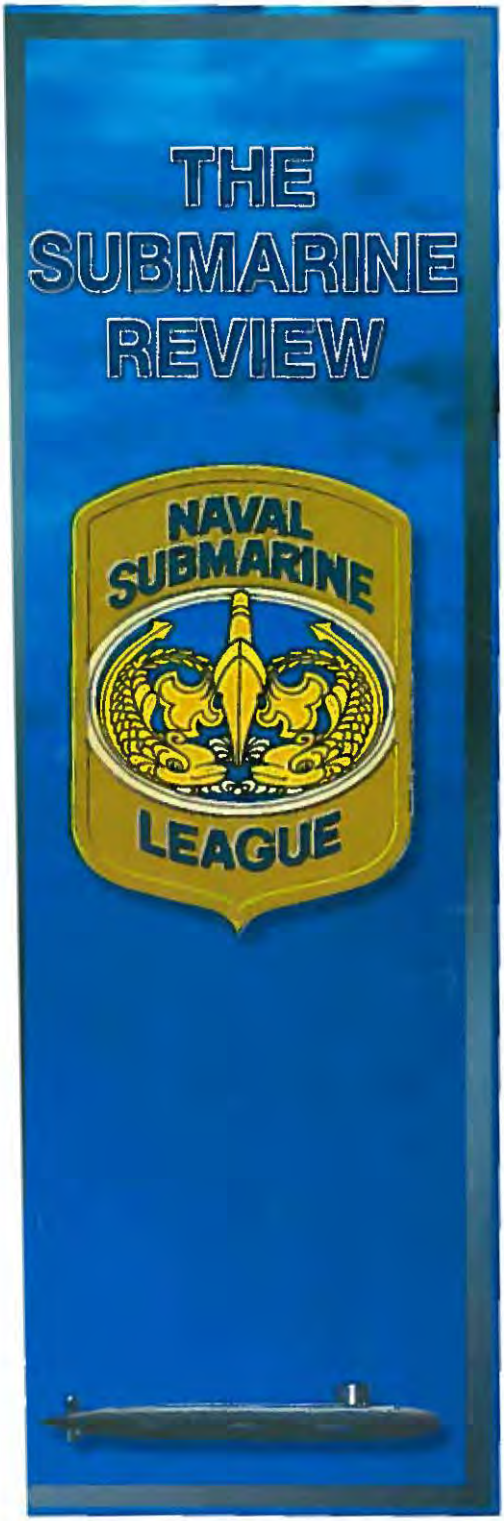

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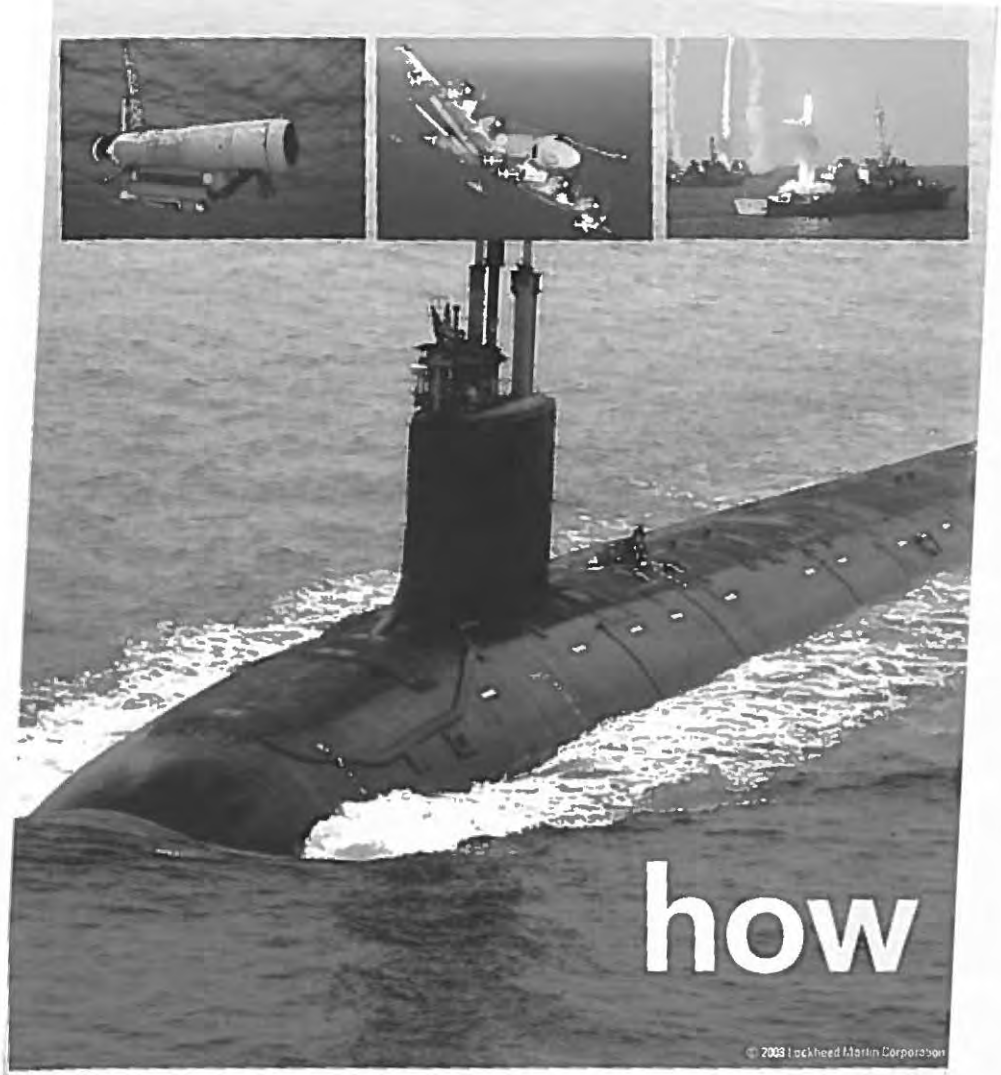

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EDITOR'S COMMENTS

THE SUBMARINE REVIEW is fortunate in being able to FEATURE the remarks of the leader of the submarine community in almost every issue we print. VADM Jay Donnelly's speech to last month's session of the National Defense Industrial Association's Joint Undersea Warfare Technology Conference, printed in this issue, is an impressive tour of the current environment and the place of US submarines. Of particular interest is the emphasis the Admiral has placed on the expansion of the concept of *Undersea Warfare Domain Awareness*, and the foreseeable potential improvements in submarine performance. This presentation is a must-read piece for anyone with an eye to the future

The ARTICLES in the October issue are lead by RADM Jerry Holland's essay on the future, and the importance, of Strategic Nuclear Weapons. He very rightly starts his discussion with a reminder of the recent troubles the Air Force encountered with the care and concern of nuclear weapons systems. In the Submarine Force that *care and concern* is more highly magnified by the concurrent, and more dynamic, operation and maintenance of nuclear propulsion systems. In addition, **the stealth factor** emphasizes the much lower risk inherent in the deployment of nuclear weapons in submarines. If higher authority has every expectation the Submarine Force will perform its nuclear duties at the highest levels, and that will be done at less risk to the nation, then it seems very appropriate that as US policy makers consider the future of our nuclear weapons needs and force structure, they put more reliance on the Submarine Force. It is, therefore, necessary for the entire submarine community to recognize the greater responsibility and take every action to support it. It is the opinion of this Editor that RADM Holland's nuclear weapons article is another must-read for submarine advocates, and is a very fitting subset to VADM Donnelly's view of the future.

On a bit lighter level, RADM Joe Callo has given us a somewhat different look at John Paul Jones and the birth of the U.S. Navy. This is a more substantive view of Jones' foresight and legacy than the "...it is by no means enough..." speech some of us learned way back at the start of our naval experience. It is also a very appropriate lesson for all today to keep in mind that the horizons of the

naval world reach well beyond the deck plates of one's one ship. In that sense Joe Callo's words follow along very nicely with those of ComSubFor and Jerry Holland.

There is, of course, much more of interest and value in this October issue of THE SUBMARINE REVIEW, but perhaps one work is deserving of some particular editorial comment here. There is a rather longish *story* by CAPT Jim Patton in which fiction is used to illustrate a different facet of what we all have come to recognize as a looming short fall in the number of our submarines. In the preface to that *story*, I have tried to rationalize the use of plausible fiction to look at a future we probably cannot fully define. Jim Patton's original *story* was designed to show a use for a different type of undersea platform. His postulated use was for advanced training along the road to submarine command. At my request he modified his *story* to illustrate the extreme case of our submarine gap occurring at the same time even more submarines are needed on the front lines. It must be emphasized that this is an ***editorial tool***, and not any kind of serious suggestion. It is meant as *food for thought.*

Jim Hay
Editor

FROM THE PRESIDENT

I hope you all had a wonderful summer. The Submarine Force has fared well with the deployment of USS FLORIDA (SSGN 728) and the imminent commissioning of USS NEW HAMPSHIRE (SSN 778) on 25 October 2008. The proposed DoD budget has two VIRGINIA Class Submarines in the program starting in 2011, a major milestone for the Submarine Force. VADM Mel Williams and VADM John Bird have been assigned to command the Second and Seventh Fleets respectively and RADM Joe Walsh has reported to Commander, U. S. Pacific Fleet as Deputy Commander and Chief of Staff.

The FY 2008 Annual Report for the League was distributed in the Symposium mailing. It reported a loss for this fiscal year primarily because of unrealized losses on the investment portfolio. The audit results are contained in this issue of THE SUBMARINE REVIEW. We have taken action to improve revenues this year through a very successful member campaign for donations and super corporate benefactor sponsorships for League events. Your Board of Directors will continue to monitor the League's financial performance.

The Annual Symposium will start 22 October initiating the new fall schedule, just about the time you receive this edition. We are pleased that CNO Admiral Gary Roughead agreed to be the keynote speaker. The highlights of the symposium will be honoring the 2008 Awardees. There is a full slate with seven Fleet awards, Mr. Tom Schievelbein and Mr. John Welch as the Distinguished Civilians and Force Master and Senior chiefs and Chiefs of the Boat (COB) as the Distinguished Submariners. Next year the Annual Symposium will be held 29-30 October 2009. The 2009 Corporate Benefactor Recognition Days are scheduled for 4-5 February 2009. Corporate Benefactors continue to be the foundation of League support. Currently 72 corporations actively support League initiatives and activities.

Preparations are well underway for next year's Submarine Technology Symposium (STS) to be held at The Johns Hopkins University Applied Physics Laboratory on 12-14 May 2009. The theme is "*Planning for the Future in an Uncertain World.*" VADM George Emery has identified all the session chairs and plenary

speakers. 2009 will feature a joint session with the United Kingdom on the US/UK Treaty and the next SSBN. The Call for Papers and Exhibits will be released by the time you receive this issue. Additional information about STS will be on the League webpage.

I welcome your comments and suggestions on what the League can do to fulfill its mission of educating the public on the importance of submarines to our national defense. I urge you to submit your ideas in the form of an article for THE SUBMARINE REVIEW. League members are uniquely qualified to contribute papers in support of the Submarine Force. The REVIEW is widely read outside the Submarine Force.

Finally, Jan and I wish you and yours a wonderful holiday season and ask you to continue to pray for the safety of our troops deployed all over the world. I am pleased to represent you in the leadership of the League and encourage you to recommend membership to your shipmates and friends.

J. Guy Reynolds
President

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FEATURE

COMMANDER, NAVAL SUBMARINE FORCES AT NDIA'S NEW LONDON CLAMBAKE VICE ADMIRAL JOHN J. DONNELLY, USN

Thanks to the National Defense Industrial Association for, once again, sponsoring the Joint Undersea Warfare Technology Fall Conference, a great annual event that has become an indispensable venue for sharing ideas, expanding working relationships, and synchronizing industry and laboratories with the Undersea Enterprise.

I want to give a special thanks to Mr. Bruce Spear, the NDIA's Undersea Warfare Division Chairman and Mr. Paul Normand, this year's Conference Chairman for organizing the conference and for providing a fitting theme, *Solutions for a Complex Environment.* The five subjects selected for the technical sessions, Aviation USW, C4I & Combat Systems, Mine Warfare, Undersea Sensors, and Undersea Vehicles, represent some of our current and most difficult technology challenge areas.

I am very excited to be a part of this event and to be given the opportunity to speak with you this morning about the complex environment of undersea warfare today.

There are three main thoughts that I will address with you this morning:

One - Irregular Warfare is getting much attention within the Navy today and submarines will play a significant role in this area.

Two - Anti-Submarine Warfare has been, and for good reason will continue to be, an area of emphasis for the Navy.

Three -The key to the success of the Submarine Force is, and will continue to be, the talented people that we attract and retain. We continue to be challenged to attract and retain the high quality people we need and I could use some help from those in the defense industry in this area.

I welcome your help and support in providing solutions to these challenges.

The complexity of undersea warfare and reliance on the help that the technical community can provide is certainly nothing new to submarining. The Submarine Force has a rich history of solving operational warfare needs with innovative technical solutions.

In June 1945, nine submarines making up the wolf-pack called *Hydeman's Hellcats* (Sea Dog, Crevalle, Spadefish, Tunny, Skate, Bonefish, Flyingfish, Bowfin and Tinosa) all entered the well protected, land-framed Sea of Japan. This first successful penetration through the minefield protected Tsushima Strait was made possible by a new and innovative sonar called QLA. Developed by the University of California Division of War Research at the Navy Radio and Sound Laboratory facility in San Diego, QLA was a frequency modulated high definition sonar system that enabled U. S. submarines to safely traverse Japanese minefields.

This game-changing technology, dubbed *hell's bells* by the men who used it, provided the ability to negate the area denial strategy of the Sea of Japan during World War II. It enabled a devastating blow to the last Japanese shipping fleet and effectively severed communications between the five main Japanese Islands, significantly contributing to the eventual capitulation of the Japanese Empire.

QLA and other collaborative efforts of the military, university laboratories and industry helped win the war and established the value of military research and development. As the nation moved into the postwar era, it was agreed that continued military R&D was vital to national defense.

Like *Hydeman's Hellcats*, submarines today have the role of providing assured access to areas where our enemies might try to deny our presence. Intelligence indicates this will only be more difficult in the future. So also like *Hell's Bells*, technology will play a key role in maintaining the assured access we are currently able to provide.

Today, submarines maximize combat power by maximizing payload flexibility and volume. The unprecedented payload capacity of the SSGN submarines deployed today and the cost effective interoperable redesign of the Virginia bow beginning with the 11th ship of the class, are two examples of the direction that

submarine design is headed to keep our options open for future innovations, such as unmanned vehicles and more versatile missile systems.

Additionally, linking submarines together and to the Joint warfighter for real time communications will achieve exponential gains and has the potential of being a *game changing* capability. Through work with ONR and DARPA, we are beginning to look at the next generation of Comms @ Speed and Depth - Optical Laser Comms has never looked more promising.

These are a couple of the things we are doing to ensure U.S. submarines maintain their position as the best and most technologically advanced in the world. But, while we work to bring new solutions to submarines, we must remember to maintain the submarine's enduring value of stealth.

Due to their stealth, self-sufficiency and significant fire power, submarines provide the National Command Authority, Joint Force Commanders and Theater Commanders with unique capabilities:

-to acquire early and accurate knowledge of pre-crisis situations and the battlefield.

-to prepare the battle space and enable the establishment and support of the expeditionary force on land.

-to clandestinely strike critical targets at sea and ashore.

-and to defeat enemy forces, control sea lines of communication and dominate the undersea battle space.

As I discussed earlier, Irregular Warfare is receiving a high level of interest within the Navy, and Joint Force Commanders are recognizing the unique capabilities that submarines provide them. Employed properly, the submarine produces asymmetric advantages that can be effectively leveraged in virtually every aspect of Irregular Warfare.

While fighting experiences in Iraq and Afghanistan have weighed heavily in the development of Irregular Warfare doctrine to date, we can help to expand the operational concepts to be more broad, enduring, and forward-looking. We must work to articulate how the submarine's stealth and payload capacity can contribute to the Irregular Warfare fight, with its unique attributes and requirements.

An area of Irregular Warfare that requires some attention is the developing threat to our national interests in the undersea domain.

The maritime domain not only includes the sea volume in which we operate and the air/water interface, but also the sea bed and the associated infrastructure that exists on it. We need to break the paradigm that undersea warfare is only sub on sub or sub on ship or sub ISR (in the classic sense).

While we are and will remain preeminent in these areas, the undersea domain is much larger than that classic perspective and we should expand our thinking in areas that have a significant role to our nation's security.

We play an integral part in developing this Undersea Maritime Domain Awareness by providing accurate and timely Intelligence, Surveillance and Reconnaissance (ISR), a bread and butter mission of submarines. Submarines and other sub-sea systems (the term used in the commercial world to identify systems used under the sea) can ensure the U.S. Navy remains the master of the undersea domain for both defense and offense by providing a critical Undersea Maritime Domain Awareness. We will provide information that only the submarine can acquire to thwart our adversaries from gaining the initiative on our critical undersea infrastructure.

The right group to lead this charge has not been determined, but the Submarine Force will play a key role in broadening the traditional definition of undersea warfare to encompass this revised vision. As a result of this potentially new definition, the capabilities needed to deny or exploit this realm require significant attention. The global undersea infrastructure is growing and fully exploitable by anyone with the technological means. How do we defend it or hold it at risk against our adversaries?

As I look to the future, some of our technological *needs* will be Unmanned Undersea Vehicles or UUVs, Remotely Operated Vehicles or ROVs and small manned submersibles, operating independently or in coordination with surface ships or submarines.

Stealthy underwater gliders, used today to collect oceanographic information, have the capability to operate silently for weeks at a time, covering hundreds of miles. These battery-powered vehicles alternately pump ballast water in and out to change their buoyancy, enabling them to glide forward as they rise and fall through the ocean. The gliders' efficiency and stealth allow them to gather essential environmental data in denied areas and could one day be used to perform surveillance or patrol duties for extended periods.

What we need from these new capabilities are Intelligence, Surveillance and Reconnaissance (ISR), as well as actions based on the information obtained.

What I mean by ISR here is not just the classic above the water using the undersea as a form of concealment, but ISR of the undersea domain. But also, these vehicles should be able to take action based on what they observe, to exploit the adversary's undersea domain or defend our own. Submarines will need the ability to reliably communicate with these autonomous and semi-autonomous systems to provide the necessary command and control.

The development of this capability and the knowledge that flows from its use will allow us to find and exploit potential adversaries' undersea infrastructure and to cause an adversary to expend enormous national treasure in defense. If we do not develop the capability, we risk having our adversaries execute a similar dynamic against our undersea interests.

The goal here should be to expand our dominance and superiority in the currently defined undersea warfare realm into the undersea warfare realm, as it will be re-defined.

This will require thinking beyond the typical campaign or platform centric analysis of the past and into critical enablers like UUVs, ROVs, and submersibles that will expand our capabilities beyond the sea volume of submarines and onto the sea bed and undersea infrastructure.

As we better understand this newly considered and complex undersea environment, we must carefully examine areas where we currently assume undersea dominance to detect possible unidentified gaps.

We must ask difficult questions like:

-How will the changing undersea environment impact the strategic triad?

The timing is right to ensure the next generation of Sea Based Strategic Deterrence is prepared to maintain its position as the *most survivable leg* in a complex and changing environment.

While we address the Irregular Warfare needs of the Joint Commander, we must not lose sight of the growing threat of China's Submarine Force.

