THE SUBMARINE REVIEW
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PAGE

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EDITOR'S COMMENTS

The Features in this issue are one-part sentiment and two-parts hard Washington facts. We lead off with Captain Don Hahnfeldt's short tribute to submariners which he composed as part of his change of command speech on leaving USS TENNESSEE.

Next is an excerpt from the Defense Authorization Act recently passed and signed to fund Fiscal Year 1996 (already half over). Because both the Administration's budget request for submarine funding and the Congressional actions on that request were very complex, we felt it best to present the actual words, as enacted into law, rather than put together our own description of what transpired and why the debate went the way it did. Even so, some explanation is necessary, so an excerpt from a Congressional Reference Service publication is offered.

As a logical follow-on to the FY 96 action we also present an excerpt from the Navy's FY 97 budget submission for submarine programs.

Our lead article concerns the SSBN Security Program and is written by one who has been involved with the program from its beginning. The reasoning behind the Navy's program of continuing and comprehensive examination of strategic submarine security factors is treated in this first of a two-part series. The July issue will carry an article describing the actions of the program and some of its history. In the current piece Mr. Razmus raises the question of future implications of "information warfare" to SSBN security. That concern can be extrapolated easily to all types of submarine operations, or indeed to any military activity dependent on stealth. Naturally, **THE SUBMARINE REVIEW** is interested in exploring all aspects of the subject and invites articles about the technological and operational considerations, as well as opinions on the future of stealth in an age of instant and pervasive communication. In making the invitation, we are quick to add we have no resolution to the question of definition for "information warfare" and do not mean to invent one; we just want to discuss it in terms of submarine warfare.

For all who have labored to solve the basic problem of keeping Battle Stations manned over the long haul there is an innovative proposal from the Executive Officer of ATLANTA. Getting everything done that needs doing in a submarine, with the limited manpower available and the constant turnover in job qualification, and without driving the officers and crew into exhaustion is one of the keys to submarine leadership. This Exec's plan is an interesting variation on a *condition watch bill* aimed at doing just that. Let's hear from the other XOs out there who are struggling with the same problem.

Two more articles from serving submariners cover big picture concerns about future submarine warship design and operating our current submarines in the increasingly combined and joint world of *other military operations* (formerly called *operations other than war* for those not yet fully politically correct). There is also a Discussion piece of great interest about current efforts to meld submarine expertise and battle group concerns into an experienced cadre of Naval Reservists to advise and support the Battle Group Commander.

Histories of torpedoes and communications add to our store of knowledge about how we came to have the Submarine Force we boast today, and the second installment of RADM Mike Rindskopf's monograph on buildings named for submariners tells us all a bit more than we knew before about those who preceded us in the boats.

This issue is rounded out with two reviews of books about the Second World War. In the first, the reviewer takes exception to an author's description of the Southwest Pacific actions in which submarines, on either side, are given scant credit for having much impact. The second recommends the book on Japanese submarine operations in World War II mainly because it gives a basis for raising questions about how we are solving current problems integrating submarines in general naval strategies.

Jim Hay

FROM THE PRESIDENT

As is always the case around Washington, the ebb and flow of budgets through the many steps of the various processes occupy an inordinate amount of time. Jim Hay, with this edition, has shown a copy of the 1996 Authorization language, enacted five months late. It too represents compromise between the request of Navy and strong diverse opinions within the Legislative arm of our Government.

I wrote last month of the Baciocco Panel which was convened to carry out the direction provided in the "Authorization Bill" (sec. 131 article (c)(3)(C)"

> "identify advanced technologies that are in various stages of research and development, as well as those that are commercially available off-the-shelf, that are candidates to be incorporated..."

That panel has reported to PEO(SUBS) and to the Assistant Secretary of the Navy (RD&A), Mr. John Douglass. By the time you receive this **REVIEW** the report will have been released and Vice Admiral Baciocco will have testified at least once on the Hill.

I thought you would be interested in, at least, what was termed the "overreaching conclusions". Although they should not astound you, and some are verification of what most of you thought you knew, they were derived independently by a diverse group of 14 people including leaders in industry, academia and retired military (one AF, one Army and three Navy flags). The conclusions were:

- The current design (previously referred to as NSSN) meets established requirements through the use of appropriate available technology.
- If certain performance thresholds were to change, there are some relevant and mature technologies which can be accommodated by the design.
- There are technologies potentially available, in the far term, which should be pursued for future inclusion in this submarine.
- There are insufficient resources to mature some of the technologies soon.
- Acquisition and life cycle support are in disparate organizations.
- The submarine R&D enterprise lacks prerequisites for an assured and viable future.

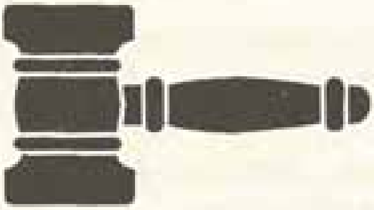
The panel made several recommendations with which the Navy will have to deal. The primary immediate recommendation, however, was that the proposed submarine (NSSN) should be authorized without delay; that is, there are no technologies for which a delay could be justified.

We are making final preparations for the Annual Symposium on 5 and 6 June. Our "submarine hero"will be Vice Admiral Eugene Wilkinson, USN(Ret.). He not only served as a junior officer in WWII but also was the first skipper of our first nuclear submarine NAUTILUS. Our banquet speaker will be the senior senator from Maine, Senator Bill Cohen. We are lining up several interesting speakers and presentations over the two day period and hope you have it on your schedule.

Two more subjects which maybe of interest:

- Our membership topped the 4000 mark recently when Newport News Shipbuilding and Drydock Company brought in 150 new members.
- Rear Admiral Ed Giambastiani has relieved as OP N87 and jumped right into the fray as the budget is again accelerated because of the election. Rear Admiral Giambastiani (please learn how to pronounce it) has a tremendous professional reputation and is a superb selection for the very difficult task ahead. Hope to see each of you in June.

Dan Cooper



The Heart that Beats in the Shark of Steel

In all of its power and glory - tactical weapons and weapons of mass destruction, precise navigation and sophisticated communications, absolute stealth and long range sonar, nuclear propulsion to steam submerged many times around the world; ability to deter an enemy, defend a people or destroy a nation; without rival among the navies of the world; respected by all, feared by most, and loved only by the men called submariners - the submarine is but a mass of steel, electronics and weaponry.

It's the sweat of the men in her that's the lifeblood flowing through the veins of the beast. It's their courage that matches the violence of the seas. It's their dedication and ingenuity that provide the margin of victory over the enemy. It's their service that assures the peace for a free nation. And it's their personal sacrifice that is shared only by their families. These are the men who live in the belly of the beast. They are the crew. They are the heart that beats in the shark of steel.

Don V. Hahnfeldt

Captain Don V. Hahnfeldt
A Submariner

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NATIONAL DEFENSE AUTHORIZATION BILL FOR FY 1996—AN EXTRACT

[Editor's Note: To set the stage for reprinting the submarine-associated section of the recently passed, and signed, bill which sets the policy for defense funding, an extract is first provided from the February 13, 1996 update of the Congressional Research Service publication Navy Attack Submarine Programs: Issues for Congress by Mr. Ronald O'Rourke.]

The Administration's defense budget for FY 1996 requested $1,507 million to complete funding of SSN-23, a third and final Seawolf (SSN-21) class submarine. The Administration also requested $1,160 million in research and development and advanced procurement funding for the NAS Attack Submarine (NAS or NSSN) program. The NSSN was designed to be a smaller and less expensive successor to the Seawolf design. The Administration's plan called for allocating the contracts for building the first two NSSNs (to be procured in FY 1998 and FY 2000) the Electric Boat Corporation of Groton, Connecticut.

Congress agreed to procure SSN-23 in FY 1996, but provided only $700 million rather than $1,507 million. The remaining $807 million will have to be provided in FY 1997 or a later fiscal year.

Congress disagreed with the Administration's plan for the NSSN program. The House National Security Committee decided that the NSSN was not affordable enough to be procured in the numbers the Navy wanted, and not capable enough to counter future Russian submarines. The Senate Armed Services Committee objected to the Administration's plan to allocate NSSN construction contracts to Electric Boat rather than award them on the basis of competitions involving Electric Boat and the nation's other submarine builder, Newport News Shipbuilding of Newport News, Virginia.

The two defense authorization committees merged their concerns and legislative proposals regarding the NSSN program in Section 131 of the FY 1996 defense authorization bill. Section 131 significantly restructures the Administration's proposed NSSN program into a program for procuring four operational prototype submarines between FY 1998 and FY 2001, followed by procurement of the first of a class of next generation submarines in FY 2003.

Each operational prototype is to use advanced technologies to be more capable and more affordable than its predecessor. Electric Boat is to build the FY 1998 and FY 2000 submarines, while Newport News Shipbuilding is to build the FY 1999 and FY 2001 submarines. The Navy's progress in implementing the operational prototype plan is to be reviewed annually by a special, bipartisan, six member panel consisting of three members from each of the two defense authorization committees.

NATIONAL DEFENSE AUTHORIZATION BILL

Sec. 131. Nuclear Attack Submarines

(a) Amounts Authorized. (1) Of the amount authorized by section 102 to be appropriated for Shipbuilding and Conversion, Navy, for fiscal year 1996—

(A) $700,000,000 is available for construction of the third vessel (designated SSN-23) in the Seawolf attack submarine class, which shall be the final vessel in that class; and

(B) $804,498,000 is available for long-lead and advance construction and procurement of components for construction of the fiscal year 1998 and fiscal year 1999 submarines (previously designated by the Navy as the New Attack Submarine), of which—

(i) $704,498,000 shall be available for long-lead and advance construction and procurement for the fiscal year 1998 submarine, which shall be built by Electric Boat Division; and

(ii) $100,000,000 shall be available for long-lead and advance construction and procurement for the fiscal year 1999 submarine, which shall be built by Newport News Shipbuilding.

(2) Of the amount authorized by section 201(2), $10,000,000 shall be available only for participation of Newport News Shipbuilding in the design of the submarine previously designated by the Navy as the New Attack Submarine.

(b) Competition, Report, and Budget Revision Limitations.

(1) Of the amounts specified in subsection (a)(1), not more than $200,000,000 may be obligated or expended until the Secretary of the Navy certifies in writing to the Committee on Armed Services of the Senate and the Committee on National Security of the House of Representatives that procurement of

nuclear attack submarines to be constructed beginning—

(A) after fiscal year 1999, or

(B) if four submarines are procured as provided for in the plan described in subsection (c), after fiscal year 2001, will be under one or more contracts that are entered into after competition between potential competitors (as defined in subsection (k) in which the Secretary solicits competitive proposals and awards the contract or contracts on the basis of price.

(2) Of the amounts specified in subsection (a)(1), not more than $1,000,000,000 may be obligated or expended until the Secretary of Defense, not later than March 15, 1996, accomplishes each of the following:

(A) Submits to the Committee on Armed Services of the Senate and the Committee on National Security of the House of Representatives in accordance with subsection (c) the plan required by that subsection for a program to produce a more capable, less expensive nuclear attack submarine than the submarine design previously designated by the navy as the New Attack Submarine.

(B) Notwithstanding any other provision of law, or the funding level in the President's budget for each year after fiscal year 1996, the Under Secretary of Defense (Comptroller) shall incorporate the costs of the plan required by subsection (c) in the Future Years Defense Program (FYDP) even if the total cost of that Program exceeds the President's budget.

(C) Directs that the Under Secretary of Defense for Acquisition and Technology conduct oversight over the development and improvement of the nuclear attack submarine program of the Navy. Officials of the Department of the Navy exercising management oversight of the program shall report to the Under Secretary of Defense for Acquisition and Technology with respect to that program.

(c) Plan for Fiscal Year 1998, 1999, 2000, and 2001 Submarines.

(1) The Secretary of Defense shall, not later than March 15, 1996, develop (and submit to the committees specified in subsection (b)(2)(A)) a detailed plan for development of a program that will lead to production of a more capable, less expensive submarine than the submarine previously designated as the New Attack Submarine.

(2) As part of such plan, the Secretary shall provide for a program for the design, development, and procurement of four

nuclear attack submarines to be produced during fiscal years 1998 through fiscal year 2001, the purpose of which shall be to develop and demonstrate new technologies that will result in each successive submarine of those four being a more capable and more affordable submarine than the submarine that preceded it. The program shall be structured so that—

(A) one of the four submarines is to be constructed with funds appropriated for each fiscal year from fiscal year 1998 through fiscal year 2001;

(B) in order to ensure flexibility for innovation, the fiscal year 1998 and the fiscal year 2000 submarines are to be constructed by the Electric Boat Division and the fiscal year 1999 and the fiscal year 2001 submarines are to be constructed by Newport News Shipbuilding;

(C) the design designated by the Navy for the submarine previously designated as the New Attack Submarine will be used as the base design by both contractors;

(D) each contractor shall be called upon to propose improvements, including design improvements, for each successive submarine as new and better technology is demonstrated and matures so that—

(i) each successive submarine is more capable and more affordable; and

(ii) the design for a future class of nuclear attack submarines will incorporate the latest, best, and most affordable technology; and

(E) the fifth and subsequent nuclear attack submarines to be built after the SSN-23 submarine shall be procured as required by subsection (b)(1).

(3) The plan under paragraph (1) shall—

(A) set forth a program to accomplish the design, development, and construction of the four submarines taking maximum advantage of a streamlined acquisition process, as provided under subsection (d);

(B) culminate in selection of a design for a next submarine for serial production not earlier than fiscal year 2003, with such submarine to be procured as required by subsection (b)(1);

(C) identify advanced technologies that are in various phases of research and development, as well as those that are commercially available off-the-shelf, that are candidates to be incorporated into the plan to design, develop, and procure the submarines;

(D) designate the fifth submarine to be procured as the lead ship in the next generation submarine class, unless the Secretary of the Navy, in consultation with the special submarine review panel described in subsection (f), determines that more submarines should be built before the design of the new class of submarines is fixed, in which case each such additional submarine shall be procured in the same manner as is required by subsection (b)(1); and

(E) identify the impact of the submarine program described in paragraph (1) on the remainder of the appropriation account known as *Shipbuilding and Conversion, Navy*, as such impact relates to—

(i) force structure levels required by the October 1993 October Department of Defense report entitled Report on the Bottom-Up Review;

(ii) force structure levels required by the 1995 report on the Surface Ship Combatant Study that was carried out for the Department of Defense; and

(iii) the funding requirements for submarine construction, as a percentage of the total ship construction account, for each fiscal year throughout the FYDP.

(4) As part of such plan, the Secretary shall provide—

(A) cost estimates and schedules for developing new technologies that may be used to make submarines more capable and more affordable; and

(B) an analysis of significant risks associated with fielding the new technologies on the schedule proposed by the Secretary and significant increased risks that are likely to be incurred by accelerating that schedule.

(d) Streamlined Acquisition Process. The Secretary of Defense shall prescribe and use streamlined acquisition policies and procedures to reduce the cost and increase the efficiency of the submarine program under this section.

(e) Annual Revisions to Plan. The Secretary shall submit to the Committee on Armed Services of the Senate and the Committee on National Security of the House of Representatives an annual update to the plan required to be submitted under subsection (b). Each such update shall be submitted concurrent with the President's budget submission to Congress for each of fiscal years 1998 through 2002.

(f) Special Submarine Review Panel.

(1) The plan under subsection (c) and each annual update under subsection (e) shall be reviewed by a special bipartisan congressional panel working with the Navy. The panel shall consist of three members of the Committee on Armed Services of the Senate, who shall be designated by the chairman of that committee, and three members of the Committee on National Security of the House of Representatives, who shall be designated by the chairman of that committee. The members of the panel shall be briefed by the Secretary of the Navy on the status of the submarine modernization program and the status of submarine-related research and development under this section.

(2) Not later than May 1 of each year, the panel shall report to the Committee on Armed Services of the Senate and the Committee on National Security of the House of Representatives on the panel's findings and recommendations regarding the progress of the Secretary in procuring a more capable, less expensive submarine. The panel may recommend any funding adjustments it believes appropriate to achieve this objective.

(g) Linkage of Fiscal Year 1998 and 1999 Submarines. Funds referred to in subsection (a)(1)(B) that are available for the fiscal year 1998 and fiscal year 1999 submarines under this section may not be expended during fiscal year 1996 for the fiscal year 1998 submarine (other than for design) unless funds are obligated or expended during such fiscal year for a contract in support of procurement of the fiscal year 1999 submarine.

(h) Contracts Authorized. The Secretary of the Navy is authorized, using funds available pursuant to paragraph (1)(B) of subsection (a), to enter into contracts with Electric Boat Division and Newport News Shipbuilding, and suppliers of components, during fiscal year 1996 for—

(1) the procurement of long-lead components for the fiscal year 1998 submarine and the fiscal year 1999 submarine under this section; and

(2) advance construction of such components and other components for such submarines.

(i) Advanced Research Projects Agency Development of Advanced Technologies.

(1) Of the amount provided in section 201(4) for the advanced Research Projects Agency, $100,000,000 is available only for development and demonstration of advanced technologies

for incorporation into the submarines constructed as part of the plan developed under subsection (c). Such advanced technologies shall include the following:

(A) Electric drive.
(B) Hydrodynamic quieting.
(C) Ship control automation.
(D) Solid-state power electronics.
(E) Wake reduction technologies.
(F) Superconductor technologies.
(G) Torpedo defense technologies.
(H) Advanced control concept.
(I) Fuel cell technologies.
(J) Propulsors.

(2) The Director of the Advanced Research Projects Agency shall implement a rapid prototype acquisition strategy for both land-based and at-sea subsystem and system demonstrations of advanced technologies under paragraph (1). Such acquisition strategy shall be developed and implemented in concert with Electric Boat Division and Newport News Shipbuilding and the Navy.

(j) References to Contractors. For purposes of this section—

(1) the contractor referred to as *Electric Boat Division* is the Electric Boat Division of the General Dynamics Corporation; and

(2) the contractor referred to as *Newport News Shipbuilding* is the Newport News Shipbuilding and Drydock Company.

(k) Potential Competitor Defined. For purposes of this section, the term *potential competitor* means any source to which the Secretary of the Navy has awarded, within 10 years before the date of the enactment of this Act, a contract or contracts to construct one or more nuclear attack submarines.

Sec. 132. Research for Advanced Submarine Technology

Of the amount appropriated for fiscal year 1996 for the National Defense Sealift Fund, $50,000,000 shall be available only for the Director of the Advanced Research Projects Agency for advanced submarine technology activities.

Sec. 133. Cost Limitation for Seawolf Submarine Program

(a) Limitation of Costs. Except as provided in subsection (b), the total amount obligated or expended for procurement of the SSN-21, SSN-22, and SSN-23 Seawolf class submarines may not exceed $7,223,659,000.

(b) Automatic Increase of Limitation Amount. The amount of the limitation set forth in subsection (a) is increased by the following amounts:

(1) The amounts of outfitting costs and post-delivery costs incurred for the submarines referred to in such subsection.

(2) The amounts of increases in costs attributable to economic inflation after September 30, 1995.

(3) The amounts of increases in costs attributable to compliance with changes in Federal, State, or local laws enacted after September 30, 1995.

(c) Repeal of Superseded Provision. Section 122 of the National Defense Authorization Act for Fiscal Year 1995 (Public Law 103-337; 108 Stat. 2682) is repealed.

The budget request reflected a policy, adopted by the Department of Defense as a consequence of its Bottom Up Review, that would cause all future nuclear submarines to be constructed by General Dynamics electric Boat Division (Electric Boat). The budget request included the following funding for submarine construction programs:

(1) $1.5 billion for SSN-23, the final increment required for full funding of this Seawolf class submarine;

(2) $704.5 million advance procurement for the first of a new class of nuclear attack submarines, designated as the new attack submarine (NAS), whose construction would begin in fiscal year 1998; and

(3) a total of $455.4 million for research, development, test, and evaluation for the NAS program.

The House report (H. Rept. 104-131) reflected the view that changes in the Navy's plan for acquisition of nuclear attack submarines should be made to incorporate advanced technologies into these submarines' designs. These recommendations were based on an underlying premise that the Navy's NAS program would not provide an adequate technological advantage over foreign submarines presently under construction or in design. The House bill would:

(1) not authorize SSN-23;

(2) authorize $550.0 million for Electric Boat to design, build, and incorporate a hull section into SSN-22 to create a lengthened, expanded capability variant of the basic Seawolf design, while retaining its full weapons load;

(3) authorize $704.5 million advance procurement for the fiscal year 1998 submarine that would be built by Electric Boat;

(4) authorize $300.0 million for Electric Boat to design and build a second hull section that would be incorporated into a fiscal year 1998 submarine, and convert that submarine from the lead ship of a serial-production class, based on the current NAS design, into an additional, one-of-kind, expanded capability platform that would be derived from the current NAS design;

(5) directs that $10.0 million of the funds in the budget request for NAS detailed design work be used only for establishing and maintaining a cadre of Newport News submarine designers at Electric Boat and for transfer of all NAS design data from Electric Boat's design data base to Newport News';

(6) authorize $150.0 million to begin an effort at Newport News to design, develop, and build prototype versions of major submarine components that would result in a follow-on submarine design for serial production that represents a substantial improvement in affordability and capability over the current NAS design;

(7) direct the Advanced Research Projects Agency (ARPA) and the national laboratories to make new technologies available to both Electric Boat and Newport News that show potential for achieving a follow-on submarine design for serial production that represents a substantial improvement over the current NAS design; and

(8) include a provision (sec. 133) that would direct the Secretary of the Navy to award, on a competitive basis, contracts for attack submarines built after the fiscal year 1998 submarine.

The Senate amendment reflected an alternate view on how to acquire nuclear attack submarines. It contained a provision (sec. 121) that would:

(1) authorize the SSN-23 at $1.5 billion, the budget request;

(2) limit the ability of the Secretary of the Navy to obligate or expend funds for SSN-23 until he restructures the NAS program to provide for:

(a) procurement of the lead NAS from Electric Boat in fiscal year 1998;

(b) procurement of the second NAS from Newport News Shipbuilding and Drydock (Newport News) in fiscal year 1999; and

(c) competitive procurement of any additional NAS vessels after the second. Potential competitors for these additional vessels would be contractors that have been awarded a contract by the Secretary of the Navy for construction of nuclear attack submarines during the past 10 years;

(3) place additional limits on the total amount of funds that may be expended for SSN-23 in fiscal years 1996, 1997, 1998, and 1999;

(4) direct the Secretary of the Navy to solicit competitive proposals and award the contract or contracts for NAS, after the second NAS, on the basis of price;

(5) direct the Secretary of the Navy to take no action that would impair the design, engineering, construction, and maintenance competencies of either Electric Boat or Newport News to construct the NAS;

(6) direct the Secretary of the Navy to report every six months to the Committee on Armed Services of the Senate and the Committee on National Security of the House the obligation and expenditure of funds for SSN-23 and the NAS;

(7) authorize $814.5 million in fiscal year 1996 for design and advance procurement of the lead and second NAS, of which $10.0 million would be available only for participation of Newport News in the NAS design, and $100.0 million would be available only for advance procurement and design of the second submarine under the NAS program;

(8) place limits on the expenditure of advance procurement funds in fiscal year 1996 for the lead NAS, unless funds are also obligated or expended for the second NAS;

(9) authorized $802.0 million in fiscal year 1997 for advance procurement of the lead and second NAS, of which $75.0 million would be available only for participation by Newport News in the design of the NAS, and $427.0 million would be available only for advance procurement and design of the second submarine under the NAS program; and

(10) authorized $455.4 million, the budget request, for research, development, test, and evaluation for the NAS program.

The conferees agree to adopt a new provision dealing with the design and procurement of future Navy attack submarines. This provision would:

(1) authorize the SSN-23 at $700.0 million;

(2) authorize $804.5 million in fiscal year 1996 for design and advance procurement of the fiscal year 1998 and fiscal year 1999 submarine (previously designated by the Navy as the NAS), of which;

(a) $704.5 million would be available only for long-lead and advance construction and procurement for the fiscal year 1998 submarine, which would be built by Electric Boat; and

(b) $100.0 million would be available only for long-lead and advance construction and procurement for the fiscal year 1999 submarine, which would be built by Newport News;

(3) authorize $10.0 million only for participation of Newport News in the design of the submarine previously designated by the Navy as the NAS;

(4) establish a special bipartisan congressional panel that would be briefed, at least annually, by the Secretary of the Navy on the status of the submarine modernization program and submarine-related research and development;

(5) direct the Secretary of Defense, not later than March 15, 1996, to accomplish the following:

(a) develop and submit a detailed plan for development of a program that will lead to production of more capable, less expensive submarines than the submarine previously designated as the NAS;

(b) ensure the plan includes a program for the design development, and procurement of four nuclear attack submarines that would be procured during fiscal years 1998 through 2001 with each successive submarine being more capable and more affordable;

(c) structure the program so that:

(i) one of the four submarines would be constructed with funds appropriated for each fiscal year from fiscal year 1998 through fiscal year 2001;

(ii) to ensure flexibility for innovation, the fiscal year 1998 and the fiscal year 2000 submarines would be constructed by Electric Boat and the fiscal year 1999 and the fiscal year 2001 submarines would be constructed by Newport News;

(iii) the design previously designated as the NAS would be used as the base design by both contractors;

(iv) each contractor would be called on to propose improvements, including design improvements, for each successive submarine so that each of them would be more capable, more affordable, and their design would lead to a design for a future class of nuclear attack submarines that would possess the latest, best, and most affordable technology; and

(v) the fifth and subsequent nuclear attack submarines, proposed for construction after SSN-23 would be procured after a competition based on price;

(d) the Secretary of Defense's plan would also:

(i) set forth a program to accomplish the design, development, and construction of the four submarines that would take maximum advantage of a streamlined acquisition process;

(ii) culminate in selection of a design for a next submarine for serial production not earlier than fiscal year 2003 with procurement to occur after a competition based on price;

(iii) identify advanced technologies that are in various phases of research and development, as well as those that are commercially available off-the-shelf, that are candidates for incorporation into the plan to design, develop, and procure the submarines;

(iv) designate the fifth submarine procured after SSN-23 to be the lead ship in a next generation submarine class, unless the Secretary of the Navy, in consultation with the special congressional submarine review panel, determines that more submarines should be built before the design of a new class of submarines is fixed, in which case the fifth and each successive submarine would be procured after a competition based on price; and

(v) identify the impact of the submarine program on the remainder of the Navy's shipbuilding account;

(6) impose certain limits on the amounts that can be obligated and expended on the SSN-23 and the fiscal year 1998 and 1999 submarines until:

(a) the Secretary of the Navy has certified in writing to the Committee on Armed Services of the Senate and the Committee on National Security of the House that procurement of future nuclear attack submarines, except as stipulated elsewhere in this provision, would be accomplished through a competition based on price; and

(b) the Secretary of Defense, not later than March 15, 1996, has:

(i) submitted the submarine design and procurement plan that would be required by the provision;

(ii) directed the Under Secretary of Defense (Comptroller) to incorporate the costs of the submarine design and procurement plan into the future years defense program, even if the total cost of the plan's program exceeds the President's budget; and

(iii) directed that the Under Secretary of Defense for Acquisition and Technology conduct oversight of the development and improvement of the nuclear attack submarine program of the Navy and established reporting procedures to ensure that officials of the Department of the Navy, who exercise management oversight of the program, report to the Under secretary of Defense for Acquisition and Technology with respect to that program;

(7) direct the Secretary of Defense to use streamlined acquisition policies to reduce the cost and increase the efficiency of the submarine program;

(8) direct the Secretary of Defense to submit to Congress an annual update of the submarine design and procurement plan with the submission of the President's budget for each o fiscal years 1998 through 2002;

(9) direct that funds authorized for fiscal year 1996 by this provision may not be obligated or expended during fiscal year 1996 for the fiscal year 1998 submarine unless funds are also obligated and expended during fiscal year 1996 for the fiscal year 1999 submarine;

(10) authorize the Secretary of the Navy to enter into contracts with Electric Boat and Newport News, and suppliers of components during fiscal year 1996 for:

(a) the procurement of long-lead components for the fiscal year 1998 submarine and the fiscal year 1999 submarine; and

(b) advance construction of long-lead components and other components for such submarines;

(11) authorize that, of the amount provided in section 201(4) of this Act for ARPA, that $100.0 million would be available only for development and demonstration of advanced technologies for incorporation into the submarines constructed as part of the submarine design and procurement plan specified under this provision, to include electric drive, hydrodynamic quieting,

ship control automation, solid-state power electronics, wake reduction technologies, superconductor technologies, torpedo defense technologies, advanced control concepts, fuel cell technologies, and propulsors;

(12) direct that the Director of ARPA shall implement a rapid prototype acquisition strategy for both land-based and at-sea subsystem and system demonstrations of advanced technologies in concert with Electric Boat and Newport News; and

(13) define potential competitors, for the purposes of this provision, as those that have been awarded a contract by the Secretary of the Navy for construction of nuclear attack submarines during the past 10 years.

