Over fifty Auxiliary ships

These 105 vessels will likely be the first units to decommission when the reduction in forces begins at the end of 2009. As new construction units of the Borey class SSBN, Yasen class SSN and St. Petersburg class SS are commissioned, the RVF will likely decommission older units of their submarine fleet, possibly on a one-for-two basis. The submarine classes that will probably be decommissioned as newer units enter the fleet over the next decade include the Oscar II, Akula, Sierra I, Victor III and Kilo classes.

Also, as new Steregushchiy and Admiral Gorshkov class frigates commission, older units will probably decommission at the same rate as the submarines until their goal of 123 active vessels is met.

With the global economic crisis in full swing and Russia experiencing double digit inflation each year for the past decade, it is important that the nation continue to look for savings in the military budget in order to fund the recapitalization of its armed services.

In addition, Russia faces an outdated military industrial complex that continues to deal with massive cost overruns, inefficiencies and long delays. AMI believes that if Russia is going to see itself through the economic crisis while rebuilding its shipbuilding infrastructure, it will certainly have to see these force reductions through fruition.

ALGERIA - Admiralty Launches Kilo 636

On 04 April 2009, Admiralty Shipyard in Russia announced that it had launched a Kilo 636 submarine for a foreign customer. AMI believes that this may be the first of two submarines for the Algerian National Navy (ANN) as construction on the hull began in 2007.

On 18 May 2006, the ANN finalized a deal with Russia for the procurement of two Kilo 636 new construction submarines and the modernization of two older Kilo 877 units currently in service with Algeria. With launching in April 2009, the first unit will probably enter service by 2010 with unit two in 2011.

Algeria's latest Kilo now nearing completion is a testament to the success of Russia's Kilo submarine design, which has a growing list of foreign repeat customers such as China and Algeria as well as potential new customers including Indonesia and Venezuela. Of all Russian naval export programs, the Kilo submarine is without a doubt the most successful and should be considered a direct challenge to the most accomplished western designs such as the French/Spanish Scorpene and the German type 212 and 214 designs.

Various Did You Know?

Japan: On 08 April 2009, the Japan Maritime Self Defense Force (JMSDF) commissioned its first Sorya class submarine JDS SORYA (SS 501).

RUSSIA: On 08 April 2009, Sevmash Shipyard in Severodvinsk announced that construction would begin on the fourth Borey class nuclear-powered ballistic missile submarine (SSBN) by the end of 2009.

From the May 2009 Issue

AUSTRALIA - Naval Priorities Through 2030

In early May 2009, the Minister for Defence released Australia's latest whitepaper, Defending Australia in the Asia Pacific Century: Force 2030. The whitepaper is the most comprehensive whitepaper released by the Australian Government and includes capability requirements through 2030. In regard to the Royal Australian Navy (RAN), it appears that there is a firm commitment by the present day government to maintain the current force levels and capabilities over the long term.

Highlights for the maritime forces include the following categories:

- **Submarine Programs:**
  12 new construction submarines (SEA 1000) that will be assembled in South Australia. This essentially doubles the submarine fleet from today's force of six units of the Collins class. The new submarines will be built and maintained through the 2050s. On 23 February 2009, the Australian Department of Defense (DoD) announced that Rear Admiral (RADM) Rowan Moffitt would head the Future Submarine Program at the Defence Material Organization (DMO). RADM Moffitt reports to the Chief Executive of DMO and leads the Royal Australian Navy (RAN), DMO and Capability Development Group Future Submarine Project Office. A construction contract can be expected

around 2020 in order to have the first unit in service by 2025.

Continued modernization of the Collins class with further incremental upgrades (including new sonars) will continue through 2025 when the first Future Submarines begin entering service.

- Surface Combatant Programs:

  Continue forward with the three units of the Hobart class destroyer (SEA 4000). The destroyers will be equipped with the Raytheon Standard Missile (SM-6) long range anti-air missile. The new vessels will also be equipped with Cooperative Engagement Capability (CEC).

  The government will continue to assess the capability need for the fourth unit of the Hobart class, which was an option when the original construction contract was signed for the first three units.

  A requirement for a new fleet of eight Future Frigates to replace the entire ANZAC class. The new class will be larger than the ANZACs and will focus primarily on anti-submarine warfare (ASW). Although no timeline was established in the whitepaper, the ANZACs will probably begin decommissioning around 2030 requiring a program start in 2020.

  Continued modernization of the eight units of the ANZAC class until replaced by the Future Frigates beginning around 2030.

  Acquisition of a fleet of 20 modular multi-role offshore combatant vessels (OCS) to replace four existing classes including the fourteen Armidale class patrol boats, six Huon class mine hunters, two Leeuwin class and six Paluma class hydrographic survey vessels (AGSs). The OCS will be around 2000 tons.

- Amphibious Ship Programs:

  Continuance of the Canberra class amphibious vessels (JP 2048) which will be commissioned in 2011 and 2013.

Both LHDs will remain in service until at least 2041. The replacement will be addressed in the follow-on whitepaper.

Acquisition of a new large strategic sealift ship in the 10,000-15,000 range. The new strategic sealift ship will replace the HMAS MANOORA in 2016. A construction contract can be expected around 2012.

Acquisition of six heavy landing craft with ocean going capabilities to supplement the Canberra class LHDs. The new craft will be able to transport armored vehicles, trucks, stores and people in intra-theater tasks.

- **Naval Aviation Programs:**

  Acquisition of 24 new naval helicopters to provide advanced ASW and anti-surface (ASuW) warfare capabilities.

  Acquisition of 46 new MRH-90 helicopters that will be split between the RAN and the Army. The naval variant will replace the Sea Kings that are currently in service.

Although not specifically mentioned in this whitepaper, the RAN is still anticipating the order of a new construction fleet replenishment ship (AOR) around 2011. The new AOR will replace the HMAS SUCCESS in 2015.

As mentioned earlier, this is by far the most comprehensive whitepaper released by the Australian Government. When considering the planning in its entirety, the RAN will continue with a substantial modernization effort, while gradually replacing it over the next three decades with a wholly new force. In order to carry out this ambitious effort, there will be a requirement for a sustained budget over the long-term. The present government is currently committed to 3% annual growth in the defense budget through 2018 and 2.2% growth after 2019.

The biggest question concerning the future planning for the RAN and Armed Forces is whether or not the government can maintain its promise on the 3% actual growth in the defense budget over the next ten years and 2.2% thereafter. The budget for 2009/2010 is expected to grow to AUD$26.6B (US$19.9B) from the 2008/2009 level AUD$23.3B (US$17.4B). Other unknown

factors over the long-term that will have direct implications on the future force include:

- Inflation
- Program cost overruns
- Political changes (new leadership) that will occur
- Requirement changes that may occur under future whitepapers
- Manning requirements for the RAN of which the sea service is currently struggling

SOUTH KOREA - Delay in KSS-3 Submarine Program

In mid-May 2009, AMI received information that the Republic of Korea Navy (ROKN) is delaying their KSS-3 submarine program by two years, until 2013. This is partially due to the global economic downturn in addition to the ROK Army having more urgent acquisition needs (although the latter has been denied by ministry officials).

The KSS-3 will be the largest submarine in the ROKN, displacing around 3,000 tons. it will have stowage for up to twenty weapons, including the LIG Nex 1 White Shark heavyweight torpedoes and Sea Star SSM-700K surface to surface missiles (SSM). Additionally, the class will be equipped with an air independent propulsion (AIP) system to allow for increased undersea time without the need for resurfacing.

Information from the Agency for Defense Development (ADD) and the Defense Acquisition Program Administration (DAPA) indicates that Samsung Thales is the front-runner for a US$120M contract to supply the combat management system (CMS) for the new submarine after rival LIG Nex 1 withdrew from the competition. Although not the supplier of the CMS system, it is anticipated that LIG Nex 1 will integrate the sonar system under a separate US$80M deal.

The construction contract for the domestically designed and equipped diesel-electric submarine was to be awarded in 2011, with the first unit beginning construction in 2015. Based on the delay from the original reform package of 2005, the first unit of the three ship class will begin construction in 2017 and enter service in 2020.

VIETNAM - Developing a Blue Water Submarine Force?

In April and May 2009, AMI began to receive information that Vietnam was in the process of moving forward with a blue water Submarine Force that will consist of up to six Kilo class submarines. Vietnam is undoubtedly considering the replacement of its two Yugo class midget submarines purchased in 1997. However, AMI believes that this sale is more than likely a result of aggressive salesmanship by Russia's Rosoboronexport.

Reporting from various sources indicates that Vietnam is close to completing the US$1.8B deal for the purchase of six units of the Kilo class although AMI believes that six units are far too great an undertaking for the Vietnamese Peoples Navy (VPN). These units, regardless of number, will be built at Russia's Admiralty Shipyards. With an annual defense budget of only US$3.6B, these units could be paid for through barter agreements in combination with forgiveness of debt owed to the Former Soviet Union. Recent Vietnamese equipment purchases from Russia were financed in the same manner and also very similar to Algeria's recent purchases of submarines from Russia. Various sources indicate that the deal also includes the modernization of Vietnam's shipbuilding infrastructure, which has been a major detractor in the nation's ability to modernize its navy. This type of barter/debt forgiveness transaction is beneficial to Vietnam as well as Russia, which is desperately trying to keep its naval shipbuilding industry afloat.

The modernization of the VPN began in the late 1990s with the purchase of two Yugo class midget submarines. The submarine purchase was followed by the procurement of one indigenous BPS 500 class fast attack craft (FAC), four Russian-built Tarantul class FAC and four Svetlyak class FAC. In March 2004, the VPN decided to order the more modern version of the Tarantul class FAC, the Tarantul IV. The first two units were delivered in 2007 with eight additional units planned through 2015.