As I previously indicated, Anti-Submarine Warfare (ASW)

rightfully has high level Navy interest and we will need your help in developing the solutions to this problem. In many ways ASW and undersea warfare today are different than the ASW of the past. We must better understand the differences and develop an effective strategy that focuses on new capabilities that provide the biggest bang for the buck.

But one thing that has not changed—Submarines bring a sensors and weapons advantage that is unmatched and are a major asset to theater ASW. And what is becoming very clear from exercises is that the proficiency of submarine Sonar Operators is extremely high in comparison to their surface counterparts. While the reason for this may seem obvious, we must look deeper into the cause. Certainly part of the answer is that the Submarine Force has some of the best simulators and trainers in the world, like the Submarine Multi-Mission Team Trainer or SMMTT.

In addition to developing and maintaining the proficiency of the best Sonar Operators in the world, we are finding other uses for the SMMTT. With the increased pressure on research and development funds, we need cost effective and time efficient ways to test new concepts and develop the Tactics, Techniques and Procedures they require. SMMTT has sufficient capability and fidelity to allow us to do experimentation that previously we could only conduct with expensive, at sea events. Using the SMMTT, we've recently conducted experiments to look at the impact of future capabilities with respect to an SSN's ability to execute specific CONPLANs.

Our experiments focused on an Unmanned Aerial System (UAS) and the Submarine Littoral Defense System (SLDS)—formerly known as the Littoral Warfare Weapon. Our scenarios used real crews in several scenarios. We conducted controlled runs without these systems and nearly identical runs with them. We were then able to evaluate the ship's performance versus pre-determined metrics to gauge the impact of the systems on the ships' performance. This is a cost effective way to learn about capabilities before sending them to the fleet for advanced demonstrations and testing.

As game-changing technologies needed for the Submarine Force of the future are identified and developed, we must ensure human performance is appropriately considered. We are pushing more and more data at our submarine crews and asking them to make the

right decision in an increasing complex and fast paced environment. A new way to integrate our people and technologies to a much greater effect could be the next big *game changer*. This would benefit the entire Navy, not just our submarines. Human System Integration is a worthy endeavor and a *must do* as capabilities for submarines are developed. But the one thing that sets the United States Navy's Submarine Force apart from the rest is the quality of the people that we bring in and retain.

At the beginning of my remarks, I mentioned that getting and keeping the right people continues to be a real challenge. The value of math and science education is becoming less and less appreciated by young people and those who mentor them. I could use your help in industry to *seed the field* by supporting math and science education in whatever way you can and promoting the enduring value of military service.

Those that answer the call will be joining an organization with a rich tradition and a very important and growing role to play.

The COCOM demand for our submarines (SSNs, SSBNs and SSGNs) remains great, even greater than we are able to provide. This is because when submarines are called upon, they produce results. We have seen some highly successful deployments this year by our fast attack force. They are providing the COCOMs with knowledge of the battlefield only a submarine can acquire and clandestine strike options never available before.

Our ballistic missile subs remain in high demand because of their long earned reputation for reliability and dependability, as the only 100% survivable leg of the Strategic Triad. All four SSGNs were delivered on budget and on time. USS OHIO and FLORIDA performed flawlessly during their first deployments, proving the operational concepts developed 13 years ago. MICHIGAN is completing her first Major Maintenance Period and will deploy before the end of this year, with GEORGIA following shortly after. As we look to the future, there is no sign of a downward trend in COCOM demand for submarines. In fact all indications are that the demand will continue to rise. We must continue to reliably deliver capability and maintain the credibility we have worked so hard to earn.

Submarine acquisition programs hold a reputation second to none in the Navy today. The Virginia Class is well on its way to

providing two Virginia Class submarines for 2 billion dollars each by 2012. One of the keys to our success has been the focus placed on open architecture, like the redesign of the bow in flight three and potentially the sail for future flights. Follow-on submarine programs will certainly benefit from the work being done on interoperability and next generation sensors.

Even with the success of the Virginia Program to deliver new ships ahead of schedule, during the next decade the total number of SSNs will gradually drop below 48, the number of submarines needed to meet our obligated requirement to the COCOMs of 10 deployed SSNs, 15 ready for tasking and 10 surge ready. Under the current shipbuilding plan, during the 2022 to 2034 timeframe we will dip below 48 and will reach a minimum of 41 SSNs. The second Virginia Class submarine being added in 2011 will delay the onset of the dip and made it smaller, but we will still have to selectively extend the operational life of some of our 688 class SSNs to help fill that gap beyond the year 2022.

We must find ways to shorten maintenance periods and lengthen the time between availabilities to recover operational time while providing the COCOMs with the reliable capability they have come to expect from the Submarine Force.

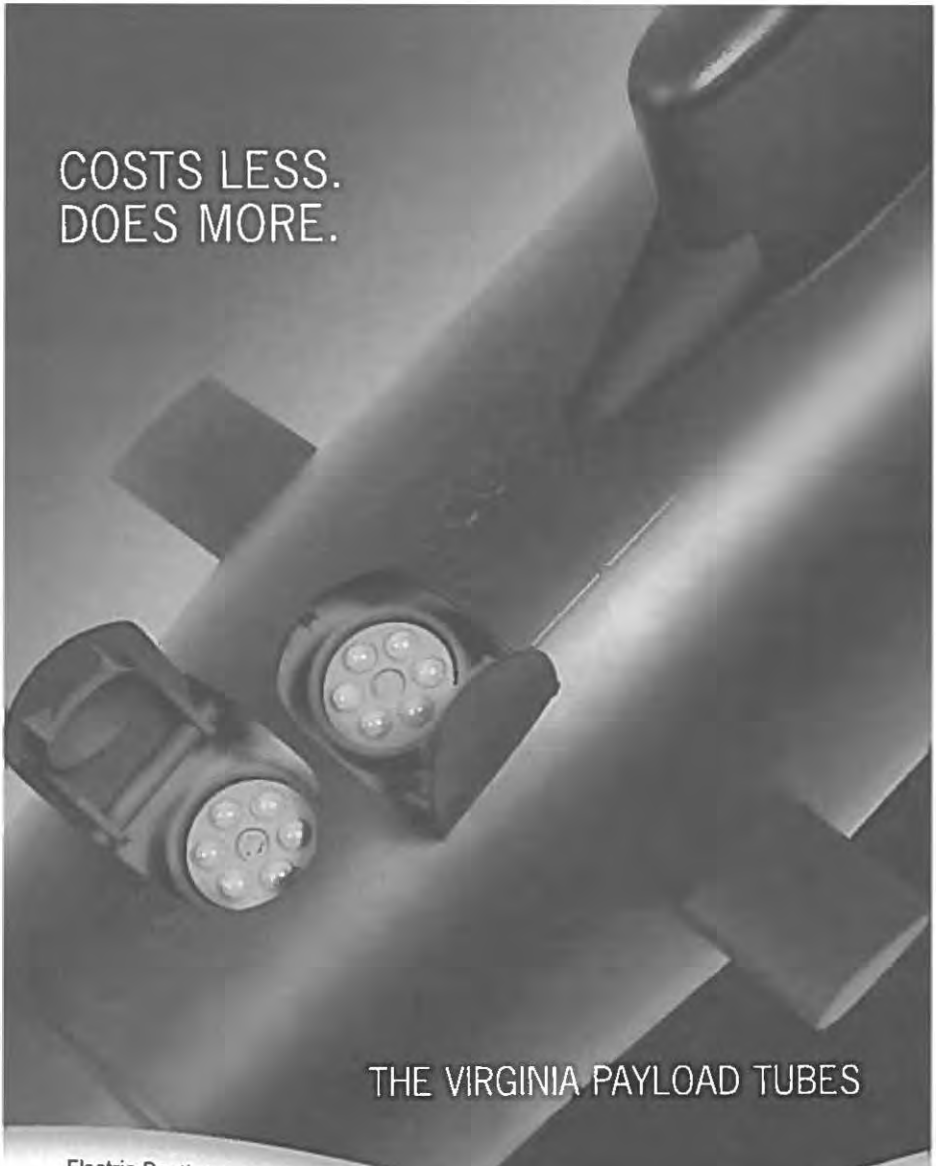
Even as we reduce the time submarines spend in availabilities, we must continue to maintain our submarines modern and reliable. Our modernization programs are lean and must be carefully managed to prevent creating a hollow force. Reliability and maintainability issues must be quickly identified and aggressively addressed to maximize operational availability. The success of the Submarine Force comes because of our willingness to look at hard problems and deal with them. It will take good planning and teamwork to make this work and we have to get this right.

The Ohio Class submarines have been an unprecedented example of reliability, maintainability and usability. As these great ships begin decommissioning in 2027, much will be expected of their replacement. We are just beginning the Analysis of Alternatives that will define that replacement. One of our first efforts will be to establish and maintain a stable Research & Development program that will meet future requirements. We will certainly leverage what we have learned with Virginia.

I thank you for attending this conference and look forward to

your help with the challenges we face in Irregular Warfare, Anti-Submarine Warfare and in attracting the right people.

In closing, I am proud to be able to brag a little on the good year that the Submarine Force has had and about our bright future. We continue to build on the coveted reputation forged from the steel of those submarines and submariners that came before us. Submarines and submariners like *Hydeman's Hellcats*. Their hard earned and well deserved reputation will be carried forward by the talented men and women that design, build, operate and sustain today's amazing warships. Many of whom are in this room here today. Thank you.■



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

GENERAL DYNAMICS
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ARTICLES

THE END OF THE STRATEGIC NUCLEAR WEAPON TRIAD? SHOULD WE CARE?

by RADM Jerry Holland, USN(Ret)

Rear Admiral Holland is a retired submarine officer. He has been a frequent contributor to THE SUBMARINE REVIEW since its founding.

The Air Force's recent difficulties related to nuclear weapons resurrects somewhat the attention level on those weapons and their delivery systems that faded with the end of the Cold War. The national absorption with the War Against Terror focused energies and concentrated attention almost exclusively on self-protection, small unit equipments and tactics and political activities related to the invasions of Afghanistan and Iraq. In the words of Admiral Mike Mullen, Chairman of the Joint Chiefs of Staff, attention to nuclear weapons has been "backsliding" from their predominance in Cold War discussions and operations.[1] The Secretary of Defense's forced retirement of both the Secretary and the Chief of Staff of the Air Force because of errors in the care of nuclear weapons is a signal that those arms remain important and serious attention should be paid to them.

By the time of the 2002 Nuclear Posture Review nuclear weapons had been demoted to the sidelines—lumped with precision guided conventional weapons as the offensive strike forces in a new Triad, the other legs of which were Missile Defense and Command, Control and Intelligence. Serious discussions about their usefulness or need nearly vanished from the academic and professional literature except for calls for disarmament. With the accompanying merging of the Strategic Command with the Space Command and replacement of the bomber cadre by the fighter pilots in the Air Force leadership, the stage was set for the decline of attention and care in handling nuclear materials.

The coming Administration will have to formulate its Quadrennial Defense Review (QDR) in 2009 (to be released in February 2010 with the Administration's first budget). Even before

the QDR gets into high gear, preparation of a new Roles and Missions study, mandated by the Congress, is taking place. As far as nuclear weapons are concerned the end result of these policy guides would likely be "Steaming as Before" without much thought devoted to the makeup of the forces so armed. No reference to nuclear weapons is to be found in the seven topic areas of the Department of Defense's current Roles and Missions Study directive except perhaps by inference in the topic, "Excessive Overlapping Service Capabilities".

However, in addition to these two studies, the Congress has mandated a new Nuclear Posture Review. This direction, coupled with the requirements of the Moscow Treaty on Strategic Offensive Reductions of 2002 may result in new consideration of the size and composition of the strategic nuclear systems. Under the Moscow Treaty, the United States is required to reduce its operationally deployed strategic nuclear warheads to numbers between 1700 and 2200 weapons by 2012. To put this in context, in 1987, at its peak, the United States deployed 13,600 warheads. In the first Strategic Arms Reduction Treaty (START I) of 1991, the United States agreed to reduce its strategic nuclear forces to 6,000 warheads on 1,600 delivery vehicles. The first steps to reach reduced numbers involved retiring all 50 of the ten warhead Peacekeeper ICBMs and converting four Trident submarines to conventional service. Some reloading of the remaining missiles, removal of 50 Minuteman II ICBMs and shifting the B-1 bombers from strategic missions to conventional service reduced the total number of weapons deployed today to meet the Treaty limits.[2] Two thirds of those remaining after these steps will have to be removed from service before the end of the next Administration in 2012.

The rules of nuclear arms treaties complicate launcher and warhead counts because of various treaty exceptions and provisions. For example the missile tubes on the two Tridents in overhaul are not counted in the tally of launchers or delivery vehicles. These complications discourage careful examination or *clean sheet* analysis of strategic forces. The result is that no effort to rationalize the forces that will be armed with these 1700 to 2200 warheads exists or seems to be contemplated. With the Strategic Command embroiled in space and cyber war, analytical and intellectual ferment seems to be engaged in all things but nuclear.

Added to the force infrastructure considerations of military utility, economic costs and international politics will be significant patronage concerns within the Congress. Without wide discussion to raise broader issues, narrow parochial concerns are likely to sway the end result of any formulation. An instance of this narrow vision was a Congressional earmark in the FY2007 Defense Authorization Act that thwarted the Air Force's plan to reduce the B-52's able to carry nuclear weapons to 56 by mandating 75 planes had to be maintained through 2018.[3]

Consideration of just what those remaining weapons mean, what they might be useful in doing and where they should be based is a desirable but not a likely outcome for the planned studies. The present force distribution spreading the weapons and launchers among three component delivery systems; bombers, land based missiles, and sea based missiles has never been wholly rational. The arrangements grew *like Topsy* out of a period of frenzy driven by the weapons manufacturers and proponents of overwhelming nuclear forces in the United States and the Soviet Union. With only the numbers of weapons on each side as a basis for analyses, the forces grew out of all proportion to their utility in anything other than impressing their own policy makers and those of the opposing side at which they were pointed. In the Cold War, deterrence was reduced to having a number and variety of weapons superior to or at least equal to those of the potential peer enemy.

Various arguments justifying the individual legs of the TRIAD were developed, usually after the creation of the forces themselves. Eventually arguments for the three different launch platforms created a number of reasons to justify a range of capabilities citing the strengths of each individual delivery system and compensating for the perceived weaknesses of the other components. Over time, launch systems were justified by one or more of the following reasons:

a. complicate enemy targeting,
b. survive an enemy first strike,
c. have the accuracy and explosive potential to attack hardened targets,
d. able to respond quickly,
e. hedge against unexpected problems or developments,

f. provide an unequivocal target (a force that had to be attacked in an all-out war),
g. able to create a signal that could be recalled, "...if a crisis did not escalate into a conflict".

Most of these theoretical attributes were developed after deployment of a particular weapons system was planned, usually in the process of justifying funding of that system. In the sixties, at the height of the theoretical discussions on nuclear war, no single leg could meet all these attributes. The utility of each attribute—other than survivability—was never closely examined—and most are of uncertain validity. Each leg grew on its own momentum without much regard for the capabilities of the other legs.

The supporting infrastructure for each launch system was rarely discussed except when it came to large or sensitive expenditures. An elaborate and expensive warning system had to be created to provide warning of an attack to allow bombers to fly out and ICBM's to be launched before arrival of incoming missiles. But no discussion about the reasons for these systems ensued as the original warning systems were black programs. The creation of the very low frequency communications link to submarines (ELF) attracted attention only because it had to be located in the midst of a population predisposed to isolationism, disarmament and political activism.

Even though bombers were postured to fly out almost instantly and ICBMs maintained on a high alert system, only the submarine based system, alone among the legs, always satisfied the survivability requirement. Attempts to improve the survivability of the land based missiles (ICBM) first by mobilizing some on railroads came to naught because of the reactions by populations that envisioned the weaponization of their local train tracks. The next attempts to add survivability to ICBM's by building very hard silos close together ("Dense Pack") or burying the weapons in mountains ("Deep Underground Missile Basing") were too complex to gain adherents and too expensive to gain approval.

ICBMs came to be promoted on the basis of their readiness to respond. Yet comparisons that suggested the landlines of communication were faster or surer than those to sea based systems were based on ignorance of the associated command, control and communication systems. By 1985 that canard had been skewered

as characteristics of submarine command and control were shown to have been better than those serving the ICBM force at least since the seventies. The reliability of the communications and the responsiveness of the submarine command and control system have been praised by everyone who has studied the details of the country's strategic command and control systems.

Next, claims for the ICBM's emphasized their accuracy and explosive potential as necessary for destroying hardened targets, i.e. ICBM silos and command bunkers. Since the deployment of the TRIDENT II D5 missile the accuracy and explosive power desired for attacking hard targets is as good or better in the sea-based weapons as in the ICBM's.[4]

These individual attributes were generated in random order, without necessarily applying to each component leg, and often in attempts to justify improving capability or in response to developments of a competing leg. Nevertheless the three legs continue to be justified using the 1960 era arguments. In 2001, CINCSTRATCOM testified, "The ICBM force provides responsiveness, the SLBM force provides survivability and bombers provide flexibility and recall capability".[5] This quote continues to be cited as justification for the three systems.[6] The facets of the original TRIAD deserve serious attention in order to lay a foundation for the coming review of the nation's nuclear weapons systems. In examining a new force structure, considerations of cost and political interest will be less important than determination of the appropriate force structure to meet the Moscow Treaty limits and the future needs of the United States.

In such an evaluation the Trident submarine and the D-5 missile are obviously the most utilitarian system both because of the flexibility of operations as well as the security of the launcher. Submarine survivability has never been a question. No country has an effective wide area search capability for submarines and no breakthroughs in ASW threaten the SSBN. The flexibility in loading of the missile provides a relatively easy way to meet the treaty limits while maintaining the mobility of the launcher. The missile is reportedly able to carry up to ten individually targeted reentry vehicles but can be downloaded to fewer.[7] This capability not only allows adjustments to meet the currently expected limit but also provides for future reductions when they are desired.

Being able to position the launcher around the world allows adjusting the azimuth and range to potential targets. Adjusting the target azimuth could be important in developing strategies that involve selective threats to a small target set or in which the flight path may be very sensitive to other parties. The SSBN's maneuverability permits positioning the launchers to reduce the missile's time of flight thus making submarine launched ballistic missiles the most responsive in the arsenal.

Additionally the SSBN and its supporting basing system provide the most secure for the stowage and protection of these high value instruments. The number of places where the weapons are stowed is small. The weapons in the ships launchers are beyond reach of any reasonable threat of sabotage or blackmail. Finally the weapons are in the custody of relatively large numbers of trusted people supervised by an elite officer corps famous for attention to detail and rigid adherence to procedure.

There are several general choices for future force alignments. The least rational and most expensive would make equivalent reductions in each of the three legs. Unfortunately this sort of reduction is the most likely. Such a lazy man's scheme will not take advantage of the improvements in weapons and launchers over the years and perpetuates the dispersal of nuclear weapons within the continental United States.

A more reasoned and logical approach before making these choices would be development of national policy that addresses the roles and values of nuclear weapons in the current and expected future global environment. The short and long term objectives of the United States relative to these weapons would have to be developed from almost a standing start for there are few theorists in the field and they are divided diametrically between the advocates of total elimination who would disarm immediately and those who consider the world a still dangerous place with peer enemies waiting in the wings and so foster large stockpiles.