Editor's Note: Navy News & Undersea Technology of February 12, 1996:

"Navy Sub Advisory Board Made Public

The Navy 's sub advisory board met for the first time in late January. The Navy panel is one of three advising the CNO and Congress on submarine policy and technologies:

Retired VADM Albert J. Baciocco, consultant
David V. Burke, Draper Labs
Retired VADM Daniel L. Cooper, consultant
Retired LGEN William H. Foster, VP Westinghouse
Charles A. Fowler, consultant
L. Raymond Hettche, Penn State University
Alfred C. Malchiodi, Electric Boat Corporation
Walter E. Morrow, MIT
Albert Narath, Lockheed Martin
James A. Tegnelia, VP Lockheed Martin
George A. Wade, Newport News Shipbuilding
Bruce Wald, consultant
Retired Air Force MGEN Jasper A. Welch, National Lab Advisory Board
Retired RADM Robert H. Wertheim, National Lab Advisory Board, consultant" ■

SUBMARINE PROGRAMS IN THE FY97 BUDGET

An extract from Highlights of the Department of the Navy FY 1997 Budget.

The submarine shipbuilding program has been structured to ensure a successful recapitalization of our Submarine Force. The FY 1997 budget reflects our continued commitment to support the necessary replacement of our aging Submarine Force in the next decade and sustain the submarine industrial base. The FY 1996 Seawolf class submarine (SSN 23) will bridge the gap in submarine construction until the New Attack Submarine is introduced in FY 1998. The FY 1997 budget for SSN 23 includes the balance of funds required to complete the submarine authorized in FY 1996. While we continue to refine the cost estimates for the New Attack Submarine program, the overall objective continues to be the delivery of an affordable yet capable platform. In this spirit, the budget has been revised to reflect the development and procurement of the Lightweight Wide Aperture Array for the New Attack Submarine. Our budget reflects the addition of funding provided in FY 1996 for a second NSSN. At the direction of Congress, the Future Years Defense Program reflects the procurement of four New Attack Submarines, two to be constructed by Electric Boat in FY 1998 and FY 2000 and two to be constructed by Newport News Shipbuilding in FY 1999 and FY 2001. The funding required to finance construction of the FY 1999 and FY 2001 submarines, which would include $513 million in FY 1997, is not accommodated in the President's Budget.

To ensure strategic deterrence, the annual procurement rate for the Trident II (D-5) missile program continues to be seven missiles across FYs 1997-1999 and 12 missiles in FY 2000 and FY 2001. The budget reflects the assumption that the United Kingdom will continue to procure five missiles a year in FY 1997-FY 1999. This budget reflects the addition of a fourth Trident navigation suite to be procured in FY 1997. This action assures that C-4 Tridents are fully supported until inactivation as well as supporting the D-5 backfit for four C-4 Tridents.

Mk 48 ADCAP torpedo performance upgrades began in FY 1995 and continue through the FYDP. The quantity budgeted for procurement over the FYDP has been reduced from 1,386 kits to

1,110 kits, reflecting decreased requirements as a result of new Non-Nuclear Ordnance Requirements (NNOR). Additionally, the budget reflects the cost savings which resulted from a recent contract award and reflects a more economical quantity. ■

REMINDER
1996 SYMPOSIA

* * * * *

SUBMARINE TECHNOLOGY SYMPOSIUM

- May 15 thru 17, 1996
- Secret Clearance Required
- Johns Hopkins University Applied Physics Lab
- Invitation only: Contact Pat Dobes (703) 256-1514

* * * * *

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SSBN SECURITY

by Jerry Razmus

Mr. Razmus has spent 35 years in SLBM and SSBN test, evaluation and assessment. He began his career at The Johns Hopkins Unviversity/Applied Physics Laboratory where he performed SSBN patrol, OT, and DASO assessments. He was technical advisor to COMSUBLANT and CINCLANT where he conceived and developed the COMCONEX and contributed to CINCLANT OPLAN 2134. He is a plank owner in the SSBN Security Program and contributed to establishing its philosophy, objectives and management plan.

He conducted SSBN Security Assessments at Systems Planning and Analysis, Inc. where he co-developed the SCOOP Project. Mr. Razmus continues to contribute to the SSBN Security Program as an independent consultant to JHU/APL.

This is a two part article on the origin and conduct of the SSBN Security Program. This installment will trace the evolution of the Cold War and how that affected thinking about nuclear weapon systems' vulnerabilities. That thinking eventually led to the formation of the SSBN Security Program. The second installment will describe the formation, management, research projects, and accomplishments of the program and the spin off SSBN Survivability and SSN Security programs.

Origin of the SSBN Security Program

The focus of my comments, of course, is the pre-launch survivability of SSBNs, but I will begin my story before that was a real concern to show how context drives how we think about system vulnerabilities. We all know how critically important SSBN pre-launch survivability was during the Cold War, but we may not all know why, and some of us at least wonder whether it continues to be in this new era. I will address both of those questions by first reviewing the context within which assessments of SLBM system survivability were performed, and then offering some comments on what may lie in the future for your consideration.

History

In the beginning—roughly 1952 through 1962—two factors dominated U.S.strategic nuclear planning. Namely, the large numerical superiority in weapons and delivery systems enjoyed by the U.S. and the culture established in SAC by General Curtis LeMay. His experience, convictions and position enabled him to personally control nuclear war planning. The plans he devised were for a single massive attack employing every deployed nuclear weapon in the U.S. arsenal immediately upon authorization. Only the President could authorize the attack (Presidential nuclear release was established by National Security Council Document No. 30 in 1948). General LeMay's approach, which led to a requirement for large force levels, was supported by the conviction of President Eisenhower that any retaliatory strike with nuclear weapons against the Soviet Union must be massive and decisive. Thus the U.S. nuclear weapons inventory rose from 1,000 weapons in 1955 to 18,000 weapons in 1960.

The advent of thermonuclear weapons prompted authorization of a new generation of U.S. strategic nuclear weapons systems in the 1955-1960 time period. These were the B-52 heavy bomber, the Atlas, Titan and Minuteman land-based missile systems and the Submarine Launched Ballistic Missile System (SLBM), Polaris. Production and deployment of these systems were accelerated by the twin shocks to the U.S. national psyche of Sputnik and the spurious *missile gap* as well as the intemperate pronouncements of Mr. Khrushchev. Accelerated production and deployment of these systems was in full swing when the defining event of the nuclear confrontation of the Cold War, the Cuban Missile Crisis, occurred.

Without restating the details of that confrontation, the result is well known, namely the U.S. and the Soviet Union both peered over the cliff of nuclear exchange, did not like what they saw and backed off. But, importantly, **both determined to stay away from that cliff from then on and with one exception did so throughout the duration of the Cold War**. That exception was the action by the U.S. to operationally *signal* its nuclear determination during the 1973 Arab-Israeli war. The U.S. went to DEFCON 3 which put the nuclear forces on Alert. U.S. SSBNs sortied and 60 B-52s were ordered back to the U.S. mainland from Guam. After the crisis ended it was admitted by the NSC participants who ordered the alert that it was probably unnecessary. Significantly, it was an action taken without the President's knowledge or approval.

After the Cuban Missile crisis Secretary of Defense McNamara and his civilian analysts weighed in heavily on the nuclear deterrence issue. The advertised principal question was how much is enough? I believe we will eventually learn, however, the crucial question he was struggling with was how to convincingly deter without resorting to brinkmanship. That is, without going to an advanced readiness posture that triggers myriad actions throughout the operational and operational support commands, giving the impression the U.S. is preparing for a first strike, whenever a crisis arose. That was done during the Cuban Missile Crisis and once begun rapidly got out of control. SAC, for instance, on its own, began conducting its war plan precursor missions to do its own *signalling* to the Soviets. Remember that at the time our war plan was still fundamentally designed for a single massive strike immediately on upon authorization. After the crisis ended, both sides understood just how dangerous the nuclear confrontation had become and how difficult the control of forces became once put in motion. At any rate, it took Mr. McNamara three years to produce the measuring stick for deterrence that came to dominate the debate that followed: the criterion of *assured-destruction*. As he left office in 1968 he stated his position with clarity: Here I quote:

> "One must begin with precise definitions. The cornerstone of our strategic policy continues to be to deter deliberate nuclear attack upon the United States or its Allies. We do this by maintaining a highly reliable ability to inflict unacceptable damage upon any single aggressor or combination of aggressors at any time during the course of a strategic nuclear exchange, even after absorbing a surprise first strike. This can be described as our *assured-destruction capability*.
>
> "...Assured-destruction is the very essence of the whole deterrence concept. We must posses an actual assured-destruction capability, and that capability also must be credible... If the United States is to deter a nuclear attack on itself or its allies, it must possess an actual and a credible assured-destruction capability.

"When calculating the force required, we must be conservative in all our estimates of both a potential aggressor's capabilities and his intentions. Security depends upon assuming the worst plausible case, and having the ability to cope with it. In that eventuality we must be able to absorb the total weight of nuclear attack on our country—on our retaliatory forces, on our command and control apparatus, on our industrial capacity, on our cities and on our population—and still be capable of damaging the aggressor to the point that his society would be simply no longer viable in twentieth-century terms. That is what deterrence of nuclear aggression means. It means the certainty of suicide to the aggressor, not merely his military forces, but to his society as a whole."

While this concept was explained in detail to the public in 1968, it was the basis of deterrent system evaluation, assessment, and planning beginning in 1965. The most significant effect the criterion had on assessment of strategic nuclear systems was to elevate system pre-launch survivability to the highest priority characteristic. That began the transition of the SLBM force to the premier force of the Triad.

When U.S.S. GEORGE WASHINGTON deployed in November of 1960 on the first operational patrol of a U.S. SSBN, it, and subsequently those that followed, could operate with impunity anywhere in the world's oceans. SSBN pre-launch survivability was understood to be an important characteristic of the SLBM force but was not viewed as a distinguishing characteristic because, at the time, there were no identified ASW threats and the operative strategic nuclear war plan called for immediate launch of all weapons, thus pre-launch survivability of all strategic systems was of secondary importance. That war plan character was reflected in the Alert Status priorities established for SSBNs and the vulnerability assessments of the SLBM force.

Until 1968 Atlantic Fleet SSBNs operated under CINCLANT OPLAN 2-YR which specified Alert status priorities as (1) maintain continuous receive communications (2) maintain weapons system readiness condition 2SQ, and (3) remain undetected. That is, the emphasis of the operational priorities was on rapid response for an immediate strike. That placed some constraints on SSBN operational flexibility for detection avoidance and transit within assigned patrol areas, because submarine speed limitations and preferred headings were required for communications reliability. In 1968, when CINCLANT OPLAN 2134 was promulgated, these priorities were reordered to (1) remain undetected (2) maintain continuous receive communications, and (3) maintain weapons system readiness condition 2SQ. The two crew operating concept developed and employed in SSBN operations was originally designed to maximize the ratio of SLBM alert missile days to total missile days. That was predicated on the then valid assumptions that the Alert force was the only significant contributor to the war plan and total cost for an alert missile day would be a key determinant for SLBM versus land based missile force level trade-offs. After the Assured Destruction deterrence criterion was established, the two crew operating concept became fundamental to maintaining the maximum sustainable OPTEMPO to maximize SSBN at-sea time and thus pre-launch survivability.

The vulnerability assessments in the early 60's were almost exclusively related to missile in-flight and reentry body penetration threats. First there was the Anti-Launch Phase Ballistic Missile Intercept (ALBIS) project. That project culminated with a live firing of a Terrier missile against a submerged launched Polaris A2. It missed! Then there was the EMP pindown tactic invented by the Defense Science Board. The quick operational fix was Project LOOK, a receiver tuned to detect an EMP pulse on the output of the trailing wire antenna. The crew of the SSBN was supposed to monitor the receiver output, determine a pattern of EMP bursts and launch their missiles between them. Project Look was completely successful in confirming that indeed there are approximately 1100 thunder storms in progress on earth at all times. The longer term technical solution was an A3 missile hardening program, TOPSY. Finally there were continual RB penetration studies as well as substantial intelligence collection and analysis of Soviet ABM development. The response, developed as a hedge against an ABM deployment was the Poseidon missile, the first MIRVED missile.

Mr. McNamara's analysis, articulation and directives that assured-destruction capability was to be the cornerstone of our deterrent posture gave rise to a virtual avalanche of *pre-launch* survivability assessments in the 1965-1970 time period. The Vulnerability Task Force of the Defense Science Board turned its attention from in-flight and penetration assessments to pre-launch vulnerability. Among the conclusions of their studies—our land based missiles would become vulnerable to the Soviet land based missiles that were rapidly being deployed with improved reliability and accuracy (the Soviets deployed 750 ICBMs between 1966 and 1969), our bomber bases were vulnerable to Soviet SLBMs with their short time-of-flight, the Soviets were embarked on a massive build up of their strategic and attack nuclear submarine forces, and **the nation did not possess the technical capability to evaluate the pre-launch survivability of the SSBN force**. That final VTF conclusion was stated as follows: "In most areas of SSBN vulnerability (that is their susceptibility to detection, trailing, and attack) there is insufficient data and understanding to permit one to make a reliable estimate of the threat posed by potential Soviet ASW developments. It is also apparent that intelligent development of countermeasures to these threats cannot be undertaken in many cases, since the physical nature of the problem is not well understood. In most cases inadequate data or inadequate analytical models prevent any definitive statements to be made regarding the ultimate survivability of the SSBNs." That is how the world looked when the revered *Foster Letter* that initiated the SSBN Security Program was drafted in 1968.

Over time the Soviets developed and deployed an array of strategic nuclear weapons systems with characteristics that tended to make one believe they had made a conclusion similar to Mr. McNamara's. Thus we arrived at the deterrent posture of Mutual Assured Destruction (MAD), a term first coined in 1972. From 1972 through the end of the cold war, that remained the strategic deterrence posture of both the U.S. and the U.S.S.R. Much intellectual effort and resource expenditure on both sides was committed seeking a more palatable approach to nuclear deterrence, but none was really ever found.

However, there were attempts to develop nuclear deterrence doctrines that avoided the single massive retaliatory strike. Indeed, every President from John Kennedy to Ronald Reagan demanded additional response options in our nuclear war plans. In the seventies options were developed for measured responses under the assumption that nuclear war, if it came, could be controlled. That approach gave rise to the potential for partial SSBN battery launches or the so called split-launches. That in turn prompted a series of split-launch vulnerability assessments which by the very nature of the process contained both pre-launch and in-flight threats. They were conducted by SSP in their Vulnerability and Effectiveness Program. Strategic Nuclear C2 Wargames, however, demonstrated that MAD was not a policy but a fact, as long as both sides, maintained sufficient *survivable* strategic nuclear systems that their destructive potential after a first strike was deemed suicidal by the initiating nation. Clearly, in that case pre-launch survivability was the paramount strategic nuclear system characteristic.

SSBN Security Assessments

Beginning in 1968 a contractor in the newly established SSBN Security Program, Operations Research Incorporated (ORI), under the direction of SSP, began developing analytical models to evaluate the survivability of SSBNs. Two fundamental assumptions incorporated in ORI's assessment formulation captured the environment at the time. First, was that the Soviets would commit whatever resources were required to counter the U.S. SSBN force. At that time it was estimated that the Soviets had invested the equivalent of $125 billion in air defense to counter our strategic bomber force and were on a track to invest $75 billion in land based missiles to counter our ICBMs. And that was in 1970 dollars! Second, the only operative strategic planning scenario at the time was the worst plausible scenario, the *bolt-from-the-blue*. Therefore, the focus of the assessments was solely on the at-sea portion of the SSBN force and attrition was not considered a viable Soviet tactic. In general the analyses assumed if detection and localization could be accomplished and an attack mechanism identified, the problem was solved. That is, little effort was placed on detailed examination of the effectiveness of the attack systems. *The analyses were intended for internal SSBN Security program use and were never designed nor produced to portray an authoritative Navy statement on the survivability of the SLBM force*. The methodology however, was in place to address the never ending what-if questions posed by the DSB, OSD, Congress, etc. Frequently, that methodology was exercised to assist in preparation of the Navy response.

From the mid-70s until the program was transferred to OPNAV in 1983, systems operational analyses, engineering analysis and threat assessments of a variety of potential threat systems that could be synthesized from both acoustic and non-acoustic technology were vigorously pursued. Efforts were based upon operational considerations of both the U.S. and postulated threat forces and upon technical intelligence. The technical activities of the program were prioritized, in part, by maintaining a continuous and iterative interplay among technology, analysis and intelligence. The assessments identified significant potential vulnerabilities associated with specific narrow band components in the SSBN radiated noise signature, periscope and mast exposure routines, certain wake contaminants, and certain acoustic transients. In each case, countermeasure systems or tactics were developed and deployed to mitigate the potential vulnerability.

In the late 70s and early 80s the suicidal result of any nuclear exchange between the U.S. and the Soviet Union finally became internalized by war planners on both sides but the ideological competition continued. In order to prevent psychological paralysis the U.S. developed a scenario involving a protracted general conventional war prior to any nuclear exchange and required of the strategic nuclear forces the ability to fight a protracted nuclear war (more options again). That approach had the effect of exposing the weaknesses in our C2 systems and it reaffirmed the pre-launch survivability requirement for our weapons systems. This time they had to be able to survive repeated attacks and the requirement became known as endurance. The Navy contribution to that planning scenario was the revised Maritime Strategy. Since the survivability of U.S. SSBNs in a protracted conventional general war had never been evaluated, the SSBN Security Program initiated a new series of force security assessments in 1985-1986. That series of assessments was conducted by Systems Planning and Analysis, Inc. (SPA) and EPL Analysis, under the direction of OP-21T1, Dr. Holmboe. Unlike the technology assessments conducted by ORI, these were far more limited in the time span considered, employed threat systems and forces that existed or were projected by the intelligence community and, clearly, attrition was a viable tactic. Those assessments were focussed on operational rather than technology considerations, and potentially serious SLBM force operational vulnerabilities were identified. Those vulnerabilities existed because the SSBN concept of operations remained predicated exclusively on the bolt-from-the-blue scenario with a single massive retaliatory strike. The SSBN Continuity of Operations Project (SCOOP) was established to address those vulnerabilities and develop a concept of operations and operational countermeasures for a protracted war scenario. SCOOP was successful and the current SSBN OPLANs incorporate the SCOOP developed procedures. The protracted nuclear war aspect of the concept also resurrected the nuclear barrage and split-launch threat assessments for update and refinement.

What of the Future?

In 1991 the Soviet Union collapsed and the Cold War ended. So the issue now is how do we even think about the survivability of strategic nuclear systems absent a superpower confrontation?

Since that collapse the U.S. has been on a track to reduce its strategic nuclear force levels consistent with maintaining an assured destruction capability against the remnants of the Former Soviet Union while carefully controlling the rate of that reduction and modernizing the remaining forces as a hedge against Russian hostility or a Former Soviet Union resurgence. That approach also provides forces adequate for nuclear deterrence against any other nation or alliance that can currently be envisioned. While the remnants of the strategic nuclear forces of the FSU represent a capability to destroy the U.S., absent today is any nation or aggregation of nations that possess plausible resources or intent to strategically confront the U.S. and threaten our autonomy. For the near term that is comforting, nuclear tension and urgency for strategic nuclear system attention are both reduced. But, neither have gone away.

Beyond a very short time horizon no one can predict what issues, alliances, or misguided leaders will provoke the next global confrontation. But history has taught us two extremely relevant things. First, history tells us there will be another major power confrontation. Every time a major war has ended in modern times there were those who naively espoused that peace for all time had been achieved. They were always wrong! Second, recent history has taught us that an aggressor nation that has been utterly defeated, disarmed and left with an economy in chaos and a society near anarchy can recover, be stronger and even more aggressive in less than 20 years.

The U.S. has already taken the decisions that place on the Trident system the responsibility of being the ultimate guarantor of its survival and freedom of action for the next 30 years. That decision was taken because the distinguishing characteristic of the

Trident system is its pre-launch survivability. The single mission of the Trident system remains deterrence of nuclear aggression. For over 30 years the best strategic thinkers of this nation have sought alternatives to the concept of assured-destruction to deter nuclear threats against the U.S. and its allies but as I have already reported none has been found. Therefore, I believe maintaining Trident system pre-launch survivability remains paramount in this post-Cold War world.

Having said that, I believe, we, who are charged with insuring that characteristic of the Trident force, must redouble our efforts to think through all aspects of the longer term what-ifs, beginning with—what if we missed something? I believe we have. Because of lack of wisdom, courage or humility we completely overlooked the Walker effect. Yes, John Walker, the spy who for three years sat in the submarine OPCON center in Norfolk. We simply did not adequately evaluate the ramifications of compromise of SSBN Top Secret operational data. Related to the damage a spy could inflict, we are already experiencing the early realities of information warfare techniques. I can foresee a constant pressure to incorporate SSBN operational information in massive data bases that will be available to many levels of command and support in order to capitalize on the advantages blue force information will provide. Clearly such data bases will be prime targets for adversary penetration attempts. What if we assumed then that a potential future adversary had available to him in near real time each individual SSBN Patrol Order and the SSBN patrol area designations? Could the SSBN concept of operations be redesigned so that eventuality would provide no more information than could be obtained by watching activity in the refit site? Or better yet, could we negate any value that may be obtained by refit site observation also?

I believe some attention should be placed on what that next confrontation might look like and what that portends for Trident survivability. What if it leads not to another Cold War, but rather a major conventional war employing advanced platforms, proliferated sensors and precision weapons? There is precedent for a nation starting a major war it knew it could not win outright. Japan in WWII for instance. What if the aggressor in that instance possessed no nuclear weapons? The U.S. would be loathe to respond with nuclear weapons unless it became obvious its survival was at stake. The Trident system in that eventuality may have to survive a lengthy conventional war—an attrition war—while still performing its nuclear deterrent mission against whatever nuclear powers exist. I believe attention to an attrition scenario is also warranted because of the tremendous strides made by the Russians with their newest submarines. Previous analyses have shown that a protracted conventional war of attrition is not a Trident survivability strong suit and, within that difficult scenario, Trident acoustic FOM advantage against threat submarines is a critical parameter for success. We are losing that advantage.

What if the Tofflers are right and information warfare per se becomes a reality? Could the Trident system be negated by disruption or deception of its automated communications, navigation, targeting, or launch preparation software? Could the continually evolving capacity to acquire, store and manipulate extremely large amounts of data and information reduce the uncertainty area of at-sea Trident submarines to ASW system manageable proportions? CIPS, a Security Program Project in the mid-70s was a fledgling attempt to explore that approach. Should the concept be looked at anew? What else does the *Revolution in Military Affairs* portend for Trident survivability?

What if the Trident priority for resources continues to decline within the Navy? What would be the effects on survivability of reduced maintenance and monitoring, reduced training, reduced manning, reduced operational support such as intelligence, surveys, environmental data and predictions and communications? Would there be any? Could they be mitigated?

I certainly do not pretend that this brief list of *what-ifs* is exhaustive or even on the mark. **My only objective is to suggest that continued confidence in pre-launch survivability of the Trident SSBN is of such importance to the nation throughout its projected lifetime, that we must maintain our commitment to excellence in the pursuits of the SSBN Security Program objectives.** We must continue to think through all aspects of Trident technical and operational characteristics in the context of our understanding of this post-Cold War era. ■

BATTLE STATIONS 2000

by LCDR Chris Ratliff, USN
Executive Officer
USS ATLANTA (SSN 712)

The year 2000 looms with a promise of great challenges for our Submarine Force. The Force will be reduced to 50 or 60 attack submarines with which to accomplish its more-than-fair share of national security objectives; the balanced budget timeline will be near terminus, inflicting greater fiscal pressure on every military branch and community; and the Regional Maintenance Center (RMC) concept will be fully in place, with an impact on submarine readiness that may vary from none to notably adverse. The need to be prepared to wage littoral warfare against a technologically advanced enemy provides the framework for addressing these challenges.

Fortunately, the tactics and strategy of submarine warfare in the littoral are not new to the Submarine Force, nor is the littoral a strange or unfamiliar place to us. We've all been there and while there, exercised the full range of our submarines' mission envelope. This claim goes back to the very inception of the Submarine Force.

An accurate and simple assessment of the Submarine Force's future is that we must do more with less, relative to the Cold War. We will have more tasks and more regions of potential conflict. We will have fewer ships, proportionally less manning, and less money to pay for maintenance, operations, and training. These strains contribute to the overarching challenge of maintaining the warfighting effectiveness of the Submarine Force and, inextricably, the quality of life of our officers and enlisted.