By 2006, the VPN took its next step and ordered two Gepard class frigates from Russia, making these two vessels the largest to date for the sea service. For the past decade, the Vietnamese sea service has been slowly modernizing itself due to its national interests in the region. The reason for the overall expansion (including a submarine purchase) can be directly attributed to what

it perceives as China's expansionist endeavors through the region, including the contested Spratly Islands. Most recently, Vietnam has protested China's newest naval installation on Hainan Island. Historically speaking, China and Vietnam have been at odds for over 3000 years. Additionally, Vietnam has watched some of its other neighbors including Indonesia, Malaysia and Singapore procure submarines over the past decade.

It now appears that Vietnam will attempt to take its final step in developing its sea service, the ability to maintain and operate a fleet of blue water submarines. This must be considered a monumental task if it comes to fruition. Without a doubt, through various financing methods and Soviet era debt forgiveness; Vietnam may indeed be able to purchase these submarines if it wishes. The biggest question will be whether the VPN will have the ability to operate, base and maintain a modern blue water submarine fleet. Before the VPN can even consider operating a Submarine Force of this type and sophistication on its own, it will require significant infrastructure improvements to base the submarines as well as many years of Russian training and operational assistance.

If Vietnam is genuinely concerned with other nations' expansionism and naval modernization within the region, this program must be considered a national priority. If this deal in fact comes to fruition, a contract could be in place by 2010, with the first Kilo submarine being delivered by 2013 although its crew will require Russian assistance for years to come.

INDONESIA - Overhaul of 2nd type 209 Submarine in South Korea

On 28 April 2009, Daewoo Shipbuilding & Marine Engineering (DSME) of South Korea was awarded a US$75M contract for the modernization of the Indonesian Navy's (IN) second Cakra class (NANGGALA) Type 209/1300 submarine.

The modernization program will likely be similar to the one CAKRA completed in 2006 that included:

- Overhaul of the submarine's four engines
- Replacement of batteries

- Upgrade of the combat management system
- Upgrade of the sonar system
- Upgrade of the electronic support measures (ESM) system
- Replacement of the surface search radar

Based on the timeline of CAKRA's modernization program, should NANGGALA enter the shipyard by the end of 2009, it will likely return to service with the IN by the middle of 2011.■

THE SUBMARINE REVIEW

THE SUBMARINE REVIEW is a quarterly publication of the Naval Submarine League. It is a forum for discussion of submarine matters. Not only are the ideas of its members to be reflected in the **REVIEW**, but those of others as well, who are interested in submarines and submarining.

Articles for this publication will be accepted on any subject closely related to submarine matters. Their length should be a maximum of about 2500 words. The League prepares **REVIEW** copy for publication using Word. If possible to do so, accompanying a submission with a CD is of significant assistance in that process. Editing of articles for clarity may be necessary, since important ideas should be readily understood by the readers of the **REVIEW**.

A stipend of up to $200.00 will be paid for each major article published. **Articles accepted for publication in the REVIEW become the property of the Naval Submarine League.** The views expressed by the authors are their own and are not to be construed to be those of the Naval Submarine League.

Comments on articles and brief discussion items are welcomed to make **THE SUBMARINE REVIEW** a dynamic reflection of the League's interest in submarines.

Articles should be submitted to the Editor, SUBMARINE REVIEW, P.O. Box 1146, Annandale, VA 22003.

THE SUBMARINE COMMUNITY

MEMORIAL DAY - 2009
USS LAPON INDUCTION INTO THE SUBMARINE HALL OF FAME

by Captain Peter Flannery, US Navy(Ret.)

Captain Flannery completed a twenty-nine year career in submarines, having served on two ballistic missile submarines and three fast attacks. He was Commanding Officer USS LAPON (1988-1991), completing deployments to the North Atlantic and the Mediterranean Sea. He was Commander Submarine Squadron Six (1994-1996) and Commander Submarine Squadron Eight (1999).

Ashore he served as the COMSUBLANT PCO Instructor (1991-1994), COMSUBLANT Deputy Chief of Staff for Tactics, Training and Doctrine (1996-1997) and COMSUBLANT Deputy Chief of Staff for Maintenance and Material Management (1997-1998).

Captain Flannery currently resides in Chesapeake, Virginia with his wife, Barbara. They have three adult daughters and two grandchildren. He is employed by Dominion Resources.

On September 11, 1942 in the South China Sea, 59 years and 8000 miles distant from the events that would eventually make that day and month forever known, Wheeler Lipes and Darrell Rector were involved in their own life and death situation.

Who were Wheeler Lipes and Darrell Rector? Wheeler Lipes was a 22-year old Pharmacist's Mate, and Darrell Rector a 19-year old Seaman. They were crewmembers onboard USS SEADRAGON, conducting US submarine operations against enemy merchant shipping. Only the day before, Seaman Rector had complained to Lipes that he wasn't feeling well. Lipes observed as Rector's temperature rose gradually to 106°F and he

demonstrated all the symptoms of appendicitis.

Pharmacist's Mate Lipes had a long conversation with SEADRAGON's Commanding Officer, LCDR William Ferrall, the two of them sizing up the challenge they were now facing. There was a life-threatening medical situation requiring surgery, but there was no surgical expertise; there was rudimentary medical equipment; there was a six-day transit to the nearest port at Brisbane; there was an enemy seeking to destroy their submarine; and there was the ever-present knowledge that with surgery, you bury your mistakes. The Commanding Officer, with the patient's concurrence, ordered Lipes to perform the appendectomy.

Let me describe SEADRAGON's reality on that day. The wardroom table was used as the operating table. Because the patient was longer than the table, his feet were placed in the drawer of a nearby cabinet. Instruments were sterilized with boiling water. Bent spoons were used as retractors to hold open the incision. Ground-up sulfa pills were used as disinfectant. Navy-issue pajamas, sterilized with torpedo alcohol, were worn by the surgical team. Gauze, taped to faces, served as surgical masks. The ship's communicator functioned as the anesthetist. A tea strainer was used as a makeshift anesthesia mask for the ether-filled gauze pads that were placed over it. Pharmacist's Mate Lipes, who was technically trained as an electrocardiographer, had been an operating room assistant during two appendectomies. His experience and an onboard medical volume provided all the available guidance and procedural know-how for the volunteer surgical team. And young Seaman Rector's life was in the balance.

Circumstances were not kind to Pharmacist's Mate Lipes that day during his first ever work as a surgeon. The appendix was not where he expected it to be. It had adhered to the wall of Rector's intestine; it was enlarged, and it had become gangrenous. Lipes had to surgically remove the adhered appendix without puncturing it, or he would lose Rector on the table. After a two hour and thirty-six minute surgery, Lipes had successfully removed Rector's appendix and sutured his work.

Let's take a moment to reflect on four attributes that are prominent here. They are: the **courage, resourcefulness, persistence,** and **aggressiveness** of these Sailors.

The kind of **Courage** that enables a person to order, perform,

assist with, and undergo life-saving surgery, performed by a 22-year old, with no expertise, with rudimentary resources, in a submarine, operating in wartime, 120 feet beneath the surface of the South China Sea.

> The kind of **Resourcefulness** that creates a way to make things work in dire circumstances.
>
> The kind of **Persistence** that moves a person to find the facts, face the facts, and do the right thing.
>
> The kind of **Aggressiveness** that focuses an individual's instinct for self-preservation with conviction.

The 1943 Pulitzer Prize for reporting was awarded to Chicago Daily News reporter George Weller for his reporting on this story. Years later Pharmacist's Mate Lipes, the one-time surgeon, said that Seaman Rector, the compliant patient, was the world's most courageous man ...probably not what you want to hear from your surgeon.

Why are Wheeler Lipes and Darrell Rector and the crew of SEADRAGON important to us today? This SEADRAGON story is a story of outstanding performance and accomplishment. These events really occurred. The people really performed and accomplished with excellence. These were very common men with an uncommonly inspired drive to succeed. The story, and others like it, serves to sustain our submarine culture. The story, and others like it, needs to be told. Its meaning needs to be understood so that the same outstanding performance and accomplishment are expected and delivered now and in the future.

Here in the shadow of the Submarine Learning Facility it is appropriate to ask the following "Are we, as a Submarine Force, a learning organization, and if we are, how is that so?" Are undersea warriors indeed **learning, growing, leading, and excelling**, as the Submarine Learning Center's crest indicates? The SEADRAGON story provides the context that illustrates:

- what the undersea warrior should be **learning**
- how the undersea warrior should be **growing**

- where the undersea warrior should be **leading**
- if the undersea warrior's **excelling** is good enough.

How do the warriors learn what, not just performance, but *outstanding* performance, looks like? How do they learn what, not just accomplishment, but *outstanding* accomplishment, looks like? For it is to outstanding performance and accomplishment that this profession calls them. Appreciating our history, understanding what they are part of, understanding what submariners have accomplished, and having a vision of what remains for them to do are important objectives for the true learning organization.

To build our future, we must know our past. So it is with the story of the men who were called to perform and accomplish during a life-saving appendectomy onboard SEADRAGON in September of 1942.

So it is, also, with the story of the submarine and crew that are memorialized on the waterfront here at Naval Base, Norfolk. *Forty-one years ago tomorrow USS SCORPION was lost in the Atlantic as she returned to Norfolk from a Mediterranean deployment.* We remember their performance and accomplishment, even as we mourn their loss. As it has been with SCORPION, any situation in which risk overcomes reliability acts as a lens through which we assess and improve our submarine culture.