But a new national policy and any force development that derived from it needs to lay aside the mythologies of the past so as to address the issues involved in a coherent and current manner. Some of the basic questions that must be studied in such an effort include:

How many of what kinds of weapons do we need to maintain a believable and effective deterrent force for the foreseeable future?

How large a force is required to discourage any potential enemy competition (i.e. preclude a new arms race) and reassure allies that they need not develop their own weapons?

How many and what kind of launch vehicles are best suited to deploy this force?

In addressing these questions care must be taken to not count how many weapons some others may have but rather to examine how many valid targets exist. In doing this one must recognize that aim points are not targets and that care must be exercised in this sort of planning not to design forces that are too large for any practical purpose and weapons assigned to targets in such numbers as to "...make the rubble bounce."

A proper approach to a rational force mix would begin with the submarine leg at its maximum size. Among the planning logic for assigning warheads to launchers the ability to threaten a single target or very small number of targets will have to be considered. Such threats are likely not to require urgent execution so single warhead launchers (bombers and land-based missiles) might be suitable. Yet considerations of launching such a strike from the central United States, rather than from some isolated spot in the ocean, may justify a very small number of single warhead vehicles in submarines. Other than that, every deployed warhead below the number that fit on submarines should address the argument "Why here and not on a submarine?"

Nuclear weapons are important. They are the ultimate persuader and will remain so for the foreseeable future. While hopefully they will continue to have no actual usefulness, these weapons must not be ignored or treated as second-class citizens. Constructing a new strategic nuclear force mix will require harder policy thinking than the relatively simple peer-to-peer logic of the Cold War. A "blank sheet" analysis is not required because the weapons based on submarines are an obvious choice to all. Supporters of land-based missiles and bombers are waning. Overcoming parochial interests

may not be as difficult as in the past as budget pressures on the Air Force squeeze that service's more desired and more immediately useful programs.

While the same financial pressures discourage enlargement of the Navy's role in strategic weapons, the present attributes of submarine launched ballistic missile systems are well established and will remain a first priority nationally whether the Navy wishes to or not. The Navy needs no proponent for its roles or forces but arguing as taxpayers and stakeholders in the Department of Defense's top line, those who understand the division of labor in the strategic forces ought not acquiesce in a less than most rational policy for deploying these armaments. The Moscow Treaty limits offer an opportunity to rationalize and justify our strategic forces. We ought to take it. As advised by VADM Lyle Bien, "Where we can, we ought not let any opportunity pass to influence national policy in affairs where we possess special competence."■

ENDNOTES

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JOHN PAUL JONES
SEA POWER VISIONARY

by RADM Joseph F. Callo, USN(Ret)

John Paul Jones pioneered the idea of global sea power a century before the rise of the modern U.S. Navy.

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Editor's Note: Rear Admiral Callo is a retired Naval Reserve Public Affairs officer. He was commissioned from the Yale University NROTC and after his active duty sea time he had a distinguished civilian career in Television as a scriptwriter and a producer. He is also a widely published newspaper and magazine commentator and has written several books on naval history. In 1998 he was named the US Naval Institute's Naval History author of the year.

He is also remembered among those of us who were involved in community relations at the New London Sub Base in the late 70's for presenting the face of the Navy to the press and TV. During a weapons handling incident which could have caused serious public concern on the first day of his active duty period, he very responsibly and professionally made timely public statements and gave interviews reporting the facts as the incident was resolved and stressing the Navy's prime concern with safety for all. The incident was not a news item after that first day.

John Paul Jones is best known as a warrior, a tough commander who repeatedly beat the odds in one of history's bloodiest scenarios: single-ship combat in the Age of Sail. His career is a stirring sea saga involving courage, audacity and a commitment to the American struggle for liberty.

But there was much more to Jones than iron determination and courage under fire. He also was a visionary, a naval officer who thought in broad strategic terms. Arguably the most important strategic concept Jones seized upon was that of global power projection. In his words and deeds, he made it a crucial part of American naval planning during the War of Independence, and it remains an influential part of U.S. military strategy.

Jones also foresaw the crucial role naval power would play in America's future. In fact, he predicted it outright in a letter to his friend Thomas Bell, captain of an American privateer. Bell had written Jones in 1778 of the bleak state of affairs in Philadelphia and within the Continental Navy. Jones responded: "Let us not altogether despond. Tho' I am no prophet, the one will become the *first* city, and the other the *first* Navy within a much shorter space of time than is generally imagined... Our Marine will rise as if by enchantment and become, within the memory of persons now living, the wonder and envy of the world."

The timing of Jones' vision may have been a bit off, but he was dead-on concerning the rise of the U.S. Navy.

The Continental Navy was an improbable setting for the kind of long-range strategic perspective Jones demonstrated during his career. It was a makeshift force—started without a single purpose-built warship—that often found itself blockaded in its own ports. When it did confront its opposite numbers in the Royal Navy at sea, it consistently lost. Its officer corps comprised men with little or no professional naval service. As a fighting force, they were seamen-warriors, not warrior-seamen, and their day-to-day challenges, including establishment of a coherent working relationship with their civilian political leadership left little room to consider much more than tactics and survival.

Complicating matters was the fact that with regard to all things military, members of the Continental Congress were engaged in *on the job training*. Those civilian leaders envisioned their nascent Navy playing a limited role, focused on coastal defense, support of the Continental Army's land campaigns and, on occasion, transport of American diplomats to and from Europe. That the Continental Navy was able to contribute meaningfully to the birth of American independence is close to miraculous, given such circumstances.

For his part, John Paul Jones would emerge as a self-taught

naval officer who not only fought with courage and skill but also was able to see well beyond his own quarterdeck. When others were thinking defensively and suffering defeat after defeat, he was thinking *attack* on a strategic scale.

Evidence suggests that Jones grasped the concept of power projection early in his naval career. In October 1776, less than a year after he became the first American naval officer to hoist his new nation's flag aboard ship, he wrote to Robert Morris, an influential Congress member. Jones had just returned from a successful deployment off the East Coast and Nova Scotia in his first command, the 10-gun sloop PROVIDENCE. The mission had been a modest example of naval power projection, but within the confines of the Continental Navy, a noteworthy one. He reported an impressive tally of 16 British brigantines, sloops and schooners captured or destroyed. He also had conducted successful raids against Canso and other fishing harbors along the Nova Scotia coast.

Jones' letter to Morris then turned to such broad issues as naval recruiting and retention. He capped this passage with a forward-thinking admonition that went far beyond his own command challenges on PROVIDENCE. "And without a respectable Navy—alas America!" While others were focused on immediate needs, Jones was suggesting a relationship between America's naval power and its future as a nation.

His letter also addressed the quality of the officer corps and the future organizational structure of the Navy:

> *We have had proof that a Navy may be officered almost on any terms, but we are not sure that these officers are equal to their commissions; nor will the Congress ever obtain such certainty, until they, in their wisdom, see proper to appoint a board of admiralty, competent to determine impartially the respective merits and abilities of their officers and to superintend, regulate and point out all the motions and operations of the Navy.*

This was unusually farsighted but politically risky advice from a Continental Navy captain to his civilian overseers. Jones was, in effect, telling Congress how to run its business, the kind of sweeping, gratuitous advice political leaders generally do not welcome from Navy captains. But Jones persisted. In his role as a

highly credible *voice from the fleet*, he was almost as important to his country as he was as a combat leader.

Toward the end of the letter, Jones wrote of his rumored next command aboard the 14-gun brig ANDREA DORIA and proposed that he lead a small squadron to the west coast of Africa. Once there, he would attack British commerce and "give a blow to the English African trade, which would not soon be recovered, by not leaving them a mast standing along the coast."

Jones' suggestion of a far-forward deployment to Africa was surprisingly audacious given the inability of the nascent Continental Navy even to keep American ports open. But it demonstrated brilliant insight on the potential strategic impact of a naval squadron led abroad by a skilled and bold officer to strike an enemy at vulnerable points. This kind of forward-leaning mission, based on mobile and flexible units, has resurfaced in modern applications of maneuver warfare at sea.

In the 1980s, for example, naval strategists proposed formation of *surface action groups* based on the East and West Coasts of the U.S. Such squadrons, which never got beyond conceptual stages, were to be built around Iowa-class battleships or Aegis-class missile cruisers and deployed to hot spots worldwide when force below the tactical capabilities of a carrier battle group was required.

In a broader and more up-to-date context, the Navy's recently published A Cooperative Strategy for 21st Century Seapower describes six core capabilities, the first of which is forward presence and another of which is power projection. The two combine to bring naval power to bear against an enemy.

Unfortunately for Jones, the lack of resources and Congress members' limited sense of the Navy's strategic potential meant there would be no mission to Africa. Instead, Jones and ANDREA DORIA were given a mission similar to the one he had carried out on PROVIDENCE. But the concept of forward projection would reemerge soon enough at a crucial stage of the American War of Independence.

In 1778-79 Jones undertook two deployments that dramatically demonstrated his understanding of the effectiveness of forward projection. Historians commonly view these missions—one in the 18-gun sloop-of-war RANGER and the other in the 40-gun frigate BONHOMME RICHARD—as freestanding events. In hindsight, however, these modest strikes enabled Jones to get inside the

British decision cycle. As such, they became a key element in a three-part American naval strategy.

The two other elements were widespread use of American privateers against British maritime commerce and the seizure of domestic naval control by the French fleet of Rear Admiral Francois Joseph Paul, Compte de Grasse, at the Battle of the Virginia Capes on Sept. 5, 1781. The former ramped up the British cost to pursue the American Revolution while providing America with a source of desperately needed material. The latter sealed Lt. Gen. Lord Charles Cornwallis' fate at the Battle of Yorktown.

For several weeks in April and May 1778, Jones commanded RANGER independently, mostly in the Irish Sea. His first major engagement was a raid on the British port of Whitehaven on April 22 and 23. It was hardly a textbook operation in the annals of expeditionary warfare: Jones had to persuade his crew to even attempt the mission, and his first and second lieutenants refused to join the landing parties.

Ultimately, Jones was able to muster 30 men to join him in the boats. Just then the wind dropped, delaying the assault and eliminating the element of surprise. Fortunately for Jones, there were no real local defenses, and he managed to land a small force, spike the guns guarding the harbor approach and set fire to a collier tied up at its pier.

From Whitehaven, Jones sailed to nearby St. Mary's Isle, where he hoped to kidnap the Earl of Selkirk and trade him for imprisoned Continental Navy sailors. The earl was absent, however, and the raid took on comic proportions when some in the landing party persisted in looting silver plate from Selkirk's manor. The lapse in Jones' leadership embarrassed him and compromised efforts to establish a professional standing for himself and the Continental Navy.

The next engagement, a single-ship action against the 20-gun HMS DRAKE, had a decidedly more positive outcome. The two ships met on April 24 off Belfast Harbor. DRAKE had a somewhat larger crew, but RANGER was heavier gunned, and when the smoke cleared, Jones had captured the British sloop-of-war. He returned to France with the ship as a prize.

The raid on Whitehaven and subsequent defeat of a relatively small British warship were, on the surface, minor military events.

There was, however, significant psychological value to Jones' victories. They contrasted sharply with the steady series of setbacks the Continental Navy had suffered as the Revolution progressed. That the action took place within sight of the British shore was not lost on military, political and business leaders in London. The Gazette and New Daily Advertiser published a Whitehaven resident's reaction to Jones' raid: "We are all in a bustle here from the late insolent attack of the provincial privateer's men." The Morning Chronicle and London Advertiser reported, "Four companies of the militia are now here."

American privateers had previously taken prizes in British waters, but the shock of a U.S. warship actually raiding an English port—it had been more than 100 years since the Dutch had come ashore and burned Sheerness in 1667—and then escaping with a captured British prize was substantial. It was also a sign of worse things to come for the British.

Jones' deployment on BONHOMME RICHARD in 1779 was an expanded version of that on RANGER. He commanded a small squadron, and his flagship was a frigate, not a sloop-of-war. The squadron included the new 36-gun frigate USS ALLIANCE and three French ships, the 26-gun frigate PALLAS, the 12-gun brig VENGEANCE and the 12-gun cutter LE CERF. The French ships were placed under Jones' temporary command.

BONHOMME RICHARD, a converted East Indiaman provided by the French, was slow, and some of its armament was dangerously old. ALLIANCE was newer but captained by Pierre Landais, a former French naval officer whom John Adams ridiculed as having an *embarrassed mind.* Before the squadron left France, Jacques Donatien Le Ray de Chaumont, the French naval minister, induced Jones to sign an agreement allowing the French captains to ignore the American commodore if they felt his orders countered their best interests. Jones' compliance was the price he paid for the donated ships and men.

By contrast, Jones' own orders from Benjamin Franklin, the American ambassador to France, were extremely permissive, the best kind for an aggressive naval commander. Franklin simply directed Jones to circumnavigate the British Isles by sailing north along the west coasts of Ireland and the Hebrides, across the top of Scotland and then down the east coasts of Scotland and England "in

order to take the enemy's property in those seas."

Jones sailed from Lorient on Aug. 14, 1779, and made landfall off the Irish coast on August 23. For the next month, he preyed on British shipping and threatened coastal areas. As a result, the admiralty mobilized militias and dispatched naval units to hunt him down—resources disproportionate to Jones' small squadron.

The deployment culminated on September 23 with Jones' bitterly fought single-ship engagement of Captain Richard Pearson in the 44-gun frigate HMS SERAPIS. The battle took place within sight of Flamborough Head, off the Yorkshire coast.

The action between Jones and Pearson, like most combat, didn't follow expectations. Jones, in a 14-year-old merchantman, had no chance of outmaneuvering his adversary, in an agile, purpose-built warship. And British gunners were better drilled than the Americans.

The ships maneuvered in light airs and slowly closed. Suddenly, there was the flash and crack of a musket shot from BONHOMME RICHARD. As the sound ricocheted off Flamborough Head, both ships ran up their colors and fired broadsides. Predictably, SERAPIS maneuvered around BONHOMME RICHARD, methodically inflicting heavy damage. As casualties aboard the American ship mounted, Pearson shouted to Jones, asking if he would strike his colors. Given the course of the battle to that point, it was a rational question. Most contemporary accounts record his response as, "I may sink, but I'll be damned if I strike!" It later morphed into the phrase that has since echoed in U.S. naval history: "I have not yet begun to fight."

Perhaps due to the slight wind shifts or a few prescient maneuvers by Jones or overconfidence by Pearson, the ships came together twice. The second time, Jones and his crew managed to hurl over grappling hooks, and the flow of battle shifted. Jones had embarked more Marines than usual, and they were effectively deployed in his ship's tops and rigging. Their muskets and swivel guns swept SERAPIS' exposed decks.

As the bloody struggle continued, a fortuitous—perhaps even chance—occurrence sealed Jones' victory. One of his crewman was perched on a yardarm, dropping hand grenades on SERAPIS' main deck, when one of his missiles sailed through an open hatch and detonated on the gun deck amid loose powder. The resulting

explosions wiped out SERAPIS' main armament, which had continued to fire point-blank in one side and out the other of BONHOMME RICHARD's hull. In a flaming instant, it was Pearson's turn to contemplate surrender. He struck, and British citizens again witnessed an American victory at sea. The shock rippled across America and Europe, particularly in London.

On October 3, Jones and his squadron—minus BONHOMME RICHARD, which had sunk after its victory over SERAPIS—put in to the Dutch island port of Texel. Jones had roiled the coasts of the British Isles, captured or destroyed British merchant ships and outfought a modern British frigate in single-ship combat, a victory that made him a hero in America and a celebrity in Paris and other European capitals. Most important, Jones' deployment was a tipping point at the Admiralty and Whitehall in London, where there was increasing concern about a French invasion of Britain. In naval terms, the Battle of Flamborough Head was what the Battle of Yorktown was to the land campaigns of the American Revolution: It shifted the paradigm.

The same unbreakable determination Jones exhibited in combat drove his dealings with civilian leaders, and as America grappled for its independence, he continued to push his forward thinking. In September 1782, he again wrote Robert Morris of the long-term future of the Navy. Morris was by then agent of marine in Congress and arguably the leading champion of young America's naval policy.

Jones' letter covered a range of subjects and began with a bit of wry humor: "The beginning of our Navy... has no precedent in history. Was it a proof of madness in the first corps of sea officers, at so critical a period, to have launched out on the ocean... to make war against such a power as Great Britain?"

Jones contrasted British and French naval tactics and assessed the difference between single-ship combat and fleet tactics. The letter also discussed a revised rank structure for officers, a signaling system for use in combat and a naval constitution that would govern the growing U.S. fleet afloat and ashore.

Toward the close of the letter, Jones suggested that America build a fleet of frigates and teach officers the principles of mathematics and mechanics at *little academies* both aboard the frigates and at shore stations. He added that officers should be "entitled to

receive instruction gratis at those academies." It was the germ of an idea that would eventually be realized with the October 1845 founding of the Naval School, precursor to the U.S. Naval Academy in Annapolis, MD.

Jones also suggested that a single frigate in his command be sent to Europe under the U.S. flag to negotiate commercial and naval agreements. If such an expedition proved too expensive, Jones offered to travel to Europe as a passenger to pursue the agreements. It was a visionary proposal for a new country struggling to emerge from the exigencies of war. Jones saw his suggestions realistically: "I am sensible it cannot be immediately adopted, and that we must first look about for ways and means; but the sooner it is adopted the better....In time of peace it is necessary to prepare, and be always prepared, for war by sea."

Unfortunately, the budget resources for the naval policy Jones outlined did not exist, nor was there broad acceptance of his vision of the role naval power would play in America's future. In fact, in 1785 America entered a nine-year period when she had no Navy at all. That lack of ships in support of national interests would contribute significantly to the onset of the Quasi War with France, the Barbary Wars and the War of 1812.

As Jones' heroic image matured, many dubbed him the *Father of the U.S. Navy*, though Robert Morris, Joseph Hewes and even George Washington have a stronger claim to that title. But if Jones —whose strategic sense of naval power was visionary and who continually lobbied for a professional Navy with global reach—does not qualify for fatherhood status, there is another title he can legitimately claim: First Sea Power Visionary.

Jones' later years and 1792 death in Paris went remarkably unheralded. He died alone, and a century later no one actually knew where he was buried—or seemed to care. But the discovery of Jones' remains in 1905 after a six-year search marked the beginning rather than end of his story, as historians rushed to discover the man behind the mythic combat hero of his 19th century biographers.