The RMC concept, not yet fully developed, is part and parcel of the trend toward less. Not only does the RMC reduce and centralize submarine maintenance activities, it also seamlessly combines them with those of the surface fleet. As an unavoidable result, the Submarine Force will lose much control of its maintenance. Neither the submarine captain nor the squadron commander will any longer be in a position to establish or modify maintenance priorities in fine-grained detail. Neither will they be able to ensure the next boat scheduled for underway can meet its commitment while also maintaining the highest readiness across the squadron. The consequence we can expect is that our tradition of greater material readiness (relative to the surface fleet) may be forever lost. To minimize the impact on readiness, many jobs otherwise appropriate for the RMC may be assigned to ship's force (the likely outcome) or deferred to a future maintenance period.

Solutions to these challenges will come from each level of the Submarine Force hierarchy, from Washington to the waterfront. The waterfront's contribution must be much more than a comment or two at a round table discussion gathered to craft a new NWP. We, the operators, must be the ones to determine everything from how to fight our ships to how to maintain material readiness in the age of doing more with less. The real measure of success for a captain and his ship will be their ability to get underway on time, fully combat ready, and deploy to a hotly contested littoral region half way around the world for employment across the broad mission envelope and for an extended duration.

The size and makeup of the deploying wardroom and crew—and therefore the number of officers and enlisted that stay behind; what watches they man; who will man them; and for how long—are the nuts and bolts issues. The questions are made more complicated by the devilish details: when do we sleep, eat, field day, perform repairs and PMS, thrice weekly aerobic workout, do laundry, and, not to be slighted, train? We cannot wait for the new attack submarine (NSSN) to be delivered to the fleet with all the issues, the challenges, answered, as if it is the *deus ex machina*. Instead, we should develop the solutions now and let NSSN derive from these solutions. USS ATLANTA (SSN 712) began to test a new concept in war patrolling in early December 1995. The experiment is not complete, so the method is still in a state of flux. But it is time to share the ideas with the Submarine Force.

In the littoral war, we can expect to begin our war patrol by traversing or engaging and destroying a gauntlet of extremely capable diesel submarines. With that success, we'll be allowed passage into puddle-shallow waters that are heavily mined here, and crowded with deep draft merchants there. A few hundred miles into these waters will be our surveillance station, Tomahawk launch baskets, Special Operations Forces (SOF) support area, mine field to be mapped or neutralized, or a combination that may include all four. We'll be close to land and an enemy port for the duration, so a diesel submarine or patrol boat may be on top of us without warning. As a result, we'll always be ready to snapshot both a torpedo or a Harpoon. After many weeks in this environment, the battle force will arrive with an invasion force; we must stay right where we are because we're the sole source for the most important surveillance.

The Tactical Readiness Exam (TRE) is three days of simulating a war of this ilk. The exam is three days of nearly continuous battle stations. Less than 18 hours into the venture, the toll of fatigue is readily apparent. The officers and crew hang on for the next two days as our combat effectiveness, the ability to accomplish the mission without being killed, ebbs by the hour. By day three, it's easy to accept that pure exhaustion caused Commander Sam Dealey and USS HARDER to become the prey of a Japanese minesweeper in August 1944.[1] We allow ourselves to operate like this because we don't think TRE simulates a real war patrol any more than ORSE simulates any imaginable two days of propulsion plant operations.

Variations of three section watch rotation punctuated by battle stations have been tried and successful during TRE. But this success only slightly mitigates the criticism; the officers and crew still emerge from the exam utterly exhausted. The best schemes to date allow maintaining sufficient combat effectiveness, *but only until the end of the exam*. We must develop a means of maintaining combat effectiveness for many weeks or months of unabated high tempo, high stress operations, a requirement that is the essence of submarine warfare in littoral war.

After we rejected three section watch with battle stations, a facile response would be to put everyone in port-and-starboard, six hour watch rotation. This requires care to man only watches that are really required to fight the ship in all but an extreme case. Much of the rest of the ship's routine would remain close to normal. This plan maintains the ship at the heightened state of combat effectiveness much longer, but debilitating fatigue is inevitable. The interval of effectiveness is probably about three days, once again the time to administer a TRE.

The port-and-starboard rotation provides the right number of watchstanders, so it has merit. But the disqualifying flaw is the short duration of the off-watch interval. During a nominal six hours off watch, no more than five are available for sleep. In a 24 hour day, that just isn't enough to stay combat ready. That second six hours off watch also isn't enough time to do everything else. As a result, many of these ancillary things that must get

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[1] Clay Blair, Jr., Silent Victory, The U.S. Submarine War Against Japan. J.B. Lippincott Company, New York, pp. 691-696.

done, even in war, don't.

ATLANTA has applied what may appear as a simple variation of port-and-starboard watch rotation. However, the rotation and its timing are only elements of a comprehensive plan of in-port and underway manpower management to improve combat effectiveness. To begin with, the officers and crew are assigned to an 8-4-4-8 watch rotation. Each member of the crew can expect to stand eight hours of watch, followed by a four hour period devoted to off-watch duties (PMS, repairs, training, cleaning), followed by another four hour watch. This regimen concludes with eight hours off watch, a large measure of which is sacrosanct personal time. During this time, he's expected to get between six and seven hours of sleep. Then the cycle begins again. This routine divides the crew into two war fighting teams, given the names Strike Forces Alfa and Bravo. A team can fight the ship through any multi-mission scenario augmented only by the Captain as Approach Officer and Executive Officer as Fire Control Coordinator.

Details are what matters, and there are plenty to address. The first is that, no matter what you call the watch rotation, it's still port and starboard, and therefore unpleasant. Six or seven hours of sleep after a 16 hour day, day after day, is still a grueling regimen. We can ease (certainly not eliminate) the burden by scheduling some regular relaxed times. All day Wednesday and every weekend from Friday 1600 until Monday 0800 should have nothing scheduled except brief supervised cleanup by the off-going watch. During these rest times, combat effectiveness remains 100 percent because a full Strike Force is on watch.

This plan leaves 32 hours (two four-hour periods on each of Monday, Tuesday, Thursday, and Friday) to do everything else. This requires meticulous scheduling and aggressively carrying out the schedule. But still there's not enough time: training for any group must be scheduled twice; some maintenance must work to completion once it begins, even if it takes more than the eight hours of back-to-back *four-offs*; equipment doesn't break on schedule, and some equipment cannot wait for repair.

The solution was found in developing a Tiger Team concept. Certain watches are not required to be manned all of the time. For example, the Radioman of the Watch and ESM Watch serve little purpose during much of the time away from periscope depth. Tactical plotters are often unemployed, just as the majority of the weapons loading team. We designed these and a few other watches as a Tiger Team.

The Tigers are available for tasking at the Officer of the Deck's discretion. A Tiger must be able to return to his Strike Team post within seconds, so he can't crawl too far into a bilge, can't stand a proficiency watch, nor can he do anything that once he starts, he must finish. We're careful not to refer to them as *secured* or *stood down* when they are assigned an ancillary function; instead, we called this *ready status*. Tigers are called back to their watch by passing the word on the 1MC "man battle stations" without sounding the general alarm.

Training for division and departments while manned for war patrol is impractical because every session must be scheduled twice, a significant crimp on a very tight schedule. As a fruitful solution, all underway training was for the watch section or logical sub-groups within the watch section. Very soon after watch relief, unless the tactical scenario precluded, one hour of operations-oriented training was conducted throughout the boat. After watch relief/meal/cleanup, another session was held for the off-going watch section. In retrospect, it makes sense that all underway training is directly related to employing and fighting the ship, while in-port training, by default, became devoted to theory, maintenance, and similar topics.

Meals were served between each watch, with the noon meal the lightest, often resembling midrats. The meal that by its fare most resembled supper was served from 2300 to midnight. We noted early that attendance at meals was drastically reduced—the crew would rather sleep more and eat less. This caused us to review how we did wake-ups. With the crew's concurrence, we stopped doing the traditional roving-messenger wake-ups one and a half hours before nominal watch relief time (e.g., 1030 for the afternoon watch). Instead, one hour before nominal watch relief time (e.g., 1100), the messenger conducted all-hands reveille (those sleeping are all oncoming watchstanders). This gave the crew a welcome 30 extra minutes of sleep twice a day.

Such a rigorous watch routine has the potential to take a toll on the officers and chiefs. They just cannot get their job done if they are on watch 12 hours every day. ATLANTA's 110 man war patrol makes provision to prevent this. Applicable watch stations are double manned, such that an officer or CPO will stand his port-and-starboard watch only every other day. He is gainfully occupied by his many other duties in the interim days.

This plan works well with as few as 110 officers and enlisted men onboard, including non-watchstanders (Chief of the Boat, corpsman, leading yeoman, leading storekeeper, leading MS).

This manning also allows a combination of up to 10 dedicated under-instruction watches or riders without *hot racking* or berthing in the Torpedo Room. This is particularly relevant because every man having his own bunk contributes per se to the longevity of combat effectiveness.

This manning allows 25 members of a nominally sized crew to remain at home as the boat gets underway. These individuals, officers and enlisted men, will be either in school, on leave, or a combination of both during the deployment's duration. Detailed planning will cause every port call to be a change-out of stay-behinds for deployers. Leaving behind 20 percent of the officers and crew for each underway period contributes well to a liberal duty section rotation in port. Maximizing the number of stay-behinds during an underway permits aggressively minimizing the number of officers and crew on leave or in school during the in-port period, perhaps allowing us to achieve genuinely a five section duty rotation. Because schools and leave are minimized and the duty rotation is optimized, greater manpower is available for the increased ship's force maintenance resulting from RMC availabilities.

Many more details remain; for some we've developed solutions. Not the least of the unresolved details are the necessary modifications to the SSORM, operating guidelines, TYCOM Training Manual, and many other long-practiced *bibles*. As well, we've tested this war patrol method during only two five-day underway periods, admittedly not a definitive test. We foresee that a minimum of three weeks underway is necessary to refine this proposal and make it credible. While we await that opportunity, we welcome feedback that we can use to improve and further test the concept.

This method of deploying and fighting the ship, if adopted, clearly dictates future Submarine Force manning requirements. It means that the sea-going portion of the Force must be always manned to about 120 percent of what is actually needed to fight the ship for an extended interval. For Los Angeles class boats, that 120 percent is 135 officers, chiefs, and sailors. For the NSSN, the temptation may be to determine the size of the crew to fight the ships, build in berthing for that number, assign only that number of personnel, *then size the Force accordingly*—a mistake that would perhaps leave us proficient at *fighting* TREs, but incapable of fighting the next war. ■

PURPLE SUBMARINES

LT Joseph M. Thompson, USN

Lieutenant Joseph McKnight Thompson was commissioned in 1989 via the NECP program after receiving a Bachelor of Science in Engineering Science from the University of Texas at Austin. His first assignment after commissioning was aboard USS HENRY M. JACKSON, where he served in numerous division officer jobs. He then was assigned to HQ USSPACECOM where he served from 1993-1995. He currently is assigned to USS ALABAMA (GOLD) as Navigator.

> *"Service members involved in joint and combined operations dissociate themselves from the inherent biases of parochial concerns to work together for the common good. The color purple symbolizes the intermingling of all the whites, blues, greens, tans, reds, gold, and silver found in the Service uniforms and insignia. Purple is joint and combined."* - The Joint Staff Officer's Guide

Ever since the passage of the Goldwater-Nichols Department of Defense Reorganization Act of 1986, the future of submarines and the need to support joint matters have become steadily and inexorably intertwined. Joint Pub 1-02 defines joint matters as "matters relating to the integrated employment of land, sea, and air forces, including matters relating to national military strategy, strategic and contingency planning, and command and control of combat operations under a unified command".[1] A weapon system's ability to be used in support of joint matters has become a litmus test for continued funding and political support. Submarines are no exception to this litmus test, and in order to remain a premier fighting force the silent service must embrace the concept of jointness. In short, our submarines, and the crews that man them, must become *purple*.

There are three major components that must be addressed in order to become *purple*: people, procedures, and platforms. Each of these areas must be examined to see how the submarine community can better meet the definition of joint matters. In the first area--people--there are many actions which can be taken to promote a joint mentality. First and foremost is the detailing of more joint duty assignments to submariners. These assignments are crucial to the purple process because they are the catalyst that allows people to "dissociate themselves from the inherent bias of parochial concerns". It is also important to realize that in order for our submarines to become truly *purple*, the joint mentality must be integrated into all aspects of the silent service down to the deckplate level. This will require detailing more joint duty assignments to submarine enlisted personnel as well as to officers.

Joint duty assignments allow submariners to better understand the needs of the joint warfighter and allow them to develop submarine unique solutions to fill those needs. These solutions, in turn, will allow unified Commander-in-Chiefs (CINCs) to make the best use of current submarine capabilities during combat operations. These solutions will also help shape and define the future roles and missions of submarines. In this manner, not only will new submarines be better orientated towards providing joint support, but our personnel will develop a better sense of how submarines are integrated into the *big picture*. This knowledge will foster a purple mentality and will promote the integrated employment of land, sea, and air forces.

In addition to the benefits gained by the joint warfighter, the submariner gains benefits in the area of professional development by interacting and exchanging ideas with members of other services as well as other parts of the Navy. This interaction enables the submariner to better understand the capabilities and limitations of other military forces. It also encourages viewing other services as peers—not as competitors. Professional development is also gained by virtue of the fact that the majority of joint billets are at major unified command headquarters. Working at these headquarters provides invaluable experience in the areas of national strategy, budgetary processes, strategic and contingency planning, global command, control, communications, computers, and intelligence (C4I), and other such *macro* issues that affect joint operations.

The number of joint duty assignments is fixed by law, therefore, detailing more billets to submariners will require transferring some existing billets from other services or warfare specialities. As an example, Headquarters United States Space Command recently converted several emergency actions billets from the surface warfare community to the submarine warfare community. This change benefited the unified command by matching more qualified, better experienced personnel to a mission requirement and benefited the Submarine Force by providing it with additional joint billets. In addition to converting existing billets, the Navy also could create new billets (albeit without *joint credit*) at joint commands. For example, Submarine Liaison Officer billets could be created at all unified command headquarters to promote the integration of submarines into joint planning and to provide additional joint opportunities for submariners.

Another action which can be taken to help people become *purple* is placing more emphasis on completing Joint Professional Military Education (JPME) phases I and II. While the Navy currently offers access to JPME phases, consideration should be given to making these courses an integral part of the submarine officer pipeline. Not only would the completion of JPME phases broaden knowledge of joint matters, it would also ensure subma rine officers receive the same level of joint instruction as their counterparts in other services.

Lastly, becoming *purple* will require the cooperation of the other services as well. One way to promote this cooperation would be to ensure joint duty officers from other services and warfare areas are placed onboard submarines during joint exercises and missions. This would allow them to gain a firsthand appreciation of the unique capabilities of submarines and to see the pride and professionalism of the Submarine Force. This firsthand experience would help the other services view submarines as unique and valuable assets—not just another weapons system competing for budget dollars.

The second major component of the submarine community that must be addressed to become *purple* is procedures. The procedures which must be addressed are those that enable submarines to interface with unified CINCs. The emphasis must be placed on viewing the unified CINC as the *customer* for the submarine product. Too often today, the group or squadron commander is seen as the *customer*. This distinction is important because a customer cannot adequately use a product they do not understand, and submarines are often misunderstood by personnel from other services. In part, this misunderstanding is because submarines use a different lexicon than do other services. For example, the relationships between task forces, task groups, and task units are as confusing to an Air Force officer as the relationships between squadrons, wings, and flights are to a submarine officer. In addition to these vocabulary differences, misunderstandings can be caused by other services not understanding submarine operating restrictions such as the inability to receive communications while running deep or fast. Even items that submarine crews take for granted can become potential stumbling blocks to the joint planner.

The Navy should remove these stumbling blocks by developing a consolidated submarine reference manual written for other services and warfare specialities. This manual should be similar in nature to the current Submarine Warfare Tactics Handbook with the exception that it would cover U.S. forces. The scope of the reference should include discussions of submarine unique terms (e.g., the difference between patrol areas and launch baskets), basic submarine operations and limitations, communications capabilities, and of the different operational chain-of-commands. In addition, this guide should contain a cross-referenced listing of all submarines, hull numbers, squadrons, and message routing indicators. This listing should also include the specific communication suites and weapon systems each submarine has. The level of detail in this reference should be sufficient to allow CINC support staffs to understand the pros and cons of using submarines for particular mission assignments.

Other procedural areas that should be looked at are those dealing with the employment of submarine launched weapons in support of joint operations. While procedures for strategic weapon employment are well understood, the procedures for tactical weapon employment are not. This is an unacceptable obstacle to the purple process because it impedes the unified command's ability to perform contingency planning of the tactical weapons which are most likely to be used in joint littoral warfare—submarine launched cruise missiles (SLCMs). From planning to execution, there is little written guidance available to the replanner regarding SLCM employment. What guidance is available is usually in the form of *tribal knowledge*. This is especially true regarding the crucial subjects of launch window determination and platform selection. It is also difficult for the replanner to determine who the tasking message should be addressed to (i.e., the boat itself, a task force commander, or a higher command center). This issue is further complicated by the fact that not all assets in the chain-of-command have the same ciphers and authenticators. As a result, many joint planners are reluctant to utilize SLCMs because they do not feel comfortable with the replanning process. This does a great disservice to the submarine community and limits the use of an outstanding response option. Standardized procedures would eliminate these problems and would ensure today's forces can train for tomorrow's missions.

The last major area the Submarine Force must address to become *purple* is the platform itself. Clearly, the submarine is an outstanding asset with which to control the undersea battlespace. When combined with the ability of the submarine to control the littoral battlespace as well, the submarine's usefulness in the joint arena is unquestioned. There are some changes though that will make the submarines more *joint-friendly*.

Perhaps the most important platform change concerns communications. All submarines should have MILSTAR terminals onboard. This would ensure direct connectivity with the nodes of the National Military Command System (NMCS), alternative fixed command centers, and ground mobile command centers. Currently, submarines must rely on intervening airborne assets or fixed ground telecommunication stations for this connectivity. During a protracted conventional war, or during the trans- and post-SIOP phases of a nuclear war, these intervening assets may not be readily available. This connectivity is crucial to the ability of submarines to execute tactical and strategic nuclear strikes. MILSTAR terminals would also allow the submarine to relay time-critical information directly to the unified CINCs and the NMCS during joint operations.

Another area of communications that would help provide support to the joint warfighter is the development of a system capable of downloading SLCM terrain mapping profiles. Today, if a preplanned profile is not onboard the shooting platform when it puts to sea, the replanner must resort to using strategic weapons in response to a CINC request for a weapon of mass destruction. Downloadable profiles would allow the replanner the choice of using tactical weapons or strategic weapons. In this fashion, the response can be better tailored to the threat. It would also allow attack submarines to be utilized against targets that have either emerged after the ship has deployed or are in locations that were not within range of the submarine's original operating area. This would give the theater CINC greater flexibility in repositioning assets and in responding to new threats.

Joint littoral warfare also requires "rigid two-way command and control employing real-time, fused, all-source intelligence".[2] This requirement could be met if submarines were equipped with a two-way communications system between the submarine and other U.S. forces. With this communications link, submarines could provide direct fire support to ground units using either SLCMs or, as recently proposed, semi-ballistic missiles.[3] Currently, direct fire support can only be provided by surface units. Submarine direct fire support would be less vulnerable to enemy attack and would provide the theater CINC with additional support assets. This two-way communications ability would also allow submarines to call in air strikes and report battle damage assessments while conducting covert reconnaissance.

A final platform modification that would help support joint matters would be the conversion of Trident I submarines into so-called *strike submarines*. The conversion would involve replacing the current C4 missile system with magazines of Harpoon missiles, Tomahawk missiles, and possibly even the Army Tactical Missile System (ATACMS).[4] The missile loadout could include conventional warheads or a mixture of conventional and nuclear warheads. A single such strike submarine would be a tremendous force multiplier in any littoral engagement and would increase the response options available to the unified CINC. With the proper over-the-horizon targeting downlinks, these submarines could become "battlespace control ships" and perform most of the missions envisioned for the *Future Strike Cruiser* proposed by Vice Admiral Joseph Metcalf III.[5] In addition, this submarine would free fast attack boats to pursue other tasks such as shallow water anti-submarine warfare or battlegroup support thereby acting as an additional force multiplier. Finally, these strike submarines would provide an outstanding deterrent value by forcing potential adversaries to contend with the threat of large numbers of different weapons being launched from a platform they may not be able to detect or destroy.

In conclusion, the future of the Submarine Force relies on its ability to provide support for joint matters. In order to provide this support, submarines and submariners must embrace the concept of jointness and become *purple*. The purple process will require the commitment of the entire chain-of-command. All submariners must look for ways that submarines can better serve the unified Commander-in-Chief. Becoming *purple* will require encouraging personnel to seek joint experiences and educations, developing procedures with the joint warfighter in mind, and designing submarines that are not just joint-friendly but are an integral part of the joint battlescape.

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DOMINATE THE BATTLESPACE

LT Rodney Luck, USN

Lieutenant Rodney Kevin Luck was commissioned in 1988 after graduating from the U.S. Naval Academy where he received a Bachelor of Science in Mathematics. His junior officer tour was aboard USS NORFOLK, where he served in numerous division officer jobs from 1990 to 1993. He then went to Naval Post Graduate School, where he received his Master of Science in Electrical Engineering. He currently is assigned to PCU LOUISIANA as the Combat Systems Officer.

Imagine a wargame involving Aegis equipped destroyers and cruisers. The wargame could involve a Surface Action Group or a Carrier Battlegroup. The exercise could be any number of missions such as a coordinated cruise missile assault, action against an enemy SAG, or providing air defenses for a landing force in an environment with a high threat of cruise missiles. The Aegis ships of today are highly capable in these types of missions; they can project power into all spheres of the battlespace and dominate. The Aegis ship's major features include: approximately 100 vertical launch tubes with standard MR missiles, land attack cruise missiles, anti-ship cruise missiles, and (in the future) anti-ballistic missile defenses; a highly capable radar; and a coordinated sensor and weapons control system. Now, for this wargame exercise add one more feature: **this ship has the ability to submerge**. This feature may not be desired in all scenarios. In that case, this capable warship will remain surfaced. For most uses of a warship in today's hostile environments, think of all the powerful strategic and tactical variations that this would add. For all modern threats faced by U.S. warships, except mines, placing the platform in the subsurfaced area of the battlespace makes it almost invulnerable. A warship that can exploit this strength and yet project power like the DDG 51 has an enhanced tactical advantage. The biggest hurdle to overcome is effective communications.

This can be achieved by incorporating a communications plan into the tactics, and understanding that anytime the advantage of submerged operations is exploited, communication and coordination will be more challenging.

Is it possible to build a platform today that can project power like the DDG 51 and operate submerged? A grossly limited and simple example would be the following: convert an Ohio class SSBN hull into a platform that can launch 50+ missiles with vertical launch; equip the ship with an advanced radar, install a CIC; and crew the ship with a combined submarine crew and surface ship operations department. However limited and rash, this example would still be a potent power projector and would be a platform that could be inserted into extremely hostile environments with little vulnerability.

Both the surface warfare community and the submarine community are at a crossroads looking for the next direction in which to take warship design. What is proposed is a new direction for the design of the next submarine/surface warship. A warship that dominates all spheres of the battlespace—including the ability to exploit the subsurfaced environment if desired.

The term, warfare platform, is preferred to the classifications of surface ship or submarine since the ability to submerge is intended as one of many potential characteristics of the platform to be discussed. The ability to submerge will be a key feature in this discussion, but the traditional role of the U.S. Navy submarine will be challenged. The innovation presented is not a technological innovation, but an innovation in the tactical and operational implementation of a submerged platform. A new warship design is required, but the design needs only the combination of existing operational warship components and capabilities. The point that the name submarine is to be avoided cannot be overemphasized; the missions of the platform to be discussed are traditionally cruiser, destroyer, or frigate missions. The ability to submerge is an obviously desirable addition based upon the threats that are faced by these platforms.

Two articles in the July and August 1994 issues of the U.S. Naval Institute Proceedings have focused on the design of the future surface combatants of the 21st century. The Right Ship by Commander Maiorano cites many important factors in the design of the surface combatant. Multimission capability is a priority, and the ship must be able to operate in the threat environment:

> "Naval forces operate extensively in a near-land environment characterized by reduced battlespace, less reaction

time, and a complex mix of high-speed, low radar cross-section anti-ship cruise missiles."

He later quotes the Chief of Naval Operations' Twenty-First Century Surface Combatant Study:

"The 21st century surface combatant must be multimission capable to deploy forward for independent operations in the face of a variety of threats, including antiship cruise missiles launched from the air, surface, and shore; theater ballistic missiles; mines, gunfire emanating from shore batteries, ships, or small craft; torpedoes, and various types of chemical, biological, and radiological weapons. The future combatant must also contribute to offensive power projection, establish battlespace dominance, and be fully interoperable with other naval expeditionary, joint, and allied forces in support of U.S. security interest."

Rueven Leopold's article, The Next U.S. Warship Design, concludes that production must continue on the DDG 51 Flight IIA and that we should use a "clean-sheet-of-paper warship design" to address the new missions and priorities of our Navy.

The capabilities mentioned above are the design criteria for the proposed submerged warfare platform. The ability to submerge would allow for covert entry and exit into a variety of hostile situations. It would allow positioning of advanced forces in front of a carrier battlegroup, amphibious task force, or surface action group. It would need little support from tactical air, and would have the fire power to engage various threats to the force. The *clean-sheet-of-paper warship design* of this concept will be easy to criticize from both a technical and an operational point of view. However, the concept is feasible and powerful.

Today's warfare platforms have pieces of the proposed warfare platform's characteristics. Today's platforms, like DDG 51 and SSN 688I, are currently performing the missions discussed in the CNO's study for the 21st Century. However, both of these platforms have major weaknesses and vulnerabilities. The DDG 51 is placed at risk when performing independent operations in a high air threat environment. Operating within 100 miles of shore, against adversaries equipped with significant shore based strike aircraft or long ranges cruise missiles, requires significant U.S.

shore or carrier based aviation to provide air superiority. Surface ships are performing missions independent of significant air cover, but the efficacy of anti-ship cruise missiles, even in the hands of Third World countries, is indisputable. Submarines are also performing independent missions to provide area commanders with intelligence and close-in strike capability. Submarines are experts at operating independently, but they are lacking in C4I capabilities, have limited strike capability, and have no capability to engage air targets for self protection or to protect other assets. The best attributes of these two platforms can and should be combined.