And so, too, is the purpose of our Submarine Hall of Fame. Today we induct USS LAPON into that Hall. There, the performance and accomplishment of LAPON's crews will serve as examples for our learning organization. In 1969, and again in later years, USS LAPON conducted operations of vital importance to national security. For these 1969 operations, LAPON was awarded a Presidential Unit Citation for extraordinary heroism, one of only five post World War II submarines to be so recognized. LAPON joins HALIBUT, PARCHE, TRITON, and NAUTILUS in a highly select group. LAPON's award citation for those 1969 operations did cite specifically the **courage, resourcefulness, persistence, and aggressiveness** of the officers and men of LAPON. Not by coincidence, these are the same attributes that we saw in the crew of SEADRAGON, but in LAPON's situation, they were somewhat differently applied.

LAPON's was the kind of **Courage** that leads young men to dare boldly to become the best in the world at what they do.

LAPON's was the kind of **Resourcefulness** that creates tactical opportunity and the willingness and skill to pursue it.

LAPON's was the kind of **Persistence** that motivates shipmates to work through fatigue, perform when challenged, and accomplish the mission.

LAPON's was the kind of **Aggressiveness** that focuses teamwork using individual dedication and conviction.

Our nation expected LAPON's crew to be physically harder and mentally stronger than any adversary at sea. LAPON's crew were men who would never quit. They persevered. They thrived on adversity. Like SEADRAGON's, LAPON's story needs to be told, its meaning needs to be understood so that the same outstanding performance and accomplishment are expected and delivered now and in the future.

We are more skillful as submariners today than we were 40 or 60-years ago. We have better equipment. We are more connected. Technology allows us to make good decisions more consistently. But make no mistake; the technological advancements will be diminished if we do not understand and then act on the need for sustaining the submarine culture, a culture that breeds such outstanding performance and accomplishment.

Back to Seaman Rector for a moment, remember him? Seaman Rector returned to full-duty only thirteen days after his appendectomy. Tragically, he eventually perished along with 77 shipmates, while serving onboard USS TANG on October 25, 1944 in the Formosa Strait when a MK-14 torpedo fired by TANG circled around and hit TANG. His brother, Earl Rector, had been captured when Corregidor was surrendered. His brother was a survivor of the Bataan Death March. His brother survived three and a half years of imprisonment in a POW camp. His brother learned of Seaman Rector's death upon being released from that

camp. Such was the reality of sacrifice, such was the reality of the time, and such was the reality of being part of an effort that was so much larger than the individual.

My name is Peter Flannery and for a time some years ago I was afforded the privilege of commanding the crew of USS LAPON. I am thankful for that time. I love the men who were LAPON's crew. I am grateful that LAPON will serve in this manner as a part of the history of our organization, continuing to define our submarine culture of outstanding performance and accomplishment. With appreciation and humility I speak for all the crews of LAPON, from her commissioning in December, 1967 to her decommissioning in June, 1992. I thank the Submarine Veterans and the Submarine Learning Facility for affording our submarine the privilege of serving in this very important way.■

IN PRAISE OF SUBMARINERS' CHILDREN

by Captain Chris Ratliff, USN

When CAPT Chris Ratliff was relieved of command of USS OHIO (SSGN 726) (BLUE) on 6 November 2008, he concluded his speech with these words of praise for all of the children of OHIO BLUE Sailors.

"Finally, I want to call attention to a group among us that is rarely recognized, rarely praised, yet the most important of all. In fact, let me say here and now that I dedicate my time in command of OHIO BLUE and this generous award[1] to my children, Melissa, Jennifer, and Christopher, and all the children of OHIO BLUE Sailors."

"The words of the English poet John Milton capture my feelings just right: "They also serve who only stand and wait." These kids do not stand with resignation, they take a stand to lead a good life. Mom does a wonderful job in dad's absence, yet we need to give them credit for being good kids because of the free will choices they make."

"They don't wait for dad to come home for their lives to be complete, instead they wait with resolve for that next challenge they must confront, not by choice but by birth: the cross-country move away from best friends, having to prove yourself all over again to get that last spot on the team, adjusting again to the vast cultural differences between north and south, east coast and west. And yes, it is a challenge not to have dad around. They teach themselves to play basketball and baseball, to build model planes, to fish, and to camp. They've learned on their own."

"Life as a submariner's kid is tough, but they don't complain, they just endure. I serve because I want to bequeath to my children a homeland that is prosperous, secure, and free. And when the time comes it will be theirs, not as a gift, but because they earned it. . .through their service. . .as they stand and wait. May God bless our children. . .and in our prolonged absence, may God continue to protect them."

[1] CAPT Ratliff was awarded the Legion of Merit for his tour in command of USS OHIO (SSGN 726) (BLUE)

A SHORT STORY
THE AGI

by Captain David G. Smith, USN(Ret)

In the early 1970's, while I was CO of JACK, we operated out of Rota in support of some special SSBN operations. Each time we would leave port we would be met by the Russian AGI. They would maneuver in behind us and follow us until we submerged. The evening before one of these underway assignments my XO, Gene Porter, and I were having a drink at the club when I noticed a particularly attractive bottle of wine on the shelf behind the bartender. The bottle had a brass-wire netting around it and an artistic label. A plan immediately developed to present the bottle to the AGI in the morning. We purchased the bottle, returned to the ship and began to assemble a presentation package–the bottle of wine, a set of dolphins, a ship's patch, a few other items and a note with the phrase, in Russian, "Man Cannot Live on Bread Alone." Everything was boxed, wrapped in plastic and attached to a loop and float with a long line.

As we departed the next morning the AGI headed towards us as we left port. They followed in behind with the spy-binoculars on both port and starboard bridge wings manned. We held up the package and when it was obvious that we had their attention, threw it overboard. Immediately we saw a group begin to assemble on the bow. As they approached the floating package we could see the boat–hooks being held out for recovery. The AGI slowed and recovered the package.

I have always wondered–who got to drink the wine?■

DOLPHIN SCHOLARSHIP FOUNDATION SELECTS NEW SCHOLARS

by Mrs. Randi Klein
Executive Director, DSF

Dolphin Scholarship Foundation (DSF) announces the selection of 30 outstanding high school and college students as the **2009 Dolphin Scholars**. Each Dolphin Scholar receives $3,400 per year which is potentially renewable for up to four years of undergraduate study at an accredited 4 year college or university, for a possible total individual award of $13,600. For the 2009-2010 academic year DSF will fund a total of 137 scholarships for an annual program total of $465,800.

One of the 30 new Scholars is the *1000th* Dolphin Scholar, Gavin D. Matthews, a senior at Granby High School, Norfolk, VA. His parents are EM1(SS) and Mrs. Billy Gene Matthews, Jr., USN,(Ret.). Gavin's stellar academic performance in the International Baccalaureate (IB) program and his leadership as captain of both the varsity swimming and varsity rowing teams–among many other accomplishments–clearly impressed the Selection Board. Gavin was the top ranked student in this year's pool of outstanding high school applicants. To recognize this historic milestone in the Foundation's history, Gavin will be designated as *"The Holland Scholar"* in honor of John Holland, inventor of the first submarine purchased by the U.S. Navy on April 11, 1900.

The First Dolphin Scholar, John L. Haines, Jr., received a $350 grant from Dolphin Scholarship Foundation in June 1961. The Foundation was organized and initially funded by submarine wives' clubs. Since 1961, the Foundation has awarded almost eight million dollars in financial assistance to children and stepchildren of members of the U.S. Navy who are members of the Submarine Force.

The 2009 Dolphin Scholars were selected from over 200 applicants. Final selection was based on three equal criteria: academic proficiency, financial need, and commitment and excellence in school and community activities. Members of the military and civilian community comprised the Scholarship

Selection Board, including Mr. John L. Haines, Jr., the First Dolphin Scholar; Dr. Jane Duffey, Headmaster, Norfolk Christian School, the daughter of DSF Founder Martha Grenfell; and Mrs. Mimi Donnelly, Chairman of the DSF Board. Of the 30 Dolphin Scholars selected, 21 were high school seniors and 9 were current college students, 15 male and 15 female. Ten of the submarine sponsors were from the enlisted community and 20 were submarine officers.