John Paul Jones' bronze and marble crypt beneath the dome of the U.S. Naval Academy Chapel bears the following epitaph: *He gave our Navy its earliest traditions of heroism and victory.* Only now do we realize that Jones also foresaw the critical role the U.S. Navy would play in our nation's history.■

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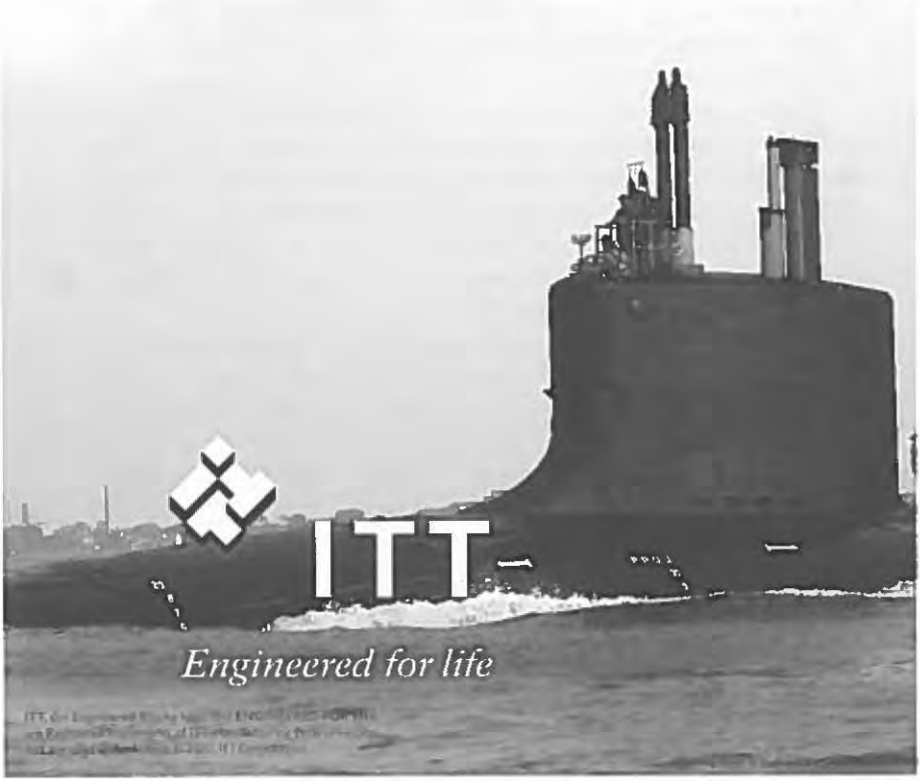

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EXCHANGE OFFICER EXPERIENCES
PEP AUSTRALIA
A GROWING ENTERPRISE

by CDR Steve Mack, USN

A USN Exchange Officer provides a synopsis of his experience in Australia on the Staff of the Submarine Headquarters and the growth of the USN Enlisted exchange during his tour.

Preparing for Australia

As my tour as Executive Officer on USS VIRGINIA (SSN 774) was coming to a close, I began to discuss shore duty options with my Detailer. I was prepared to discuss a job in the Pentagon or at the Naval War College, as I had never done a tour in Washington, DC, nor had I completed my JPME requirements. While initial conversations focused on these two principal areas for post-XO jobs, one day the conversation took an interesting turn. 'Well, I do have this job in Australia, if you are interested?' I was interested, particularly since I had spent some time with a few Australian Prospective Commanding Officers during an earlier tour of mine on the UK Submarine Command Course - Perisher. However, I asked if I could have a day to discuss the assignment with my wife, Diane. She still laughs about this. My initial trepidation stemmed from the fact that Australia was extremely far from Groton, CT, far from everything we were familiar with. Additionally, aside from my experience with the RAN officers on Perisher, I knew precious little about Australian submarine operations or the Australian people. In communications with my predecessor, CDR Doug Sampson (currently LA JOLLA CO), I learned that the job title was Principal Staff Officer for Operational Preparedness and that it most closely resembled that of an N7 on the Type Commander's Staff in the USN.

My route to Australia included several intermediate stops in the US. Only then would I start to learn the deep level of cooperation

between the USN and RAN. My first stop was in Washington, DC for discussions with the teams from PMS 404 and PMS 425, the Project Managers for the Heavyweight Torpedo and the BYG-1 Fire Control System, respectively. I was just beginning to learn about the Armaments Cooperative Program (ACP) and its significance to both the USN and RAN. The ACP began in 2003 when Australia determined that the Combat System on Collins Class submarines and the Mk 48 Mod 4 torpedo required upgrading to remain competitive in the rapidly developing military, political and economic world of the Western Pacific. With this determination, Australia became full partners with the United States in the current employment and future development of both the BYG-1 Fire Control System and the CBASS torpedo.

The USN has had a Command Screened post-Executive Officer stationed in Australia at the Submarine Headquarters for over 20 years. This job has taken on various roles in the past, but has generally focused on employment of the Mk 48 Mod 4 torpedo. My operational experience in Australia would involve the older Mod 4 torpedo (Active Snake, for those who still remember), as well as Harpoon (I vaguely remembered this from SOBC), all the way through the first ever Mk 48 Mod 7 CBASS SINKEX. In addition to these official duties, my tour included several ceremonial duties as well as significant travel throughout Australia. Along the way I met some interesting people and saw some of the most amazing scenery, all in one extremely rewarding shore duty—all thanks to my Detailer.

At Sea Operations

After arriving in Australia in late February, I relieved two short weeks later in early March. By April I was on travel to Pearl Harbor for discussions on the Submarine Command Course (SCC) for July 2007. SCC is held four times a year, twice on each coast of the United States, and features participation from the RAN annually during the July/August convening. During years in which RIMPAC occurs (even years), these operations are conducted in the Hawaiian OPAREAS. On odd years, the USN deploys an SSN to Western Australia to operate with and against a Collins Class submarine, and for the first time in 2007, also against RAN surface warships. Operations in SCC cover the spectrum of submarine capabilities

including navigation and Piloting, Inshore operations, special forces evolutions, weapons employment, evasion, and tracking, all done during roughly 3 weeks of continuous operations at sea. Throughout all of this, the students are challenged to work with the submarine crews to develop plans and respond to changing operational requirements in order to safely accomplish their assigned mission. The course provides Prospective Commanding Officers from both the United States and Australia valuable experience in operations on and against well trained nuclear and diesel submarines. This varied perspective provides insight into what a potential adversary on a similarly propelled submarine may be thinking as well as how he may operate, and could provide a significant tactical advantage during time of hostilities. I had the opportunity to be involved in the planning for SCC as well as act as the Safety Officer aboard HMAS RANKIN as she participated in SCC later that year in August along with USS BUFFALO (SSN 715). The students arrived in Australia on the 15th and we were at sea on the 18th. The students spent half of the time on BUFFALO seeing what it was like to track and shoot against a challenging SSG and the other half on RANKIN, gaining an appreciation for the capabilities and limitations of an SSG. I remained aboard RANKIN for the duration as the Safety Officer as well as providing for general *translation* and assistance in the execution of the OPORD.

In 2008, RAN participation in SCC immediately followed RIMPAC. During RIMPAC, WALLER was planned to conduct the first CBASS SINKEX—the culmination of roughly five years effort to bring BYG-1 and CBASS capability into service in the RAN. The target was the ex-USS FLETCHER (DD 992). On July 16, 2008 CMDR Brett Sampson brought HMAS WALLER to periscope depth. A target solution was rapidly and precisely developed while the weapons system was brought to the ready. At the time, STS2(SS) Vincent Campo and STS2(SS) Corey Rothrock were standing watch in the Control Room as Acoustic Warfare Analysts. CMDR Sampson ordered the weapon in tube 4 fired. In only a matter of minutes, the FLETCHER felt the full effect of the weapon, lifting it out of the water and *breaking its back*. It was only a matter of time—and a short bit of time at that—before the bow rose prominently in the air and the noble vessel slid beneath the waves, appearing to be backing down to her new watery grave. For

the firing, I was aboard as the Submarine Headquarters representative and Safety Officer. WALLER also conducted the first RAN submarine Harpoon firing since 2000 on 14 July—another event for which I was aboard. Following completion of RIMPAC, WALLER returned to port to load exercise weapons for participation in the Submarine Command Course. SCC included 23 American submariners and one Australian, LCDR James Lybrand. LCDR Lybrand had recently passed the demanding requirements of the Dutch Perisher Course and was ready to test his highly honed tactical skills with the Americans. The course includes numerous exercise torpedo firings and WALLER was to have her share. Ultimately, WALLER fired numerous exercise weapons at both submarines and surface ships. Upon completion of SCC, I disembarked WALLER along with the students to attend the debrief the following week and then return to Australia.

In addition to SCC support, I experienced additional underway time aboard Collins Class Submarines in support of weapons certification. In mid-May 2007, I was underway on HMAS RANKIN, an outstanding boat that I spent many weeks aboard during that first year of the tour. RANKIN was commanded by CMDR Phil Stanford and would later be recognized as the most capable warship in the entire Australian Fleet for 2007 by winning the Gloucester Cup. This underway was in support of her Weapons Certification and lasted about a week. RANKIN still carried the Mod 4 torpedo, so this was my first time at sea firing the Mod 4 since my JO tour. I'll take a minute to mention something that every US rider notices aboard a Collins Class submarine—more so than the fact that it is small, has women serving onboard, and rolls around a lot on the surface—the meals. The food served at sea in the RAN is fantastic. For lunch and dinner there are three choices of meals, each extremely well prepared. Several US riders—civilian and military— have commented to me that the food served at sea was the best they had ever eaten on any ship. The chefs—and they are chefs—will tell you it is the smaller crew that gives them the flexibility to prepare meals this way. I have had everything from fresh grilled barramundi to steak, pasta and chicken and found every meal to be excellent. This conclusion was also strongly supported by the enlisted sailors serving on COLLINS, RANKIN and WALLER—the food onboard an Australian submarine cannot

be beat.

In December 2007, I was underway on HMAS WALLER for planned exercise firings. Although December is summertime in Australia, you would not have known it by the sea states we experienced. For the week we were out there, we were not able to shoot a single weapon, despite the fact that the weapons recovery vessel, SEAHORSE Standard, had capably recovered in what was certainly sea state 5 during SCC a few months earlier. These conditions were markedly worse and we returned to port with all weapons we had gotten underway with. Underways and import activities in the early part of 2008 were focused on meeting the requirements for certifying HMAS WALLER to shoot the CBASS torpedo. The effort culminated with WALLER's weapons certification in April. The boat performed safely and well and was another step closer to deploying for RIMPAC 2008, SCC and Exercise LUNGFISH. The WALLER team, including Petty Officers campo and Rothrock, had worked for over a year to bring WALLER out of ASC in Adelaide and return her to full capability as a deployable asset for the Fleet Commander.

Growth of the Enlisted Exchange

During my tour, I saw the enlisted exchange program grow rapidly. Before I had completed the relief process in Australia and just one week after we had arrived in country, we were joined by the first four enlisted Sonar Technicians who were to undergo training and then assignment to Collins Class submarines. They were STS3(SS) Corey Rothrock, STS2(SS) Evan Butler, STS2(SS) Vincent Campo, and STS2(SS) Kris Davis. All had served on Hawaii based SSNs, all were single, and all were very excited about serving on a diesel submarine and earning their RAN Dolphins. They started right into training with a planned report date to their submarines of April 2007. Petty Officers Butler and Davis reported to HMAS RANKIN (SSG 78) and Petty Officers Campo and Rothrock reported to HMAS WALLER (SSG 75). Both boats had very different and interesting planned operations that would provide memorable experiences for all four of them.

In addition to the first four STS's who had arrived at the beginning of my tour, two additional Sonar Technicians, STS1(SS) Joshua Seward and STS2(SS) Timothy Mays, arrived three months

later in June 2007. Like the others, they had served on Pearl Harbor SSNs and were ready to begin qualifications on an Australian diesel submarine. They would complete the same training as the original four and would serve on HMAS COLLINS (SSG 73). April 2008 saw the arrival of a new type of USN sailor for service in Australia—ET2(SS) Patrick Tucker and ET2(SS) Walter Volkmann reported aboard, destined for service on HMAS FARNCOMB (SSG 74). They were both experienced ESM Operators from Pearl and Guam boats. They rapidly completed initial training and reported to FARNCOMB in the shipyard in Adelaide along with the rest of her crew to take delivery of the submarine following an extended maintenance period. In September of 2008, STSC(SS) Craig Werley reported aboard. A very welcome addition, he will fill many significant roles including providing direct leadership and assistance to the growing enlisted community here, expert training assistance at the Australian Submarine Training Center, and assistance in the continued development of the sonar systems carried aboard Collins Class submarines. The next planned addition will be an EHF operator/maintainer to be assigned to HMAS FARNCOMB in October 2008.

Training

My tour also included training—in some cases as the instructor and others as the trainee. In June 2007 I was at the RAN Submarine Escape Training Facility where I received training in pressurized submarine escape in the RAN 20m dive tower. The one-week long course was a requirement as I would be frequently riding RAN submarines. It featured a thorough review of the Guard Book, several hours of classroom instruction, and time in the trainer. The first event in the trainer was a 20m 'dry run' where we students were put six at a time into the recompression chamber and gradually taken to 20m to identify any problems before even attempting any in-water runs. The first two in-water runs were from a depth of 10m where we conducted buoyant ascents. This took place only after we had all satisfactorily demonstrated the correct technique for breathing on the way up. The last two events were 20m pressurized ascents in SEIE suits. The training was outstanding and safety was always clearly the top priority. In May of this year, I taught the Prospective Executive Officers Course weapons

employment along with several additional personnel interested in learning more about the weapon.

Ceremonial Duties

In addition to my formal duties, I also had the honor of participating in several commemorative ceremonies celebrated annually in Australia. One of these events is ANZAC Day, celebrated on 25 April. Unlike any holiday we have in the US, ANZAC Day is a national holiday that pays tribute to the original ANZACs (Australia New Zealand Army Corps) who left Albany, Western Australia in troop transports bound for the beaches of Gallipoli during World War I. Over the years it has expanded to recognize all those who have served or are currently serving in any branch of the armed forces. All currently serving military personnel are organized into platoons for marching in the local communities. For my first year, the Submarine headquarters marched in Perth. For my second year, we marched in Fremantle. It was a remarkable experience and one of many in Australia I will never forget. The celebration starts with dawn services around the world—anywhere there are Australians you will find a dawn service on ANZAC Day. Parades start around 0900 and the bars are generally open at the end of the parade—however, after the Fremantle march, we had to wait until 1200 for the bars to open. The rest of the day is spent with friends and colleagues in uniform, sharing a beer and a good time. The uniqueness and spirit of the holiday were put into perspective for me when my wife & I went to the dawn service in Fremantle in 2008. Service personnel, myself included, always attend in full dress uniform. As we were getting out of our car at 0445, another car parked in front of ours and out poured four young Australians with beers in hand, obviously continuing their 'socializing' from the previous evening. As soon as they noticed me in my USN uniform, they approached me, shook my hand, and thanked me for being in the military, while mentioning their love for the US. Then they gently put their beers on the roof of their car and quietly went up the hill to observe the solemn service. Only in Australia.

In May of my first year, I participated in a wreath laying ceremony in Fremantle to commemorate the Battle of the Coral Sea. Australians recognize this battle as a key point in World War II where the Japanese were turned back from a planned invasion of

Port Moresby, which was seen as a stepping stone to an invasion of Australia. In the bigger picture it was also a key victory for the Allies, one month before the Battle of Midway, in which the Japanese lost one carrier and another was too badly damaged to participate in their plans for Midway. In addition to laying a wreath, I also had a small speaking part in the ceremony which was accentuated by the backdrop of the BOXER Amphibious Readiness Group sailing from Fremantle harbor following a several day port visit.

Each year, I also participated in a wreath laying ceremony in Albany. During World War II, many US submariners served on boats that were stationed in Australia. After the War, several of these submariners moved back to Australia, homeland of their new brides. Although Memorial Day is a US holiday not observed in Australia, the City of Albany and local submarine veterans conduct a wreath laying on the Sunday of Memorial Day weekend in honor of the submarine sacrifice during the war and those still on eternal patrol. As the only US submarine officer in Australia, the person occupying my billet provides representation for the Submarine Force and generally makes a few remarks. During my second visit to Albany, we were able to bring along Petty Officers Tucker and Volkmann as the first enlisted sailors to attend the service in many years. In fact, the former mayor of Albany produced an old newspaper clipping of the last time she could recall having sailors at the memorial – it was USS DALLAS during a port visit that provided outstanding representation for the US Submarine Force. Since the trip to Albany provides the opportunity to spend time with a few surviving WWII submariners, I found these experiences to be extremely personally rewarding.

Completing the Tour

The opportunity to travel around beautiful Australia was another benefit of this tour. Over the Christmas holidays my wife and I spent a week in Melbourne and another eight days in Tasmania. After eight years in Groton, CT, it was an unusual experience to be on the beach the day after Christmas while it was 113 degrees out! By mid 2008, we had spent time in Brisbane, Sydney, Canberra, Melbourne, Tasmania, Adelaide, Broome, and all over the south-west of Western Australia. Australia is an absolutely beautiful

country and we have enjoyed the people, culture and scenery of every place we have visited.

It was not long before I began to realize just how fast our tour in Australia was clicking by. When we had been in country for about 15 months, I started talking to the Detailer about leaving at the 20 month point—much to Diane's dismay—but I wanted to get into the Command pipeline and also squeeze in JPME II. I had completed JPME I through the Air Force correspondence course in February. From the personal perspective, we had really enjoyed our time in Australia. We had decided that for flexibility it would be best for Diane to take the entire tour off from her job as an engineer with SAIC. The complications of how to deal with her taxes if she worked in Australia combined with the fact that her income would be taxed at 49% made the decision easy. However, the biggest factor was probably her desire to have the freedom to accompany me on business travel as well as plan our personal vacations around Australia.

As I returned to the office in early September 2008, I knew my relief would be on the way. LCDR Paul Varnadore will have the good fortune of serving *down under* as the USN Exchange Officer at the Submarine Headquarters starting in November 2008. In December, Diane and I will depart to start the Command pipeline in January 2009. I am reminded of something Doug Sampson told me upon my arrival: 'They only send Command Screened guys to Australia, because if they weren't they probably would not come back!' Reflecting on the 20 months I have been here, I can see why he would say that. The people are all very friendly, the country is beautiful, America is held in high regard, we speak (nearly) the same language, and we share an interesting history as *colonies* of the British Empire—what's not to love? I still haven't figured out the Vegemite thing though, but I do enjoy most other local cuisine including kangaroo and crocodile.

As I begin to prepare for turnover, I have to admit I thought my tour was going to be interesting with the varied weapons I would train on and the exercises I would participate in—and it has been. However, Paul can look forward to even more growth, with work on certifying the next platform to deploy—HMAS FARNCOMB. He will also get to work with the crew of HMAS DECHAINEUX—the first BYG-1 TI-06 boat for Australia. He will

get to participate in two more Submarine Command Courses before he enters the pipeline as well as RIMPAC 2010. He will be at the leading edge of CBASS employment and development—and—he will be living in Australia.■

REUNIONS

Submarine NR-1 Reunion/Inactivation Nov. 21, 2008 Groton, CT
LOC: Subase New London
POC:EMC(SS) Roy Hoagland, Chief of the Boat.
E-mail nr1reunion@nr1.navy.mil
Phone: 860-271-6582

USS SEA DEVIL SSN-664/SS-400 Apr. 23-26, 2009 Norfolk, VA
POC: Jim Schenk, Secretary USS Sea Devil Assoc.
P.O. Box 476, Morrisville, NY 13408 Phone: 315-824-3162

USS SAM RAYBURN SSBN-635 Apr 26-30, 2009 Fredericksburg, TX
POC: Doc Rushing 16269 My Road, Miles, TX 76861
Phone: 325-468-2213 E-Mail: SSBN-635@HullNumber.com

USS BUSHNESS AS-15 May 3-6, 2009 Raleigh, NC
LOC: Raleigh North Hilton, 3415 Wake Forest Road, Raleigh, NC 27609
POC: Ben Supowitz, 13675 Philmont Ave., Unit #3, Philadelphia, PA 19116
Phone: 215-676-3585 E-mail: benel24@comcast.net
APOC: Mike Wentzel, 417 Main St., Oley, PA 19547 Phone: 610-987-6641

USS SCAMP SSN-588 May 5-9, 2009 Charleston, SC
LOC: Mt. Pleasant Holiday Inn
POC: Lou Minor, 3260 Hector Road, Newcastle, CA 95658
Phone: 916-425-2149 E-mail: lou@uss-scamp.com
Web Site: http://www.uss-scamp.com

USS SEA FOX SS-402 May 10-14, 2009 Branson, MO
LOC: Settle Inn
POC: Roy Athey, Phone: 417-581-1887 E-mail: rondo_94590@yahoo.com
George Arnold, Phone: 913-441-1998 E-mail: seafox@kc.rr.com
Web Site: http://seafoxassoc.homestead.com/09muster.html

USS SEGUNDO SS-398 May 31 - Jun 4, 2009 New London, CT
LOC: Edgewater Hotel, Laughlin, NV
POC: Ken Owen E-mail: kenowen@cox.net

USS GUARDFISH SSN-612 Jun 23-27, 2009 New London, CT
POC: R.E. "Twig" Armstrong, 15 Duckworth Road, Hebron, NH 03241
Phone: 603-744-2078 E-mail: ussguardfish@metrocast.net
Web site: http://www.guardfish.org


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A COMPARISON OF SECOND WORLD WAR FIRE CONTROL METHODOLOGY IN U.S. TANKS AND U.S. SUBMARINES

by Dr. Edward Monroe-Jones and Mr. Michael Green

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

Mr. Michael Green is one of the country's leading experts on tank technology and tank history. He is the spokesperson for the Littlefield Tank Restoration Facility in Santa Clara, CA and author of several books on tank development including The Tiger Tank at War, The Sherman at War and The Panther at War, all published by Zenith Press.