In the current fiscally constrained Defense budget, there may be limited room for innovative concepts; this discussion, right or wrong, will be devoid of an analysis of the costs or the cost to value ratio. Some mention will be given to ideas to make the design simpler. The concept is the important point.

What are the characteristics of this warship? Some basic characteristics could include:

1. **The ship should be capable of extended surface operations.** Seakeeping is a big concern for a ship that is also designed to submerge. Obviously, trade-offs would have to be made in the hull design to achieve acceptably high surfaced and submerged speeds. The ship should be capable of at least 25 knots surfaced or submerged—similar to a frigate. The design should present an extremely low cross-section, being close to the water, using stealth technology.

For seakeeping, the ship should be in a condition to submerge at all times (always *rigged for dive*). Except in low threat environments, with excellent weather, the ship should be ready to submerge. To achieve this goal, the ship could have an enclosed, submergible bridge that has windows, and can accommodate a sufficient surface watch. The sealed bridge could be designed to submerge only a few hundred feet. While the ship is submerging, the bridge is cleared, sealed, and flooded to become a free-flood space. Nuclear power and current submarine atmosphere and ventilation systems would allow indefinite operations in the submerged condition. For very heavy seas, the ship would have the option to submerge and ride out the storm in the calm depths like any nuclear powered submarine.

Submerging to avoid incoming missiles is not an acceptable tactical plan; submerging in a controlled manner takes several minutes and only if the ship is properly compensated. Submerging in a high threat environment to hide is an option, but this gives up the option to fight the incoming threats. The ship will be designed to defend itself while surfaced with an air search radar, anti-air missiles, and close-in defense systems.

2. The ship must contribute to **offensive power projection**, and be **fully interoperable** with other naval forces. As previously mentioned, the ship should have a highly capable air-search radar, a CIC, a large communications suite with multiple antennas, and all tactical data links. This ship is capable of independent operations, but the design should ensure the ability to coordinate with traditional surface units. One limitation is the lack of a helicopter. This deficiency only increases the need to operate with traditional surface units.

Weapons should include anti-air, anti-ship, and anti-submarine vertically launched missiles, as well as torpedoes. Tomahawk land attack missiles (TLAM) and the ballistic Army Tactical Missile System (ATACMS) will be used for long range shore strike missions. The design could include an anti-ballistic missile defense system. A fully automated 76mm or 5 inch gun could be mounted aft of the superstructure/sail in a hydrodynamically chosen location.

3. As a submarine, the design will be challenging. Submerged communications and missile launch capabilities developed for SSBNs could be incorporated. A big concern will be the size, the draft, and crew complement necessary for this warship. Will it all fit and be effective? This is a large submarine. At least the size of the SEAWOLF, it would be a deep draft vessel like any SSN. Since the cost of traditional submarines tends to be proportional to size, it would imply a prohibitive cost. However, a shallower depth capability, lower submerged speed, and less quieting sensitivity could cut the cost. The change in the primary mission of this warfare platform away from traditional deepwater ASW should allow trade-offs in many of the expensive, traditional submarine design characteristics.

The manning required for the extensive surface operations requires a mix of submarine and surface warfare specialties. The crew size should be minimized for living space and atmosphere control considerations. The proper mix would be a careful trade-off minimizing warfighting capability while maintaining the manning for safe submarine and reactor operations.

These ideas are provided only to help the reader envision the concept, and are based on at sea experiences. This is not a formal design proposal. The details should be solved by ship designers. The concept is the issue.

Since the end of the Cold War, U.S. Navy submarine officers have been busy attempting to justify the cost to build and operate nuclear attack submarines. The Cold War priority mission of the attack Submarine Force, anti-submarine warfare--specifically against Soviet SSBNs, has diminished with the demise of the Soviet Union. New emphasis in submarine operations has begun to include strike warfare with cruise missiles, operations with special forces, fighting diesel powered submarines in the littoral environment, and carrier battlegroup support. Although the Los Angeles class submarine is capable of performing these missions, there are other platforms in the carrier battlegroup designed to perform each of them. Covert surveillance is one of the few jobs that only an SSN in a battlegroup can perform.

In Winning the Next War, Innovation and the Modern Military, author Stephen P. Rosen devotes a chapter to the analysis of the development of the tank as an innovation in warfare during World War I. The tank was recognized as a potentially potent weapon by the highest ranking officers in the British Army before it was fully tested in warfare. Nonetheless, in hindsight, it did not achieve overwhelming battlefield success in World War I that would have been expected based on the success of the tank in later wars. The problem was that "a conception of how to use the tank at the tactical and operational level was not delineated until later in 1918".

The failure of the British Army was their inability to develop the potential of an extremely capable weapon. Short on infantry soldiers due to battlefield losses in 1916, the British generals decided that manning new tank divisions could not be risked. They failed to see the force multiplier presented by the technological innovation of the tank. Similarly, the U.S. Navy has failed to fully develop the potential of a warfare platform that incorporates the latest advances in weaponry with the invulnerability, flexibility, and stealth of a nuclear powered submarine.

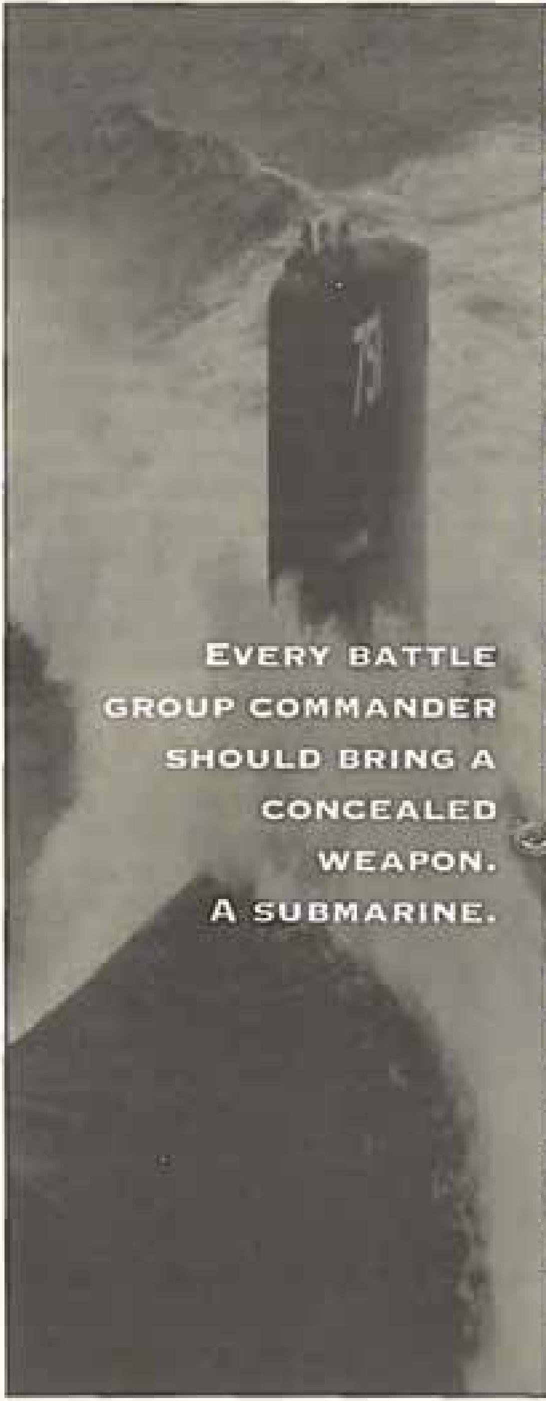
Stephen Rosen also discusses the successes of the U.S. fleet submarines in WWII. Two details that he mentions are pertinent to this discussion. First, in the 1930s the designers of the fleet submarine were given no definitive plan for the use of the submarine in the Pacific. However, the designers produced a warfare platform that was very successful. "The designers emphasized the special characteristics of submarine warfare against all conceivable enemies." They emphasized the dominant characteristics of a submarine to include the ability to penetrate enemy waters, perform reconnaissance, and conduct attacks upon the enemy. These characteristics are still true today except that the battlespace for warfare has grown from tens of miles to several hundreds of miles and includes the air, the sea, the depths, and the land. Second, Rosen points to the innovation in the tactical use of the submarine during WWII. Pre-war doctrine emphasized staying undetected. Minimum scope use, staying submerged, and performing sonar only attacks was Submarine Force doctrine. During the war, these tactics failed, and submarine captains who failed to adapt were relieved. The submarine had to risk possible detection in order to be able to engage the enemy effectively. The primary battlespace was above the surface, not below. The submarine still, however, retained the ability to exploit the subsurface environment. These facts are still true today.

A very comprehensive discussion of the current and future role of the submarine in the U.S. Navy based upon the national security environment is written by John T. Hartley, a submariner, and contained in the August 1993 issue of the Naval War College Review. Implications of the Changing Nature of Conflict for the Submarine Force spends 15 of 20 pages assessing the current world order and the roles of the U.S. military. With basically no mention of the submarine in this discussion, he proceeds to address the impact for the Submarine Force. He begins, "The fact that this discussion has seemingly wandered well away from the Submarine Force illustrates its major implication for that arm." He concludes that based on the dominance of U.S. Navy air and surface assets, the case to build SSNs is weak. SSNs are not thought to be cost effective, and the only way to ensure future SSN procurement is to reduce the cost to build them. He judges the value of a SSN based on its current emphasis in ASW and its weak performance in other missions.

Similarly, according to The U.S. Navy Submarines in a Minefield (USNI Proceedings, April 1994), the then Director of the Submarine Warfare Division in the Office of the Chief of Naval Operations, Rear Admiral Ryan, has drawn the same conclusion. As the Seawolf program faltered in 1990, the

Centurion and now the New Attack Submarine programs have officially replaced it. The main design criteria is low cost. However, despite many opinions in the submarine community to enhance the strike capability of the design, Rear Admiral Ryan announced in 1993 that the New Attack Submarine would be optimized for four missions: 1) covert intelligence collection and surveillance; 2) covert mine detection; 3) covert insertion and support of special forces, and 4) antisubmarine warfare.

Like the pre WWII Submarine Force, the current direction of submarine warfare is locked in the wrong region of the battlespace —below the waves. The U.S. should maintain a force of attack submarines that concentrate on ASW superiority, but this need not be the only role for a submerged platform. The failure is that a warship that is immune to most of the modern threats is not being exploited to its potential. As countries worldwide develop more cruise missiles, chemical, biological, and nuclear weapons, U.S. warships that are sent to represent U.S. interests will be increasingly vulnerable. Is the concept presented too expensive? perhaps, but is a concept that combines the most powerful warship attributes into a package that could assure continued dominance of the seas. ■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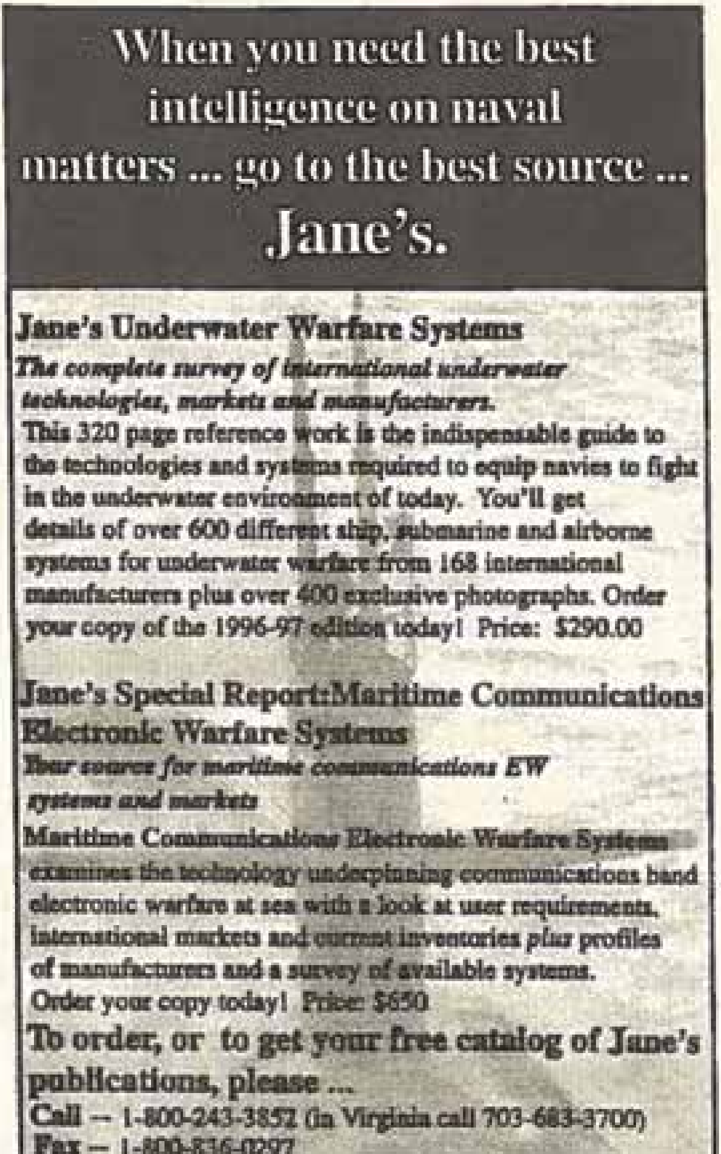
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U.S. NAVY TORPEDOES
Part One: Torpedoes Through the Thirties

by Frederick J. Milford

Dr. Milford retired from Battelle Memorial Institute in 1989 as Vice President for Special Projects. He is a life member of the Naval Submarine League.

Torpedoes have two very important claims to fame: they were the first guided missiles, and they have probably sunk more ships than any other naval weapon. Further, from the viewpoint of sub-surface warfare the torpedo has always been the major offensive weapon of submarines and during WWII it began its development into the pre-eminent anti-submarine weapon. In spite of this, the literature on torpedoes is skimpy.[1] This series of papers is an attempt to chronicle the evolution of U.S. Navy torpedoes, especially self-propelled or automobile torpedoes, from the earliest weapons to those currently deployed. Serious attempts have been made to construct technically correct, but readily understandable explanations of critical aspects of torpedo performance and, at the same time, to avoid some of the glib explanations that have sometimes appeared elsewhere.

American Underwater Weapons Before 1869

During the Revolutionary War attempts were made by the colonial naval forces to use underwater explosives in attacks by TURTLE against HMS EAGLE in 1776 and possibly HMS ASIA in 1775. Also, floating kegs of gunpowder were launched upstream of Philadelphia in a vain attempt to damage British ships in the harbor. Underwater explosive devices were extensively used by the U.S. Navy during the War of 1812, but had little impact other than to provoke vitriolic letters in the public press.

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[1] The most useful publication covering U.S. Navy torpedoes is Jolie's 1978 report "A Brief History of U.S. Navy Torpedo Development", which is very difficult to obtain. It has been largely reproduced in Gerkin "Torpedo Technology" (1989) which also contains other material. The NDRC reports "Torpedo Studies" and "Acoustic Torpedoes" are excellent, but report only WWII research and development. A bibliography has been published: "Torpedo Bibliography" SUBMARINE REVIEW, April 1995, p. 122.

The Civil War[2] produced Farragut's famous "Damn the torpedoes! Captain Draton, go ahead Jouett, full speed!" Of course, he was talking about stationary torpedoes or what would now be called mines. Spar torpedoes were also used with some success and attempts were made to use towed torpedoes. Confederate torpedoes of all types, mostly mines, sank 29 Union ships[3] and damaged 14 others thus sinking more Union ships than all the rest of the Confederate States Navy. The Confederate Navy suffered one ship sunk, the modern ironclad ALBERMARLE, and five damaged by Union torpedoes.

After the Civil War the U.S. Navy entered a period of decline that lasted until the birth of the *New Navy of the United States* in the early 1880s.[4] During this period of decline, in what must be viewed as a small but significant counter-current and quite possibly a response to the losses incurred during the Civil War, the U.S. Naval Torpedo Station at Newport, Rhode Island was established.

U.S. Navy Automobile Torpedoes

Early Attempts to Acquire Automobile Torpedoes. When the U.S. Naval Torpedo Station, Newport, Rhode Island was established on Goat Island in 1869 it was the first establishment in any

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[2] Underwater warfare in the Civil War is treated briefly but well in two chapters of Alex Roland's "Underwater Warfare in the Age of Sail" (1978). More detail on the Confederate campaign is given in Milton F. Perry "Infernal Machines: The Story of Confederate Submarine and Mine Warfare" (1965). Accounts from soon after the war are provided in W.R. King "Torpedoes" (1866) and John S. Barnes "Submarine Warfare".

[3] One of these was the USS HOUSATONIC which was torpedoed in February 1864 by the Confederate submarine CSS H.L. HUNLEY operating on the surface using a spar torpedo. This unlucky submarine was destroyed along with the Union ship and had itself previously killed five crews in attempting submerged operation. The 43 ships are listed by Perry, pp. 199-201 and p.4, and his list includes some very small vessels such as ship's launches. Jolie gives somewhat smaller numbers, but does not list the ships.

[4] Although there were earlier stirrings of interest in rebuilding the U.S. Navy, especially following the *Virginius* affair, the beginning *New Navy* is usually taken as the construction of the ABCD ships, ATLANTA, BOSTON, CHICAGO and DOLPHIN, which were authorized by Congress in 1883.

navy devoted primarily to the development to torpedoes.[5] The NTS was established at low cost even by the standards of the then impoverished U.S. Navy—the island already belonged to the Federal Government and existing buildings were used. The general mission was the development of torpedoes, torpedo equipment, explosives and electrical equipment.[6] Improvements in spar torpedoes and stationary torpedoes (mines) were the first projects.

The initiation of work on *automobile* torpedoes (movable torpedoes in the language of the day) at NTS was described by Lieutenant Commander Royal Bradford as follows: "In 1869, after the appearance of the Whitehead torpedo, an attempt was made at this Station to construct one similar in principle, so far as known."[7] The objectives were loosely stated as:

"To go under water for a considerable distance at a fair rate of speed."

"To make a straight course and maintain a constant immersion, whether started at the surface of the water or any point below it."[8]

The design that emerged was externally very similar to the contemporary Whitehead torpedo, fusiform, 14 inches in diameter and 12-1/2 feet long, a little shorter than the Whitehead torpedoes. The principal interior difference seems to have been in the engine which consisted of two cylinders (2 inches by 4 inches) with their

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[5] Recall that it was in 1869 that the Austrian Navy acquired rights to the Whitehead torpedo and that the Royal Navy negotiated their first agreement with Robert Whitehead in 1871.

[6] The association of electrical equipment with torpedoes was common, but the logic is not easy to follow. There are books on torpedoes and electricity and at least through WWII, HMS VERNON, the Royal Navy's torpedo school, was also responsible for electrical training. The connection may have been no more subtle than the early use of electrically detonated mines or the employment of mysterious technology in both torpedoes and electrical equipment.

[7] R.B. Bradford "Notes on Movable Torpedoes", U.S. Torpedo Station, 1882, p. 15. The point here is that this was an attempt to replicate the torpedo built by the English engineer Robert Whitehead working for Austro-Hungary, rather than to build a competitive automobile torpedo.

[8] Bradford *op cit* p. 15.

axes parallel to the torpedo axis. The piston crossheads engaged in sinusoidal groove cut in the surface of a drum which converted the linear motion of the pistons to rotary motion of the drum. The drum was geared through a 3.5 to 1 reduction to the propeller shaft.[9] By comparison, the contemporary Whitehead torpedo used a two cylinder, oscillating, 90 degree vee engine. The first NTS Fish Torpedo was tested in 1871. As Bradford says "Generally speaking, the results of the trials were unsatisfactory, though the diving apparatus worked reasonably well".[10] The difficulties were a hull that was not watertight, an air flask that was not air tight[11] and an inadequate engine which, collectively, seem to make Bradford's comment at least an understatement. Attempts to remedy these shortcomings were made in a second torpedo which was tested only at pierside. On the basis of these two torpedoes, plans for a *fish torpedo* were prepared by Lieutenant Barber and submitted to the Bureau of Ordnance in June 1874.[12] Though the torpedo was not fully successful, it was an auspicious start. The submission of plans to the Bureau is, however, the end of the known record of the NTS Fish Torpedo.

From 1874 until 1891 the development of automobile torpedoes for the U.S. Navy was in the hands of innovative private inventors. The NTS Newport budget was meager[13] and its role in

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[9] This engine configuration is strikingly similar to that used in the contemporary Mk 46 and Mk 48 torpedoes.

[10] Bradford *op cit* p. 17.

[11] The air tank problem certainly reflected the lagging state of the U.S. iron and steel industry, a situation that plagued the Navy's initial efforts to build large caliber, steel breech loading rifles for the ABCD ships.

[12] The plans may be found in Barber, Francis Morgan, "Lecture on the Whitehead Torpedo", Newport: USN Torpedo Station, November 29, 1874.

[13] The total funding for the U.S. Navy *Torpedo Corps* in the July 15, 1870 appropriation was $60,000. The total budget for *General expenses* of NTS Newport for five fiscal years, 1880-1884, was $295,000, barely covering these costs. For the year ending 30 June 1885 (FY 1884) the budget request for NTS was $50,000 for general expenses, $100,000 for *the purchase of auto-mobile torpedoes* and $55,000 for the purchase of a torpedo boat. Against this request $60,000 was appropriated for general expenses and $100,000 for the purchase

these developments was basically to provide test and evaluation facilities. On a worldwide basis, there were well over a dozen of these inventions.[14] Some were the fruits of the genius of great inventors of the day; others were produced by unknowns. Great ingenuity is evident and some contain the seeds of developments that subsequently became central to torpedo development. Three of these precursors that are particularly interesting are the electric torpedo, wire guidance and the rocket torpedo. None of these, however, found their way into the U.S. navy torpedo inventory at the time. Several inventions were submitted in response to a circular letter and subsequently evaluated in detail by the U.S. Navy Torpedo Board in 1883. Of these only the Howell torpedo, which is discussed below, was any sort of success. At this point in time, 1884, the U.S. Navy did not have a usable automobile torpedo, whereas by 1881 about 1500 Whitehead torpedoes had been sold to other navies and by 1884 Whitehead and Schwartzkopf together could probably have produced close to 1000 torpedoes per year.

In addition to the indigenous inventive efforts, the Whitehead torpedo was at least twice offered to the U.S. Navy: in 1869 for $75,000 and in 1873 for $40,000. These offers were declined. Stolen plans and specifications were also offered, and may have been given to the U.S. Navy, by an employee of the Woolwich Arsenal. It appears that in any case the plans were of not real significance in the development of U.S. torpedoes. The full story surrounding the offer and the alleged delivery of the plans would be interesting, but only fragmentary comments have been published.

The Howell Torpedo. The Howell torpedo was developed by then

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of torpedoes. It appears that the latter was so restricted that none of the moneys were spent. It should also be noted that the same act (3 March 1883) appropriated $1,300,000 for the first steel ships of the *New Navy* and so marked the end of the post-Civil War neglect of the Navy.

[14] Some of the names and dates for privately invented and developed torpedoes are : Lay (1872), Barber (1873), Ericsson (1873-77), Ericsson (1880), Lay-Haight (1880-83), Weeks, Wood-Haight (1885), Nordenfelt (1888), Sims-Edison (1889), Cunningham (1893-94), and, of course, the Howell torpedo (1870-1889). Comments on most of these can be found in Gray or Jolie.

Lieutenant Commander John A. Howell[15] beginning in 1870. The development was completed in 1889 and the U.S. Navy ordered 50 Howell torpedoes from Hotchkiss Ordnance Co. in the same year. These seem to be the only production Howell torpedoes that were built. There were, however, other Howell demonstration torpedoes. The torpedo entered service in 1890 and was the U.S. Navy's only torpedo until Whitehead torpedoes produced by Bliss and Williams came into service around 1894. Howell torpedoes continued in service into the 20th century. In his 1903 report the Chief of the Bureau of Ordnance reported that there were still 36 Howell torpedoes (as compared to 258 Whitehead type) on hand and the Inspector of Ordnance at NTS reported issuing 10 to USS IOWA as she was then the only ship still using them.[16] Although development was slow and its service life short, the Howell torpedo was initially one of the few credible competitors to the Whitehead torpedo and elicited interest in other countries and favorably comment as late as 1945.[17]

The Howell torpedo went through several stages of development. The first proposed version was, even by 1870 standards, very small, about 12 inches in diameter and 48 inches long. It was equipped with propellers at both ends which were on a common shaft together with a cylinder that contained the explosive charge. The whole rotating assembly, except, of course, for the propellers, was contained in an exterior cylindrical shell. The rotating assembly was given a spin with high angular velocity, thus storing energy for propulsion, and then launched.[18] This proposal was presented to the Bureau of Ordnance in June 1870 and referred to NTS for evaluation. The evaluation was unfavorable, but the Bureau permitted Howell to build a small model.

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[15] Development of the Howell torpedo began in 1870 when Howell was a Lieutenant Commander. By the time development was complete he was a Captain. He retired in 1902 as a Rear Admiral.

[16] Secretary of the Navy Annual Report for FY 1904.

[17] Peter Bethell "The Development of the Torpedo", Engineering, October 19, 1945, p. 302.

[18] The point, of course, was to store the energy required for propulsion as kinetic energy of rotation rather than as internal energy of compressed air.

The model ran well enough that Howell, at his own expense, made a full sized torpedo. This also ran, but Howell concluded that having the axis of the flywheel (the rotating charge in these early devices) parallel to the torpedo axis was faulty in principle.

The propulsive arrangement was changed to use a flywheel on a shaft perpendicular to the torpedo axis to store energy and development of the Howell torpedo continued with gradually improving performance. The main virtues of this torpedo were good course keeping and the absence of a tell-tale wake. The service torpedo,[19] which was designated the Howell Torpedo Mark 1, was 14.2 inches in diameter, 129.75 inches long and carried a 96 pound charge 400 yards at 25 knots.

Early USN Whitehead and Bliss-Leavitt Torpedoes 1891-1906.

Even as the Howell torpedoes were entering the U.S. Navy inventory, arrangements were being made to procure Whitehead torpedoes. In an interesting arrangement Bliss and Williams (later known as E.W. Bliss and Co.), rather than the U.S. Navy, negotiated a contract with Whitehead that provided drawings, sample torpedoes and a manufacturing license. Bliss, however, had only one customer for its Whitehead torpedoes, the U.S. Navy. The final capitulation and switch to Whitehead torpedoes was probably caused by two factors: objectively, the range and speed characteristics of Whitehead torpedoes were somewhat superior to those of the Howell torpedo and offered significantly greater growth potential. More subjectively, all other major navies were using Whitehead or Schwartzkopf torpedoes thus causing a definite risk that the U.S. Navy would be left behind if only Howell torpedoes were acquired.