The following students were selected as 2009 Dolphin Scholars:

Student	Sponsor	Home State
Katherine V. Adams	CDR Timothy A. Adams, USN (Ret.)	VA
Clayton C. Anderson	LT Leonard C. Anderson USN (Ret.)	WA
Erika R. Bjorklund	CDR Bruce R. Bjorklund, USN (Ret.)	IA
Erich J. Brandeau	CDR John F. Brandeau, USN (Ret.)	NE
Chase P. Brown	CAPT Michael W. Brown, USN	VA
Nicholas C. Carullo	CDR Anthony C. Carullo, USN	VA
Tyler S. Clinch	LCDR Kevin D. Clinch, USN (Ret.)	VA
Benjamin N. Cooper	STSCS(SS) Ricky F. Cooper, USN (Ret.)	NC
Heather N. Cormier	ETCS(SS) John E. Cormier, USN (Ret.)	FL
Christopher R. Daugherty	CAPT John R. Daugherty, USN (Ret.)	VA
David P. Dawson	CDR Peter M. Dawson, USN	VA
Olivia B. Farley	PN1 Wayne L. Farley, USN (Ret.)	GA
Taylor M. Guinn	LCDR Thomas M. Guinn, USN (Ret.)	VA
Christopher M. Jones	CDR Michael C. Jones, USN (Ret.)	VA
Robert M. Kennedy	LCDR Joel D. Kennedy, USN (Ret.)	ID
Winford W. Knowles	CDR Winford W. Knowles, USN (Ret.)	GA
Brittany L. Larson	LCDR Timothy J. Larson, USN (Ret.)	WA

Student	Sponsor	Home State
Solana Lund	CDR John J. Lund, USN	WA
Gavin D. Matthews	EM1(SS) Billy G. Matthews, Jr., USN (Ret.)	VA
Elizabeth L. Moore	MM1 Timothy R. Moore, USN (Ret.)	KY
Brandy N. Morneau	MM1(SS) Paul T. Morneau, USN (Ret.)	CT
Danielle W. Noriega	LT David W. Noriega, USN	VA
Brittany N. Oravec	LCDR Michael J. Oravec, USN (Ret.)	VA
Chelsea E. Prough	MMC Brent R. Prough, USN (Ret.)	VA
Matthew J. Quinn	CDR Michael J. Quinn, USN (Ret.)	VA
Marisa R. Schultz	ETC(SS) Ronald L. Schultz II, USN (Ret.)	MO
Kelly M. Stadler	ET1(SS) Jon M. Stadler, USN (Ret.)	NC
Brian M. Stitt	ET1(SS) Alvin L. Stitt, USN (Discharged)	VA
Sydney L. Traub	CAPT William F. Traub, USN	GA
Amberly P. Wright	LCDR William L. Wright, USN	VA

REUNIONS (continued)

USS STERLET SS-392 Oct 8-11, 2009 Branson, MO
POC: Dick Jarenski, YN1(SS), Assoc. Commander, Phone: 520-744-0869 (H)
LOC: Lodge of the Ozarks Phone: 877-327-9894

USS SENNET SS-408 Oct 11-15, 2009 Myrtle Beach, SC
POC: Ralph Luther, P.O. Box 864, Summerville, SC 29484-0864
Phone: 843-851-7064 E-mail: rluther@bellsouth.net
LOC: LandMark Resort, Myrtle Beach, SC

USS TRUMPETFISH SS-425 Oct 8-12, 2009 Fairfax, VA
LOC: Hyatt Fair Lakes Hotel
POC: Terry Trump Phone: 843-873-9563 E-mail: ss425@hotmail.com

UCC CHIVO SS-341 Oct 14-18, 2009 Myrtle Beach, SC
POC: Stan Pollard, 2447 Tiffin Ave., #176, Findlay, OH 45840
Phone: 910-352-2572 E-mail: justan2@earthlink.net
Web Site: http://usschivo.org

YEAR 2010

USS OMAHA SSN-692 Feb 6-13, 2010 Cruise
LOC: Leave from Miami, FL
POC: Stan Walton E-mail: oma-cruise@comcast.net

THE BATTLE OF THE ATLANTIC 1939-1945

WHY THE U-BOAT CAMPAIGN FAILED, PT. III OF III

by VADM James A. Sagerholm, USN(Ret.)

VADM Sagerholm is a retired submarine officer who commanded USS KAMEHAMEHA (SSBN642) (Gold). As a flag officer he served as Commander South Atlantic Force, Executive Director of the President's Foreign Intelligence Advisory Board, and Chief of Naval Education and Training.

Part I posed the question as to why Germany lost the Battle of the Atlantic, since the German Navy "Arguably possessed the most experienced submariners of any navy in the world." It provided the background of the German Navy and its U-boat force leading up to the outbreak of the Second World War in September 1939, and described the relative advantages and disadvantages of the U-boats versus their Allied adversaries, as well as the strategy and tactics employed by the U-boat force. The primary innovation in tactics was the use of wolfpacks to defeat the convoy system of the Allies, but wolfpack tactics required large numbers of submarines, yet Germany had only 22 ocean-going boats at the outbreak of war, a disadvantage somewhat offset by the dearth of Allied ASW escorts and aircraft. It then became a question of adaptation of strategy and tactics to accommodate resources, the ability to produce forces quicker than the other side, and the ability to create innovations in tactics, sensors and weaponry, including ships and submarines.

Part II described the early successes of the U-boat campaign; the insistence of Admiral Dönitz to personally direct the employment of his U-boats thus requiring frequent radio transmissions from the boats that revealed their position to Allied code-breakers and HF/DF

intercepts; the failure of Hitler to give top priority to the U-boats in resources and allocation of technical expertise, whereas the Allies gave the Battle of the Atlantic first priority in all aspects; and discussed and analyzed these and other factors that affected the outcome of the battle. Implicit in the discussion and analysis is the effectiveness of the early individual U-boat crews despite the handicaps under which they operated, a tribute to the German submariners, and a testimony to the potential of submarines in naval warfare.

Part III concludes the series, then provides a summation of the author's findings and conclusions. The reader is invited to draw his or her own conclusions, and is encouraged to submit comments for discussion.

When the United States first entered the war, little was done to protect shipping along the east coast; coastal cities were not blacked out; ships were not convoyed; and the few resources available to the east coast permitted only an ASW patrol of meager proportions, hardly adequate to meet the size of the task. In addition, those few who were engaged in ASW were not trained for the task. Dönitz dispatched five long-range Type IXC boats to the area of the east coast between New York and Miami, and six Type VIIC medium range boats to the area east of Newfoundland and Massachusetts, this being the limit of the Type VII's range. Called Operation *Paukenschlag,* which translates roughly as *drum beat*, it was known within the U-boats as the *second Happy Time*. With virtually no protection and their silhouettes against the bright lights ashore providing clear outlines, the ships traveling the waters along the U. S. east coast were literally targets in a vast shooting gallery. In sixteen days, thirteen ships totaling 95,000 tons were lost, with seventy per cent of the tonnage being tankers carrying petroleum needed for the war. It was not until the April-May period that military and naval authorities ordered the coast to be blacked out. By the spring of 1942, U-boats had penetrated the Gulf of Mexico, where in May 1942 forty-one ships were sunk with a total tonnage of 218,867 tons. Every month had seen multiple sinkings in every area along

the east coast and later in the Gulf of Mexico, a feat achieved with usually only six boats on station at any one time. The lack of sufficient numbers of long-range U-boats was painfully evident, the *happy time* notwithstanding, since the abundance of unprotected shipping, particularly tankers, if fully exploited, could have significantly affected the American war effort, delaying the production of ships and other war material, and perhaps causing the delay of Operation TORCH.

The U. S. Navy's sparse escorts on the east coast as of December 1941 increased sufficiently by May to permit convoys to be organized, and by August, an interlocking convoy system had been established, covering the entire east coast.[1]

Before 1942, American shipbuilding was producing an average of one million tons annually. By 1943, however, merchant shipbuilding had reached over ten million tons and did not go below that figure for the remainder of the war. Warship building also ramped up in parallel, and carriers, cruisers, destroyers, submarines, and smaller ASW craft, as well as the thousands of different types of amphibious landing craft, were produced. The merchant shipbuilding production was sufficient not only to offset losses to U-boats, it actually increased the tonnage of merchant shipping available. At the same time, the ASW forces assigned to protect merchant ships at sea were being constantly reinforced and enlarged, and new classes of destroyer escorts were designed and built in record time, less than ten weeks in some cases from keel laying to commissioning. This phenomenal growth was accomplished by expanding jobs to include women, by clever engineering techniques involving the manufacture of prefabricated parts, and the use of assembly-line techniques that had been developed in the auto industry.[2]

The new ASW forces also included escort carriers (CVE), relatively small carriers that displaced 10,000 to 15,000 tons at full load, with a top speed of twenty knots. Built on a merchant hull, the CVE carried a squadron of Wildcat fighters and a squadron of Avenger torpedo planes. Operating with a screen of four to six

[1] Samuel Eliot Morison, the Two-Ocean War: A short history of the United States Navy in the Second World War (New York: Galahad Books, 1963, 108-115).

[2] Gardner, *Decoding History*, 40.

destroyers and destroyer escorts, the CVE was the nucleus of hunter-killer groups that were introduced to the Battle of the Atlantic in the late spring of 1943, the point at which the tide of the battle was beginning to turn in favor of the Allies. The use of long-range B-24s and B-17s had proved to be effective in forcing the U-boats to run submerged both day and night, but it was considered that aircraft at sea that could quickly respond to convoys under attack would significantly enhance the protection of shipping, and would further tip the scales in favor of the Allies. Ten CVEs eventually were added to the Atlantic ASW forces, and from May 1943 to May 1945 accounted for fifty-three U-boats, using a combination of HF/DF, radar and Ultra intelligence to detect, locate, and attack approaching U-boats. Typical of the hunter-killer operations was the deployment of Task Group 21.15, consisting of Croatan (CVE-25) with Escort Squadron 13: Frost (DE-144), Inch (DE-146), Huse (DE-145), Snowden (DE-246) and Barber (DE-161). Having departed Hampton Roads on 24 March 1944, TG 21.15 had proceeded to the area southeast of Nova Scotia where submarines were reported by intelligence to be operating. After days with no results, on 7 April, an Avenger on night patrol encountered gunfire from a surfaced submarine. Unable to make visual contact, the Avenger dropped sonobuoys, but heard nothing. At 0600, four aircraft covered the area of the contact with more sonobuoys, but still nothing was detected. At 0710, four destroyers from TG 27.6 that was operating in the vicinity took over the search, and at 0810, Boyle (DD-215) gained a strong sonar contact at a range of 950 yards. As Boyle ran in to make a depth charge attack, a periscope was seen just aft of the destroyer. The U-boat captain had come up to periscope depth to check the situation, and saw the horrifying spectacle of eleven depth charges settling into the water near his boat. He took the boat deep as the charges detonated, and in the noise, Boyle lost contact. Three more destroyers arrived, joined by Frost and Huse, and the nine ships commenced a box search, half to the east and the rest to the west. At 1542, some six and a half hours later, Champlin (DD-601) gained contact, but the rough seas made it difficult to hold the target. Huse was sent to assist, and the two regained contact and commenced coordinated attacks that forced the U-boat, U-856, to the surface. On the Huse, Sonarman 3/c