Tanks and submarines have a few common characteristics. They are mobile weapon platforms that encapsulate their crews. Their missions are to destroy their opposite number in the enemy's arsenal as well as crippling other enemy valuables. Their dissimilarities outnumber their commonalities by virtue of their operational environments and discrepant motion patterns. During the Second World War, these differences manifested themselves in dissimilar fire control methods.

The United States produced the M4 series of Sherman tanks in great quantity. It was classified as a medium tank because of its weight and had limitations that have been described elsewhere in detail. Many of the tank's shortcomings were corrected during the war, including the improvement of its 75 mm cannon. In making improvements to the tank's fire control, the Army found that, as

telescopes and periscopes became more complicated, operational reliability was reduced. For that reason it built into its tanks a redundancy of fire control sighting equipment. For example the Sherman tank commander had a vane type sight mounted on the turret top in addition to its telescopic gun sight and periscope.[1] This could be used when the gunner's optics were knocked out of alignment. The German Panzer IV medium tank used a bar sight as back up.

Tanks were equipped with a coaxial machine gun. It was exactly parallel to the cannon and was used to lay the cannon onto a target. The gunner fired the machine gun and when the tracer bullets were observed to strike the target the cannon was fired. This practical approach to fire control accuracy had the obvious drawback of revealing the location of the firing tank. Nevertheless, it was a primary method of gaining an accurate range.

Submarine fire control methodology consisted of solving mathematical problems in the sinking of ships, while tank crews relied on the commander's spontaneous ability to determine range and azimuth.[2] A submarine's water environment required it to accurately define its own motion and that of the target. The captain and fire control party visualized the attack situation from the comfort of a quiet and relatively level conning tower.

On the other hand, the commander of a Sherman tank had no such luxury. His tank was equipped with a primitive pitch dampening gyro which was designed to hydraulically maintain cannon stability as the tank bounced over uneven terrain, but the gyro was so unreliable that it was seldom used. Even when the system operated as designed, it only compensated for movement around one axis and as such was of little use.[3] The Germans also unsuccessfully tried to install a stabilizing gyro in its tanks. Second World War tanks could not shoot their cannons with accuracy while moving.

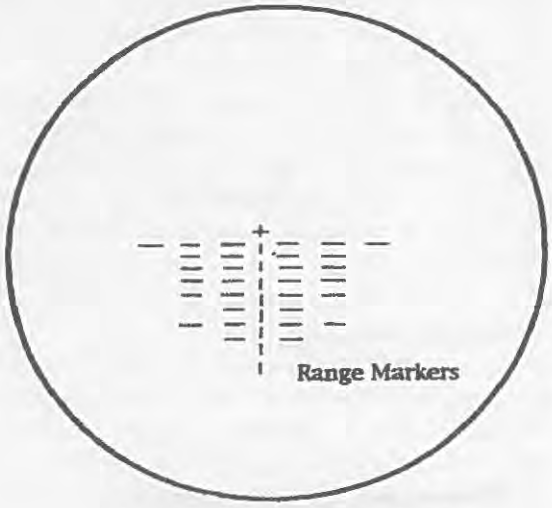
Projectile velocity was produced by expanding gases in a tank's barrel. The longer the barrel the greater the exiting velocity. German Panzer IV and Panther tanks increased the length of cannon barrels from L33 to L44 to L48 and finally to L70. Medium German tanks were limited to barrel lengths of L48. These had muzzle brakes which helped to dampen the violent recoil. The Sherman's 75 mm gun was likewise lengthened for greater muzzle

velocity.[4] Modifications to the Sherman turret included strengthening gun trunnions, installing recoil shock absorbers and adding a travel lock for the barrel. The German Panzer IV's turret floor had to be modified to allow for full barrel elevation.

Greater muzzle velocity produced longer ranges and medium tanks on both sides increased cannon ranges up to about 2000 yards, although such an extreme distance was achieved at reduced penetration power and accuracy. A Sherman tank commander, seeking to increase his barrel elevation often placed his tank on the rise side of an earth depression. It is interesting to note that the optimum range for a submarine's torpedo attack was about 1200 yards with most approaches being less that 2500 yards.

Tank battles were fast-paced with repetitive target acquisition requiring furious loading of either HE or AP rounds as determined by the tank commander. Instant reactive response to the tank commander's orders were required in aiming the cannon on successive targets. While American tank training manuals called for precise phraseology, the tank commander typically used terrain features to guide his gunner onto target. The gunner had the option to use the tank commander's estimate of range, to use his coaxial machine gun to validate range or to use his gun sight to obtain a range. In practice, he might use all three or any combination.[5]

The Sherman gun sight was a low power telescope (M70F, 3 power, 22 inches in length) with a drum on the side of the telescope mount. By turning the drum the gunner could align range markers (AP on one side of a vertical reticle and HE and on the other side) onto the target image. In so doing, the telescope was moved upward or downward in relation to the cannon barrel. As the telescopic sight was depressed for greater range, the barrel was correspondingly elevated. The amount of the barrel's super elevation determined the ballistic arc of the projectile in flight to the target.[6]



Sherman Tank Sight Image

Second World War tank fire control methodology has been described as *seat-of-the-pants*. In contrast, during the same period, United States submarines sank ships using fire control methods that centered on bringing the submarine into firing range so that it could release a torpedo to hit the target at impact point.

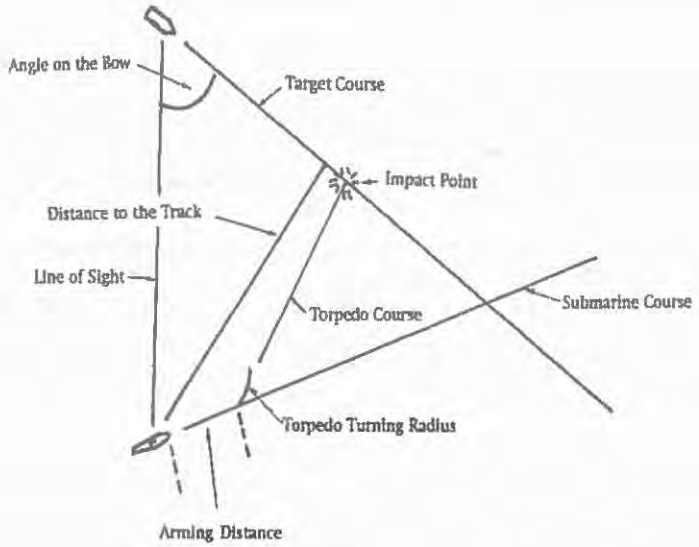
Bearings, the line-of-sight direction from the submarine to the target ship, were obtained through the TBT, (Target Bearing Transmitter), when on the surface and periscope when running submerged at periscope depth. Bearings could also be acquired using radar and active sonar; however, enemy ships were normally equipped with electronic emission detection gear and the use of radar/active sonar meant divulging the submarine's presence.[7] It chose to emit electronic impulses into the air or water as sparingly as possible. When obtaining target bearings, passive sonar, which detected underwater sound by hydrophones, was normally used without compromising the submarine's position.

Obtaining bearing information was relatively simple. On the

other hand, range information posed a much greater problem. When making a surface approach the experience of the captain in estimating range was the primary source, just as it was with the tank commander. When running submerged, the periscope was used. It was equipped with a stadimeter which presented a vertical split image of the target. Knowing the height in feet from target waterline to top of masthead, (obtained from a ship-type reference manual), the target split image could be vertically aligned so that the waterline of one image was at the tip of the masthead of the opposite image. The quartermaster could then read the range in yards from a range dial on the opposite side of the periscope. Typically, the quartermaster or a designated officer read relative target bearing from a periscope ring calibrated in degrees, and target range from the stadimeter dial. This information was fed into the Torpedo Data Computer, which mechanically generated a continuous picture of changing submarine motion and target motion.[8]

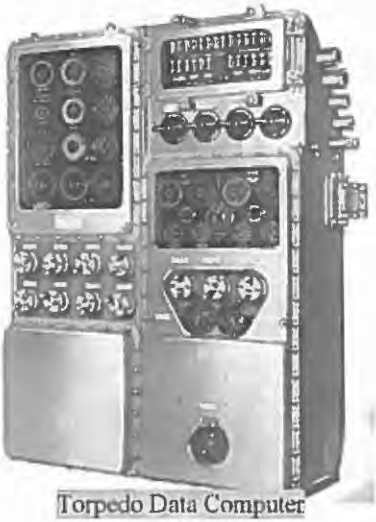
The primary weapon used by American submarines was the Mark 14, Mod 3A torpedo.[9] The TDC produced electrical signals through a synchro-servo system that turned spindle settings in the torpedo. These consisted of running depth, course to the impact point and torpedo speed which could be set at either 30 or 45 knots. Since the range of the torpedo greatly exceeded most firing solution ranges, the normal speed setting was 45 knots.

The essence of the submarine fire control problem was defining the impact point when both submarine and target ship were normally in constant motion. With own-ship (submarine) course and speed entered into the TDC, the problem became one of estimating target speed, from sonar turn-count information and captain's observations of bow wake, and of estimating target course by the captain's estimate of target's angle-on-the-bow or aspect angle.[10] By translating relative bearing to true bearing and knowing the angle-on-the-bow an accurate target course could be entered. It then became a matter of trigonometry. Knowing the distance to the target (leg of a right triangle) and the angle in degrees formed by the target's track and line-of-sight, an accurate distance to the track could be calculated.[11] Extending the track by knowing the target's speed, a torpedo course could be determined taking into account the torpedo's travel before turning and the turning radius of the torpedo.



Submarine Fire Control Diagram

A critical concept was that when zero torpedo gyro angles were used, (when the submarine's torpedo tubes were aligned to the impact point as one would shoot a gun) an accurate range became less critical to a hit. Of course, the solution's weakness lay in the possibility that a target could change course or speed during the torpedo's run and thereby avoid the impact. Likewise, it could change course at intervals (zig-zagging) which would require the submarine tracking party to restart its problem-solving effort. Submarine fire control techniques tended to be somewhat complicated because nearly all approaches were with large target deflection angles and slow-running torpedoes. This meant large lead angles with less probability of a hit unless the impact point was precisely predicted. The process involved input from several sources: periscope, sonar, TDC and a plotting party that was not in the conning tower and that had all the inputs of the TDC. This party, usually of two or three officers and highly qualified enlisted men, independently ran a geographical plot and acted as a confirmation of data produced by the TDC.



Torpedo Data Computer

Unlike the tank, the submarine had time on its side. Being the predator, it stalked its prey and often threw in the towel when a correct solution was impossible. It then surfaced, went to flank speed and out ran the target ship to again lie in wait for the ship to cross its path. More than one end-around was sometimes necessary and a single chase might take up to several days. Patience and persistence were the watch-words for successful submarine captains, but it was an exhausting process. Since most target ships were escorted by anti submarine escorts, the attack also involved the trauma of repeated depth charge attacks.

The obvious similarity of Second World War tank and submarine attack doctrines was the need for visual contact with the target. If one couldn't see the enemy it couldn't be destroyed. This meant that ranges beyond 2000 yards were improbable.[11] The nature of the submarine attack was slow, calculating and required great patience. The tank battle could be defined as, *kill him before he kills me.* The tank crew worked feverishly to find favorable cover, load the proper ordnance and quickly determine the azimuth and range to target. This was repeated many times during a battle.

The one paramount similarity was the claustrophobic environment of tank and submarine. The respective crews depended entirely on their vehicle's strength, on the reliability of their equipment and the ability of every man working as a member of a team.

ENDNOTES

1. Green, Michael and Brown, James D., *M4 Sherman at War*, Zenith Press, St. Paul, 2007, p. 85.
2. The layman's term for direction is *bearing* in the parlance of the submariner and *azimuth* in that of the tanker. The layman's term for distance is *range* for both submariner and tanker.
3. After the war the M60AIE2 tank was equipped with the General Electric Optimum Ratio Stabilization Drive. This dual axis system allowed tanks to shoot while moving over rough ground at maximum speed.
4. The 75 mm M4 was improved to include a muzzle brake on a longer barrel. The M4A3 (76) with a 76 mm barrel was produced in early 1945.
5. Ogorkiewicz, R. M., *The Technology of Tanks*, Jane's Publishing, London, 1991, p. 62.
6. Matheny, Michael R., Development of Fire Control Equipment, *Armor Magazine*, March 1980, p. 42.
7. Friedman, Norman, *US Submarines Through 1945*, Naval Institute Press, Annapolis, 1995, p. 218
8. Prior to the installation of the TDC, periscope approaches were made using a hand-held, slide-rule type calculator called the, "Is-was" or "Banjo." In the early 1950s the Mk 101 fire control system replaced the TDC.
9. Ibid., p. 242.
10. Alden, John D., *The Fleet Type Submarine in the US Navy*, Naval Institute Press, Annapolis, 1979, p. 46,47.
11. NWIP (Naval Warfare Information Publication) 23, Fire Control and Tactics Manual, p 47.
12. In January, 1945 gunner Corporal Frank Conway in an M4A1 Sherman was ordered by tank commander, Sergeant Edward P. Vickless to fire at a Panzer IV at an estimated range of 2250 yards. Conway was able to elevate the gun sufficiently because the tank had been dug into a slight terrain rise. The target was stationary and he was able to carefully adjust the sight before firing. He destroyed the Panzer IV with only one round and later described the feat as, "the luckiest shot in World War Two." The target had been 1.278 miles according to Andy Woods, loader, who regarded any shot over a mile as a waste of ammunition.

ONE KNOT AT ONE MILE EQUALS ONE DEGREE A MINUTE

by Captain Jim Patton, USN(Ret.)

Captain Jim Patton is President of Submarine Tactics & Technology of North Stonington, CT. He is a retired submarine officer who commanded USS PARGO (SSN650). He is a frequent contributor to THE SUBMARINE REVIEW.

Background

At the Naval Submarine League Technical Symposium at APL Johns Hopkins last May, RADM Joe Walsh, COMSUBPAC, essentially threw down a gauntlet to the Submarine Force when he shared his observations that junior officers no longer seemed to be the resident experts on the newest Fire Control processes and techniques, but were relegated to lesser duties during Battle Stations – leaving the operation of the Fire Control systems to admittedly well-trained and competent Petty Officers. This was not the scenario that he, and others of his and previous generations of submariners were used to. A justifiable question begging an answer is— if, at the Ensign and Lt(jg) level, fire control skills are not acquired, refined and polished, at what point prior to Command will they be, or will future COs become totally dependent on their admittedly well-trained and competent Petty Officers?

Discussion

The acquisition of human skills involves three distinct and necessarily sequential steps. First, *Concepts* must be taught (F = ma is not intuitive to most); second, *Procedures* (solidly based on valid concepts) are studied; and third, *Technique* is practiced. In such as baseball, concepts (hit a ball to land where nobody is) and procedures (fail three times and someone else gets to try) are almost trivial, and technique is everything. For a sub-atomic particle physicist, concepts are everything with procedures and technique being almost non-existent. Submarining is somewhere in between.

Significant problems can arise if the CPT steps aren't taken in the proper sequence. It is no accident that in our naval nuclear propulsion business one is taught the concepts of the 4-factor formula and sub-critical multiplication long before doing a *pull-and wait* initial reactor startup.

If young officers are having problems assimilating the skills necessary to operate the Fire Control System on their first boats, could at least a partial part of the issue be that they are being *trained* (procedures and techniques) on a system other than what they will have rather than being *educated* on the universal concepts behind all of those systems? The 4-factor formula and sub-critical multiplication are as applicable to the OHIO's S8G plant as they were to S1W of NAUTILUS.

There are many elemental truths associated with Fire Control Systems, Target Motion Analysis (TMA) and relative motion (which are really essentially all the same thing). One of these is the title of this article which, when armed with, enables the rapid derivation of the Ecklund range formula—surely existing, in some digital form or another, in *any* Fire Control System. A million or so years ago, when the author was the XO to then CDR Bruce DeMars on the fine ship CAVALLA, he required me to start all wardroom meetings with a brief *mental analysis* quiz that was over in about 2 minutes—these quizzes consisted of about 10 *simple* problems presented some 7 seconds apart (i.e. what is the reciprocal of bearing 258?; what is the speed-across-the-line-of-sight of a 24 knot target with a stbd 18 AOB?; what is the range to a destroyer type target that is 0.8 divisions in high power?; a 306 Hz line shifts to 308 Hz – what has been the change of speed-in-the-line-of-sight?; etc.). The object was to acquire the ability to get almost the right answer very quickly, and depended on exploiting a number of simple *thumb rules* – i.e. for reciprocals either add 200 then subtract 20 (for *small* numbers), or subtract 200 then add 20 (for *large* numbers); for sine values, every 6 degrees is a tenth and every 10 degrees is a sixth; for telemetric ranging all ships are 100 feet tall except those that aren't; for range rate, 3000/freq=knots/Hz.

As might be expected, the initial exam results were awful, but surprisingly soon everyone was getting 9 or 10 out of 10 correct every time, having developed the *technique* of exploiting the thumb rule *concepts*. Those who attended tactical team training at

Submarine School during the early 80s probably remember being given a cassette tape containing dozens of such drill questions for their on-board use as desired.

A very real explanation of why *paper plots* hung around so long could be that there are few evolutions that, at least subliminally, *educate* one on the essential elements of TMA better than manipulations of a strip or expanded time-bearing plot or looking at a contact evaluation plot from across the Control Room. If they are no longer taught in SOBC, perhaps they should be—regardless of whether they're used in the fleet anymore or not.