E.W. Bliss and Co. produced five varieties of Whitehead torpedoes for the U.S. Navy: 3.5 meter Mks 1, 2, and 3, and 5.0 meter Mks 1 and 2, all 17.7 inches (45 cm) in diameter. The propulsion systems were compressed air powered, three cylinder, radial Brotherhood pattern engines. All used standard Whitehead

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[19] Drake Proc. USN Vol. XIX, 1893, No. 1, pp. 1-52 contains a very detailed description of the operational torpedo.

pendulum and hydrostat depth control systems[20] and the 5.0 meter Mks 1 and 2 and the 3.5 meter Mk 3 had Obry gyros for course control. Another, often overlooked, Whitehead torpedo was used by the U.S. Navy at this time, namely, the Whitehead 5.0 meter Mk 1A[21] which was purchased directly from Whitehead. Though it was slightly different in detail, it was operationally interchangeable with the 5.0 meter Whitehead Mk 1 produced by Bliss (fewer than 50 5.0 meter Mk 1A torpedoes were purchased). A total of 438[22] of these very standard Whitehead torpedoes were procured. Very similar torpedoes were used in all the major navies at that time.

The torpedo project engineer at E.W. Bliss and Co., Frank McDowell Leavitt saw room for improvement in the Whitehead torpedoes and proceeded to develop what came to be known as the Bliss-Leavitt torpedoes. The distinguishing technical features of these torpedoes as compared to the Whiteheads were, larger diameter (21 inches), turbine engines, alcohol fired dry heaters and higher pressure air. Operationally the Bliss-Leavitt torpedoes had larger warheads and much longer range, 4000 yards @ 27 kts for the Bliss-Leavitt Mk 2 vs. 1500 yards @ 28.5 kts for the best U.S. Navy Whitehead (5.0 meter Mk 2.). The first Bliss-Leavitt torpedo, Mk 2, had a two stage, single wheel turbine which produced an unbalanced torque and unwanted gyroscopic effects. Mks 2 and 3 had two counter-rotating turbine wheels which eliminated both problems. In all three the turbine axis was parallel to the torpedo axis. The use of chemical energy, the heat

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[20] The first Whitehead torpedoes used a simple bellows to measure the hydrostatic pressure and infer the operating depth of the torpedo. This depth information controlled the horizontal rudders to correct any depth error. Unfortunately, this arrangement is unstable. In a stroke of genius, Whitehead added a pendulum to sense the pitch angle and combined the pitch and depth information to control the horizontal rudder. The result was a stable, but not optimized system, which is usually referred to as *Pendulum and hydrostat* control.

[21] Probably the Whitehead Fiume 18 inches Mk 1 or Mk 2 with one or two acquired as part of the licensing package and others purchased separately.

[22] This includes Whitehead torpedoes produced by E.W. Bliss and Whitehead, but not the Mk 5. BuOrd Report for FY 1904, p. 572.

of combustion of alcohol, was a great innovation, but similar innovations were being made by both Whitehead and Armstrong at about the same time. Approximately 750 Bliss-Leavitt torpedoes, Mks 1 through 3, were procured by the U.S. Navy. They entered service between 1904 and 1906 and remained in service until 1922.

Three Decades of Torpedo Development: 1908-1938. Twenty-one inch torpedoes were suitable for launch by large surface ships, but they were too heavy and too bulky for the torpedo boats, destroyers and especially the submarines of the day. Four new 17.7 inch torpedoes were designed to address this problem. The Bliss-Leavitt Mk 4[23] was similar to the Mk 3, but designed especially for submarines. Mk 5 was a Whitehead design produced by Vickers and by the new torpedo factory at Newport. One of three speeds could be selected and set, but this had to be done before the torpedo was loaded into the tube. The power plant was a dry heater system using a four cylinder reciprocating engine, the last piston engine used in U.S. torpedoes until the Mk 46. The Bliss-Leavitt Mk 6 introduced a new turbine configuration in which the wheels were horizontal. This configuration has been the most common choice for U.S. Navy torpedo turbine systems ever since.

The Bliss-Leavitt Mk 7 was the last 17.7 inch torpedo acquired by the U.S. Navy, but it was a milestone. It introduced cooling of the combustion chamber by spraying water into it in addition to the fuel and air. The resulting mixture of steam and combustion products was a better working fluid for the turbine than heated air and dramatically improved the range. Another first for the Mk 7 was the use of TNT in the warhead. In addition, this torpedo could be launched from submarines or destroyers and was used later in experimental air launchings. The Mk 7 entered service in 1911 and with many modifications remained in service in older

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[23] Beginning with the Bliss-Leavitt Mk 4 torpedo the practice of assigning a series of marks to each manufacturer was changed to a single series of marks for all manufactures. Thus from Mk 4 on, the mark number alone, or in a few cases the mark and Mod., uniquely identifies each torpedo.

submarines through 1945. After 1922[34] it was the only U.S. Navy 17.7 inch torpedo in service.

Marks 8 through 12 were 21 inch steam, turbine powered torpedoes, with the same general features as described above, differing mainly in detail. Mk 9 was the last torpedo manufactured by E.W. Bliss and Co. and the Mk 10 was the last designed by them. Both functions were taken over entirely by the Newport Torpedo Station effective 1 July 1923 and no new U.S. Navy torpedoes, or even piece parts for torpedoes, were designed or produced by any other U.S. Navy establishment or industrial firm until 1940 when NTS Alexandria resumed operations and began producing piece parts. Mk 11 introduced multiple speeds that could be selected after loading into the tube. All of these torpedoes, Mks 8 through 12, remained in service through 1945. The Mk 8, in particular, was the standard weapon for the flush deck destroyers DD 75 through DD 347). Just outfitting these ships required over 3000 torpedoes and this was certainly a production record until WWII. Mk 8 was also extensively modified during its long service life; Mk 8 Mod. 8 was the last major modification of this remarkable weapon. Marks 11 and 12 were pure NTS products, but altogether only a few hundred were built.

Beginning in 1915 with a contract with Sperry Gyroscope Company and continuing sporadically at NTS[35] after 1918 attempts were made to develop an electric torpedo. These efforts led to three development torpedoes Electric Torpedoes Mk 1 and Mk 2 and the Mk 20. None of these were issued as service weapons. As compared to the steam torpedo program, this was not a major effort.

The trio Mk 13, Mk 14 and Mk 15, which completed development in 1936, 1931 and 1935 respectively, had a great deal in

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[34] In 1922 all torpedoes prior to the Mk 7 were declared obsolete and removed from service. Only four torpedoes, Mk 7 (17.7 inches) and Mks 8, 9 and 10 (all 21 inches), remained in service.

[35] General Electric also participated in some of the NTS efforts.

common and are justifiably famous as the workhorses of WWII.[26] The object in designing these torpedoes was to provide a modern weapon for each of the three platforms, aircraft, submarines and surface vessels. These designs were to take account of all that had been learned in the development and production of earlier weapons particularly Mks 7 through 12 and wherever possible improve performance. The development took place at NTS Newport during the period of that station's total torpedo monopoly. Furthermore, through that period NTS seems to have operated in what was almost total technical isolation and certainly a complete competitive vacuum. As noted above, from 1923 on, only NTS Newport had designed or built torpedoes for the U.S. Navy. Neither the Mk 11 nor the Mk 12, the two earlier entirely NTS designed and built torpedoes, had, however, been produced in large quantities[27] or become important service weapons.

The common features of the three new torpedoes were the turbine and other mechanical parts of the propulsion system, the depth engine and gyro and the contact part of the exploders. The Mk 13 was the first torpedo developed by the U.S. Navy specifically for launching from aircraft. It was shorter and larger in diameter (22.5 inches) than either of the other two. Its maximum speed was lower, 33.5 kts vs. 46.3 kts for the Mk 14 and 45 kts for the Mk 15.[28] The lower speed had important consequences as we shall shortly see! Also, the Mk 4 exploder used in the Mk 13 torpedo did not contain the magnetic influence feature that was deemed so important in the Mk 6 exploder used with the other two torpedoes. Externally the three torpedoes were different to suit the different platforms. The Mk 13 structure was also designed to survive an air launch from 50 feet at 100 kts and thus somewhat

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[26] The production figures for these torpedoes during WWII are staggering: Mk 13 17,000, Mk 14 13,000, Mk 15 9,700 also Mk 18 electric 9,600 and Mk 23 (a Mk 14 variant) 9,600.

[27] The total production of Mk 11 and Mk 12 combined appears to have been less than 200 and almost all Mk 12. Existing Mk 12 torpedoes were issued to destroyers during WWII, but the number was insignificant compared to the 9700 Mk 15 torpedoes that were produced.

[28] The only other 45+ kt torpedoes in the U.S. inventory were the Mk 11 and Mk 12 and experience with them was limited.

more rugged than either of the other two, however, for the higher altitude and greater air speed launches that became important in WWII accessories were required to maintain satisfactory aerodynamics and prevent damage on water entry.[29]

The mechanical parts of these weapons were beautifully made but the mechanisms seem excessively complex. It is difficult to appraise this complexity without attempting an alternative design within the framework of 1930s design practice, but it is also difficult to escape the feeling that these devices are yet another example of arcane instrument engineering as practiced by BuOrd without competition from other design teams.[30] In their defense it must be noted that there were very few, perhaps only one (structural failure of the contact exploder), purely mechanical problems that were not quickly found and easily fixed.

What does seem to have been overlooked is the effect of increased speed on details of the hydrodynamics and on the inertial forces experienced by torpedoes. The first led to a significant depth control problem in the Mk 10 and was exacerbated by a factor of about two by the increased speed of the Mk 14. The second led to the structural deformation and attendant failure of the contact portion of the Mk 6 exploder. An entirely separate problem was the failure of the magnetic influence portion of the Mk 6 exploder. These problems, which were particularly acute in the Mk 14 submarine launched torpedo, are discussed in the next part of this series. ■

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[29] In particular, a wooden nose drag device was used to reduce water entry speed and wooden tail fins provided aerodynamic stability after release from the aircraft and before water entry. Both of these devices broke off on water impact.

[30] An interesting comparison is that between the complex inertial ring and trigger mechanism in the early Mks 4, 5 and 6 exploders and the elegantly simple ball switch of the Mk 6 Mods. 5, 6 and 10 exploders.

SUBMARINE RADIO COMMUNICATIONS 1900-1945

by John Merrill

*John Merrill is an electronics engineer emeritus of the Naval Underwater Weapons Center at New London, CT. He is a frequent contributor to the **REVIEW**.*

[Author's Acknowledgement: This paper is heavily dependent on many sources. However, special note is made of Evolution of Naval Radio-Electronics and Contributions of the Naval Research Laboratory by Louis A. Gebhard. This book helped to clarify the many technical developments at NRL that improved submarine radio communications.]

In the winter of 1896-97, John P. Holland's sixth submarine, which would become USS HOLLAND (SS 1) on April 11, 1900, began to take shape at Nixon's Crescent Shipyard, Elizabeth, New Jersey.

At the same time 24 year old Guglielmo Marconi, recently from Italy, was in England demonstrating his wireless equipment and taking out his first patent. Returning to Italy in June 1897, Marconi established wireless communications from land to Italian warships located at distances of up to some 10 miles. By 1902, on the United States liner PHILADELPHIA en route to the United States, he was receiving wireless messages at distances of 700 miles during the day and 1500 miles at night. Customers for his system of wireless telegraphy included various navies and armies as well as the commercial sector. These achievements in wireless telegraphy led to his Nobel Prize for Physics in 1909.

Naval Communications 1896

Communication between ships at sea was considered a knotty problem in 1896 when Marconi was demonstrating his early wireless communication in England. Later in 1922, a retired United States Navy captain relating the history and development of radio or wireless telegraphy looked back to his time at the Naval War College in 1896 and summarized ship communication then.

> "Outside the use of carrier pigeons, the sense of sight and hearing only were under consideration, that is, visual or

audible communications between ships in extended formation...searchlight reflection on clouds at night...30 mile communication sent and answered. A signal gun was estimated to be audible at 10 miles if conditions were favorable."

The captain went on to note that by 1901-02 (after the Spanish War), Marconi's concept of wireless communication between naval vessels up to 50 miles apart was achieved.

On 21 January 1900, the New York Herald reported "the day of flag and lamp signaling system in the Navy is drawing to a close". At this time, Navy Board considerations included the advisability of discontinuing the homing pigeons service and evaluating wireless radio. The Navy board reported favorably for the wireless. The next year, 1901, the Bureau of Equipment bought duplicate wireless sets from France, Germany, Britain, and from the DeForest Company in the United States. Two years later 45 more sets were procured.

With wireless transmitting ranges of the order of 74 miles, the Royal Navy by 1900 had 26 ships equipped with wireless and six coast stations constructed. The British were the first to equip submarines with wireless telegraphy. The British submarine HOLLAND I, laid down in February 1901 with sea trials in April 1902, had a wireless compartment.

Military application in wartime quickly followed. During one of the final sea engagements between Russia and Japan in the northern Pacific on May 27, 1905, in a lifting fog at 3:30 AM the captain of the armed merchant cruiser SHINANO MARU used wireless radio to his advantage. He sighted the Russian fleet and, using the wireless, within 90 minutes was able to bring four of Japan's finest battleships on a course to intercept the Russians and successfully destroy the opposing fleet. Without relay, the Japanese were generally able to communicate to ranges of about 60 miles.

General use of radio by the United States Navy in 1906 finds 57 equipped ships, 39 shore stations, and a transmit-receive capability between surface ships of about 640 miles. The primary wireless use at this time was for fleet reporting and ship-to-shore and vice versa, with additional support on land by use of the telegraph. Visual communication methods were still somewhat preferred. During this period, good operating discipline among naval wireless operators was generally lacking; this did not contribute to a broad acceptance of wireless.

Radio communications with submarines remained operationally unsatisfactory for several more decades. Space available in the submarine for radio equipment was limited, the power capability of the available transmitters was low, and the small antennas were too short for the low radio frequencies and equipments available through the 1920s.

<u>An Early 1907 View of the Submarine and Wireless Telegraphy</u>

In 1907, Cyprian Bridge, an officer in the Royal Navy (later Admiral Sir Cyprian Bridge), wrote "Why do we want submarine boats? To do with increasing of invisibility, but otherwise under greater difficulties the same work as torpedo-boats, viz, to sink or injure an enemy's ships." Regarding radio-telegraphy, Bridge observed, "It permits between an observer and his chief, scores and perhaps hundreds of miles apart, the exchange of question and answer...the range of direct communication has already been increased to twenty times its former amount, if not still more."

To assure better wireless equipment performance from the manufacturers, the Navy established the U.S. Naval Radio Telegraphic Laboratories in the fall of 1908 under the Navy's Bureau of Equipment. Working space and facilities were made available at the National Bureau of Standards in Washington, DC. Further performance needs led the Navy by 1915 to develop radio equipment in house. The Washington Navy Yard was assigned the development of radio receivers and wave meters. Naval Laboratories at various locations such as Great Lakes, Illinois and the Naval Air Station at Washington (Anacostia), DC addressed research and development aspects of the Navy's radio needs during and immediately after World War I. The efforts included radio broadcasting, radio detection and aircraft radio.

At the time Bridge was making his observations, both the United States and Great Britain had already accepted the notion of the submarine primarily for coastal defense. In 1908, British D-boats appeared with radio masts, the first for a British submarine. Cage type antennas were slung from the masts.

By 1910, the number of German submarines began noticeably to increase. Starting with the outfitting of the U-5 in June 1910, all further U-boats were fitted with radio telegraphy. On the U-5, two aerial masts could be lowered from inside the submarine. The wireless system communication distances achieved were about 50-62 nautical miles between ships and U-boats and distances of about 30 nautical miles between U-boats. British submarine radio distance performance matched that of the U-boats.

With the beginning of World War I hostilities, 45 U-boats were ready for service or in construction. The Royal Navy submarine fleet was the largest in the world with 74 boats, 31 under construction and 14 more either on order or projected.

In the last pre-war British maneuvers of 1913, the submarine was perceived by some as having greater possibilities than those of harbor defense. Two distinct roles for the submarine began to evolve: those of a submarine killer and of a fast long range cruiser-like underwater support of the line of battle.

Communications with and among military ships at sea through the centuries has always been a continuing unwieldy problem. Even with all the current technological advances at the start of the 20th century, surface ship wireless communications were only embryonic in view of the progress in wireless communications which the new century would bring. Although the 1901 annual report of Secretary of the Navy John D. Long referred to the advisability of discontinuing the homing pigeon service and substituting for it some system of wireless, World War I would still see the use of this mode to pass information from a submarine to the shore base.

An often encountered story of that period tells of a British E class submarine operating off Heligoland, the German North Sea Gibraltar-like naval base. The need arose for the submarine to send an urgent message to Harwich, a homeport for destroyer and submarine flotillas on the east coast of England 140 miles from the submarine. The submarine's wireless telegraph range was 50 miles. The submarine captain at 4 AM ordered four pigeons, each carrying identical words, to be dispatched in a moderate wind for Harwich in a west-south-westerly direction. The message arrived at about 3:30 in the afternoon. This took place almost 20 years after Marconi's development. Communications were certainly among the submariner's problems.

The need for enhanced submarine communications would soon be apparent, but the technologies to achieve this would only slowly evolve. The surface ship's communication dilemma by the mid-1920s would be under reasonable control. The solutions to submarine wireless communication problems through and beyond

World War I would lag. Reasons for the lag stemmed in part from the immediate environment and proximity of the sea to the submarine and its appurtenances.

Through the years, submarine antenna problems due to temperature (from the tropics to the Arctic regions), pressure as the submarine went deeper, drag forces as it moved faster, wave slap, and high sea states always ranked high. Adding to these primarily mechanical challenges, the sea around the submarine is generally opaque to the radio waves. Notwithstanding these realities, the submarine gradually became electromagnetically connected although sometimes the pace was imperceptible. In retrospect, the slowness was due to a combination of shortfalls in understanding, technological developments, and fiscal allocations.

At the beginning of World War I in 1914, one would find both wireless and diesel engine for propulsion as innovations in the E class, the fifth evolution of U.S. Navy submarines.

A 1915 book regarding modern submarines and their role in naval warfare at that time prompted the comment that radio (day or night) means of signaling was first in a list of eight techniques or methods of signaling. That same year, author Frederick A. Talbot observed that German boats were using wireless telegraph to relay 150 miles to Berlin. In 1916, the U-20 (which had sunk the LUSITANIA the previous year) established a submarine distance wireless record of 770 miles, communicating with Germany. In March the following year after sinking a French battleship off Sardinia in the Mediterranean the U-64 reported that event that same night to a German cruiser operating off the coast of northwest Germany. This was accomplished with a transmitter power of about 1 Kw and telescopic aerial masts. U-boats operating against commerce west of the British Isles routinely were able to talk directly with stations in Germany and Belgium

The concept of a fleet submarine in support of the battle group grew. This was articulated in 1916 by Lieutenant (junior grade) F.A. Daubin in *The Fleet Submarine*, an article in the Naval Institute Proceedings. Daubin observed that by February 1916, 487 ships had been sunk by submarines. He discussed the characteristics of a fleet submarine and noted that the increased size of the fleet boat would allow for a radio plant of greater power than the limited space available in the then current coast defense submarines. This fleet concept persisted for the next several decades and heavily influenced submarine design. The evolving role of an independent offensive submarine brought the submarine further into the command and control radio communications needs. From 1915, anti-submarine warfare was the primary submarine mission.

A 1917 book, Secrets of the Submarine, mentioned that the submarine wireless problem was one of antenna masts. At that time experiments with telescopic and folding masts, mounting and dismounting without crew on deck, had not been successful. The author also speculated that Germans off Great Britain were using wireless.

U.S. Navy World War I submarine missions occasioned many escapades of near disaster from hostile or near hostile action by friendly convoy and convoy escorts. Primarily as a result of **lack of communications**, four U.S. Navy submarines, N-3, N-4, O-4, and O-5, were inadvertently fired upon during the summer of 1918. Total disaster was only avoided at the last moment in each case.

The N-3, after being hit by fire from a British transport and taking water in the torpedo room, was nearly rammed by an American destroyer coming within 20 yards. As a result of the accidental skirmish, an unexploded British 7.5 inch shell was found in the submarine's forward superstructure.

The N-5, previously damaged by a collision, was fired upon by a British steamer while the submarine was slowly en route to New London.

Six days out of New York City, after completing convoy escort and inbound, the O-4 was fired upon by a convoy steamer; but the shots fell short. Identification was then successfully established. There were procedures for recognition in place, but positive identification and reliable ways to communicate were not available. Friendly force action against submarines also occurred during World War II.

A 1920 Naval Institute Proceedings article on American submarine operations during the War commented on World War I submarine N-5's radio communication posture. The N-5 was one of seven N class submarines constructed by the Electric Boat Company during 1917-18. During the last year of the War in order to receive radio communications the N-5 surfaced, raised the radio masts, and listened for further orders from the Navy shore radio stations at Arlington, Virginia (completed late in 1912) or at Siasconset on Nantucket off the coast of Massachusetts.

In the early post-World War I period, the establishment of the Radio Corporation of America and the start of the Naval Research Laboratory at about the same time significantly impacted Navy radio communications growth and effectiveness.

In October 1919, RCA was founded by the General Electric Company and included the holdings of the Marconi Wireless Telegraph Company of America, a subsidiary of a British owned company. The Marconi Company owned Navy-leased wireless equipments, both shore-and ship-based. This action provided a United States based radio equipment manufacturing source for the Navy that would always remain under American control. Lessons from World War I regarding potential problems in the event of foreign monopoly of some segment of the wireless industry led the Navy to look favorably at such a corporation.

Further, by consent, RCA had legal access to a number of radio and related patents stemming from a variety of sources. In the early 1920s, in addition to General Electric, Westinghouse and American Telephone and Telegraph Company were the original stockholders of RCA. These three companies accounted for more than half of the stock holdings. Radio related patents of the several companies were available to the new corporation.

Scientific American of April 1920 reported *Loop Aerials for Submarines*. The article was based on a paper read before the American Physical Society and reported some results of experiments made aboard a submarine to determine radio communication performance. This successful antenna concept is sometimes called the clearing line loop. The clearing lines, cables located over the submarine from bow to stern, were used to keep off debris and prevent damage to the submarines when surfacing. The loop attached to the clearing lines consisted of two insulated wires connected (grounded) to the submarine hull at the bow and the stern. It was carried over suitable supports to the bridge and then through radio lead-ins to the receiving and transmitting apparatus. The submarine loop antenna out performed ordinary antennas. The maximum depth of submergence for receiving was found to be frequency dependent. At radio frequencies of the order of 30 kHz, signals could be received when the top of the loop was submerged 21 feet. Transmitting from the loop at a frequency of about 300 kHz, distances of 10 or 12 miles were obtained when the top of the loop was practically at the surface. The range was found to decrease to two or three miles when the top of the loop was eight or nine feet below the surface. It was also noted that the loop could be used as a direction finder, maximum signals being received when the submarine was pointing toward the transmitting station. Limitations of the clearing line loop included obstruction of firing from the deck guns and easier detection of a surface submarine by enemy aircraft.

These findings indicated modest progress and a growing understanding of the submarine's needs and its environment. The requisite radio communication technologies making the submarine the ultimate war machine would only slowly evolve and begin to be available in the post-World War II era and beyond.

The submarine's continuously broadening acceptance, increased numbers, propulsion enhancements, improved weapons and tactical value placed radio communications demands beyond the state-of-the-art of available radio communication equipment.

<u>The Naval Research Laboratory (NRL) Begins</u>

Early in World War I, Germany's submarine effectiveness and the observed importance of science on warfare affirmed the need for a new Navy laboratory for experimental research, to be managed by civilians under the direction of a naval officer. In August 1916, an Act of Congress established and funded the new research laboratory under the direction of the Secretary of the Navy. NRL's charter included a vast number of technical areas including radio. Lack of agreement on the location of the laboratory and the United States' entrance into the War the following year delayed the construction of the laboratory until December 1920.

In early 1923, the first five buildings of NRL were completed. The site selected was at the Bellevue Arsenal on the Potomac River below Washington. They were augmented by the addition of the Naval Aircraft Laboratory, the Naval Radio Telegraphic Laboratory, and the Radio Test Shop from the Washington Navy Yard.

Some of the areas of NRL's work which contributed to the effectiveness of submarine radio communications during the period between World War I and World War II included radio propagation studies, the Navy's adoption of high frequencies (HF), high frequency equipment, intrafleet HF equipment, crystal frequency control, and submarine HF transmitters.

By 1924, the growing needs for commercial radio broadcasting led to the establishment of the broadcast band, 550-1550 kHz. Between 1900-1920, the Navy primarily used radio frequencies below 600 kHz; but the Navy had plans to use what became the broadcast band for future intrafleet communications. This development led the Navy to consider frequencies above the broadcast band. Building on the experience of the radio amateurs who from 1912 had access to frequencies above 1500 kHz, NRL examined this part of the spectrum and developed propagation theory to predict performance at the high frequencies. For long range communications, HF provided improved performance. The equipment required less power and was more compact and lighter. The equipment cost was relatively lower; and, further, more channels were available to the Navy.

Interest in HF was further increased because the new Navy fleet organization made in 1922 created a need for more channels for radio circuits between the various fleet elements. Multiple frequency reception and transmission from the ships was also a requirement for consideration.

After several years of HF propagation studies, equipment development, and various experiments and tests, a definitive long range round-the-world HF test was conducted in 1926. Successful extensive long distance tests at HF were held between NRL and the USS SEATTLE operating in Melbourne, Australia. In late 1926 the Navy decided to include HF equipment in its Radio Modernization Plan, then undergoing revision. Planned HF installations were greatly extended beyond the earlier recommendations.

The Navy's use of HF (2,000 to 18,100 kHz) made possible antennas smaller in size and reasonably compatible with the spaces available on a submarine. Further in 1927-28, NRL developed a new HF transmitter for submarine use.

To demonstrate the HF capability, two fleet submarines (V-1 and V-2, commissioned in 1924) had the new transmitters and antennas installed in June 1928 at San Francisco. The submarines conducted transmit and receive tests in the Pacific. They were able to communicate both day and night with NRL in Washington, DC from Hawaii. At the time, this was a long distance communication record for a submarine.

Other United States submarines were smaller than the V class and could not accommodate the HF transmitter. Therefore, in the following year (1929) NRL developed a second HF submarine transmitter suited to the smaller space available on the non-fleet type submarines. This new submarine transmitter was made in sections to fit the limitations of submarine hatch diameters and passageway constraints of the S class. Using higher radio frequencies (shorter wavelengths) also made it possible to use several different antenna configurations which were less constraining than the antenna needs for the previously-used lower frequencies. In particular, the success of HF made it possible to eliminate the cumbersome clearing line loop previously mentioned. Loop, flat top, and periscope-mounted antennas could be used with these new NRL transmitters.