Lawrence M. Rackson was at his battle station, gunner on the port bridge 20mm gun, when he saw the boat break the surface. After a short delay, German sailors came streaming out of the conning tower, and Rackson and every other gunner in the vicinity opened fire. According to Rackson, they were under the impression that the U-boat crewmen were racing to their topside guns and were firing at them, an impression reinforced when an explosion hit the bridge of Champlin, fatally injuring the captain and wounding three others.[3] However, the Germans were unable to fire their guns, and were trying to escape their sinking boat and surrender. Later investigation revealed that the 20mm ammunition locker on the port side of Champlin's bridge had exploded, causing shrapnel that showered the bridge. Champlin's port 20mm gun had swung hard against the traverse restricting cam and dislodged it, allowing a round from the gun to hit the locker, causing the explosion. U-856 was flooding aft and was settling by the stern when Champlin rammed the boat's stern. Huse made a ramming run but missed. The boat was now flooding rapidly with the stern under water, and soon slid beneath the waves in its final plunge to the bottom. The captain of the U-boat and twenty-seven others were rescued from the rough seas. By the time TG 21.15 returned to homeport four months later, there were seven less U-boats in the Kriegsmarine.[4]

The presence of the hunter-killer groups likely prevented additional attacks on convoys where submarines turned away rather than pressing an attack in the face of the air and escort coverage provided by a hunter-killer group. With their arrival in the ASW fleet, the CVEs helped the Allies to seize the initiative and go on the offensive against the U-boats. Land-based air had begun the change, but could not sustain it the way that the continually present hunter-killer groups could.[5] Although Admiral Dönitz elected to continue the battle in the Atlantic for two more years, he did so with the realization that unless unforeseen events changed the course of the war in the Atlantic, his U-boats were

[3] Lawrence M. Rackson, interview by author, Lutherville, Maryland, 28 October 2008.

[4] William T. Y'Blood, *Hunter-Killer: U. S. Escort Carriers in the Battle of the Atlantic* (Annapolis, MD: Naval Institute Press, 2004), 160-164.

[5] Morison, *The Two-Ocean War*, 366-370.

fighting for a lost cause. He had lost the Battle of the Atlantic.[6]

Dönitz's insistence early in the restoration of the U-boat force to build a preponderance of medium range boats reflected a failure to take the long strategic view in the event of war with Britain, a war that Dönitz was convinced was going to occur, a war that he had said would inevitably include the United States. His initial decision to build a preponderance of Type VII boats may have worked satisfactorily if war had not occurred until his 300 Type VIIs and 100 Type IXs actually were in the fleet, but when the war started with the relatively small numbers on hand, he lost sight of the long view and became concerned with the need for numbers to execute his wolf-pack tactics. If he recalled his prediction that America and Britain would both be fighting Germany, it is not evident in his decisions and planning, which were solely focused on Britain. At that point, he would have been able to modify his program of U-boat construction to build the two types in equal numbers, thus giving his force a balance that would have enabled him to strike much more effectively against American shipping in the first months of America's entry into the war. Dönitz showed an apparent lack of the use of intelligence on American capabilities and what America might add to the war in the Atlantic. Even after President Franklin Roosevelt initiated various kinds of assistance to Britain, including the use of U. S. Navy escorts for convoys within America's declared zone of neutrality, there is no evidence of Dönitz seeking information about the U. S. Navy. It would not have been difficult for an analyst following the force levels and disposition of American naval forces to have kept abreast of the lack of anti-submarine capability existing on the U. S. east coast. That realization would have been of value in looking ahead to attacking shipping off the coast of America, and could have prompted a recognition of the need for a better balance in his Submarine Force.

Dönitz's insistence on controlling the positioning of his boats right up to the point of attacking a convoy, combined with his refusal to recognize the hazard to his boats posed by the Allies' use of HF/DF, both by land stations and at sea on escorts, undoubtedly contributed to the loss of U-boats. Based on the

[6] Dönitz, *Memoirs*,341-344.

reports of escorts and their use of HF/DF to run down U-boats even before the latter were in attack position, it would appear that the losses in U-boats on the one hand, and the loss of opportunities to sink Allied shipping on the other hand, made the use of HF/DF doubly effective for the Allies.

Much has been made in recent years of the impact of Ultra, the general premise being that the Allies were reading all German traffic in near real-time, and thus the U-boats never had a chance. In fact, the ability to read some of the traffic, never all, varied from time to time, depending upon the key used and whether the analysts at Bletchley Park had mastered that key, either entirely or partially. There were stretches of months without any information as to German operations or intentions because the analysts were unable to break a new code immediately, hardly the picture of a system that was all-knowing. At times, the German code breakers at B-Dienst were providing more information to the German Navy than was the case for Ultra and the Allied navies. Nevertheless, Ultra did play a significant role overall, and enabled a number of convoys to avoid U-boats or to anticipate their attack. It is interesting to note that neither side was aware of the ability of the other to read their traffic, and when Dönitz questioned German intelligence because of the diversion of a convoy, for instance, he was assured that it was impossible to break the Enigma system.

It must have been a source of deep frustration for Raeder and Dönitz to have been unable to convince Hitler of the importance of the U-boat campaign to the overall success of the war. Hitler's inability to see the role played by the German Navy in clear terms had an impact on the course of the Atlantic battle in direct and indirect ways. Hitler's insistence that the U-boats be sent into the Mediterranean to assist Rommel by interdicting supplies going to the British army showed his ignorance of U-boat capabilities and limitations, and his superficial view of how submarines operate. The Allied control of the air from bases on Malta made it virtually impossible for German submarines in the confined area of the eastern Mediterranean to operate on the surface, or to take aggressive action against British shipping entering Alexandria. The net result was a loss of the use of the boats in the Atlantic with little to show for their presence in the Mediterranean.

Indirectly, the lack of understanding of the importance of the

Battle of the Atlantic by Hitler and his senior advisors and the resultant lower priority accorded the U-boats was a constant complaint of Dönitz, and justifiably so. In the technology give-and-take that ensued in the Atlantic war, the German level of support for the U-boats did not match the efforts of the Anglo-American scientists and engineers. Furthermore, there was no imaginative use of academic talent similar to ASWORG in America, analysis that was sorely lacking in the German navy, and if available to Dönitz, may have helped him to understand better the innovations he encountered on the part of the Allies, and may have assisted him in devising better tactics in response. As it was, the U-boat force was always in the reactive mode as opposed to the proactive, insofar as technology was concerned, with the exception of the anti-escort acoustic torpedo, and even here, the Allies quickly countered with a noisemaker devised by ASWORG that nullified the torpedo.

The failure of the magnetic detonators in the 1939-1940 period was a serious impediment to the possible success of the U-boat campaign, for the obvious reason that the U-boats were like wolves without teeth in trying to attack under those conditions. The Norwegian experience was especially traumatic, and was the catalyst for the extensive testing that eventually identified the problems in both the detonators and the torpedoes as well, problems that should have been discovered by the agency responsible for torpedo development. The number of submarines lost and the extent of lost opportunities to sink ships because of these malfunctions can not be known, but intuition says that both must be substantial.

The German failure to establish a joint command to fight the Battle of the Atlantic resulted in a lack of air support for the U-boats to the extent necessary to produce positive results. Aerial reconnaissance using truly long-range aircraft could have made a major contribution to the German side in the Atlantic war. Locating convoys by air would have reduced or eliminated the inefficient use of U-boats in search tasks and allowed increased efficiency in their at-sea employment, a critical factor when a force is deficient in numbers, as was the U-boat force.

Was Dönitz correct in his judgment that wolf-pack tactics were the answer to defeating the convoy system? In examining the

history of the attempts to employ wolf-packs, one notes that there are a number of factors that come into play for example, the state of training and level of experience of the U-boats; the ability of the U-boat captains to recognize opportunities and seize them during the attack on the convoy; the visibility and sea state; the condition of the boat and of the crew (state of material readiness of the boat and amount of rest the crew has had); level of opposition encountered from escorts and ships in the convoy; presence of Allied aircraft; and just plain luck, all played a part. In addition, there was Dönitz's requirement of making his captains communicate in order to give him a reasonable picture of the situation, necessary since he also insisted on personally directing the wolf-packs and individual submarines. Anything that gives away the hidden presence of a submarine in effect nullifies the advantage of the submarine, all else being equal. It is arguable that the requirement for communications in the amount demanded by Dönitz may well have nullified the theoretical effectiveness of the wolf-pack as a reliable tactic to employ against convoys. The successes realized were just as readily explainable by the particular attendant circumstances, and there were enough failures to justify questioning the reliability of the tactic.