Conclusions

I am certainly not in a position to know what is or is not presently being done in SOBC, and absolutely have no right do to be judgmental about things I am ignorant of—perhaps all of the above is already operative and these words are but the ramblings of a "ustabe"—I would hope that is the case. If not, the observation is made that enlisted *pipeline* time limitations make it appropriate to *train* (minimum concepts, but heavy on system-specific procedures and techniques) our *admittedly well-trained and competent Petty Officers*, but to assure a seamless evolution from Division Officer to Commanding Officer, there is no alternative but to *educate* (heavy on concepts, adequate on non-system specific procedures and techniques) the wardroom bosses of these exceptional Petty Officers. After all, these young officers actually become PCOs at the completion of SOBC and will require a firm foundation in fundamentals as specific features of Fire Control (and other) systems change many times during their decade and a half of apprenticeship.■

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ABOUT AN AMERICAN NUCLEAR SUBMARINE OF THE NEXT GENERATION

By Dr. George Sviatov
Naval Architect
Captain 1 Rank (Ret.), Russian Navy

Dr. Sviatov is a frequent contributor to THE SUBMARINE REVIEW and has been a knowledgeable observer of submarine characteristics across the world.

The problem of a configuration of the next generation of the United States of America nuclear attack submarine is a reality.

On the other hand, it is possible to say that existing American nuclear attack submarines of the Virginia class are ideal and it is not necessary to create something new. Maybe, but let us also think about something else.

First of all it is necessary to say that in proper time the naval architects and submarine community of the USA will be confronted with the dilemma of what to do? Continue to build the Los Angeles class subs, build Seawolf new attack class or create something new?

Because of less displacement and cost, they decided to choose the Los Angeles as a prototype of the Virginia class new American SSN, and now maybe it is reasonable to go by a similar pattern.

Following that way and using the Virginia as a prototype of the new American Nuclear Attack Submarine, it is possible to preserve almost all of her naval architectural and operational characteristics, increasing only some 10% the sub's diving depth, using improved hull steel, and keeping almost the same but more sophisticated weapons and electronics systems. The result would be a bit improved Virginia class sub with 40 weapons (and 12 vertical missile launchers and four torpedo tubes) and a minimum possible cost. It is a very attractive option.

But there is another option: to take as a prototype of a new US nuclear attack submarine the SSN Seawolf. From the point of view of this article's author it is, maybe, a more attractive option.

The Improved Seawolf class American nuclear attack submarine, which now have eight 26-inch torpedo/missile tubes and 50 weapons (torpedoes and cruise missiles) could be easily modified for carrying not 50 but 66 weapons by installing in its first ballast tank 16 cruise missiles in the vertical launching tubes. That gives a possibility to have almost doubled the weapons payload on a future submarine in comparison with VIRGINIA by a very small increase of cost.

People are saying that brevity is a sister of talent. I agree.

In support of the premise I would like to present characteristics of Seawolf. Virginia, improved Virginia and improved Seawolf class American nuclear attack submarines in comparison with Acula class (Project 971) Russian nuclear attack submarine.

Characteristics	*Seawolf*	*Virginia*	*Acula*	*Improved Seawolf*	*Improved Virginia*
Submerged displacement, t	9,125	7,800	13,000	10,000	9,000
Length, meters	107.6	114.9	114.3	110.0	120.0
Number of torpedo tubes	8	4	8	8	4
Number of missile launchers	0	12	0	16	12
Number of weapons	50	38	40	66	60
Underwater speed, knots	37	33	32	37	35
Test diving depth, m	600	600	600	700	700
Complement, men	133	113	53	100	90
Cost, billions dollars	1.5	2	1	2	2

It seems that the Improved Seawolf would be a very attractive and cost-effective option. The most advantageous indicator of that option would be an increase the number of the sub's weapons from 38 to 66. And increasing the number of vertical cruise missiles launchers from 12 to 16 and the number of torpedo/missile tubes from 4 to 8 is an additional operational advantage of the Improved

Seawolf. It should be mentioned that using practically ideal naval architectural scheme with a little more steel strength will give the possibility of an increase to some degree of the diving depth of the submarine and its blast resistance.

It should be stressed that the more simple option of the United States nuclear attack submarines development is continuation of building the Improved Virginia class SSN's using new steel and increasing a little bit their diving depth and blast resistance. It would be the cheapest way and in principle the number of weapons on the subs can be increased by increasing the number of internal reserve weapons from 22 to 44 and the overall number of weapons from 38 to 60. But in such a case the Improved Virginia would be too long and not completely perfect from a naval architectural point of view. But that option would be the most cost effective and cheap way of an American Nuclear Attack Submarines development.

On the first glance, the problem of choosing a new United States nuclear submarine configuration is extremely difficult and sophisticated. In principle that's correct. In the civilian area a similar problem is choosing of a new mass production car for the American people. In deciding that problem the major role must belong to the US Navy, which must solve the problem: what is better for it: an improved Virginia or an improved Seawolf?

The crucial question in this dilemma is the overall cost of a program for building of 20-30 new nuclear attack submarines with a unit price of some 2 billion dollars. Certainly such a cost would be lower if the United States Navy will choose the Virginia class SSN as a prototype for a new US Navy's nuclear attack submarine of the XXI century.

In conclusion I would like to answer a question, which the Chief Editor of THE SUBMARINE REVIEW put to me recently. Is it reasonable to reduce the sizes of the submarines' torpedoes and missiles in order to increase the numbers of them and increase its combat cost-effectiveness?

By my opinion, such a way is not proper for the United States Submarine community. Why?

The Soviet Navy went in the contrary different direction.

Having the two meters longer than American same caliber (21 inch, 533 mm) torpedoes, Russians decided also to create a huge 650 mm caliber 12 meters long torpedoes. Maybe, their monsters

had some advantages in explosive power and range, but they were not decisive in comparison with standard 533 mm torpedoes. In addition it appeared that the big torpedoes were less reliable and more dangerous. The loss of the Russian SSGN huge nuclear submarine KURSK in 2000 happened as a result of an accidental blast of such a 650 mm torpedo.

So, as it seems to me, the existing size of 533 mm 6 meter long MK-48 type American submarines' torpedoes and the same size cruise missiles is optimal and must be preserved for future American nuclear attack submarines. The reduction of the American nuclear submarines' torpedo and missile sizes cannot be recommended.■

FRIENDLY FIRE ATTACKS

by ENC(SS) (DV) C. Mike Carmody, USN(Ret.)

Mike Carmody enlisted in the Navy December, 1941 at the age of seventeen. After attending three weeks of accelerated Boot Camp at Newport R.I. he volunteered for submarine duty. Due to the shortage of submarine sailors he was assigned to submarine duty without attending Submarine School.

During WWII he made eleven war patrols on submarines as a Machinist Mate. His military service earned him the Submarine Combat Pin with four bronze stars, the Naval Commendation Medal for valor and numerous other awards. During the Cold War era he made several submarine deterrent patrols. He retired from active duty in 1963.

Mike Carmody has written over 20 submarine stories which have been published in several military magazines.

During World War II most submariners could probably recall close calls from friendly fire attacks by aircraft and surface vessels. Luckily, most of these encounters resulted in minor damage.

Submarine sightings struck fear into any observer and often a friendly vessel or aircraft would attack without taking precautions.

My story is about an aircraft attack on USS S-17 (SS-122), commanded by Brooks Harrel, that resulted in major damage and injuries to several of her crew. Before doing so, I will first relate three such incidents that proved fatal to American submarines.

In the latter part of January, 1942, USS S-26 (SS131) was assigned to escort duty. She departed Balboa, Panama, under the guise of darkness, en-route to her patrol area. A naval patrol vessel struck her on the starboard side of the torpedo room. The S-26 sank quickly, taking 46 of her crew with her. The only survivors were the Captain, Executive Officer and a lookout. They were all on the bridge when the collision occurred. Rescue and salvage operations

were impossible because of the water depth.

On 6 October 1943, USS DORADO (SS248), a new construction submarine, departed from the New London Submarine Base, Groton, Connecticut, en-route to the Pacific. A few days later, a PBY Mariner Flying Boat from Guantanamo Bay Air Station spotted the DORADO on the surface traveling south in the designated submarine safety lane. Ignoring this, the aircraft attacked and dropped bombs on her. DORADO went down with all hands.

Searchers were sent to the incident location. Tragically, all that was found was a large oil slick and floating debris. 90 men lost their lives in that incident.

In October 1944, USS SEAWOLF (SS197) was involved in a special mission to land 17 soldiers and supplies on the island of Samar, one of the Philippines. While north of Halmhera SEAWOLF was submerging in a submarine safety lane when two Grumman TBM Avengers from a US aircraft carrier spotted her. Thinking she was an enemy submarine, the planes dropped two bombs and a dye marker. Also involved in the attack was USS ROSWELL, a destroyer escort. ROSWELL made six attacks on the SEAWOLF with hedgehogs and depth charges. The escort heard SEAWOLF's signal, but continued its attack. SEAWOLF was lost with her crew of 82 men and 17 soldiers.

My personal experience took place in July, 1942, a few days before my eighteenth birthday. It was my third war patrol onboard the S-17 (SS-122).

We were patrolling on the surface, making 5 knots in heavy fog, off the Windward Islands in the Caribbean. The fog was so thick it was impossible to see the bow from the bridge.

I was the high lookout located between the periscopes. The slow forward movement and rocking motion of the ship put me into lolling dreamy state. I asked myself, "What the heck am I doing on this twenty-two year old pig boat?" The crew totaled 38 men and we had to share one head and a shower. There was no air conditioning, no radar, no hydraulics, no Corpsman, and all dives had to be made by hand.

A large circle was painted on the after deck with different pie shaped colors. The colors were changed every month distinguishing us from the many German U-boats operating in the area.

In an instant I was jolted back into reality by an opening in the fog. We had entered a clearing approximately one and a half miles in width. The Captain instructed us to keep a sharp lookout as we crossed the clearing.

A moment later, I saw a large Lockheed radar equipped twin engine patrol bomber closing in on us. The aircraft was just above the water off our port beam.

The Captain immediately fired off the designated color recon flare. The plane banked sharply and disappeared into the fog. Approximately two minutes later it reappeared and closed in off our port beam. The aircraft was so low I could see the pilot. I was shocked and surprised to see the plane's bomb bay door was open. Four five-hundred pound aerial depth charges were discharged. One after the other they hit the water as I watched spellbound. The first two exploded approximately 200 feet off the boat, showering us with a large spray of water. The next two exploded beneath the hull with a devastating effect. The force lifted the boat out of the water, completely exposing the stern and propellers. I was struck in the face and chest with flying objects. The skipper was also struck in the face and was bleeding. My two top front teeth were knocked out and my upper lip was severed and hanging by thread of flesh.

Below, in the engine room, men suffered broken bones. Others throughout the boat had sustained cuts and bruises.

Through his bloodied mouth, the captain ordered, "Shoot that bastard down on his next pass!" We stood by with our three Lewis machine guns and one BAR (Browning Automatic Rifle).

The aircraft was circling approximately a half mile from us. The pilot eventually realized his mistake and signaled us by light. He apologized and advised us he had radioed for help.

Later, in the Captain's state room, the skipper sutured my lip back together with the use of the ship's emergency medical supply kit.

We could only use our port shaft for propulsion. The starboard motor had broken loose from its mounts and was out of line. The S-boats were direct drive, not electric, as were the Fleet Boats. The attack also caused extensive ballast tank damage and considerable loss of hull rivets, making diving impossible.

We steamed to Coco Solo, a Naval Air Facility in the Panama Canal Zone, for repairs and medical treatment. It took four days to

reach our destination. Air protection was provided to us by the Navy.

The injured received medical treatment at the base hospital and returned to full duty. The base doctor commended the skipper for the fine job he did in repairing my lip.

During a subsequent investigation the pilot explained to the investigation panel that the German U-boats were displaying colored circles on their aft deck, as were the American submarines.

The only good news that stemmed was that we were being sent stateside to the Philadelphia Naval Shipyard for repairs.■

SUBMARINES IN THE CINEMA

by Dr. Anthony Bellomo

I have been researching my book, Submarines in the Cinema, for the past several years. The purpose of the book is to review the experiences of those who have served in submarines in comparison to how they have been portrayed by film makers. In particular, I feel it extremely important to try to more accurately chronicle the efforts of those heroic submariners who turned the tide of the war in the Pacific during WWII. Sadly, in the decades to come, all that will remain will be the somewhat distorted cinematic glimpses of what actually took place. As part of my research, I have conducted interviews with many submariners in order to explore how their history is versed by Hollywood. I have also been interviewing those involved with the production of the various films to determine how they arrived at their portrayal of life in submarines. A large part of my own contribution is primarily to discuss the accuracy of various models used in these movies. In my professional life as an orthopedic surgeon the analysis of visual detail is extremely important. In my private life I have been building models for over forty years and attempt to put the same attention to detail into my hobby. Therefore, I find researching this subject is both challenging and rewarding.

Through my research of submarine movies it has become apparent to me that there are three major categories of submarine movies. First, there are the submarine movies where the sub shown as a main part of the plot and almost the entire movie takes place on a submarine at sea or on a war patrol (I will discuss three in detail). Second, as a supportive role and it is only seen at various times to support the plot of the movie. An example of this type of film is On the Beach in 1959 with Gregory Peck. And thirdly, as cameo *roles* where the sub is only seen briefly to add intrigue to the movie.

The three films of the first category that will be discussed in depth are Destination Tokyo, Operation Pacific, and Run Silent, Run Deep. It would be safe to say that these films have long been considered, for better or worse, *quintessential* submarine movies.

As a youngster, in the pre-VCR era, I would scan the weekly TV Guide for these types of movies and attempt to watch them even if they were in the early morning hours.

Destination Tokyo is a 1943 film with Cary Grant. It is a fairly exciting film with very good model footage that is used in many other submarine movies that followed. In particular, the screenplay for Submarine Seahawk (1958) was actually written around the model scenes. Incidentally, Submarine Seahawk was directed by Spencer Gordon Bennet who also directed that B-movie sci-fi classic The Atomic Submarine (1959). In general, Destination Tokyo is a fine film, but it is a typical wartime film with a propaganda type message and many Japanese racial slurs. The crew takes their boat, COPPERFIN, into Tokyo Bay and obtains weather and tactical information for the Doolittle Raid. A similar mission to that actually took place March 1942. Clay Blair describes in his book, Silent Victory, that USS THRESHER under command of William L. Anderson was sent to Tokyo Bay on a special mission to supply weather reports prior to the bombing of Japan..

The film also shows an appendectomy being performed by a pharmacist's mate while on the bottom of Tokyo Bay. As indicated in Blair's book, three appendectomies actually took place on submarines while on war patrols in 1943 (specifically SEA DRAGON, GRAYBACK, and SILVERSIDES). Also of interest the submarine in the film has four forward and four aft torpedo tubes. This would indicate that it was a boat of the New "S" classes (1st and 2nd groups). Only sixteen boats in the US Navy had this configuration. *(Editor's Note: SS182 through SS 197)*

The submarine set is of a typical early war fleet boat with only the rear of the superstructure cut away and it also it appears to have a very low freeboard. The scenes of the interior of the sub are somewhat simplistic. However, you get a feeling for the curvature of the inside of the conning tower.

The models used in the movie are fairly accurate, showing a pre-war fleet boat which, similar to the submarine set, has the aft superstructure cut down. The freeboard of the surfaced model is also too low. The model does have a raised bullnose rather than the recessed bullnose that became standard for all fleet boats after the Tambor class. The model has a bow net cutter, which was never used in the US Navy. The models of the Japanese aircraft carrier

and destroyer are somewhat rudimentary. The carrier looks like a composite of an early and late Japanese Navy designs, similar to the KAGA. There is tiered forward flight deck that was seen when the carrier was initially built using a battleship hull. There is also a small bridge structure on the model that was present after reconstruction of the KAGA with the flight deck being converted to one level. Finally, there is a rather unique underwater model scene that shows the capsized destroyer settling towards the bottom as the submarine moves away.

A final word on this movie, in Paul Kaplan's Book Run Silent there is a photograph of a fleet boat being launched in Groton after the movie came out with a banner covering the torpedo tubes reading *Destination Tokyo*. This is an example of life imitating art.

The second movie of this category is Operation Pacific (1951) with John Wayne and Ward Bond. This is a film which appears to be a complication of various documented wartime submarine activities. The first being the evacuation of a new born, several children and Catholic nuns from a deserted jungle beach using rubber rafts. There were several occurrences where missionaries and orphans were taken out of harm's way by U.S. submariners in the Pacific. Theodore Roscoe's book United States Submarine Operations in World War II discusses a situation where NARWHAL transported a group of evacuees including a baby (p.273). That drawing at the beginning of the chapter also shows Catholic Nuns coming aboard NARWHAL. This episode took place in Nasipit Harbor, Mindanao. A similar situation took place involving NAUTILUS during its fourth war patrol in late 1942. A group of 29 evacuees, including three Catholic nuns and several children, were brought aboard. I spoke to Floyd "Red" Porterfield who was a part of NAUTILUS' crew at the time and he indicated they surfaced at night in Teop Harbor in the Solomon Islands on December 31st. Red was personally involved with bringing the nuns aboard using the 26 foot motor launches that were kept inside the boat's large superstructure. The evacuees also included a German citizen but not an infant. They were on board until January 5 and then taken ashore at Tulagi Harbor.

The film also shows a depiction of how Commander H.W. Gilmore heroically sacrificed himself to save GROWLER after it was badly damaged by a collision with a Japanese gunboat. Ward

Bond is shown giving the famous order, "take her down" while Gilmore remains wounded on the bridge. Roscoe's book has a drawing of this event and a good series of photos showing the damage to GROWLER's bow and how it was repaired. The movie shows the bow damage quite accurately.

Thirdly, the movie also depicts how the problem of the torpedo warheads was solved during World War II. In the movie, they take a torpedo warhead and drop it from a height. Blair's book corroborates these events. He discusses how dummy warheads were fitted with exploders and dropped "from a cherry picker on to a steel plate from a height of 90 feet" (p.411). Also, the film shows involvement of the submarines in the Battle of Leyte Gulf. American submarines were extensively involved in all aspects of the Leyte operations from detection, tracking the enemy formations and offensive involvement to life guard duties.

In general, consensus among the WWII submarine veterans I have interviewed, including Red Porterfield, is that the portrayal of submarine wartime activities in Operation Pacific is much more *Hollywood* than history.

The stock footage of submarines used in the film is a hodge-podge of different submarines and is quite inconsistent. Submarines of Gato and Balao classes in various war configurations were used to depict the same submarine. Apparently it was felt that the audience would not be able to tell the difference. Interestingly, footage of a Japanese I-400 class submarine being bombed is used to represent an American submarine. I spoke to those involved with the cable channel special on the SEN TOKU, Japanese aircraft carrying submarines. He indicated that this particular footage could very well be from Operation Road's End in which these large submarines were sunk to prevent inspection by Soviet submarine experts.

As far as the models used, with the exception of the initial depth charge sequences which use a rather simplistic Balao class model, all the under water model scenes are from Destination Tokyo. Additionally the storyline of Operation Pacific has a submarine movie being shown to the crew while on patrol. That movie is actually Destination Tokyo. The character playing the XO actually made the comment "the things those Hollywood guys can do with a submarine." However, later in the film they sink the same aircraft

carrier and the same destroyer that were sunk in Destination Tokyo. Additionally, John Wayne is on the same set that Cary Grant used eight years earlier. They did add a gun platform forward of the conning tower to represent a boat had its superstucture cut down forward of the bridge that was done in the second half of WWII.

The movie Run Silent, Run Deep, is based on Edward L. "Ned" Beach's book of the same name. The story line does not follow the book very closely at all. Beach's books are quite comprehensive. They describe all aspects of submarine warfare in World War II, starting with resurrection an old S-Boat for training purposes, fitting out a newly built fleet boat, avoiding U-boats on the way to the Panama Canal, and fighting in the Pacific.