November 1929 submarine patrol trials with the new NRL HF transmitters proved successful, establishing an HF range capability of about 575 miles. Under various limited and constrained conditions of submarine operating depth, ranges of the order of 90 miles were achieved.

During 1930 and 1932, 20 of NRL's LF/HF transmitters were procured from industry. They were for use on some of the S class coastal submarines which operated with the larger V class submarines. Additional production of submarine transmitters occurred in 1933 and 1935. In the period 1930-1945, leading up to and including World War II, various versions of NRL's transmitters provided the foundation for both the shipboard and shore station transmitters.

By 1930, submarine HF communications proved to be useful for scouting and screening submarines in support of the fleet. It was noted that submarines could be maneuvered by radio in a way not unlike visual communications.

To support the HF transmitters, NRL developed a tuned radio frequency HF receiver in the mid-1920s. A commercial procurement made the receiver available to various ships, shore stations, the Marine Corps, and the U.S. Coast Guard. A later receiver was produced in quantity, (about 1000) and provided throughout the naval service.

By 1934, NRL's work toward developing a suitable Navy HF superheterodyne receiver resulted in commercial procurement. This series of receivers was purchased in large numbers during World War II.

In 1940, after four decades of radio development, submarine communications had improved, but with continuing limitations. At the beginning of World War II, the submarine could receive messages at long ranges of thousands of miles with a dependable very low frequency (VLF) one way link to shore. Messages were sent via the VLF Fox method (developed in 1914 during World War I), a no receipt transmission from a shore station on a four hour schedule with repeated messages to ensure reception. The submarine posture for reception was at that time typically at periscope depth with a loop receiving antenna aligned with the distant VLF transmitter. Receiving posture could require as long as an hour. Another factor in the time equation for message reception was the sea state and its impact on the submarine.

HF transmission and reception for the submarine was the other primary channel. At HF, an important adverse consideration during transmission was the vulnerability of the submarine from enemy direction finding techniques. These frequencies also required operation at periscope depth, a constraint similar to that of VLF.

Communication, an essential part of submarine operation, therefore presented a high risk aspect which had to be balanced with the submarine's purpose or mission and its safety.

As the intensity of World War II deepened in 1940, the typical submarine was vastly different than HOLLAND's 53 foot long craft with a crew of nine, a bow torpedo tube and three torpedoes. The wartime fleet type submarine was 300 feet long and had a cruising range of 11,000 miles. A crew of about 80 was average. Radio communication equipment, although not perfectly matched to this submarine much advanced from HOLLAND's designs, did meet the needs of the time.

After World War II

Both ends of the electromagnetic spectrum were exploited to enhance submarine communications after World War II. Satellites, computers, and other new knowledge during the next half century alleviated some of the needs. But the oceans above and below the submarine do not easily submit to the submarine's communication needs.

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THE NEW JERSEY NAVAL AND MARITIME MUSEUM

by Ron Pellegrino

It is not often that you hear of a museum that was never meant to be, but one is about to be constructed is a 20,000 foot facility overlooking the New York skyline. The New Jersey Naval Museum will be expanding and will also incorporate maritime history of the state of New Jersey to help teach about the naval history of this great state on the Atlantic Ocean. The new museum will be called the New Jersey Naval and Maritime Museum, and will be the centerpiece of the waterfront rejuvenation project in the city of Hoboken.

While the Vietnam War was raging in 1971, nobody was thinking about building a naval museum in New Jersey. Several submarine veterans got together and wanted to create a small memorial to fellow submariners still on eternal patrol. This was the beginning of the Submarine Memorial Association that would become the caretakers of this memorial. From this small start, a request was sent to Washington for a donation of a torpedo to be used as a part of a memorial to be erected in Hackensack, New Jersey, on land cordially donated by Mr. Malcolm Borg, owner of the New Jersey newspaper The Bergen Record.

The request was returned approved, with a small catch—the torpedo was aboard USS LING (SS 297). As an Act of Congress on 28 June 1972, USS LING was to be turned over to the Submarine Memorial Association as a memorial. On 13 January 1973 LING was transferred from the Brooklyn Navy Yard and arrived at Borg Park to start her new life as a memorial, and a symbol of American dedication to defending the free world against foreign aggressors.

The submarine and museum are currently open from 10 AM until 5 PM Wednesday through Sunday. The museum is located on the corner of Court and River Streets across from the Bergen County Courthouse in Hackensack. There is easy access from all major roads. If there are any question please feel free to call or write. The phone number is (201) 342-3268, and the address is P.O. Box 395, Hackensack, New Jersey 07602-0395.

USS LING (SS 297) is one of the last Balao class fleet boats to be built. These boats were constructed to bring the war to Imperial Japan while the surface Navy rebuilt after the attack on Pearl Harbor. It was also this same type of submarine that rescued then LT George Bush after his Avenger was shot down during an attack on a Japanese held island.

The keel of LING was laid down on 02 November 1942 at the Cramp Shipyard of Philadelphia, but she was finally finished by the Boston Shipyard. She was commissioned on 08 June 1945. LING is 312 feet long and measures 27 feet at the beam. She displaces 2040 tons. When on active duty, she had a complement of 80 officers and men, and had an armament capacity of 24 torpedoes or 40 mines.

When pulling up to the museum it is hard not to see LING, but your eyes are quickly taken away by the large vintage missile collection on the Memorial lawn next to the monuments to the ships on eternal patrol. Many of these authentic missiles are of Korean War vintage which makes them a rare sight even to an avid museum buff.

The New Jersey Naval and Maritime Museum is proud to announce that the surviving members of the World War II destroyer escort USS MASON (DE 191) will be donating all remaining records, paperwork, and photos to be maintained on display to protect her place in history. USS MASON was the only ship with an almost all African-American crew. She had won several awards, but due to racism, she did not receive the recognition that she deserved until 50 years later from President Clinton.

The museum also has numerous artifacts, photos, miniatures, and memorabilia of submarine history. The new museum shall be greatly expanded to cover other naval elements such as surface warfare, naval air warfare, and special warfare. The museum shall also incorporate maritime history of New Jersey going back before the Dutch and the British settled this area.

People have asked why a naval museum in New Jersey? Most people don't think of the amount of shipping that comes into New Jersey from all over the globe. Many of the large shipping companies' headquarters are located right here. John Holland designed and built his submarines here in Paterson until he moved to Elizabethport and merged his company with the Electric Launch Company. This merger led to the creation of the General Dynamics Electric Boat Company, maker of today's modern nuclear attack subs.

The Electric Launch Company was famous for building the British over 500 liberty ships in only 488 days during the First

World War. Another little known fact is that the first use of a submarine was during the Revolutionary War here in New York harbor. Army Corporal Ezra Hull took off after the British warship EAGLE in September 1776 in an attempt to sink the ship. Just three months later in December General George Washington led his men in an historic crossing of the Delaware River into New Jersey to defeat the British at the Battle of Trenton.

USS BONEFISH (SS 582), the last diesel electric submarine built in the United States, was built in Camden, New Jersey in 1959. This was the end of an era in American submarine history. It is hard to believe, but submarine history started here, and an era ended in this great state.

Several German submarines were sunk right off this coast by the Coast Guard. German submarines would come to prowl around New York Harbor trying to stop shipping. Many of these U-boats used the Coney Island ferris wheel as a landmark before finding the harbor. The press kept this fact very quiet until now. In the spring, salvage operations are expected to learn more about the U-boat found off Sandy Hook.

The state also has several large defense contractors located here as well as some key naval installations. The Lakehurst Naval Air Station is noted not only for training naval air crews, but was the final stop for the great airship HINDENBURGH. Further up the shore is the Naval Station at Earle. This Naval Station is responsible for supplying the fleet as they leave for deployment.

This was one of the largest jumping off points for American forces going to fight in Europe during the First and Second World War. Millions left just steps away from where the new museum will be built. Just at the end of the pier from the museum is the original Boiler Technician School. It was this school that taught many of the young sailors how to operate the main plants of the famous ships of the Navy. Boilermen for many of the ships of President Teddy Roosevelt's Great White Fleet were trained here in Hoboken.

Part of the Great White Fleet was the original battleship NEW JERSEY which was built in 1904. She was the lead ship of a class of five (NEW JERSEY, VIRGINIA, GEORGIA, NEBRASKA, and RHODE ISLAND). She should not be mistaken for the famous battleship NEW JERSEY (BB 62) of later vintage. This NEW JERSEY was built in 1943 and is one of the last four dreadnoughts in the world. Currently, she is fighting a battle of survival. There are members of Congress that wish to re-commission her onto the active Navy roles for use in any littoral water situation, a group that wishes to bring her to New Jersey as a museum, and a group that wishes to see her and her sisters lay victim to the scrap dealer's cutting torch.

There have been several ships named after New Jersey cities or battles fought here in this state: USS PRINCETON (gunboat) (1896), USS PRINCETON (CV 37) (1945, redesignated LPH 5), USS PRINCETON (CG 56), USS TRENTON (1923), USS TRENTON (LPD 14) (1971), USS BARNEGAT (aircraft tender) (1938), USS BARNEGAT (AVP 10) (1941), and USS CAMDEN (sub tender) (1900), to name a few.

All of these famous ships and events shall have displays commemorating these milestones and more. Not only will there be static and interactive displays, but different types of nautical courses will be taught. Courses like small boat handling, naval model building, and canoe building are just examples of things that will be going on. Different organizations like Submarine Vets of World War II, or SubVets Inc. will have meetings here. The New Jersey Naval and Maritime Museum will be more than just a museum, it will be a place of excitement, learning, and interaction.

Ground breaking for the Waterfront Project and museum will be in the spring of 1996. All inquiries or ideas for displays are welcome. Donations or sponsorships are always appreciated. Please call or write the museum currently in Hackensack and ask for Ron Pellegrino for details or call (201) 328-3458. ■

BUILDINGS HONOR SUBMARINERS
Part II

by RADM M.H. Rindskopf, USN(Ret.)

[Editor's Note: Part I, covering buildings at U.S. Naval Submarine Base, New London, Connecticut and the U.S. Naval Academy, Annapolis, Maryland appeared in the January 1996 issue of THE SUBMARINE REVIEW.]

Submarine Training Facility, Norfolk, Virginia

Ramage Hall was dedicated in 1990 to serve as the Administrative Office of the Command. It contains engineering laboratories, training devices, and many classrooms.

It was named for Vice Admiral Lawson P. Ramage who was born in 1909 in Massachusetts, and graduated from the Naval Academy in the Class of 1931. After Submarine School in 1935, he served in S-29, and was on the staff of Commander Submarines Pacific on Pearl Harbor Day. He made the second war patrol of GRENADIER (SS 210), after which he commanded TROUT (SS 202) in which he sank 6,000 tons on four patrols. He commissioned PARCHE (SS 384), sinking four ships of 26,000 tons. He was awarded the Congressional Medal of Honor for his daring night surface action in PARCHE on 30 July 1944 against a convoy of 10 Japanese ships. Ramage fired 19 torpedoes during the melee, remaining on the bridge alone in the face of heavy enemy fire. After the war, he commanded Submarine Division 52 and Squadron 6, was Deputy Commander Submarines Atlantic Fleet, and retired in 1970 following a tour as Commander Military Sea Transport Service. He was also awarded two Navy Crosses, the Silver Star and Bronze Star and two Distinguished Service Medals. He died in 1990.

Miller Hall serves as the Fire Fighting and Damage Control Training Facility and was dedicated in 1991.

It was named for Lieutenant Commander Frank Bertram Miller, born in 1903, and enlisted at 15 in 1918. He was at sea in M-1 on Armistice Day in 1918, patrolling off the coast of France. He was serving in S-10 as a Chief Torpedoman when World War II broke out, but it was his other activity which brought him considerable fame.

His first exploit as a diver took place in 1925 when Miller assisted Captain Ernest J. King in the salvage of S-4, and later, S-51. As an instructor at Submarine School in 1931, he *saved* Vice Admiral Red Ramage's submarine career by interceding when he failed the escape training tank exercise. It is fitting that the Submarine Training Facility has honored both of these men. Miller retired as a CTM in 1938 but as a civilian working in the Naval Shipyard, Portsmouth, New Hampshire volunteered his services in the sinking of SQUALUS; and made many dives, first determining that there were 33 men alive, and later assisting in the operation of the McCann chamber which rescued the crew.

He was recalled to active duty in 1940, and as a Warrant Gunner dove on U-85 off the Virginia Coast—reporting that the U-boat could dive deeper than its U.S. counterparts. He later flew with the Air Force in Europe, was assigned to the Coast Guard in the Mediterranean, was sunk by a torpedo and endured five months as a prisoner of war.

He was awarded the Silver Star for his performance in the U-85 project. He retired again in 1946 as a Lieutenant Commander.

U.S. Naval Station, Norfolk, Virginia

Murphy Center is the Headquarters of the Navy Relief Society on the Naval Station. It was dedicated in 1976 in memory of Vice Admiral Vincent R. Murphy.

Admiral Murphy was born in Norfolk, Virginia in 1896 and graduated from the Naval Academy in 1917 as a member of the wartime Class of 1918. After tours in surface ships, he completed instruction in submarines on board FULTON (AS 1), and served in R-23 and O-11, commanding the latter from late 1920 until 1923. He was War Plans Officer on the staff of Commander-in-Chief, Pacific Fleet early in the war, after which he served his last tour at sea as Commanding Officer of ALABAMA (BB 60). He was physically retired in 1946, and promoted to Vice Admiral on the basis of his awards which included the Legion of Merit, the Navy and Marine Corps Medal and the Bronze Star Medal. He died in 1974.

U.S. Naval Base, Charleston, South Carolina

Kossler Hall is a Bachelor Enlisted Quarters dedicated in 1989 in memory of Rear Admiral Herman J. Kossler. He was born in

Virginia in 1911, graduated from the Naval Academy in 1934, and Submarine School in 1937. He served in ARGONAUT (SM 1) and NAUTILUS (SS 168) prior to World War II. During the war, he served as Executive Officer of GUARDFISH (SS 217) for four patrols, and commanded CAVALLA (SS 244) on six patrols, sinking over 34,000 tons, including the carrier SHOKAKU on his first. He commanded a submarine division and squadron. His last tour was as Commander Sixth Naval District in Charleston, from which he retired in 1973. He was awarded the Navy Cross, three Silver Stars, and two Legions of Merit. CAVALLA and GUARDFISH each earned one Presidential Unit Citation. For his support of the public sector in Charleston, he received the Outstanding Citizen Award in 1970. Rear Admiral Kossler died in 1988.

U.S. Naval Submarine Base, Kings Bay, Georgia

Raborn Hall serves as the Submarine Training Facility for the Kings Bay complex.

It was named for Vice Admiral William F. Raborn, born in Texas in 1905, and graduated from the Naval Academy in 1928. He earned his wings in 1934 and enjoyed a highly successful career both in the air and at sea in carriers. He has been honored by the Submarine Force and Kings Bay for his outstanding performance as Commander of the Strategic Systems Project Office from its inception in 1955 until 1960. He put GEORGE WASHINGTON (SSBN 598) to sea with the Polaris missile in less than five years, assuring the Navy a secure role in strategic warfare. He retired as Deputy Chief of Naval Operations for Development in 1963. He was Director of Central Intelligence in 1965-66. He was awarded the Distinguished Service Medal and the Bronze Star, and the SSPO a Presidential Unit Citation. He died in March 1990.

U.S. Naval Submarine Base, San Diego, California

Bishop Hall is a Bachelor Enlisted Quarters dedicated in June 1970 in memory of Chief Torpedoman's Mate Walter W. Bishop. He was Chief of the Boat in SCORPION (SSN 589) when she was declared lost at sea on 6 June 1968.

Kain Hall is a Bachelor Enlisted Quarters complex of five buildings, dedicated in September 1981 in memory of Senior Chief Engineman/DV Robert E. Kain. He was the leading engineman in BONEFISH (SS 582) and was swept overboard and drowned in the South China Sea on 3 March 1981.

Jones Hall is a Bachelor Enlisted Quarters dedicated in December 1988 in memory of Chief Quartermaster Sidney W. Jones. He was Assistant Navigator in TANG (SS 306) on her fifth war patrol off Formosa when she was struck by her last torpedo and sunk on 24 October 1944. Jones was the most decorated Petty Officer of the most decorated submarine in World War II, having been awarded two Silver Stars and one Bronze Star Medal, in addition to the two Presidential Unit Citations bestowed upon TANG.

Harvey Hall is a Bachelor Officers Quarters, containing a wardroom and patio, with a fine view of San Diego harbor entrance. It was dedicated in September 1970 in memory of Lieutenant Commander John Wesley Harvey, born in New York in 1927, graduated from the Naval Academy in 1950, and from Submarine School in 1952. He served in SEA ROBIN (SS 407), NAUTILUS (SSN 571) on her trip beneath the North Pole, TULLIBEE (SSN 597), as Executive Officer of SEADRAGON (SSN 584), and Commanding Officer of THRESHER (SSN 593). Wes Harvey was lost on 10 April 1963 in the sinking of THRESHER off Portsmouth, New Hampshire, during sea trials following installation of a new weapons systems. THRESHER was awarded the Presidential Unit Citation under his command.

O'Kane Hall is the Submarine Training Facility, equipped with thoroughly modern training devices and simulators for both basic submarine operations and fire control training.

It was named for Rear Admiral Richard H. O'Kane, born in New Hampshire in 1911, graduated from the Naval Academy in 1934, and from Submarine School in 1938. He was ordered to ARGONAUT (SM 1), from Submarine School and was still serving in her when World War II began. In March of 1942, he was ordered to WAHOO (SS 238) as Executive Officer under Lieutenant Commander D.W. (Mush) Morton until mid 1943, when he fitted out TANG (SS 306) as Commanding Officer. TANG made five highly successful patrols under Dick O'Kane, sinking 24 ships totalling 94,000 tons. One her fifth patrol, a circular run of her last torpedo sank the ship. Only nine men were rescued of which O'Kane was one. They spent the rest of the war in Japanese prison camps. O'Kane was awarded the Congressional Medal of Honor, three Navy Crosses, Four Silver Stars, and the Legion of Merit. TANG was awarded two Presidential Unit Citations. Subsequent to the war, O'Kane commanded Submarine Division 32, the Submarine School, and SPERRY (AS 12). He retired as a Rear Admiral in 1957 and died in 1994.

Williams Building is the Submarine Extended Cycle/Selected Restricted Availability Training Building, located on the pier of the Submarine Base. It provides a major capability to San Diego-based submarines which would otherwise have to move to a shipyard for certain repairs.

It was named for Admiral John G. Williams, born in Oregon in 1924, graduated from the Naval Academy in 1946 as a member of the Class of 1947, and from Submarine School in 1949. He served in POMPODON (SS 486), CHIVO (22 341), and STICKLEBACK (SS 415). He was Commanding Officer of STERLET (SS 392), HADDO (SSN 604) and DANIEL WEBSTER (SSBN 626), and the squadron at Rota, Spain. His last tour of duty was as Chief of Navy Material. He was awarded the Distinguished Service Medal, the Legion of Merit, the Navy Commendation Medal and the Meritorious Service Medal. He retired in 1983 and died in 1991.

Naval Ship Weapon Systems Engineering Station, Port Hueneme, California

Reich Hall is the Station's Engineering On-Site Facility which houses electronic simulation of combat systems and many of the equipments and system elements of the programs for which the Station is responsible.

It was named in honor of Vice Admiral Eli T. Reich, born in New York in 1913, graduated from the Naval Academy in 1935, and from Submarine School in 1939. After a short tour in R-14, he commissioned SEALION (SS 195) in late 1939, and served as Executive Officer until the ship was severely damaged alongside the pier at Cavite in the Philippines on 8 December 1941, and was scuttled. He escaped Corregidor in STINGRAY (SS 186) and remained on board as Engineer and Executive Officer until late 1943 when he was ordered to commission SEALION II (SS 315) as Commanding Officer.

In three patrols in 1944, SEALION sank over 60,000 tons. Reich was the only commanding officer to sink a battleship (KONGO) unassisted. He also rescued 54 British and Australian prisoners of war who had spent several days in rafts off Formosa when their ship RAYUKO MARU was sunk by the wolfpack of which SEALION was a part. After the war, he commanded Submarine Division 100 and Submarine Squadron 8.

From 1962 to 1965, he was Commander of the Surface Missile System Project which was key to the development of the 3-T missile systems. He was Deputy Comptroller of the Navy and Assistant Secretary of Defense for Product Engineering and Material Acquisition. He retired in 1973.

He was awarded three Navy Crosses and the Presidential Unit Citation for his exploits in SEALION; the Legion of Merit and the Army Distinguished Unit Badge for other submarine service; a Bronze Star Medal for ASW duty in Southeast Asia in 1966; and two Distinguished Service Medals for his missile and comptroller duties. He lives in the Washington, DC area, and has been the leader in the establishment of the Naval Undersea Museum in Keyport, Washington for the past several years.

<u>Mare Island Naval Shipyard, Vallejo, California</u>

<u>Wilderman Hall</u> was named in memory of Commander Alvin L. Wilderman, born in Illinois in 1937, a 1959 graduate of the Naval Academy and a 1961 graduate of Submarine School. Commander Wilderman was washed overboard from the bridge of PLUNGER (SSN 595) on 1 December 1973 outside Golden Gate while the ship was enroute to routine post-overhaul sea trials. In spite of an intensive search by air and sea, his body was never recovered. He had cleared the bridge of all other personnel when the ship encountered extremely heavy seas and no one else was lost. He was awarded the Meritorious Service Medal posthumously. Commander Wilderman previously served in VON STEUBEN (SSBN 632), WOODROW WILSON (SSBN 624), and as Executive Officer of PARGO (SSN 650), before assuming command of PLUNGER. Wilderman Hall was dedicated in 1983. It was built as a Nurses Quarters at the U.S. Naval Hospital in 1939, converted to Bachelor Officers Quarters in 1976 and modernized in 1983.

<u>U.S. Naval Submarine Base, Pearl Harbor, Hawaii</u>

Nine enlisted barracks, the Enlisted Club, and an athletic field on the Submarine Base have been named for submarine personnel who performed their duties in exemplary fashion. All were awarded decorations, ranging from the Navy Cross to the Navy Commendation Medal. Seven of the 11 so honored lost their lives in action or in line of duty.

Andriolo Hall was named in memory of Radioman Second Class Charles Andriolo who was awarded the Navy Commendation Medal for outstanding service in TANG (SS 306) on her third war patrol during which 39,000 tons of enemy shipping were sunk. Petty Officer Andriolo was subsequently lost in action during TANG's fifth war patrol in the Formosa Strait.

Dalwitz Hall was named in honor of Machinist's Mate Second Class Wilbert Dalwitz who was awarded the Navy Cross for extraordinary heroism during the third war patrol of SCAMP (SS 277). During a heavy depth charging on 18 September 1943, a hull fitting carried away allowing a large stream of water under great pressure to enter the ship. Petty Officer Dalwitz threw himself against the stream of water through a superhuman effort and reached the valve which would stop the flow. He finally managed to shut the valve preventing serious flooding and possible loss of SCAMP and her crew. He died in the 1980s.

Freaner Hall was named in honor of Chief Torpedoman's Mate Eugene Freaner who was awarded the Silver Star Medal for conspicuous gallantry while serving as Chief of the Boat in BONEFISH (SS 220) during her third war patrol in the South China Sea. During repeated attacks against vital enemy military and naval forces while under constant enemy depth charges, bombing and shelling, Chief Freaner rendered invaluable services in contributing to the sinking of 21,000 tons of hostile shipping and to the infliction of serious damage upon 19,000 additional tons.

Paquet Hall was dedicated to the memory of Gunner's Mate First Class Feeman Paquet, Jr. who was awarded the Navy Cross for extraordinary heroism during the fourth war patrol of HARDER (SS 257). Petty Officer Paquet was instrumental in the rescue of a downed naval aviator from an enemy held island while under intense small arms fire. He was still serving in HARDER during her sixth patrol when she was lost in action in the South China Sea as a result of an enemy depth charge attack.

Robertson Hall was named in memory of Motor Machinist's

Mate Third Class George Robertson who was awarded the Navy Commendation Medal for outstanding performance of duty in TANG (SS 306) during her third war patrol in which she sank 39,000 tons of enemy shipping. Petty Officer Robertson was subsequently lost in action during TANG's fifth war patrol in the Formosa Strait.

Thomason Hall was named in honor of Chief Commissary Steward W. Thomason who was awarded the Navy Cross for extraordinary heroism during the fourth war patrol of HARDER (SS 257). Chief Thomason volunteered to lead a team from HARDER to an enemy held island to rescue a naval aviator whose plane had been shot down. Although fully aware that unforeseen circumstances might result in the forced abandonment of the entire party, Chief Thomason courageously fought his way through the surf despite dangerous hostile sniper fire and, locating the exhausted aviator, succeeded in bringing him back to HARDER.

White Hall was named in memory of Gunner's Mate First Class James White who was awarded the Bronze Star Medal for meritorious service as gun captain in TANG (SS 306) during a war patrol in enemy waters. Petty Officer White steadfastly manned his battle station throughout numerous attacks against enemy shipping, contributing to TANG's success in avoiding intense enemy countermeasures and in completing an extremely hazardous mission. Petty Officer White was subsequently lost in action during TANG's fifth war patrol in the Formosa Strait.

Zelina Hall was named in honor of Chief Torpedoman's Mate George Zelina who was awarded the Silver Star Medal for conspicuous gallantry while serving as leading torpedoman in NARWHAL (SS 167) during her first war patrol in the Wake Island area during which 12,000 tons of enemy shipping were sunk.

Smallwood Hall was named in memory of Engineman Third Class James E. Smallwood who was awarded the Navy and Marine Corps Medal posthumously. He was supervising the charging of the oxygen system on board SARGO (SSN 583) alongside a Submarine Base pier in June 1960 when a violent explosion and raging fire engulfed the charging compartment. His adherence to safety precautions prevented additional loss of life and saved the ship from catastrophic damage.

Beeman Center is the Enlisted Club and was named in memory of Chief Pharmacist's Mate Arthur C. Beeman who was awarded the Bronze Star Medal posthumously. Beeman lost his life instantly when struck by machine gun fire on the bridge of AMBERJACK (SS 219) on her third war patrol in the Southwest Pacific in February 1943. Beeman had gone topside to aid an officer injured earlier by the same gunfire. AMBERJACK was lost in the encounter.