The lack of a comprehensive and cohesive naval strategy is reflected in the decision to make the medium range Type VII boats the major force of the U-Bootwaffe, and further reflects the failure of both OKM and Dönitz to recognize the need to attack Britain's sea lines where the most effect could be realized, namely, the transportation of oil. It was oil that fueled the armed forces of all countries, and without adequate supplies of oil, forces were reduced to immobility in the case of ships, aircraft, tanks and trucks, vital elements of modern armed forces. In the initial stages of the war, when Britain was so short of ASW escorts and there were no long-range aircraft covering the Atlantic, Germany had the best opportunity to deliver a crippling blow to the British war effort, for industry relied on oil to a significant extent for its energy requirements, although British plants had access to the coal supplies of Wales and England. Once the United States was a formal combatant, Dönitz was able to send only five to six long range boats to attack the east coast shipping. In the case of America, there was no pipeline from the Gulf of Mexico to the

northeast industrial concentration, rendering the tanker traffic a most vulnerable target for a concentrated U-boat campaign, but Dönitz lacked the long range boats in sufficient numbers to be able to exploit the opportunity. In fact, there is no evidence that he recognized the vulnerability to the extent that he should have. While he did inform his captains that tankers were a preferred target, he did not require that the boats, with their limited load of torpedoes, save their *eels* for tankers, but instead continued to follow the practice carried over from the First World War of sinking any and all ships sighted, rather than concentrating on the high value targets. Ninety-five per cent of oil and petroleum products used by the east coast came by tanker, a statistic that should have been a basic strategic consideration of the OKM and of Dönitz, since "movement of oil and petroleum products was among the most vital of wartime enterprises."[7] Rather than seeking to attack a key center of gravity, however, the Germans followed the approach of simply counting ships sunk, regardless of the value of each ship in a strategic sense, permitting thus a waste of resources since torpedoes were in limited supply on each U-boat, and when expended, a boat had to return to base to replenish unless it could affect a transfer from a supply U-boat.

Midway through the war, Dönitz saw the need to keep boats on station longer than their individual capacities would permit, and had resorted to building large boats carrying fuel, food and torpedoes for transfer at selected rendezvous points. This endeavor met with limited success at best. Initiated in the spring of 1942 when three Type XIV boats were commissioned, each of some 1,700 tons, carrying 700 tons of fuel from which was available for transfer 400 to 600 tons, depending on the supply boats transit needs. In late April and early May, twelve Type VIIs and two Type IXs were refueled northeast of Bermuda, and by the middle of June, twenty out of thirty-seven boats in the western Atlantic and Caribbean had been refueled, and were ordered to attack shipping ranging from Hatteras to the West Indies. At the same time, however, the U.S. Navy had begun convoying on the east coast, and by June, had also instituted convoys in the Caribbean. Thus, what had been a fruitful source of targets from January to

[7] Blair, *The Hunters*,467.

April suddenly became barren of targets for the U-boats.[8] Once again, the failure of Dönitz and OKM to take the long-range strategic view at the outset of war had denied the U-boats the ability to exploit to the fullest the opportunities when they were available.

The system of using large U-boats to resupply boats at sea was fraught with difficulties, and required good weather and a low sea state, as well as excellent ship-handling and skilled seamanship by the U-boats. Furthermore, the supply boat's crewmen were on deck for long hours, handling the cumbersome refueling hoses and the lines controlling transfer of torpedoes and food, in conditions of rolling and heaving decks and the ever-constant risk of being spotted by an enemy aircraft or destroyer. At best, the system was a stop-gap measure that attempted to compensate for the lack of long-range boats. Once the Allies discovered the *milch cows* as they were dubbed by the U-boats, they rightly gave their destruction a high priority, and by August 1944 the operation had become so dangerous it was abandoned.[9]

It can be argued that concentrating submarines against a specific type of shipping would result in concentration of enemy forces to counter the submarines, and that is so if the enemy has sufficient forces to do so. But early in the war, the British ASW forces were in short supply, and a large reduction of oil and petroleum products could have had a telling political effect on Britain at a critical point early in the war, the fall of France.

It is also instructive to compare the priority accorded the Battle of the Atlantic by the British prime minister, Winston Churchill, with the lack of same by Hitler. It was the former who had named it, and it was he who had given it the highest priority in his directive issued on 6 March 1941, a priority that was responsible for the resources of material and labor which resulted in the continual increase in strength and numbers of the forces assigned the task of fighting the war in the Atlantic. When America entered the war, Churchill had already persuaded President Franklin Roosevelt of the strategic importance of the Atlantic in the eventual defeat of the Axis in Europe, and the vast

[8] Dönitz, *Memoirs*, 219-221.

[9] Ibid., 418.

resources of American industry played a significant role by producing literally prodigious amounts of warships and merchant ships, such that by war's end, the Allies possessed more ships than at the beginning despite the numbers sunk by the U-boats. Against this capability, the longer the war lasted, the less chance of success did Dönitz's strategy have; once America was in the fight, sinking more ships than could be replaced was a losing gambit. The best chance for success was early in the war, and the German high command did not apparently understand that, since the war in the Atlantic never seemed to have been given its due in the German grand strategy. Although Dönitz appreciated the importance of the U-boat campaign to the total war effort, he was fixated on numbers rather than quality of ships sunk as the gauge for measuring results, and thus he continued on a course of action that was increasingly likely to fail. His memoirs are full of such phrases as "fortunate in our estimates" and "my feeling was ..." or similar statements that indicate the decisions for employment of the U-boats were largely *seat-of-the-pants* intuitive guesswork, devoid of any analysis of a concrete nature, and the general approach of the U-boat command as the war progressed was one of reaction to Allied initiatives rather than a proactive seizing of the initiative. Attempts to be proactive through the development and building of the Type XXI and Type XXIII boats were too late to be effective, having been of lower priority in the overall production of the implements of war. As it was, the hasty construction of the XXI and XXIII boats resulted in submarines that were designed for a depth of 1200 feet being unsafe below 700 feet due to poor structural integrity, as shown in post-war tests conducted by the U.S. Navy.[10]

In conclusion, it is evident that no one factor can be identified as causing the defeat of the U-boats in the Battle of the Atlantic; rather, it was a complex interweaving of a number of factors which produced the outcome. The person and personality of Dönitz loom large, but there were factors over which he had no control that also played a role, the onset of the war well before the German Navy was prepared, for instance. On the other hand, he was responsible for the decisions made in response to those

[10] Blair, *The Hunters*, x.

factors, particularly the failure to adjust his strategy to the lack of numbers at the outset of the war. Concentrating on the tankers in September 1939 would not have guaranteed success, but it would seem to have had a better chance, at least early in the war, than did the unimaginative tactic of simply sinking any ship in sight.

In summary, the primary causes of defeat of the U-boats were

- The primacy of the Battle of the Atlantic in Allied priorities versus the inability of Hitler to see its importance, with consequent lack of a comprehensive strategy, and lack of support in weapons and sensor research, construction, and air support. The consequent lag in electronics technology was a constant hindrance to U-boat operations.
- No joint Atlantic command to provide coordination of air and submarine assets, and to discern special needs such as development of truly long-range aerial reconnaissance capability. The latter was a critical shortcoming for the Germans in the Atlantic campaign.
- The inflexibility of Dönitz regarding Allied use of HF/DF, causing needless loss of numbers of U-boats.
- The insistence of Dönitz on controlling wolf-packs via numerous radio transmissions from his boats, opening his boats to detection and location by the Allied ASW forces.
- Over-reliance on Type VII medium-range boats at the expense of sufficient numbers of long-range boats with greater endurance, so that opportunities to exploit Allied vulnerabilities were lost.
- Allied convoy system, which created a set of conditions that were favorable to the Allies so long as the U-boats followed the tactic of attacking any and all convoys, rather than those containing ships of the most value to sink, such as tankers. Convoy system also increased the difficulty of locating ships to attack. Intelligence received from B-Dienst and other intelligence sources could have identified which convoys were of most value to attack, and operational analysis could have been used to determine the optimum tactics to employ.
- Allied coordinated employment of escorts, hunter-killer groups, and land-based long-range aircraft.

- Onset of war in 1939 before the German Navy was adequately prepared, and the failure of OKM and Dönitz to adjust accordingly.

BIBLIOGRAPHY

Bird, Keith. *Erich Raeder: Admiral of the Third Reich*. Annapolis, MD: Naval Institute Press, 2006.

Blair, Clay. *Hitler's U-Boat War: The Hunters, 1939-1942*. New York: Random House, 1996.

_____ *Hitler's U-Boat War: The Hunted, 1942-1945*. New York: Random House, 1998.

Brown, David K. *Atlantic Escorts: Ships, Weapons & Tactics in World War II*. Annapolis, MD: Naval Institute Press, 2007.

Dönitz, Karl. *Memoirs: Ten Years and Twenty Days*. Translated by R. H. Stevens with David Woodward. New York: The World Publishing Company, 1958.

Gardner, W. J. R. *Decoding History: The Battle of the Atlantic and Ultra*. Annapolis, MD: Naval Institute Press, 1999.

Giese, Otto and James E. Wise, Jr. *Shooting the War: The Memoir and Photographs of a U-Boat Officer in World War II*. Annapolis, MD: Naval Institute Press, 1994.

Halpern, Paul G. *A Naval History of World War I*. Annapolis, MD: Naval Institute Press, 1994.

Hessler, Günter, Alfred Hoschatt and Jürgen Rohwer. *German Naval History: The U-Boat War in the Atlantic, 1939-1945*. Facsimile edition. London: HMSO, 1989.

Hirschmann, Werner with Donald E. Graves. *Another Place, Another Time: A U-Boat Officer's Wartime Album*. Toronto: Chatham Publishing, 2004.

Hutchinson, Robert. *Submarines: War Beneath the Waves from 1776 to the Present Day*. New York: HarperCollins, 2005.

Ireland, Bernard. *Battle of the Atlantic*. Annapolis, MD: Naval Institute Press, 2003.

Massie, Robert K. *Castles of Steel: Britain, Germany and the Winning of the Great War At Sea*. New York: Random House, 2003.

Miller, David. *Submarines of the World*. St. Paul, MN: MBI, 2002.