The plot of the movie centers on a submarine commander played by Clark Gable, whose boat is supposedly sunk in the opening scenes by an almost mythical Japanese destroyer captain *Bungo Pete*. The struggle for revenge causes a confrontational relationship between the submarine Commanding Officer and his Executive Officer, played by Burt Lancaster. The confrontation between captain and exec heats up as the movie progresses to the point where the Executive Officer takes command. Bungo Straights is a *graveyard* for American boats because a Japanese submarine lies-in-wait as they attack surface vessels. In the film the Japanese submarine attempts to sink the American submarine while submerged and the American crew assumes it is a runaway torpedo. There were instances in WWII in which an American sub was sunk by its own torpedo making a circular run. However, it was extremely rare during WWII for one submarine to sink another while submerged. It should be noted that in Norman Polmar's book, The American Submarine, (page 79), that during World War II, a number of submarines were sunk by other undersea craft. (All were sunk with the victims caught on the surface with one exception, the U-864, was sunk by VENTURER off Norway on February 9th, 1945. On that occasion, both submarines were submerged.) In the final scenes of the movie the American sub does, in fact, sink the other sub, but they are both on the surface.

Another aspect of the movie that appears somewhat unusual is the sonarman appears to double as the radioman because he hears both the approaching destroyers as well as radio transmissions. Additionally, in the depth charge scenes, a depth charge bounces

off the hull of the submarine and explodes underneath the keel close aboard without any significant damage. This type of explosion would actually break the back of the submarine.

The name of the submarine in the film is NERKA. The USS NERKA, SS-380, was laid down but actually never launched. It was canceled in July 1944. Wikipedia indicates that the submarine used in the filming of the movie was the USS REDFISH, SS-395. It appears to be a mid-war government boat. Interestingly, there are no guns or hand railings mounted forward at the bridge.

The two Japanese destroyer classes mentioned in the film are the Momo and the Akakaze. The Akakaze is apparently more formidable because Jack Warden's character states "the Momo is no Akakaze". In Capt Edward Beach's book he describes Bungo Pete's destroyer as an older of destroyer class with a well deck. It seems he is referring to the Minekaze class or the very similar Kamikaze class. There was no Akakaze Japanese destroyer class. So therefore, either it is just a fictitious class name ending in *aze* (meaning *wind*) which is typical for most Japanese destroyer classes or the filmmakers decided to change Kamikaze to Akakaze to avoid confusion with well-known suicide aircraft. Similarly, there is no Japanese Momo destroyer class. However there is a smaller destroyer of the Moni class that was re-rated as patrol boats in the late 30's. Although this is speculative, it makes sense that this is what was being referred to in the movie since, due to its smaller size; a Momi/Momo is no Kamakaze/Akakaze. The filmmakers may have simply changed the name because it sounds less strange to the Western ear.

The models used appear to be quite good. The stern section is shown in detail, but the end of the pressure hull appears somewhat square and shortened. The end of the superstructure also appears to be squared off. The model only has four forward torpedo tubes instead of six. It also appears that they used similar models to represent the American and Japanese subs with the exception of how they are painted. The American sub is light above the waterline and dark below. The Japanese sub has the reverse.

The model of the American submarine was also used in the movie Torpedo Run (1958) with Glenn Ford. In this film there are very similar scenes of the stern of the submarine model only now they are in color instead of black and white. Portions of the

underwater model scenes were also used in the film In Harm's Way (1965) It has been rumored that this model hung from the ceiling of a bar in Alameda, California for many years.

The second category of movie is where the submarine has the supportive role but is not in the majority of the plot. As mentioned above, the 1959 film On the Beach with Gregory Peck is one of these types of movies. In this film an American submarine goes to Australia in the last days of a WWIII holocaust. Incidentally, Wikipedia indicates that the submarine used in the film is the HMS ANDREWS P423, an Amphion class of the Royal Navy. Interestingly, the opening scene shows the boat coming into port with clouds of diesel exhaust even though it is supposed to be nuclear powered.

The final category is where the submarine is just used for a very short period of time, as a plot device, in a cameo appearance. This is seen in many films over the years such as Laura Croft Tomb Raider in which Angelina Jolie washes up on the stern of a British ballistic missile boat. Another example is First Strike, a Jackie Chan movie, which shows a Russian Kilo class for a few moments. Another would be a Bob Hope film, Sergeant Farrell's Army in which at the very end of the film, a Guppy II sub with an Electric Boat sail is represented as a Japanese submarine. Even films as early as the silent era fall in this category. Buster Keaton's The Navigator used a mockup of an old S-boat conning tower. In this role the appearance of a submarine adds intrigue and bolsters the storyline.

In closing, the film Run Silent, Run Deep and Ned Beach have been extremely instrumental in the motivation for my book and this article. I had been corresponding with Ned for several years prior to his death, and he actually was the person that first told me about the Submarine League. I had been intending to make a trip to Washington, DC, to use the Library of Congress Film Archives and interview Ned regarding his books and their film representation. I had also intended to ask him to write the forward to my book and present him with a model of destroyer BUNGO PETE that I had made for him from the description that he given in his books. I had not heard from Ned for a while. I called his home. His wife, Ingrid, informed me that he had contracted cancer. I told her of my project, and I asked her if it would be all right if I could at least send him

photographs of the model. I then received a letter from Ned thanking me for the photographs. I then called Ned because, as a physician, I was concerned about him. I spoke to Ingrid and she thanked me again for the photographs. She indicated that they had discussed where the torpedo tubes and depth charges were on the model, that in general, the photos seemed to have brightened his day. I thanked Ingrid for all of Ned's help and guidance and mentioned that I deeply regretted not being able to formally sit down with Ned and discuss his books and how they were represented as a film. Some time later, I received a letter from Ingrid informing me of his death. I am deeply honored by my contact with such a great man. He is greatly missed.■

Model of BUNGO PETE made by Dr. Bellomo

SUBMARINE NEWS FROM AROUND THE WORLD

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

From the June 2008 Issue

UNITED STATES—Mobile Landing Platform (MLP) RfP in 2008

On 10 June 2008, the US Navy (USN) announced that the Defense Acquisition Board had granted approval for the issuing of a Request for Proposals (RfP) for the design of the Mobile Landing Platform (MLP).

In accordance with the FY-08 Shipbuilding Plan, the USN will begin acquiring the class of three MLPs beginning in 2010 with unit one, followed by one additional unit in 2012 and one in 2013. Based on this acquisition plan, an RfP will likely be released by the end of 2008, followed by a design selection in 2009.

Likely respondents to the RfP for the US$450M program (US$150M each) are Bath Iron Works (BIW), Northrop Grumman Ship Systems and NASSCO. Because of current construction schedules and work-loads, AMI believes that BIW could be given priority consideration for the contract as they will be lacking steady work once the final Arleigh Burke class destroyer is commissioned in 2010. It is also possible that Northrop Grumman and BIW could form a work share agreement similar to that of the Arleigh Burke destroyers and San Antonio class LPDs in order to keep BIW actively involved in naval construction until more definitive answers are known concerning future programs such as DDG-1000 (or additional Arleigh Burkes) and CG (X).

The MLP is envisioned essentially as a floating pier that troops and equipment will be offloaded onto in preparation to embark in smaller craft which will then carry them to shore. The new MLP will be similar to the heavy-lift ship BLUE MARLIN. According to the US Naval Sea Systems Command (NAVSEA), the new MLP will resemble a cut-down tanker that would have a ballasting capability that would allow the platform to raise and lower itself in the water.

Based on these assumptions, it can be expected that the MLP will have a length of approximately 217 meters (712 feet), a beam of 42 meters (137.8 feet), and a draft of 10.1 meters (33.1 feet). Additionally, the MLP will be powered by two diesel engines and will have a range of 25,000nm at 14 knots.

INDIA—Commando Sub Tenders Will be Re-floated Internationally

In mid-June 2008, AMI received information that the Indian Ministry of Defense (MoD) intended to re-float tenders for the acquisition of four Swimmer Delivery Vehicles (SDVs). Although the timeline for the US$320M program was not announced publicly, AMI estimates that the tender release could occur by the end of 2008.

A tender was initially floated in 2007 to India's Mazagon Docks Ltd (MDL) and Larsen & Toubro (L&T), of which L&T had already developed its own indigenous design. The sticking point with the first tender was that MDL could not meet the Navy's qualitative requirements leaving L&T as the only qualified bidder. Since single-vendor contests are no longer allowed under India's procurement policies, the MoD has no choice but to reopen the competition to all yards, including both domestic and foreign.

The re-bidding process will effectively delay the procurement timeline by an additional two years. The MoD has also requested that the Indian Navy (IN) modify its requirements in order to draw foreign bidders. Since L&T already has its own design, MDL will most assuredly seek a foreign partner in order to qualify in the re-bid. It can be expected that builders with recent SDV/mini-submarine design experience will also enter the competition as a partner with MDL or as an independent entity. SDV/mini-submarine builders such as Northrop Grumman and Columbia Group of the US and Fincantieri of Italy will likely respond to the tender.

Assuming the RfP is released by the end of 2008, responses will probably be due by mid-2009, a preferred supplier selected by the end of 2009 with a construction contract in place by 2010.

The IN has levied the requirements for a vehicle that can transport divers and their equipment from their mother craft to attack anchored vessels as well as coastal and offshore installations. The vehicles should be able to operate at a depth of 60 meters and

capable of carrying up to 250 kilograms of explosive charges. The SDVs will have a 20-year service life and be transportable by all Indian submarines (externally).

FRANCE—Less FREMMS and Delayed Aircraft Carrier Program

In mid-June 2008, French President Sarkozy announced his plans for the future of the French Armed Forces. The plans are based on the latest defense policy changes that resulted from Sarkozy's request for a bottom up review of the services when he took office in May 2007.

With the completion of the latest white paper, it appears that the armed forces will face a 20% reduction of personnel as well as a consolidation in its base infrastructure to create a slimmer, more deployable force over the next 15 years. Although personnel and the basing structure will be reduced, French defense budgets will actually remain at current levels through 2012 with 1% increases (over inflation) through 2014. Large investments will be made in the intelligence and the technology fields with funding deriving from savings associated with the reorganization. In addition, France is also expected to rejoin the North Atlantic Treaty Organization (NATO) alliance, possibly at the end of France's six-month EU Presidency later this year.

In regards to the French Navy, it appears that the FREMM program will be scaled back from 17 units to 12 and the decision on the PA2 aircraft program will be delayed three years to 2011. In regards to technology, the new white paper also calls for France to develop its own cruise missile that will be fired from submarines, probably the Barracuda class that will be commissioned from 2016 through 2026.

Although the PA2 aircraft carrier program has only been delayed, one must question if this is the unofficial decoupling with the British CVF program, which is to begin this year. This shared program with the British was expected to yield savings through shared industrial co-operation and joint procurement, and it now may be in jeopardy.

One must also question if it will ever be built assuming that new cruise missiles will be deployed with the submarine fleet, in essence taking over some of the long-range strike capability. If the

cruise missiles do in fact replace some of the carrier strike capabilities, could this result in a strengthened Submarine Force for France?

Assuming that the five-unit reduction in the FREMM force takes effect and the PA2 carrier program is delayed and possibly cancelled at a later date, it would be considered a big hit for French yards. These decisions will make it even more important for firms such as DCNS to remain strong in the export market.

INTERNATIONAL—World Missile Developments

Germany

On 29 May 2008, the German Navy successfully test-fired the fiber-optically controlled Interactive Defense and Attack System for Submarines (IDAS) missile from U33 in the Baltic Sea.

The IDAS missile was developed jointly by Howaldtswerke-Deutsche Werft (HDW-part of ThyssenKrupp Marine), Diehl BGT Defense and Kongsberg Defense and Aerospace (KDA) as the replacement for the now defunct Polyphem that was scrapped when it was realized that it would not be ready for the U-212 class in time.

IDAS is fired from a standard submarine torpedo tube. A few seconds later the wings and fins deploy and rocket motor ignites propelling the airframe through the water allowing it to break the surface and continue its flight to the intended target. During its flight, it is controlled via fiber-optic wires that send a video picture back to the submarine and correction controls to the missile.

The 2.45 meter (8.1ft) airframe carries a 13kg (28.7lb) shaped-charge warhead. It flies at nearly 400 knots and has an estimated range of about 8 nautical miles.

One unique characteristic of the missile is its three-stage burn of the motor; 25 percent for underwater maneuvers, 25 percent for acceleration after it breaks the surface and 50 percent for sustained flight.

This successful test firing was a crucial step in preparing IDAS for service. It can be anticipated that the consortium will begin preparing to develop and finalize an international development program in the near future. The first operational IDAS missiles will likely enter service around 2011 if all agreements can be reached and further tests are as successful.

VARIOUS DID YOU KNOW?

SOUTH KOREA—On 04 June 2008, the third Republic of Korea Navy (ROKN) Type 214 class submarine was launched from Hyundai Heavy Industries (HHI) in South Korea.

MALAYSIA—On 06 June 2008, the Royal Malaysian Navy's (RMN) first Scorpene class submarine, KD TUNKU ABDUL RAHMAN, completed sea trials at Lorient, France.

From the July 2008 Issue

TURKEY—Down-select in New Type Submarine Program

In late July 2008, AMI received information that Turkey had chosen a preferred supplier for its New Type Submarine Program. The Turkish Navy has apparently selected Germany's ThyssenKrupp Marine (Howaldtswerke-Deutsche Werft—HDW) Type 214 submarine. The preferred supplier selection follows the 12 November 2007 announcement by the Turkish Undersecretariat for Defense Industry (SSM) that it had down-selected to the three final candidates, which included France's DCNS, Germany's ThyssenKrupp Marine and Spain's Navantia.

The SSM is currently in negotiations with HDW concerning the final details and pricing for the six submarine procurement that is estimated to cost around €2.5B. The program involves the construction of all six Type 214 Air Independent Propulsion (AIP) submarines at Turkey's Golcuck Naval Shipyard, which also built eight of the TN's Type 209/1400 submarines. Negotiations could be complete by early 2009 followed by a construction contract in mid-2009 in order to have the first unit in commission by 2015.

A major determinant in the selection of the preferred supplier, Turkish industry will satisfy 80% of the contract value in Turkey. Up to 20 of the major systems and subsystems will be produced by Turkish industry including the Integrated Underwater Command Control System (IUCCS). The entire class will be in service by 2020 and will replace the Atilay class that was commissioned from 1976 through 1984.

INDONESIA—Still Pitching for Barter Agreement on South Korean Submarines

In late July 2008, AMI received information that the Indonesian

Navy was still considering the procurement of submarines from South Korea. AMI's source indicates that the deal proposed consists of South Korea assisting Indonesia in the construction of two Chang Bogo class (German Type 209) submarines in Indonesia. The construction assistance also includes modifications of the selected Indonesia yard (PAL Indonesia Shipyard) that will build the submarines. The use of the Type 209 design will most assuredly require the assistance of Daewoo Shipbuilding & Marine Engineering (DSME) as well as Germany's Howaldtswerke-Deutche Werft (ThyssenKrypp Marine), the designer of the submarine.

In return, South Korea will receive eight EADS CN-235 maritime patrol aircraft (MPA) built under license at Indonesia's PT Dirgantara. The US$1B counter-trade agreement (although not finalized) follows a strategic partnership between the two countries that was announced in December 2006.

This partnership follows the US$1.2B deal that was struck by Russia and Indonesia in 2006. This deal includes the procurement of Russian systems including 22 helicopters, 20 tanks and two Kilo class submarines (with options for six additional Kilo class submarines and two Amur class) under a 15-year finance package with a 5.6% interest rate. A construction contract for the first two Kilo submarines was anticipated by the end of 2008.

However, it now appears that Indonesia has not made a decision on which submarine to procure, Russian-sourced or Type 209s. Indonesia currently operates two German-built Type 209 (Cakra) class submarines, of which one unit was overhauled by DSME in South Korea from 2004 through 2006. On the surface, it appears that the South Korean deal appears more likely due to Indonesia's familiarity with Germany, South Korea and Type 209 submarines. A key factor in this deal is building submarines in Indonesia for the first time. Indonesia has experience in building patrol vessels in-country but has had trouble in moving forward with its own National Corvette Program, let alone a submarine design. AMI believes this option would lead to huge cost overruns and long delays.

With timing of delivery fast becoming an issue, the Kilo program could well be the better alternative as Russia will probably make delivery in three years. It is also possible that Indonesia could move forward with both options and get some Russian units in the

near term while developing its own indigenous construction capabilities. However, the downside would be two distinctly different platforms and supply chains that would make it difficult at best to integrate and operate.

Various Did You Know?

INDIA—In early June 2008, the Indian Navy named the Russian-leased Akula class submairne, INS CHAKRA. The submarine is scheduled to be delivered to India in the second half of 2009.

RUSSIA—On 08 July 2008, the Russian Navy Typhoon class nuclear-powered ballistic missile submarine (SSBN) TK-13 was decommissioned at Zvezdochka shipyard. TK-13 will be scrapped by March 2009.

UNITED KINGDOM—On 10 July 2008, the Royal Navy (RN) Vanguard class nuclear-powered ballistic missile submarine (SSBN) HMS VICTORIOUS completed a 39-month overhaul at the Devonport Royal Dockyard.

PORTUGAL—On 15 July 2008, the first Portuguese Navy Type 209PN class submarine, NRP TRIDENTE, was launched at ThyssenKrupp Marine's Howaldtswerke-Deutsche Werft shipyard in Kiel, Germany.

From the August 2008 Issue

UNITED KINGDOM—Future Programs Taking Shape

With the Queen Elizabeth class aircraft carrier, DARING (Type 45) class destroyer and Astute class submarine programs firmly underway, the UK Ministry of Defense (MoD) is now progressing in its planning for the next generation of new construction programs. These programs include the Military Afloat Reach and Sustainability (MARS) project, the Successor Submarine (Future Ballistic Missile Submarine), Future Surface Combatant project, a Future Mine Countermeasures Capability (FMCMC), and the Future Amphibious Task Group 2035 project. Highlights of these projects are as follows:

A. Military Afloat Reach and Sustainability (MARS) Project: This project began in early 2004 when the Royal Navy (RN) began to formalize the concept of its future sea-based naval logistics support structure, identified as the Military Afloat Reach Sustainability Program. The MARS program will consist of 11 new vessels which will include six fleet tankers, two fleet support ships and three joint sea-based logistics vessels.

The first vessels to be built will be the six tankers. On 21 May 2008, the UK MoD announced that candidates for the MARS Fleet Tanker had been short-listed to four candidates down from 20 prospective builders. The final four include Fincantieri of Italy, Hyundai Heavy Industries of South Korea, Navantia of Spain and the BAE Systems/BMT/Daewoo Team of the UK and South Korea. An Invitation to Participate in Dialogue (IPD) to the short-listed bidders was issued in June 2008. Final bids will be submitted in the second quarter of 2009 with a contract in place by late 2009 or early 2010. The first unit will enter service in 2013 and all six units by 2016.

The fleet support ship and joint logistic ship phases will probably begin by 2013.

B. Successor Submarine (Future Ballistic Missile Submarine – SSBN): This project is intended to replace the four Vanguard class SSBNs beginning in 2024. The Successor Submarine project is currently in the concept phase, which began in 2007 following Parliamentary approval for the replacement of the Vanguard class.