Gabrunas Field was named in memory of Chief Motor Machinist's Mate Philip J. Gabrunas who was awarded the Silver Star Medal posthumously. He was lost on 19 November 1943 when SCULPIN (SS 191) was scuttled on her ninth war patrol after suffering severe depth charge damage. He volunteered to assist in the scuttling and went down with the ship along with Captain John P. Cromwell and ten others.

Millican Field was named in memory of Commander William J. Millican. He was born in New York in 1904, graduated from the Naval Academy in 1928, and the Submarine School in 1932. He served in S-10, S-29, and was Commanding Officer of S-18 prior to the war. He made four war patrols in command of THRESHER (SS 200) in 1942-43, sinking five ships of more than 21,000 tons. He commissioned ESCOLAR (SS 294) in June 1944 and was lost on her first patrol in October 1944 in a wolfpack with PERCH (SS 313) and CROAKER (SS 246) in the East China Sea, probably to enemy mines.

Grenfell Pool is the all-hands pool named in honor of Vice Admiral Elton W. Grenfell who was Commander Submarines Pacific Fleet in 1956 to 1959 and Commander Submarines Atlantic Fleet from 1960 to 1964, the only officer so posted to that date. His biography appears under the Submarine Base/Submarine School, New London, Connecticut.

Cromwell Pool is the Enlisted pool named in memory of Captain John P. Cromwell whose biography appears under the Submarine Base/Submarine School, New London, Connecticut.

Lockwood Hall serves as the Officer's Quarters and Club. It was named for Vice Admiral Charles A. Lockwood who was born in Virginia in 1890, and graduated from the Naval Academy in the Class of 1912. After two years in battleships, he was sent to the Asiatic Station where he spent time under instruction in submarines on board MOHICAN, a steamship launched in 1873, which supported submarines but was never classified as a tender. In rapid succession, he was Commanding Officer of A-2, B-1, G-1, N-5, the German NC-97, R-25, S-14, and in 1926 commissioned

BONITA (SS 165). Thereafter, he was Commander Submarine Division 13 and Chief of Staff to Commander Submarine Force U.S. Fleet (which became the Submarine Force Scouting Fleet in 1939). Early in World War II, he was Commander Submarines Southwest Pacific where he was the driving force behind the resolution of the Torpedo Mark XIV fiasco. He was Commander Submarine Force Pacific Fleet from February 1943 until December 1945, and credited with the grand strategy which brought the Japanese to their knees. He was promoted to Rear Admiral in October 1942 and to Vice Admiral in October 1943. He retired after a tour as Navy Inspector General in September 1947. He was awarded three Distinguished Service Medals, the Legion of Merit, and Dutch and British Medals. He died in 1967.

Three submariners have been honored by the naming of spaces within buildings, one of which was named for a submariner.

U.S. Naval Shipyard, Portsmouth, New Hampshire

John H. Billings Conference Room in Planning Building was named in memory of Lieutenant Commanding John H. Billings, born in Jamaica, New York in 1928, graduated from the Naval Academy in 1950, and from Submarine School in 1952. He served in BUGARA (SS 331) and BONITA (SS 552), after which he received a doctorate in applied mathematics. He was assigned to the Planning and Estimating Department of the Portsmouth Shipyard and was lost in the sinking of THRESHER (SS 593) on 10 April 1963.

U.S. Naval Academy, Annapolis, Maryland

John F. Laboon Chaplain Center was dedicated in 1993 in memory of Captain John F. Laboon. He was born in Pennsylvania in 1921, graduated from the Naval Academy in 1943 as a member of the Class of 1944, and Submarine School in late 1943. He completed five war patrols in PETO (SS 265), the only submarine in which he served. He later decommissioned the ship. He resigned in 1946 and spent the next 10 years studying for the Jesuit priesthood. He was recalled to active duty in 1957 as a Reserve Chaplain, was the first Chaplain to work with Polaris submarines while on the Staff of Commander Submarines Atlantic

Fleet, and was augmented into the regular Navy in 1966. He served with the Marines in Vietnam in 1969 and 1970, and retired in 1980. Jake was awarded the Silver Star for the rescue of a downed aviator while in PETO, and the Legion of Merit for his duty with the Marines. He died in 1988.

Submarine Training Facility , Norfolk, Virginia

Frank Allcorn Theater in Ramage Hall, the auditorium in Ramage Hall, was named in honor of Captain Frank W. Allcorn, III, USNR who served as Torpedo Officer of PARCHE (SS 384) for two war patrols in 1943-1944 during which she sank nine enemy ships of over 64,000 tons. It was Lieutenant Allcorn's exceptional performance in training his torpedo crews which enabled Commander Lawson P. Ramage to fire 19 torpedoes in an intense 46 minute action under heavy enemy gunfire. PARCHE sank four ships and damaged one with 15 hits. Lieutenant Allcorn was awarded the Silver Star for his service in PARCHE.

■

*** IN MEMORIAM ***

CAPT James Gold Andrews, USN(Ret.)
CAPT Joseph F. Heald, USN(Ret.)
CDR Jim Holian, USN(Ret.)
RADM C.O. Triebel, USN(Ret.)
CAPT Robert K.R. Worthington, USN(Ret.)

REUNIONS

USS CARP (SS 338) - Norfolk, Virginia, July 26-28, 1996. Contact: Mike Hemming, P.O. Box 743, Easton, MD 21601-0743. Phone: (410) 822-1320, (410) 822-6202 (fax).

USS THOMAS A. EDISON (SSBN 610) - Kissimmee, Florida, May 10-12, 1996. Contact: C. Frank Wreath, 1117 South Florida Avenue, Tarpon Springs, FL 34689. Phone: (813) 937-8461, (813) 938-5867 (fax).

USS IREX (SS 482) - Milwaukee, Wisconsin, September 3, 1996. Contact: Ron Liles, 5254 E. Huntington Avenue, Fresno, CA 93727. Phone: (209) 251-3204.

USS POMPON (SSR 267) - North Charleston, South Carolina, June 21-23, 1996. Contact: John Lookabill, 2501 Bengal Road, North Charleston, SC 29406-9704. Phone: (803) 797-2991.

USS TECUMSEH (SSBN 628) - Portland, Oregon, August 21-25, 1996. Contact: John J. Flynn, 1040 Santana SE, Albuquerque, NM 87123. Phone: (800) 428-1036.

USS TRITON (SS4N/SSN 586) - Contact: Ralph Kennedy, 89 Laurelwood Road, Groton, CT 06340. Phone: (860) 445-6567.

USS WAHOO (SS 565) - Honolulu, Hawaii, February 17, 1997. Contact: Tom Young, 1 Pine Knoll Drive, Atkinson, NH 03811. Phone: (603) 362-5781.

DOLPHIN CALENDAR CARTOON CONTEST

The annual search for cartoons for the 1997 Dolphin C dar has begun! Each year 12 winning cartoons are ch to represent the 12 months of the following year. Sales of the calendars benefit the Dolphin Scholarship Foundation in its effort to assist children of all submariners, enlisted and officer, including those Navy personnel who have served in submarine support activities. The calendars have been a part of the Dolphin Scholarship fund-raising efforts since 1963. We currently award 100 college scholarships of $2250.00 per year for up to four years of undergraduate studies.

The rules for the cartoon contest are listed below. Most of us have laughed at the ridiculous and sublime in our lives. Now is the time to commit those experiences to paper and submit them (or find an artist friend who can help you express yourself!). The contest is open to submariners, submarine support activity personnel, their dependents, and friends.

1. A total of 12 drawings will be selected. $25.00 will awarded for each cartoon selected for use in the 1997 calendar.
2. Drawings are to be of a humorous nature depicting life in the Submarine Service.
3. All entries must be in black ink on white paper measuring 9 inches vertically and 11 inches horizontally.
4. All drawings become the property of the Dolphin Scholarship Foundation and are non-returnable.
5. All drawings must be accompanied by the following information:
   a. Artist's name (dependents should also include sponsor's name)
   b. Rank/rate (dependents should use sponsor's)
   c. Duty station (dependents should use sponsor's)
   d. Social security number (dependents should use sponsor's)
   e. Mailing address (including phone number)
6. Send drawing to:

Kathy Lotring
Dolphin Scholarship Foundation
405 Dillingham Boulevard
Norfolk, VA 23511
Attn: 1997 Dolphin Calendar Cartoon Contest

7. Entries must be postmarked no later than May 31, 1996.

BATTLEGROUP EMPLOYMENT OF SUBMARINES

by CDR Kenneth A. Hart, USNR

Commander Hart is the Executive Officer of Battle Group Support Unit COMSUBLANT BGS 106. He qualified in LOS ANGELES, served as an instructor at S8G prototype, and was Engineer in KAMEHAMEHA. After leaving active duty he went to the Nuclear Regulatory Commission and is now Technical Coordinator for the Secretary to the Commission. He has been selected for Captain.

I am prompted to respond to an article appearing in the October 1995 issue of **THE SUBMARINE REVIEW** by Lieutenant Mike Dulas, USN, entitled The Battlegroup Commander's Most Unused Asset: The Submarine. The author states that

> ...examining the tactics used by today's battlegroup commanders, evidently they still do not understand the versatility of all assets at their ready. Specifically, it appears that battlegroup commanders do not understand the multi-mission capability of a submarine. This results in failure to use the submarine to its maximum effectiveness.

My observations over the last two years yield different conclusions which are most likely attributable to a different perspective.

Lieutenant Dulas is correct in bringing up the problems encountered by the potential for BLUE on BLUE engagements. This issue has been a nagging problem for many years and requires careful thought and planning to prevent. He also correctly identifies communications as a serious drawback to employment of submarine assets. Both issues have created a great deal of hesitation and reluctance on the part of battlegroup commanders to work with submarines, but I believe the evidence is clear that the Submarine Force has responded and addressed these difficulties to the point where current battlegroup commanders are very comfortable employing submarines in solving the battle problem. As usual, I have never known a submariner to shy away from a problem because it seemed difficult and these issues are no exception.

In the past, the employment of submarines by the battlegroup commander was met with reluctance because it often meant sacrificing the use of other assets to allow the submarine to conduct its mission. The solution to the BLUE on BLUE encounter was to separate the units by as much space as possible. As a result, the submarines were relegated to the periphery or only used when nothing else was available. Compounding the problem was poor and unreliable direct communications with the submarine.

Also, contributing to the hesitation of battlegroup commanders to use submarines was the lack of direct control of the submarines. If it became necessary to change the tasking, a frequent occurrence in a dynamic scenario in littoral waters, the battlegroup commander was required go through SUBLANT (Commander Submarine Force U.S. Atlantic Fleet) in order to get the tasking changed. While the battlegroups may have lacked full knowledge about the capabilities or employment strategies of submarines to solve their battle problems, that was not the primary reason for their lack of desire to use them. In the final analysis, the result was that true integrated operations involving submarines were simply too hard.

In order to bridge the gap, the knowledge of submarine-experienced officers was required on the battlegroup and DESRON staffs. SUBLANT has recognized that need and is detailing post-command submariners to the battlegroup staffs and submarine-qualified officers to the DESRON staffs. Also, a few years back, SUBLANT established three reserve units to establish a cadre of submarine experienced personnel to man the Submarine Element Coordinator (SEC) and Submarine Advisory Team (SAT) positions during battlegroup operations involving submarines. These reserve units have proven so effective that additional units are in the process of being stood up and SUBPAC (Commander Submarine Force U.S. Pacific Fleet) is implementing a similar program.

As a reserve submarine officer, in the past two years I have been to sea and served as SEC in several exercises with both the George Washington Battle Group (GWBG) and the Eisenhower Battle Group (IKEBG). In all cases, the battlegroup commanders made excellent decisions, effectively employing their submarine assets in numerous different missions. The battlegroup commander and the ASWC (Anti-Submarine Warfare Commander—soon to be renamed the Under Sea Warfare Commander (USWC) and more recently combined with the Surface Warfare Commander in the role of Sea Combat Commander (SCC)) very clearly understood the submarine capabilities and were well versed in how to employ assigned submarines. Not only did the battle staff recognize the submarine multi-mission capability, but they did not hesitate to shift the submarine mission as changing circumstances dictated. In fact, they were anxious to employ the submarine, often taxing the boats to their limits.

Some difficulties still exist, but with a properly manned and trained SAT and an experienced SEC, these problems can be effectively managed and controlled. The submarine becomes an integral part of the battlegroup, helping to solve the problem, and not a hinderance to the other assets trying to accomplish similar or supporting missions. I have seen it in action and it works. I admit that it is still a demanding job and problems abound, but with experienced personnel on my watch team, the difficulties were managed and the results were extraordinary.

To be effective, the strategy in establishing Joint Tactical Action Areas (JTAAs) and Submarine Action Areas (SAAs) must be well planned and clearly thought out. That strategy plays a significant role in resolving BLUE on BLUE encounters, a key piece of the waterspace management puzzle. SAAs should be based on local acoustic conditions, expected threats, and many other factors. Operating in the littoral, geographic constraints will surely play a role. Importantly, SAAs should be kept as small as practical consistent with the mission assigned and the duration until the next communication window and certainly no larger than can be searched in the time allowed.

Guidelines for establishing and using these areas are set forth in a classified publication and have been developed through many years of practice and coordination. As in most cases, the rules have been laid out for good reason, but have also been designed to permit the battlegroup commander a great deal of flexibility. In a dynamic situation, flexibility requires all players to understand the rules and to communicate often.

Communications are key. The submarine CO must be willing to communicate frequently in order to be a useful and valuable asset to the battlegroup commander. The use of BGIXS (Battle Group Information Exchange System) for coordination and control of the submarines is very effective and BGIXS II holds the promise of an even more reliable communications link with the submarine. This means the SEC/SAT must be ready to communicate with the submarines at any moment, providing them with the most current tactical information and instructions. Typically, the submarines that have been most effective in supporting battlegroup operations have been the ones that maintained frequent communications with the battlegroup. Even if tasked with a below layer search for the next four hours, a prudent submarine CO might consider reporting in after two hours with a negative contact report. The ASWC may have updated contact information to pass along or a change in the tactical situation may call for a change in mission. While methods exist to contact a submarine when it is not at communications depth, it may not always be practical and very little time is lost in a quick trip to periscope depth. There is certainly a trade-off in lost search time for a trip to periscope depth but if changes have occurred, it could save two more hours in a fruitless search. Certainly any contact on a hostile submarine should be reported immediately. Use of a slot buoy may be the best approach to avoid breaking contact. As always, the particular situation must dictate the CO's response and the best method to relay the information to the battlegroup.

In the last few paragraphs, Lieutenant Dulas notes the reluctance to hand off the submarine to control by the battlegroup. I have seen both tactical command and tactical control provided to the battlegroup commander, depending on the situation, and it has worked very well. I believe that, as more experience is gained by the battlegroups and their staffs, increasing amounts of control of submarines will be assigned to the battlegroups.

Lieutenant Dulas is also fully correct in acknowledging the commitment of SUBLANT in providing submarine expertise to the battlegroup commander as demonstrated in the establishment of three additional battlegroup support units in the submarine reserve program and the assignment of submarine officers to the battlegroup and DESRON staffs.

In his conclusion, Lieutenant Dulas states that "...warfare commanders and battlegroup commanders must realize and truly understand the robust multi-mission capability of the submarine". While I agree wholeheartedly with the statement, I would add that, in the cases I have observed, the battlegroup commander and the ASWC fully understood the various mission capabilities and were well versed in the employment of submarine assets.

Having said that, I also agree that more cross-deck training of officers is required at a more junior level with SWOS and SOAC (Surface Warfare Officers School and Submarine Officers Advanced Course--pre-department head courses for surface and submarine officers) being the logical point in a career progression to include some of that training. We should also include the air community as well as special operations and even the other services to provide an introduction to joint operations.

Lieutenant Dulas' second concluding remark is that "the battlegroup commander must surround himself with submariners during the tactical planning phase of a mission". While I'm certain the author did not mean to imply that submariners should be there to the exclusion of all others, he is correct in that experienced submarine officers must be integral players in the planning phase of a mission. I believe the assignment of a post-command submariner to the battlegroup staff will adequately meet this need.

Also, the battlegroup commander needs a proficient SEC/SAT to handle the details of waterspace management and prevention of mutual interference when operating with and controlling submarines. The submarine experienced personnel, trained by SUBLANT for the SEC/SAT role provides both SUBLANT and the battlegroup commander with a level of comfort when the submarines are being controlled by the battlegroup. While understanding the multi-mission capabilities, the battlegroup commander (and ASWC/USWC/SCC) do not have a thorough appreciation for the detailed problems and impacts being faced by the submarine in meeting those taskings. The SEC/SAT can provide that level of detail such that the battlegroup commander can knowledgeably assume control of submarine assets and make full use of that potential in a complex, multi-mission and multi-asset environment. ■


Newport News Shipbuilding
WE BUILD
MORE THAN SHIPS.
WE BUILD
PARTNERSHIPS.
TENNECO

YESTERDAY'S SILENT HEROES
GONE
BUT NEVER FORGOTTEN

by Noreen Wagers

It was a peaceful Saturday afternoon with a warm sea breeze blowing. The sun was beaming down on my shoulders, pleasantly warming my hair. I walked solemnly toward the brow to USS WOODROW WILSON, the nuclear submarine being deactivated in dry dock #1. There was no one in sight, only the standard noises of fans, blowers, and venting pipes.

As I neared the safety chain at the edge of the dry dock, my heart sank. The old sub was cut into two separate pieces from top to bottom, exposing her missile compartment. She was dissected, lifeless! Only a few years earlier we had given her a complete overhaul and refueling. In my mind I tried to recall if it was this particular sub or USS NARWHAL on which I had worked the most. Over the years, it's easy to lose track of just how many boats had passed through the yard and the amount of time spent on each one. Now, WOODROW WILSON was destined for the graveyard.

Slowly crossing the brow, I felt the solemnness of the yard. How could we—the most efficient shipyard—be closing? Yet how appropriate that our last two boats had completed their last patrols. As I approached the aft hatch to the engine room it was as if an old friend was beckoning me to come aboard. After negotiating the curved ladder and stepping onto the deck, I was greeted by the lone, roving watchstander. I toured my normal working areas as if searching for something but not really knowing what. Passing through the machinery spaces I remembered all the work, surveys, and times spent on station for various testing evolutions. Now the empty, quiet of the compartment was as if the sub know she was history. I reluctantly departed from the engine room, said good-bye to the rover, a farewell to the sub, and slowly headed toward the adjacent dry dock.

One of the first subs I had ever worked on occupied dry dock #2. USS GEORGE BANCROFT was there to have her missile tubes removed; the defueling operation had been completed in previous months. Walking toward the brow, I could see familiar work buildings—the condos—as they were affectionately known. In past years they had been bursting with activity. This day, the quietness of the yard was eerie. It appeared as though all the inhabitants had just disappeared; a ghost town.

Overhead, a small Cessna flew by. There were a few white clouds sprinkled around the beautiful blue horizon. The sun was beaming proudly as it does after a brief thunderstorm. The warming rays felt so relaxing as I approached the gangway.

Crossing the brow, I could see the canteen while nearby two large, blue cranes were looming motionless as if frozen in time. The harbor water was being churned softly by the warm, spring breeze. Glancing downward, the dry dock bottom was so empty without the usual equipment or staging strung about. It even appeared somewhat clean. How perfectly aligned the keel blocks were as if standing at attention, but no pleasure in the thought that these blocks would never be used again. No more even keel!

Stepping onto the sub, I noticed that inside the topside watch's shack, it was dark and deserted. The hatch leading to the sub's operations compartment appeared to be somewhat open. Further investigation proved it to be locked ajar with an old gas-free tag still attached. Moving aft, the engine room hatch was secured except for various leads and hoses routed through the small opening leading to below decks. No entry today. I was partially relieved, after remembering my last entry aboard her. Deactivated boats are torn apart and not a pretty sight.

Retreating from topside, I momentarily stopped to peer into the only exposed missile tube. It was as if it had purposely been left open for me. What a long way down; what destructive power had lurked inside these walls; what an ingenious idea to place missiles inside a moveable, hidden fortress!

The dimpled, solid black, topside hull appeared as a freshly paved asphalt road. It was rusty in places and dirty in others. Several pieces of equipment normal to ship work were laying adrift, but no more repair jobs or fresh paint were slated for this hull. How sad I thought, while walking away. My heart was breaking. How silly, After all, these were just old, worn-out submarines, machines, pieces of metal welded together. Not so! Each one had had its own life, history, and a story to tell if we would just open our eyes, ears, and our hearts.

Last year we were all saddened by the news of our shipyard closing. However, today, I realized that it was these boats that had made the yard special! We will greatly miss these mighty undersea marvels. After all, how many people report to work each day aboard submarines? How can one logically explain loving such a thing, a non-being? Well, I became attached to each and every one on which I had worked. Having seen one being torn apart was like saying so long to an old friend!

Stepping off the gangway, the sun was glaring in my eyes. The wind was effortlessly tossing my long hair about, partially blocking my view. I paused, then turned around for one last glance. My heart ached, my throat choked up, and I could feel tears welling in the corners of my eyes. I realized that she like so many others had done her duty; given many faithful years of service protecting our country while providing shelter and life support for her crews throughout her numerous patrols.

NOTE:

On a gloomy, fall afternoon destiny played her final hand with the farewell of these mighty submarines. A friend and I stood on the flight deck aboard the Carrier Museum YORKTOWN, anxiously awaiting them. I recalled events of that spring day when the boats were dry docked.

I thought about the bond which often occurred between the workers, the crews, and even with the submarines. Although shipyard workers were always left behind, this did not seem to diminish their feelings of pride and attachment associated with having worked these vessels.

I remembered how special it was to drive across the Cooper River Bridge and watch the submarines cruise in and out of the harbor. I wondered if the drivers on the bridge realized that history was being made; the last submarines completed by Charleston Naval Shipyard were being towed slowly through the harbor, out to sea, never to return.

A sadness came over me as they slithered graceful under the Cooper River Bridge one last time, marking the end of an era and the close of the final chapter of experiences and memories with these mighty undersea wonders. In my heart, I knew that I would never see them again nor be able to go—forward to aft—port to starboard—the sail to the bilges—topside to beneath the hull. Now they were a memory, gone forever, and greatly missed.

Can anyone understand my feelings for these *magnificent machines*? Machine—such a cold word to describe them. I wanted to tell this story for they and the brave crews of the *silent service* sailed the seas, performed their duty, and protected our freedom. For this, THEY SHOULD NOT BE FORGOTTEN!

WHEN THE CAPTAIN FOUND HIS MARBLES

by CAPT Dick Laning, USN(Ret.)

In 1958 the Russian success in Sputnik had raised a demand for U.S. spectaculars, and President Eisenhower had let it be known that he wanted advanced notice of any such to allow for proper exploitation. Bombers circumnavigated the earth, NAUTILUS and SKATE were involved in visiting the North Pole, and TRITON would circumnavigate the earth submerged.

USS SEAWOLF (SSN 575), the second nuclear powered submarine which I commanded, was very much like NAUTILUS except that its power plant used liquid sodium instead of high pressure water in the primary coolant loop. After a couple of years of fascinating operations she was approaching the end of first core life and we were preparing for one more major operation.

With the approach of the Polaris mission it was vital that we prove the ability of submarines to operate completely submerged (no contact with the atmosphere) for 60 days at a time. Engineering this capability had involved a process of discovery of one toxic gas after the other and the invention of ways to purify the atmosphere of its long term buildup of the contaminants. Our main support in this activity was Mr. Red Gates in BUSHIPS.

We could make the 60 day demonstration during a prolonged ASW exercise except that the long planned electrolytic oxygen generator was not yet available. I asked Red Gates if there weren't some other way to provide the 30 day supply of oxygen required to supplement the 30 day supply we had in compressed oxygen and in our compressed air banks.

In an amazingly short time, Red had let a contract and acquired the couple of thousand oxygen candles needed. These were cylindrical grains about 3 inches in diameter and 3 feet long in which a thermite reaction heated potassium perchlorate to generate oxygen in a pair of cylindrical ovens with internal ignition.

As I remember, we were due to leave our berth alongside the submarine tender USS FULTON on a Tuesday. Oxygen candles and gear arrived on the preceding Thursday. As soon as these were loaded we started test runs only to find that in addition to generating oxygen we were generating a trace of chlorine such that in about 20 hours the boat's atmosphere would be unacceptable.

A phone call to our stalwart bureau friend Red Gates must have been one of the most traumatic he had received; but he gamely said that he'd try for a solution. I said we'd also try from our end. Knowing that silver nitrate will *get* chlorine we calculated the quantity required and placed a tentative requisition with my classmate supply officer in the tender. Knowing a solution was feasible we decided to try for a cheaper solution when our chief hospitalman pointed out that while he had been with Marines in Korea, they sometimes added photographic Hypo to reduce excess chlorine in drinking water. We sent out immediately for some of the magic substance for a test, calculated the amount required; and turned to the design of a chemical reactor in which to purify the oxygen.

About this time an enraged supply officer arrived to report that our two hour old requisition would amount to all of the silver nitrate east of the Mississippi in 4 ounce bottles with air pickup from hundreds of points. He was much relieved when I sheepishly changed the need to a few hundred pounds of Hypo; proving that outrageousness is relative. We had the stuff late the next day.

The chemical reactor design included two vessels, each constructed of the tops of two 50 gallon plastic carboys used to contain sulfuric acid—chemically welded together and connected to in-and-out tygon tubing. The oxygen would be purified as it passed through the Hypo solution. When none of the local companies could supply the 1/4 inch plastic beads normally used to promote the gas-liquid mixture, I handed $10.00 to an auxiliaryman and told him to go the near town of Norwich and buy $10.00 worth of marbles. To allay any fears in the mind of the vendor that this massive purchase of marbles might be intended for purposes of some deleterious celebration, I sent with him a very official letter.

By now it was late Friday evening. I called Red Gates and went home to dinner. When I returned a couple of hours later, I noticed some mirthful glances in my direction and a file of giggling sailors peering into my cabin. On my bunk was an enormous pile of bagged marbles. My grinning Exec, Yogi Kaufman, explained that the whole crew was happy that I'd found my marbles!

Tests proved that the kluge worked. Red Gates was relieved. I whispered to the Force Commander, Rear Admiral *Fearless Freddy* Warder, whose WWII exploits had made the SEAWOLF name memorable, of our intent to set a new world record of 60 days out of touch with the atmosphere. He agreed it seemed a bit too shaky to alert the President about.

About five days before our return to port, we had set the record and I sent a message to that effect. We arrived to a huge quickly arranged welcome and world media coverage.

Then I heard that the President, who had visited SEAWOLF a few months before, had been enraged by the lack of notice.