Paterson, Lawrence. *First U-Boat Flotilla*. Annapolis, MD: Naval Institute Press, 2002.

_____ *Second U-Boat Flotilla*. Barnsley, Yorkshire : Pen & Sword Books, 2003.

BIBLIOGRAPHY (Cont.)

Showell, Jak Mallmann. *The U-Boat Century: German Submarine Warfare, 1906-2006*. Annapolis, MD: Naval Institute Press, 2006.

Suhren, Teddy and Fritz Brustat-Naval. *Teddy Suhren, Ace of Aces: Memoirs of a U-Boat Rebel*. Translated by Frank James. Annapolis, MD: Naval Institute Press, 2006.

Vause, Jordan. *U-Boat Ace: The Story of Wolfgang Lüth*. Annapolis, MD: Naval Institute Press, 1990.

Westwood, David. *The Type VII U-Boat*. Revised edition. Annapolis, MD: Naval Institute Press, 2003.

Y'Blood, William T. *Hunter-Killer: U. S. Escort Carriers in the Battle of the Atlantic*. Annapolis, MD: Naval Institute Press, 1983.

CONVOY, THE BATTLE OF THE ATLANTIC A COMING TELEVISION MINI-SERIES

Produced by Cream Productions of Toronto, Canada and Darlow Smithson of the United Kingdom for History Television, Canada, Smithsonian Channel US, Channel 4 UK, and National Geographic Channels.

Previewed by Submarine Research Center

SUBMARINE REVIEW readers who are fascinated by VADM. James A. Sagerholm's, *The Battle of the Atlantic 1939-1945*, the first part of which appeared in the January, 2009 issue of the Review with parts II and III following in the April and July issues, will find a new, exciting television mini-series equally powerful. The four-part video presentation will premier on the Smithsonian Channel and National Geographic Channel in the fall of 2009.

Through exhaustive research and personal interviews with U-Boat skippers such as Reinhard Hardegen and merchant ship survivors such as Ken Ramsden, *Convoy* will be an important contribution to an understanding of the crucial battle of the Atlantic. What sets *Convoy* apart from prior television portrayals of the battle is its balanced approach to the contest of submarine vs. merchant ship and escort. In *Convoy* we see sailors on both sides of the conflict doing their jobs as best they can. There are neither *good guys* nor *bad guys*, just men fighting for what they believed was right. Nor is it a pure British effort to defeat the U-boat, but rather the combined effort of merchant seamen, and Canadian, American and British military. Under the sea were the Germans who pushed their boats beyond design limits as they initially enjoyed great success, then experienced ever-increasing odds as the strength of Allied A.S.W. improved.

Utilizing advanced computer imaging and actual footage, the Type VII and IX German submarines and their weapons are explained in detail. The viewer sees from a computerized aerial perspective how a German wolf-pack was able to out-maneuver a

convoy. With computer generated diagrams of U-boats, Corvettes and Destroyers we gain a clear understanding of what it was like to attack and be attacked. Many of the scenes taken from Canadian archival footage have never before been seen. The grim reality of what it was like to be torpedoed comes to life as computer enhanced footage becomes vivid. Using modern techniques, we are able to see for the first time the Battle of the Atlantic as it was really fought.

Critical to the series is the exhaustive research spearheaded by the noted historian and expert on the Battle of the Atlantic, Dr. Mark Milner of the University of New Brunswick. He and other experts on the battle carry us along the path of research with interviews of officers and seamen on both sides. The story is told in four episodes, starting with the dark days of 1939 and 1940, through the initial Allied effort to protect ships using escorted convoys, through the German attacks on American ships after Pearl Harbor and finally into the days when the Allies gain the upper hand through increased numbers and improved technology.

Episode One tells the story of the opening days of the Second World War when the U-boat was thought to be indomitable. From the sinking of the liner ATHENA to the daring mission into Scapa Flow, the U-Boat seemed to be everywhere. In reality, Admiral Karl Dönitz was forced to fight Nazi complacency as he struggled to build his submarine fleet. Hitler had promised him 800 submarines, but Dönitz was able to put less than 50 boats to sea as the war picked up speed. Protection of ships was minimal with few escorts and out-dated detection equipment. Aiding the U-boat fleet was the capture of Brest and Lorient on France's west coast. This dramatically cut transit time prolonging the U-boats time on station. With too few submarines, Dönitz was able to squeeze Britain's life line to a trickle.

Episode Two begins at the end of 1940 when Britain stood alone against Germany. Hitler ordered the battleships SCHARNHOSRT and BISMARK to sea. Britain was able to sink BISMARK, but SCHARNHORST attacked with impunity convoys leaving Newfoundland. Sinking 22 ships in Canada's backyard, the battleship diverted critical effort away from the anti U-boat campaign.

Prior to the war, British intelligence had been able to heist a

German enigma machine from Poland. Later, when Allied sailors were able to board a German submarine and retrieve its code manuals, the Bletchley Park code-breakers obtained the key to deciphering U-boat communications. This was a boon to the British A.S.W. campaign. U-boat commanders were shocked to find destroyers when they surfaced to recharge batteries. But when SC-42 lost 16 ships to torpedoes, it was clear that Ultra would not be enough. Insufficient escorts and ineffective procedures overshadowed Britain's intelligence breakthrough.

Episode Three sees the second era of U-boat easy-pickings. After Pearl Harbor and Hitler's declaration of war against America, German U-boats transited the Atlantic to devastate coastal shipping along America's eastern seaboard. Daily sinkings took place within eye-sight of coastal inhabitants who witnessed oil and debris being swept onto American beaches. Only after Admiral King was persuaded by a Royal Navy delegation did America adopt a convoy system.

Retired sonar operator Geoff Smith describes his frustration in trying to locate German U-boats in the waters at the mouth of the St. Lawrence River. With salinity and temperature inversion layers the U-boats were able to evade Canadian Corvettes and Destroyers. The episode traces U-517's 1942 rampage in Canada's home waters.

By then, Dönitz had been able to double his fleet and wolf-packs roamed at will in the area of mid-Atlantic beyond the range of land-based aircraft. The year 1942 ended with losses topping 1,500,000 tons. Using extensive computer generated imaging sequences and eyewitness accounts, the bloody November, 1942 struggle for SC 107 is recreated. We watch as U-boats set up for the attack, then coordinate their movements to keep punching away at the merchant ships. Simultaneously, we witness the frantic Allied effort to disrupt the attack as merchant seamen fight to survive.

Episode Four describes events that portend the changing tide of battle. While the Germans were maintaining over 100 U-boats on station, the Allies prepared for the invasion of Europe through northern France. For the preparation effort to continue, the U-boat menace had to be eliminated. Three technical innovations were pivotal in reducing the effectiveness of the U-boats: Advances in

radar and sonar equipment allowed escorting vessels to detect submarines at much longer ranges. The *air gap* in mid Atlantic was closed by the use of *jeep* carriers from which search aircraft could be launched. And the development of ahead-throwing *Hedgehog* volleys allowed destroyer crews to envelope a submarine with multiple depth charges. The Germans took terrible losses, but they too developed new weapons. Their noise-seeking torpedo homed on propeller cavitation so that merchant ship evasion became much more difficult.

The pendulum swung irrevocably in favor of the Allies when hunter-killer groups became the operational standard. U-boats were kept submerged and even the snorkel was not enough to stem the over-powering Allied presence.

In combination with VADM Sagerholm's excellent written series the illuminating mini-series *Convoy* will bring us a clear appreciation of the desperate struggle in the Atlantic during the Second World War. Watch for *Convoy* in the fall of 2009.■

ETERNAL PATROL

RADM John Michael "Jack" Barrett, USN(Ret)
CAPT John "Andy" Borchardt, USN(Ret)
VADM James F. Calvert, USN(Ret)
CAPT Bladen D. Claggett, USN(Ret)
RADM Robert H. Blount, USN(Ret)
CDR R.B. "Pete" Hailey, USN(Ret)
LCDR Don LaForce, USN(Ret)
CAPT Galen Robert Plummer, USN(Ret)

BOOK REVIEW

NAUTILUS FOUND...AT THE BOTTOM OF A NORWEGIAN FJORD!

by Dr. Don Walsh

Editor's Note: Dr. Don Walsh is the Submarine Officer who, with Jacques Picard, piloted the bathyscaph TRIESTE to the worlds' deepest spot, Challenger Deep in the Pacific, in 1960. He later earned his doctorate in Oceanography and is a renowned expert in diving and undersea exploration.

Sabotage in the Arctic – Fate of the Submarine Nautilus
Stewart B. Nelson, Ex Libris Corporation 2007.
222 pages, 123 illustrations, epilogue,
three appendices and a bibliography. $21.99

This year the US Navy's first nuclear submarine USS NAUTILUS (SSN 571), now a museum ship, celebrates the 50th anniversary of its historic 1958 submerged transit of the Arctic Ocean via the North Pole. It was a 'first' and truly a remarkable feat.

However, few remember that 26 years earlier there was another NAUTILUS that attempted this same voyage. It used the former US Navy submarine O-12, manned by a civilian crew. Sir Hubert Wilkins, one of the great adventurers of the 20th Century, organized the expedition. In this book, author Dr. Stewart Nelson, skillfully recounts the short history of this ship and also gives the reader the fascinating story of Sir Hubert's life and how he got a US Navy submarine for a private expedition.

Sir Hubert, an Australian who lived much of his life in the US, used a wide variety of platforms for his exploits. They included ships, aircraft, a dirigible and NAUTILUS. He primarily explored in the Arctic and Antarctic becoming one of the great polar legends. Yet few know that he also circumnavigated the world in the *Graf Zeppelin* or that he was involved with Roald

Amundsen's *Norge* zeppelin flight from Spitzbergen to the North Pole.