He was mollified to hear the story about *The Captain's Finding His Marbles*. ■

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 content of articles is of first importance in their selection for the **REVIEW**. 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. Annually, three articles are selected for special recognition and an 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.

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

E-MAIL ADDRESSES

In the January 1996 issue of ***THE SUBMARINE REVIEW*** *the League issued an invitation for the members to send in their E-Mail addresses for listing in the next directory. The* ***REVIEW*** *will continue to run the notice throughout the year so all who wish to be listed can participate. We can be reached at* ***subleague@aol.-com****. The following is our first set of addresses from those who have responded so far:*

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In 1929, the Hamilton Standard Propeller Corporation, the largest manufacturer of airplane propellers in the world, became a part of United Aircraft Corporation which is now known as United Technologies Corporation (UTC). Hamilton Standard today is the most diversified division of UTC with product applications including submarines, aircraft and spacecraft. While the majority of Hamilton Standard products are found on commercial and military aircraft, the Space and Sea Systems (*S&SS*) department manufactures manned life support systems for customers ranging from the U.S. and British Navies, to NASA and international space programs.

S&SS was formed in 1964 as a spinoff from the aircraft environmental control system product line. The spacesuit, or by its NASA name, the Extravehicular Mobility Unit (EMU), is probably the best known *S&SS* product. The EMU was developed for the Apollo mission to the moon and has been continuously improved ever since. The EMU now flies on the space shuttle and will be used to construct the International Space Station. *S&SS* also manufactures the atmosphere revitalization system and several thermal control systems for the space shuttle and is developing similar equipment for the space station. Products manufactured or being developed for submarines include the Oxygen Generating Plant (OGP) for SEAWOLF, the Gas Management System (GMS) for Trident and SEAWOLF, oxygen generating electrolyzers for the British Navy, Electrolyte Chlorine Generators (ECG) for several U.S. Navy submarines, the Integrated Low Pressure Electrolyzer (ILPE) and Submarine Advanced Integrated Life Support System (SAILS) for the New Attack Submarine (NSSN).

The OGP was qualified for shipboard use in 1988 and installed on USS ALABAMA in 1989 for sea trials. The heart of the OGP is the SPE® electrolysis cell stack which generates high pressure oxygen (3000 psi) by electrolyzing water. The SPE electrolyzer uses a solid polymer electrolyte membrane which replaces the potassium hydroxide (KOH) electrolyte used on prior submarine life support systems. The solid polymer electrolyte membrane increases system operating life many times over the KOH based systems and provides increased safety and reliability. The OGP is now installed on SEAWOLF (SSN 21) which is scheduled to start sea trials early this year.

S&SS also provides SPE electrolyzers for the British submarine fleet. CJB Developments Limited integrates the electrolyzers into the submarine's life support system. All 43 electrolyzers delivered to date have operated flawlessly, some of which have been in the field for more than 10 years and have accumulated well over 20,000 hours of operation.

The GMS and ECG systems were developed and qualified for submarine use in the late 1980s. Since that time 20 GMSs and 15 ECGs have been manufactured and delivered for shipboard use. The functions of both of these systems are classified.

The ILPE is being developed for NSSN and represents a major improvement over the OGP and GMS. The key improvements include low pressure oxygen generation and reduced system volume. Generating oxygen at low pressure significantly reduces the cost and safety risk associated with handling high pressure oxygen. Also, eliminating high pressure oxygen components allows the ILPE, which integrates both OGP and GMS functions, to be packaged in a small volume with a footprint equivalent to an OGP alone. The use of a common electronic controller for the GMS and oxygen generating functions also contributes to the reduced packaging volume.

The SAILS systems is a further improvement to the ILPE and is being considered as an upgrade for later NSSNs. SAILS will integrate carbon dioxide reduction and removal and atmospheric contaminant removal along with gas management and oxygen generation functions. New innovative electrochemical processes are being developed for SAILS to precisely match the life support system functions to human metabolic rates which results in a zero gas discharge life support system. ■

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MORE ON FIDO

1 February 1996

Mr. Pelick's interesting article on FIDO (**THE SUBMARINE REVIEW**, January 1996, pp. 66-70) does an important service in bringing this intriguing and important weapon to the attention of the wide circle of **SUBMARINE REVIEW** readers. Other publications indicate that several organizations in addition to the Harvard Underwater Sound Laboratory were heavily involved in various aspects of the development of FIDO. In The History of Engineering and Science in the Bell System: National Service in War and Peace, 1925-1975 Murray Hill: BTL, 1978, p. 188, it says "A first meeting of the Navy, NRDC, General Electric Company, Harvard Underwater Sound Laboratory, and Bell Laboratories was held at Harvard on December 19, 1941. A second meeting was held at Bell Labs on December 24 [1941] to outline the general requirements...". And later on the same page "The General Electric Company took responsibility for the design of the propulsion and steering motors; the Navy's David Taylor Model Basin was authorized to give any assistance it could; and both Harvard and Bell Labs were asked to attack the overall problem with independent lines of approach but on a cooperative and information-sharing basis." Also on p. 188, "...in view of the urgency, Bell Labs was authorized in a letter of May 15, 1942, ..., to start a development program aimed at production". My conclusion, based primarily on the Bell System history, Mark Gardner's paper Mine Mk 24: World War II Acoustic Torpedo, GE Review Undersea Thunder: Torpedoes with Brains and Vol. 22, Acoustic Torpedoes, of the NDRC Division 6 Summary Technical Report, is that:

> Bell Labs was what we would today call the systems engineer for FIDO and also developed the control system that was used in the production model, the structure for FIDO and various smaller items. Western Electric (the Bell Labs parent organization) produced FIDO with major support as indicated in the following material. GE developed the propulsion and servo motors and apparently produced the complete afterbody. GE may also have developed components for the hydrostatic depth control.

The very important propeller was designed very quickly by David Taylor Model Basin. The storage batteries were developed and produced by Electric Storage Battery Company under sub-contracts first to Bell Labs and later to Western Electric. The Harvard laboratory (HUSL) was involved in FIDO self noise measurement and performance testing. They also developed a passive homing system using magnetostrictive transducers in the nose of the torpedo that was otherwise quite similar to the Bell Labs system. This system was apparently used in an early small batch, 40-50, of FIDO's produced under the aegis of HUSL. (Their most important contributions were in active homing.) The Columbia University Underwater Sound Laboratory provided assistance with development testing at New London. Other subcontractors were also involved in the manufacture of relatively conventional components.

FIDO was a fantastic weapon, which sank its first victim in May 1943 just 17 months after the earliest possible start date for the project, on December 10, 1941. Collaboration among all parties appears to have been outstanding and there are many interesting anecdotes about the project and the personalities involved.

FIDO's operational success was even more impressive than a casual look at the figures cited by Mr. Pelick indicates. Of the 68 submarines sunk by FIDO five have been identified as Japanese. The remaining 63 were all, to the best of my knowledge, U-boats. FIDO was not useful in attacking submarines in the presence of surface vessels; their propeller noise was distracting. Thus the evaluation of FIDO should look at sinkings by FIDO as a percentage of the 221 sinkings by aircraft alone, ie., without the assistance of surface vessels (other than CVs or CVEs serving as platforms for the aircraft), from May 1943 when the weapon was first used through VE Day. FIDO thus sank an astonishing 28 percent of the U-boats sunk by aircraft alone during the period it was operational in the Atlantic. FIDO was, in fact, so effective that the order for 10,000 was, as indicated by Mr. Pelick, cut back to 4000, perhaps not a success in the eyes of the accountants. The Mk 24 torpedo went thought several Mods and remained in service until it was replaced by the Mk 34, a larger improved Mk 24, around 1948.

Frederick J. Milford

EVEN MORE ON FIDO

11 February 1996

The article FIDO—The First U.S. Homing Torpedo in the January 1996 issue of **THE SUBMARINE REVIEW** was incorrect when it stated that the FIDO's mission upon entering the water "was to enter a preset passive circle search and home in on the submarine propeller noise..."

Rather, when dropped into the water from an aircraft the FIDO dived to a pre-determined depth and began an acoustic search for the submarine without a particular pre-set pattern. (The torpedo's effective detection range was approximately 1,500 yards.) Only if no propeller sounds were detected would the torpedo initiate a circular search, which it could maintain for 10 to 15 minutes.

Most FIDO runs were much shorter; on one occasion, in an attack against the U-1107, a FIDO entered the water only 80 yards from the submarine but ran for three minutes before striking the undersea craft. Apparently the FIDO had not initially detected the submarine and had gone into a circular search pattern before finding its target. These watery meanderings led to FIDO being called *Wandering Annie* by many Allied pilots.

The FIDO did have a very high success rate for an anti-submarine weapon. Allied aircraft using depth charges against U-boats achieved a 9.5 percent kill rate compared to 22 percent for FIDO torpedoes. However, FIDOs sank only 68 U-boats—less than ten percent of the U-boats lost in the war, certainly not a major factor in the ASW war.

Also of possible interest, the FIDO was officially designated a mine, not a torpedo, in an attempt to disguise the weapon's true configuration. Apparently the German U-boat command did not learn of the existence of the FIDO until after the war.

Yours sincerely,
Norman Polmar

A TEST ON THINKING OUTSIDE THE BOX

When I opened the January issue of **THE SUBMARINE REVIEW** and read the title of General Downing's article Thinking Outside the Box it reminded me of the visual training aid to help a person remember to *think outside the box*. You are welcome to use it if you believe your readers would find it of interest.

Draw four straight lines connecting all nine dots in the following sketch without lifting your pencil from the paper.

Best Wishes,

William A. Whitman, Captain, USN(Ret.)
9815 21st Ave. N.W.
Seattle, WA 98117-2420
(206) 728-8278

P.S. Solution on page 132.

THE PAINE BIBLIOGRAPHY

February 12, 1996

Your January 1996 publication arrived about two weeks ago. Page 104 of that issue discusses submarine writing and bibliography. I am very interested in learning what The Submarine Registry and Bibliography by Thomas O. Paine is. It is entirely unknown to me, despite years of collecting of submarine books.

To save the trouble of writing you all, I checked Books in Print for the last few years, in vain. Nor is that title on the OCLC system at my local library, or in any of their indexes to periodical literature. From this I conclude that Mr. Paine's product is not a book at all (and thus should not be underlined if not published). Is it some sort of unpublished compilation to which you all have access? Is it a forthcoming book? What can you tell me about it? I very much want a copy of it if it really is a systematic listing of published submarine literature. Perhaps an earlier number of your journal addressed this subject, but as a relatively new member I have not seen all the back issues.

With Thanks,
Robert E.L. Krick

RESPONSE TO MR. KRICK'S QUESTION

To address the last part of your request for information first, The Submarine Registry and Bibliography by Thomas O. Paine was reviewed in this magazine for the January 1994 issue by Commander John Alden. To clear up some of the difficulty in locating the book, however, it has to be noted that the 1992 edition was published privately by Thomas Paine Associates of Santa Monica, California, therefore it is held by very few libraries and is not listed in many standard references.

It is really an amazing compendium of submarine literature comprised of an annotated bibliography covering some six thousand books and articles—plus—a registry of eight thousand submarines of fifty countries, and, it is all cross-indexed. The book is large sized and has 828 pages. The first part is the Registry, which in itself is an excellent reference resource. For each nation all submarines built for that navy are listed, with an index citing every reference in the bibliography to each submarine. Section Two is an annotated Author Index, and the third part lists the same references but alphabetically by Title rather than by Author.

Dr. Paine died in May of 1992 just after the book was published and both the rights to The Submarine Registry and Bibliography and Dr. Paine's personal library of over three thousand submarine books have passed to the Thomas O. Paine Foundation. Final arrangements currently are being made to transfer the books to the Nimitz Library at the Naval Academy as a special collection. Several copies of the 1992 publication will be included.

Considering all that has been published in the past few years, and all the information which has become available since 1992, the Foundation intends to update the data base and the Naval Institute has agreed to publish the revised issue in a CD-ROM version.

Editor

NAVAL SUBMARINE LEAGUE
TASK FORCE FOR FUTURE DIRECTION

The League's Executive Committee directed that a special task force be established to investigate the subject of future League direction from which to make recommendations to the Board of Directors. This task force (for Future League Direction) is to function as the League's Planning Committee but with more urgency and no permanence. The Chairman is to be Captain John Shilling, the League's Membership Chairman.

Purpose

To examine all aspects of the Naval Submarine League to determine if its existing goals, mission, structure, and procedures are relevant and supportive of the needs of the present League and the future Submarine Force.

Background

The NSL has been an effective and vocal organization over the past years in supporting the needs of our Submarine Force. Our membership, 3900 members in 11 chapters, has leveled off over the past three years. The ratio of non-active duty to active duty members is 3.5 to 1.

Since the NSL was founded in 1984 there have been major changes in submarine roles and missions that have resulted in the Submarine Force experiencing today, something which those of us who served as few as five years ago never experienced—a rapidly shrinking force. Competition for dollars has strained the Navy's efforts to develop new technologies and ships that will ensure the continued supremacy of the United States Submarine Force. Every year the Submarine Force faces a "do or die" budget battle within and without the Navy. Now, more than ever before, there is a need to increase public awareness of the incredible capability of our submarines and the people who man them in order to generate the support that translates to continued investment in the Submarine Force.

The NSL must continue to critically support the direction chosen by the Submarine Force leadership in its efforts to evolve the health and well-being of the Submarine Force. Our record in this area has been excellent and appreciated by the Force leadership.

Discussion

There are some who believe that there is more that the League could do to aid and abet the mission of the Submarine Force by improving and increasing our support to the active Force. Our previous efforts in this area have fallen short in terms of having a significant impact on our active duty submariners. Unlike our well planned and coordinated national campaigns to save the Seawolf and the NSSN, no similar integrated and well planned effort to improve our support of the active duty people has been obvious.

Our chapters have tried with varying degrees of success to develop stronger ties to the active duty submariners located in their regions. For the most part, each has acted autonomously in this endeavor as well as in their quest for more success in recruitment and retention of members.

Action

The development of a vision of the NSL's role in a changing world appears to be essential as we enter the 21st century. This vision should integrate the things we do best today with a realistic assessment of what changes might be needed to ensure our viability and worth in the out years. Given this broad charter, there are some fundamental high level questions that underlie the Task Force Assessment:

- Are the existing Objectives of the League still valid?
- Is the League's level of support for the active Force adequate?
- Does the role of the chapters require a sharper definition that might lead to a stronger relationship to the whole of the Naval Submarine League?
- Can the role of headquarters be improved, changed, or modified to more effectively assist the chapters?
- Are our members being utilized to the maximum extent possible in the pursuit of our goals?

There exists a considerable volume of suggestions and recommendations by a number of our members concerning ways to improve the NSL both in support of its members and in support of the Submarine Force. This material, as well as new ideas, will provide the basis for the Task Force Assessment. It is important to understand that the role of the Task Force will be to initially establish a high level framework within which more detailed actions and changes can be implemented. The goal must be to establish an overall process that will by its very nature attract the interest of individuals and groups to want to join in supporting submarine warfare.

<u>Implementation</u>

- The Task Force, chaired by Captain John Shilling, will consist of about 12 invited members from the active and retired Submarine Force community.
- A milestone plan will be developed for the Task Force activities.
- Consideration of geographic constraints will place strong emphasis on phone and fax communications for this effort, although some meetings will be required.

<u>Membership</u>

Rear Admiral Hank McKinney
Rear Admiral Larry Vogt
Captain Jim Collins
Captain Jim Hay
Captain Denver McCune
Captain George Newton
Captain Jack Renard
Captain Jim Patton
Captain Jay Donnelly
BuPers Representative
NavSea Representative
Captain John Will (ex-fficio)

PACIFIC TURNING POINT: THE SOLOMONS CAMPAIGN OF 1942-1943

by Charles W. Koburger, Jr.
Praeger Publishers
88 Post Road West, Wesport, CT 06881
ISBN 0-275-92536-3

Reviewed by CAPT W.J. Ruhe, USN(Ret.)

As a summary of the Solomons Campaign of 1942-1943, this is a useful book. The references Koburger employs are also impressive. And the author's premise that the Battle of Guadalcanal from 11 November to 15 November was the turning point in the Pacific War is possibly a good one. But why this is so is never satisfactorily explained, although Koburger says that in this battle, Admiral Yamamoto missed his last chance to win the Mahanian *decisive fleet battle*—by failing to commit more than a part of his available fleet.

Why Koburger's confusion? Having read many of the references used by Koburger, it must be assumed that he believed them implicitly and didn't detect the basic flaw in their rationale of why the U.S., having thoroughly wargamed Plan Orange before the war—a thrust across the northern Central Pacific to relieve the (captured) Philippines with a defeat of the Japanese fleet along the way—failed to effect this U.S. grand strategy for winning the war. What is not recognized, particularly by Koburger, is that the U.S. got side-tracked into first trying to gain control of the Solomons.

It seems evident that General MacArthur threw a monkey wrench into the single, pre-war U.S. grand strategy, by getting President Roosevelt's go-ahead for MacArthur's *"I shall return"* (to the Philippines) strategy. The U.S. was thus stuck with a dual grand strategy with MacArthur's needs to control eastern New Guinea and Guadalcanal coming first—to insure a return to the Philippines via New Guinea, the Admiralties, and the Carolines (Palau). But the Japanese were even more discomfited by having their grand strategy for winning the war thrown off the track with MacArthur's arrival in northeast Australia in March of 1942. The Japanese timetable for seizing Papua and solidifying the lower Solomons as part of their outer perimeter defense for protecting the Southeast Asia Co-Prosperity sphere—seized at the start of the war—was thrown out of whack.

Moreover, Koburger confuses and obfuscates his arguments by adding a second premise that it was amphibious warfare (which he says had to be learned by the U.S. Navy) that created *the turning point*, rather than *fast carrier* war. In developing his amphibious warfare or *expeditionary* war premise, the author says that "submarines contributed little to the Solomons Campaign". This statement is made despite his notations that: U.S. submarines were used to blockade Rabaul and CincPac assigned five fleet boats for patrols off Truk; the S 38, patrolling at the bottom of St. George's Channel on 7 'August, reported on a large force of Japanese warships headed for Guadalcanal; on 8 August, a day after U.S. Marines were landed on Guadalcanal, the S 38 sank the MEIYO MARU, a transport loaded with troops to reinforce the Japanese garrisons on Guadalcanal—causing the convoy commander to turn his remaining five troop transports back to Rabaul, giving the U.S. Marines on Guadalcanal the opportunity to consolidate their hold on the airfield at Lunga Roads; on 10 August the S 44 sank the heavy cruiser KAKO as it was returning to Kavieng; although no mention is made of the U.S. submarines patrolling of Savo Island, they might have caused Admiral Mikawa who, after sinking three U.S. heavy cruisers and the Australian's CANBERRA and heavily damaging CHICAGO, made the *remarkable* decision to leave the scene of battle and withdraw to the north without trying to destroy the Allies' transports offloading in the sound between Guadalcanal and Tulagi; similarly, Koburger makes no note of the paranoia generated in the minds of the Japanese commanders by the ubiquitous U.S. submarines operating in the Solomons.

On the other hand, Japanese submarine attacks on U.S. ships greatly affected the tide of battle in the Solomons Campaign: on 31 August, a Japanese submarine sank the U.S. aircraft carrier SARATOGA with four torpedoes; on 15 September WASP was sunk by two torpedoes and the battleship NORTH CAROLINA had her bow blown off; on 26 October HORNET was sunk by four torpedoes; on 6 June YORKTOWN was sunk by four torpedoes; and finally, that *in extremis* submarines were used to supply beleaguered troops throughout the Solomons. In fact, submarines played a major role in the Solomons Campaign even though Koburger was apparently unaware of their overall effectiveness.

In addition to U.S. and Japanese submarines affecting the tide of battle in the Solomons, Koburger fails, in part, to recognize how the very superior Japanese torpedo, the Long Lance, gave the edge to the Japanese surface forces in their night actions against U.S. warships. The Long Lance had five times the range, double the warhead weight, ran at three knots higher speed and was wakeless—unlike the U.S. Mk 14 torpedo used for surface and submarine attacks that was a great wake maker, had an insufficient warhead of less than 600 pounds, ran three knots slower to only 4,500 yards. The many defeats of U.S. surface forces in night engagements can be laid mainly to the superior tactics that the Japanese could employ when using this weapon.

The editing of this book is not good. Most disturbing was the mislabeling of Maps 2 and 3 and their placement in the wrong positions in the test.

But again, if the reader wants to read an orderly description of the Solomons Campaign, this book will provide a satisfactory account.

THE JAPANESE SUBMARINE FORCE AND WORLD WAR II

by Carl Boyd and Akihiko Yoshida
1995, Naval Institute Press: Annapolis, MD.
ISBN 1-55750-080-0, 296 pp, $32.95

Reviewed by Capt. James C. Hay USN (Ret.)

Professor Boyd and Captain Yoshida have produced a very readable and informative account of the Submarine Force that faced the U.S. Pacific Fleet during World War II. They trace the building of Japan's submarines from the initial five HOLLAND type boats purchased from the Electric Boat Co. in 1904 to the three gigantic I-400 class submarines of 6500 tons submerged displacement. In all they describe over thirty classes of submarines built between the end of World War I and 1945.

With all that known design/build activity, this reader admits to never being sure what was meant by the I-boat label. Helpfully enough, early in the book the authors clear up the point by explaining the method by which the IJN designated its submarines:

"'I' is a romanization of the first letter in the traditional Japanese syllabary (written as the Greek lambda), 'RO' is the second, and 'HA' the third. Therefore, under three separate classes established in 1924, an I-boat was a first-line Class A submarine, the RO-type submarine was a somewhat smaller Class B boat, and the HA-type Japanese submarine was a small coastal Class C boat with an appreciably more limited range and displacement. Midget submarines were later listed in the HA series."

The authors are uniquely able to detail the story of Japanese submarine warfare in the Pacific and put it in context for American readers. Carl Boyd served in U.S.N. submarines in the fifties and is now a professor of history at Old Dominion University as well as being the author of a number of books and articles relating to the Second World War. Akihiko Yoshida is a retired captain in the Japanese Maritime Self-Defense Force and it was he who led the bulk of primary research in Japan.

In addition to relating the wartime operational record of Japanese submarines, the book includes a wealth of supporting data about the weapons and equipment carried by the IJN boats and the training of their officers and crews. There are also ten very useful appendices ranging from excerpts of the pre-war "IJN Instructions for Submarine Warfare and the Decisive Battle", through descriptions of submarine organization for several of the major operations of the war, to a summary of their losses and short biographies of "Key Members of the IJN Submarine Force."

Doctrine for the employment of submarines also gets important treatment in the setting of the stage for wartime performance. The major emphasis in pre-war Japanese submarine doctrine, of course, was on the immediate support of the main battle fleet rather than on independent logistic interdiction operations. The authors give a very useful background of the philosophy and history of that doctrinal foundation to the design of Japanese submarines and the training of their crews. They also carry throughout the chronology of the war the theme of the naval leadership's strategic dependence on a Mahanian decisive battle to partially explain the Submarine Force's undistinguished performance.

For the effect on submarine operations it would have been interesting to compare the Japanese Navy's too-long-held aim and plan for a mid-Pacific decisive battle and the U.S. Navy's War Plan Orange to use the same path to victory—but in the opposite direction. In their book Code-Name Downfall about the plan to invade Japan at war's end, Tom Allen and Norman Polmar hold that War Plan Orange was lowly regarded by Admiral Richardson when he was arguing against President Roosevelt's desire to base the Pacific Fleet at Pearl Harbor. If it was his reasoning which influenced the U.S. to abandon the pre-war strategy, and as a consequence make an immediate declaration of unrestricted submarine warfare, perhaps the Japanese could have made the same deduction. Perhaps that comparison could even lead to the conclusion that submarine employment considerations should have driven overall strategic fleet planning on both sides.

In any case the Japanese Navy tried to conduct their early war submarine operations in much the way they had been planned in the '30s. Boyd and Yoshida split the war itself into five phases: 1937 to mid-1942, titled Successes and Missed Opportunities; New Operational Patterns and Devastation in the Second Half of 1942: The Attrition of War and Submarine Ops; Sub Ops and Plans for the Decisive Battle, 1944; and Submarine Ops near the War's End. The dispositions of the submarines are well laid out on chartlets for all the major operations and the command structure in place is explained.

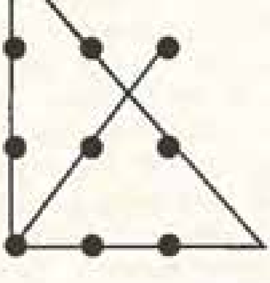
As the U.S. Navy incorporates submarines more fully into naval formations perhaps we should look to this World War II experience of the Japanese, the only major maritime combatant of the period to use submarines as a close fleet adjunct. Of particular interest in that regard are the sections of this book on the Pearl Harbor operation with 28 I-boats involved as well as five midget submarines, the Battle of Midway, and the Battle of Leyte Gulf. In each case it was primarily, but not completely, a failure of high command that led to disappointing submarine results.

Naturally, from the standpoint of a fifty year retrospection, it is the lack of decisive results by Japanese submarines which demands our attention, and the authors treat that issue as their first priority. As one might expect, no one answer serves to bear the full responsibility. After the 1943 campaigns the authors placed a large share of blame on the Japanese Navy's neglect of ASW, and the consequent lack of countermeasures. They also state that the boats themselves, being designed primarily for offensive operations, and having slow submerged speed and shallow depth capability were not up to fighting fully defended American fleet formations. There should be a lesson in that about building hard-to-change hardware to fit very specific strategic projections.

In describing the Marianas campaign in mid-1944, they concluded that the sinking of six submarines by the ENGLAND (DE 635) group in May and the subsequent loss of eight other boats in June was indicative of big problems. They wrote: "Once again the Japanese submarine force was the victim of changing orders from the high command, of superior U.S. Navy ASW activities, and of the effectiveness of American intelligence." The last factor of course was largely a matter of code-breaking and gave the Americans a great advantage.

A high level investigation of submarine employment practices was conducted and its September '44 report is quoted to the effect that "ferocious and thorough" US ASW made "group submarine methods, which are in accord with former tactical concepts" no longer feasible. That report also discredited the picket line disposition of submarines which had been a favorite, but hugely unsuccessful, ploy.

The overarching problem with the Japanese submarine operations during the '41-'45 war, however, was the strategic rigidity of the Navy's high command in their overall thinking, and their specific failure to formulate "a comprehensive submarine strategy similar in scope and purpose to those implemented by Vice Admiral Charles A. Lockwood, Commander of Submarines, Pacific, or German Admiral Karl Donitz in their respective submarine forces. And the Japanese paid dearly for this failure in strategy." ■



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