Now he would cross the Arctic Ocean submerged surfacing in open leads in the sea ice to charge batteries and ventilate the submarine. Forming an American syndicate he was able to get the US Navy to let him *borrow* an old submarine, *the O-12* that was to be scrapped. A WWI era sub with very limited submerged capabilities, it was not an ideal choice but for Sir Hubert it was the only choice.

After Wilkins' team completely overhauled and extensively modified NAUTILUS in the Philadelphia Navy yard, the plan was to cross the Atlantic to Bergen Norway. From there they would proceed north to Spitzbergen in the Svalbard Archipelago before crossing the Arctic Ocean under the ice, with a brief stop at the North Pole. Their destination would be Point Barrow Alaska.

That was the plan but what actually happened was very different and the expedition became a magnificent failure. There were major technical problems requiring time consuming repairs so that when they got to Spitzbergen it was too late in the season to go into the ice. However they decided to go north just to the edge of the sea ice.

When NAUTILUS finally did attempt to submerge it was discovered that the sub's stern planes were missing. Was it sabotage? Author Nelson gives the reader some interesting theories on what might have happened. Also NAUTILUS's bow planes had been removed as part of the conversion work there so there was no way it could make any sort of controlled dive.

A determined Wilkins attempted to force the sub under the edge of the sea ice. The forward end of the boat got wedged there but it could go no further. So after doing some scientific observations the expedition returned to Bergen with great difficulty. The expedition was over.

The terms of the US Navy's *loaning* the sub to Wilkins was that it was to be returned when the project was completed. However NAUTILUS could not withstand another Atlantic crossing and the Navy gave permission to scuttle it in Bergen Fjord. In November 1931 it was done and the *O-12* came to rest right side up at a depth of 1138 feet.

It remained forgotten until about 10 years ago when the

Norwegian Navy was doing testing of a mine hunting sonar and they discovered NAUTILUS. At that point author Nelson began to plan a visit to the site. Working with the German JAGO submersible, he was able to dive to NAUTILUS in 2006. This book follows the NAUTILUS saga from its conception in the late 1920's to Nelson's visit two years ago.

It is a great, well-told sea story about a man, a dream and how failure was met and reluctantly accepted.■

LIFE MEMBERS
CDR Richard S. Bennett, USN
ADM Frank "Skip" Bowman, USN(Ret)
Mrs. Bonnie J. Campbell
LCDR Brian P. Elkowitz, USN
CAPT Glenn Flanagan, USN(Ret)
YNCM(SS) James A. Hunnicutt, USN(Ret)
CAPT Michael E. Jabaley, Jr., USN
CAPT John McNish, USN(Ret)
ET1(SS) Grant Romaine, USN(Ret)
CDR Eric S. Stahl, USN(Ret)

PATRON
Mr. Joseph J. Buff

SPONSOR
Mr. and Mrs. David R. Hinkle

SKIPPER
ADM Frank "Skip" Bowman, USN(Ret)
LCDR Kenneth S. Brown, Jr., USN(Ret)
CAPT David H. Boyd, USN(Ret)
Ms. Pamela Hurst
Mr. John Merrill
Ms. Jill M. Winkelman

ADVISOR
CAPT Sherman G. Alexander, USN(Ret)
CAPT William H. Barnes, USN(Ret)
KCS(SS) James A. Englund, USN(Ret)
CAPT Wallace A. Greene, USN(Ret)
YNCM(SS) James A. Hunnicutt, USN(Ret)
LT COL William Northacker, USA(Ret)
CDR Graham T. Reader, RN(Ret)

ASSOCIATE
LCDR Warren G. Martens, USN(Ret)
CDR John F. Mangold, USN(Ret)
CAPT F. Michael Pestorius, USN(Ret)
CDR William F. Ruoff, III, USN(Ret)

Naval Submarine League Honor Roll

Benefactors for Twenty Years or More

American Systems Corporation
Applied Mathematics, Inc.
Booz Allen Hamilton, Inc.
Cortana Corporation
Curtis-Wright Flow Control Corporation
DRS Technologies, Inc
General Dynamics Advanced Information Systems
General Dynamics Electric Boat
Kollmorgen Corporation, Electro-Optical Division
Lockheed Martin Corporation
Northrop Grumman Shipbuilding
Northrop Grumman Corporation - Sperry Marine Division
Pacific Fleet Submarine Memorial Association, Inc.
Planning Systems, Inc. - QinetiQ North America
Raytheon Company
RIX Industries
SAIC
Sonalysts, Inc.
Systems Planning and Analysis, Inc.
The Babcock & Wilcox Company
The Boeing Company
Treadwell Corporation
Ultra Electronics Ocean Systems, Inc.
URS Corporation, EG&G Division

Benefactors for More Than Ten Years

Alion Science & Technology
AMADIS, Inc.
American Superconductor Corporation
Battelle
Goodrich Corporation, EPP Division
Hamilton Sundstrand Energy, Space & Defense
L-3 Communications Oceans Systems
Materials Systems, Inc.
McAleese & Associates, P.C.
Northrop Grumman Corporation - Marine Systems
Northrop Grumman Corporation - Undersea Systems
Perot Systems Government Systems
Rolls Royce Naval Marine, Inc.
Sargent Controls & Aerospace

Benefactors for More Than Five Years

Business Resources, Inc.
Dresser-Rand Company
Foster-Miller, Inc. - QuinetiQ North America
L-3 Communications Corporation
Micropore, Inc.
OceanWorks International, Inc.
Oil States Industries/Aerospace Products Division
PaciPinkerton Government Services, Inc.
Progeny Systems Corporation
SSS Clutch Company, Inc.
Superbolt, Inc.
Whitney, Bradley & Brown, Inc.

Additional Benefactors

3 Phoenix, Inc. (New in 2009)
Applied Physical Sciences Corporation
Advanced Technology Institute
L-3 Chesapeake Sciences Corporation (New in 2008)
Cunico Corporation
DRS Sonar Systems, LLC (New in 2008)
Dynamic Controls, Ltd. (New in 2008)
Epsilon Systems Solutions, Inc.
Ettem USA, Inc.
IBM Global Business Services, Public Sector
Imes Strategic Support – Ltd.
In-Depth Engineering Corporation (New in 2009)
iRobot Maritime Systems
L-3 Communications, Space and Navigation Division (New in 2009)
Lockheed Martin Corporation - Space Systems Company (New in 2009)
Murray Guard, Inc. (New in 2009)
Nuclear Fuel Services, Inc.
Oceaneering International, Inc.
Trelleborg Emerson & Cuming, Inc. (New in 2008)
TSM Corporation
VCR, Inc.
WSI Internet Marketing

SUPPORT YOUR NAVAL SUBMARINE LEAGUE

( ) $1,000 Patron
( ) $500 Sponsor
( ) $250 Commodore
( ) $100 Skipper
( ) $ 50 Advisor
( ) Other _____ Associate

METHOD OF PAYMENT:
( ) My check made payable to **The Naval Submarine League** is enclosed.
( ) Please charge my: ( ) VISA ( ) MasterCard

Card No. _____ Exp. Date ____/____

Name_____ Amount_____

Card Billing Address: _____

_____

Please indicate your NSL Chapter by checking one of the following:

9 Aloha 9 Atlantic Southeast 9 Capitol
9 Hampton Roads 9 Levering Smith 9 Nautilus
9 Northern California 9 Pacific Northwest
9 Pacific Southwest 9 South Carolina

Please mail your contribution to:
The Naval Submarine League
P. O. Box 1146
Annandale, VA 22003-9146

The Naval Submarine League is a Virginia-based non-profit 501(C)(3) corporation. It is dedicated to educating the public and promoting awareness of the importance of submarines to U.S. national security and the defense of our Nation.

THE SUBMARINE REVIEW

THE SUBMARINE REVIEW is a quarterly publication of the Naval Submarine League. It is a forum for discussion of submarine matters, be they of past, present or future aspects of the ships, weapons and men who train and carry out undersea warfare. It is the intention of the **REVIEW** to reflect not only the views of Naval Submarine League members but of all who are interested in submarining.

Articles for this magazine will be accepted on any subject closely related to submarine matters. Article length should be no longer than 2500 to 3000 words. Subjects requiring longer treatment should be prepared in parts for sequential publication. Electronic submission is preferred with either MS Word or Word Perfect as acceptable systems. If paper copy is submitted, an accompanying CD will be of significant assistance. Content, timing and originality of thought are of first importance in the selection of articles for the **REVIEW**.

A stipend of up to $200.00 will be paid for each major article published. For shorter Reflections, Sea Stories, etc., $100.00 is usual. Book reviewers are awarded $52.00, which is that special figure to honor the U.S. submarines lost during World War II. Annually, three articles are selected for special recognition and an additional honorarium of up to $400.00 will be awarded to the authors. **Articles accepted for publication in the REVIEW become the property of the Naval Submarine League.** The views expressed by the authors are their own and are not to be construed to be those of the Naval Submarine League. In those instances where the NSL has taken and published an official position or view, specific reference to that fact will accompany the article.

Comments on articles and brief discussion items are welcomed to make **THE SUBMARINE REVIEW** a dynamic reflection of the League's interest in submarines. The success of this magazine is up to those persons who have such a dedicated interest in submarines that they want to keep alive the submarine past, help with present submarine problems and be influential in guiding the future of submarines in the U.S. Navy.

Articles should be submitted to the Editor, SUBMARINE REVIEW, P.O. Box 1146, Annandale, VA 22003.