The design phase is being conducted by a team from the MoD, BAE Systems Submarine Solutions, Babcock Marine and Rolls Royce at the Future Submarines Integrated Project Team office at the Barrow-in-Furness shipyard. The concept phase will be completed by September 2009 and pass through its Initial Gate Milestone. With the first submarine entering service in 2024, the Main Gate approval will probably occur by 2012 with a construction contract in 2017. At least three units will be built under this program.

C. Future Surface Combatant (FSC): The FSC program is intended to replace the majority of the RN's surface fleet through 2035 (four Broadsword (Type 22 Batch 3) class frigates, 13 Duke

(Type 23) class frigates, eight Hunt class minehunters MHCs) and eight Sandown class MHCs). The program will consist of three types of ships consisting of the Force Anti-Submarine Warfare (ASW) Combatant (C1), a Stabilization Combatant (C2) and an Ocean-Capable Patrol Vessel (C3).

By late 2006, the MoD began releasing information concerning the Sustained Surface Combatant Capability (S2C2) Program, the blueprint for the future of the RN's surface fleet. Currently, it is estimated that the C1 Combatant will displace around 6000 tons and be utilized as part of a maritime strike group or amphibious task group offering ASW, land attack and coastal suppression capabilities. In addition each C1 will have its own organic mine countermeasures (MCM) suite. The design team, known as the Naval Design Partnership (NDP) was established in 2007 and utilizes resources from Thales, BAE Systems, VT Group, Babcock, QinetiQ and BMT Defence Systems. Current scheduling calls for the initial Gate Milestone in mid-2009 and Main Gate approval in 2011. The first unit should enter service by 2019 indicating a construction contract by 2014. Up to eight of these units could be procured under this program starting construction at the rate of one per year from 2014 through 2020.

The C2 Combatant will probably be around 5000 tons utilizing the same generic hull as the C1 although it will be more lightly armed. It will be capable of supporting small-scale stabilization operations, sea line protection and choke point escort. Assuming that eight C1 vessels are built, possibly as many as ten or eleven C2 units could be built. Construction on the first unit could begin by 2018 or 2019 following the launching of the last C1 unit.

The C3 Ocean-Capable Patrol Vessel is envisioned as an ocean patrol vessel with MCM capabilities (mothership for portable MCM assets) to replace the Hunt and Sandown class MCMVs as well as legacy survey vessels and offshore patrol vessels (OPVs). This vessel will probably be based on an existing hull from VT Shipbuilding. Up to eight C3 vessels could be built possibly beginning in 2019 in order to have the majority of hulls in service by 2023 when the remaining MCMV force is decommissioned.

D. Future Mine Countermeasures Capability (FMCMC): MoD sponsored studies began in 2006 to plan for the replacement of the

legacy mine countermeasures forces (MCM). It is anticipated that the future MCM force will consist of two type of systems, portable and organic unmanned systems. The organic systems will be built into existing assets (other than MCMVs) such as the FSC (C1 element) and will begin entering service by 2013.

The portable assets will be operated by a mother vessel such as the FSC (C3 element) and could begin entering service in the 2022-2023 timeframe. All of the legacy MCMV assets such as the Sandown and Hunt classes will be decommissioned with virtually no dedicated MCMV hulls remaining in naval service.

E. Future Amphibious Task Group 2035: Initial analysis undertaken by the MoD indicates that the future amphibious force will consist of one Queen Elizabeth class aircraft carrier, two general purpose amphibious assault ships (LHDs) and up to five dock landing ships (LSDs). These units would replace the one Ocean class helicopter landing platform (LPH) which will decommission in 2024 without replacement, the two Albion class landing platform, docks (LPDs) and the four Bay class LSDs. The Queen Elizabeth aircraft carrier that is not assigned strike role duties will alternately perform amphibious roles with the amphibious force.

With the Albion class LPDs and Bay class LSDs entering service from 2003 through 2006, the first replacement will need to commission by 2035 indicating main-gate approval by around 2025 and a construction contract in 2030.

ITALY/UNITED STATES

Fincantieri Buys Manitowoc Marine Group, Gains Foothold in LCS Program

On 04 August 2008, Fincantieri Cantieri Navali S.p.A. signed an acquisition agreement to acquire the Manitowoc Marine Group (MMG) from its parent company, the Manitowoc Company, Inc. The transaction is valued at around US$120M and is an all cash deal with Lockheed Martin a minority investor in the acquisition.

MMG is one of the leading mid-sized shipbuilders in the US for both commercial and government clients and is comprised of Marinette Marine Corp., Bay Shipbuilding Company (both in Wisconsin) and a repair yard in Cleveland Ohio.

This strategic partnership will allow Fincantieri to participate in the US Littoral Combat Ship (LCS) program, which is expected to consist of as many as 55 vessels being built for the US Navy (USN). In addition, MMG has historically been the supplier of various craft for the US Coast Guard including small icebreakers and buoy tenders and will probably be a big provider of such vessels in the future. Not only will Fincantieri benefit from the ability to acquire US contracts in the domestic mid-size ship market, but also the US export market.

MMG will also derive great benefits from Fincantieri's vast experience in naval as well as commercial ship construction and repairs. Fincantieri is anticipating a US$100M investment in construction and technical improvements to MMC in the coming years that will increase both efficiency and productivity.

Other Italian system houses such as Finmeccania (electronic equipment and components) and Isotta Fraschini (diesel engines) will also benefit from this new market.

ITALY—Contract for Two Additional Submarines

On 01 August 2008, AMI received information that the Italian Navy Directorate General for Naval Armament had ordered the second batch of two Type 212A submarines from Fincantieri. This follows information received in late May that the Italian House of Representatives Defense Committee formally approved the procurement. With the construction contract in place, construction on the first unit will begin in 2010 at Finacantieri's Muggiano yard and the second in 2011. Both units will be commissioned into the Italian Navy in 2015 and 2016.

The second two units were part of a US$1.45B contract, which called for construction of the first two units of Batch I and options for two additional units of Batch II at a later date. The Batch I units were commissioned in June 2005 and May 2006, respectively.

The second two units will include technology upgrades in the command and control systems in order to mitigate obsolescence issues. The costs of the two latest submarines will be spread over the 2008-2016 timeframe with the final payment occurring when the last unit is delivered.

INTERNATIONAL—World Missile Developments

A: INDIA: On 01 August 2008, BrahMos Aerospace announced that they have successfully developed air and underwater launched versions of its BrahMos supersonic missile and are currently working on hypersonic missiles that could reach speeds of up to Mach 7.

In February 2008, the Indian Defense Research and Development Organization (DRDO) tested a submarine launched ballistic missile from a mobile submersible platform. It is believed that this same vertical-launch platform was readied and used for the test of the BrahMos as well.

It is likely that the underwater version will be fired from a new class of submarine with vertical launch missile tubes as AMI's sources indicate that BrahMos will only be vertically launched and not tube launched.

As for the air launched version of the missile, it will likely be a few years before full-rate production and fleet integration will occur due to the requirement for structural modification to the Russian-built Su-30 MKI aircraft that the missiles are going to be deployed from. Currently, tests of the missiles have been done from on modified Su-30MKI as well as a Tu-142 Bear aircraft.

In addition to the announcement of the successful test of the BrahMos, company officials stated that the new hypersonic BrahMos II will likely begin the development stage under a major expansion plan in the near future.

B: RUSSIA: On 04 August 2008, AMI received information that the Russian Navy (Rosiyskiy Voennomorsky Flot - RVF) was continuing its plans to revitalize its ballistic missile forces when it tested an SS-X-26 missile from the Delta III class submarine RYAZAN in the Northern Pacific.

The missile was fired in the Barents Sea and reportedly hit its intended target on the Kura test ground in Kamchatka. Igor Dygalo, a senior public affairs spokesman for the RVF stated: "The regular check-up of the nation's naval strategic nuclear forces has been conducted successfully."

The SS-X-26 is a modernized version of the Tender missile system, now re-designated Iskander (vice Iskander-E which is the export version). It has been upgraded with an inertial guidance

integrated with GPS/GLONASS and with alternative terminal seekers. CEP is better than 8m (26.2ft) using terminal guidance. Guidance is achieved by gas-dynamic vanes at launch, then by aerodynamic surfaces (vanes) later in flight. Iskander has a reported range of 400km (216nm) and can be equipped with either a 700kg (1544 lb) high explosive warhead or sub-munitions. There have also been indications that the missile could be equipped with electro-magnetic pulse (EMP), fuel/air explosive (FAE) or nuclear warheads.

This test is likely a continuation of missile development for the Project 955 (Borey class) SSBN and may indeed be testing an even longer-range missile than the reported 400km reported range of the Iskander.

From the September 2008 Issue

SOUTH KOREA—Competition for Batch II and Export Type 214s

In mid-September 2008, AMI received information that South Korea's Defense Acquisition Program Administration (DAPA) finalized an agreement in August with ThyssenKrupp Marine's Howaldtswerke Deutsche-Werft (HDW) for their contribution of the second batch of six Type 214 submarines (KSS-2 program). The entire deal, including construction with either Daewoo Shipbuilding & Marine Engineering (DSME) or Hyundai Heavy Industries (HHI), is estimated to be worth US$3B.

The Batch II order will enable the Republic of Korea Navy (ROKN) to meet its force level of nine Son Won-Il class Type 214's by 2018. The Batch I order consisted of three vessels, all manufactured by HHI.

Under the new deal, HDW has agreed to offsets associated with weapon systems. Under the previous contract for the Batch I units, HDW is known to have agreed only to technology transfers associated with hull construction. AMI has learned South Korea will receive, among others, design and manufacturing technologies associated with the torpedo system, a technological capability desired by South Korea in order to indigenously develop an underwater ordnance launch system for the 3,500 ton KSS-3 submarine, which is currently under the design phase.

Additionally, HDW has also reportedly agreed with DAPA to

permit an as-yet designated South Korean shipyard to manufacture two Type 214's to be exported by HDW to an unnamed third country. Progression in the ROKN KSS-2 (Type 214) Program follows DAPA's reconsideration earlier this year over reported problems with the propeller shaft of the first vessel, ROKS SON WON-IL. While AMI has been informed of satisfactory resolution to the reported problems, earlier problems with ROKS SON WON-IL contributed to rumors that DAPA may have reduced the Batch II order to three vessels instead of the initially considered six. When considering the US$3B estimated price tag by DAPA and the nine-unit class in service target date of 2018, it appears that all six units of Batch II will be procured.

While HHI manufactured all three units of Batch I, both HHI and DSME are expected to bid for the Batch II contract, with the winner announced by the end of 2008. DSME manufactured eight of the ROKN's nine Chang Bogo (Type 209) class submarines under the KSS-1 program, with the first unit constructed in HDW's shipyard in Kiel, Germany. Both shipbuilders have also been designated as joint lead contractors for the KSS-3 program, the ROKN's new 3,000 - 3,500 ton indigenous submarine program.

RUSSIA—Defense Budge Increases Through 2011

In mid-September 2008, AMI received information that Russia would continue increasing its defense budget through 2011. In 2009, the budget would increase to US$50B with subsequent increases in 2010 and 2011 as part of the state budget. Although the 2009 budget is around 20% higher than in 2008, the majority will be offset by higher inflation rates that have been averaging between 11 and 14 percent annually.

This essentially leaves the overall increase at 6-9 percent. While this is a substantial increase, it seems insufficient when considering the massive requirements to rebuild the infrastructure and weaponry of the outdated Russian forces. These rebuilding plans did not include lessons learned from the recent Georgian conflict in which Russia apparently showed weakness in many areas, areas in which improvement is needed.

The major issue that Russia faces is the outdated military industrial complex that continues with massive cost overruns, inefficiencies and long delays. AMI believes that many of the

inefficiencies and reduced capabilities reside in the second-tier suppliers to large shipyards. In regards to the Russian Navy, AMI believes that the budget increases from 2009 through 2011 will do little for the sea service as the high priced Borey class nuclear-powered ballistic missile submarines (SSBNs) will absorb the majority of the funding along with the slow rate of construction continuing with the remaining active programs including the Yasen class nuclear-powered attack submarines (SSN), St. Petersburg class conventionally-powered attack submarines (SS) and Steregushchiy and Admiral Gorshkov class frigate programs.

The only way for Russia to make any headway with its larger projected defense budgets is to hope that inflation begins to drop to a manageable level enabling the Russian forces and industrial complex to begin investing in real improvements in its second-tier suppliers over the long-term.

IRAN—More Submarine Programs

On 25 August 2008, the Iranian Defense Minister Mostafa Mohammed Najar announced Iran was opening a domestic submarine line for a new class of 1000-ton submarines, known as the Qaeem class, that will be capable of firing torpedoes, missile sand Shkval rocket torpedoes.

The Iranian Navy (IN) probably began planning for the new class of submarines around 2005 in order to augment first, then eventually replace the three Tareq (Kilo) class submarines currently in service. A construction contract for the new 1,000-ton Qaeem class was likely signed in 2007 with construction beginning immediately there after.

Unit one is currently being constructed at Persian Gulf Shipbuilding Co. (PGSC), likely with Russian assistance as models of the Qaeem appear to be based on the Russian Amur 950 class. Unit one will probably commission in 2011 followed by up to four additional units through 2018. All sensor and weapon systems will likely be Russian-built.

Similar to the Amur 950, the Qaeem has the Amur standard hull design and anechoic coating to reduce the overall acoustic signature. Propulsion will be provided by two diesel engines connected to generators to power the large permanent magnet electric motor driving a single seven-blade screw. Due to its primary potential

operating area being so close to its own ports in the Arabian Gulf Region, the IN probably does not have a requirement for the Air Independent Propulsion (AIP) system, allowing for additional weapons and more simplified construction.

The new submarines probably have four 21-inch (533mm) torpedo tubes for sixteen torpedoes. In lieu of torpedoes, the Qaeem class will probably be able to carry a mixture of mines, Shkval rocket torpedoes, Novator Stallion (SS--16), Novator Klub (SS--27) or newly designed SSMs.

Iran has recently begun to construct their own small submarines (the Nahang and Ghadir class mini-subs), and the Qaeem class appears to be the next step in their submarine building evolution.

INTERNATIONAL—World Missile Developments

Russia: On 18 September 2008, the Russian Navy (Rosiyskiy Voennomorsky Flot – RVF) test-fired a Bulava submarine-launched ballistic missile (SLBM) from the DMITRY DONSKOI, a Typhoon (Akula) class nuclear ballistic missile submarine (SSBN), in the White Sea to the Kura test-site on the Kamchatka Peninsula.

The multiple-warhead missile (up to 10 warheads) was launched at 1505 GMT with each of the warheads hitting their targets, according to a defense ministry official. (Although according to the Russian Kommersnat news, the warhead bus failed and if it had been a wartime shot the warheads would not have detonated). The test firing, at a range of 5,600 km (3,500 miles) was still far from the missile's reported maximum range of 8,000 km (5,000 miles).

Originally tested in 2005, the Bulava is the submarine version of the Topol-M ballistic missile, and was developed to arm the new Borey class SSBNs, the first of which is scheduled to commission into the RVF in 2009, followed by six additional units through 2020. This test is yet another crucial step in the development of the new Borey class.

This test comes on the heels of last-month's test of a Topol RS-12M missile (reported in AMI's August 2008 Hot News) and is being viewed as the action Russian President Dmitry Medvedev's promise during his *military response* to the US-Polish agreement for a US interceptor missile base in Poland that was signed last month.■

SUBMARINE FICTION

THE RAISING OF WARRIORS
THE SUBMARINE FORCE IN THE 2020'S

by Captain Jim Patton, USN(Ret.)

Editor's Note: THE SUBMARINE REVIEW normally does not publish works of fiction unless there is a specific reason to do so. This is the second time these pages have hosted such a work and the purpose now is to highlight the approaching problem of a Submarine Gap. We have all known of the coming shortfall in force structure numbers under that which was previously determined to be necessary. With the apparent re-emergence of Russia as a force, and the acceleration of the emergence of China, we may be faced with both forces to consider at the same time our force of submarines is at its lowest.

In 1998 THE SUBMARINE REVIEW published a two part fiction work with a vision of the future for submarines in the year 2050. Predicting the future is necessary for determining the warfare requirements of long-lasting, expensive capital investments like submarines. It is well recognized, however, that although some such prediction is necessary, it is very difficult to do successfully enough to warrant large excursions in the development path. The 1998 effort in these pages relied on a Jules Verne-like derivation of a future vision using the skills of a proven novelist, Mr Joe Buff with five submarine novels to his credit.

The introduction to Part I of the 1998 fiction piece offered as the logic for doing a Verne-like derivation of a vision of the future, the following three part reasoning:

A. There are very few cases of a perfect coupling between Requirement Pull and Technology Push, as there was for the SSN and the SLBM/SSBN. For those two developments there was a crystal-clear requirement and a perceived near term technical attainment.

B. The usual case is to create a credible view of the future on which to quantify a set of requirements which can be used to particularize the design of a weapons system within the bounds of the technologically foreseeable.

C. The novelist can put together his Verne-like vision of the future by learning all he can about his subject and about the various sciences acting on that subject, and putting the various trends together.

In the above postulated case of the US Submarine Gap occurring concurrently with the maturing of two potential peer rivals, the obvious solution is near-term increased production, but the problem there is funding--neither Requirement Pull nor Technology Push. A different approach to viewing the situation; therefore, may be useful. To this end, a bit of fiction is again employed to illustrate the potential of a future structure appendage for the Submarine Force. This suggested fix to the GAP problem is super imposed on the author's original suggestion for strengthening the all-important training for submarine command.

Captain Jim Patton originally wrote his fictional account of small submarines and Junior Officer training in the 1970s while on a one-year SecNav Professional Development Sabbatical. At that time he got his Masters and was also able to learn about some advanced project thinking being done. One of those projects was for a small non-nuclear submarine of limited capability, but consequently of much lower cost. His fiction was an attempt to rationalize such submarines in terms of training and numbers. THE SUBMARINE REVIEW recently came across a copy of CAPT Patton's story and asked that he update it to fit the Submarine Gap problem.

The vintage Porsche was purring along a Long Island back road as the seven o'clock weather report announced that it promised to be another cool, clear spring day around Narragansett Bay. LT Bill Townsend absorbed this with pleasure, as he downshifted to second at 4000 rpm to negotiate an approaching s-curve. He'd be going to sea this morning, and the visibility would be good.

Bill realized that he could easily save ten or fifteen minutes on the trip from his apartment at Westhampton Beach to Sag Harbor if he took the expressway, but he thoroughly enjoyed this early morning solitude and opportunity to exercise his automobile. Perhaps these were two of the primary reasons that he had decided to become a career submariner. He was by no means an introvert, but he did find the small, professional, and closed society on a submarine very much to his liking. Problems were bounded within a few hundred feet by the pressure hull, responsibilities were clearly defined with individuality encouraged, and there were deep personal relationships with juniors and seniors alike in which everyone's strong and weak points were known and accepted. He also received the same, almost sensual, pleasure from the close fitting, well designed mechanical perfection of his ships as he did from his car. To him, a polished main engine journal bearing was beautiful; a well groomed sonar system was exciting; the infinitesimal leak rate of a reactor grade valve was fascinating.

Bill hadn't always felt this way about his profession. He had stood very high in his Naval Academy class, but initially had every intention of getting as much as possible from the Navy, getting out as soon as possible, and then selling his considerable talents to the highest industrial bidder. He was going to be a first string player in the national game of maximizing remuneration for a minimum of effort. His first ship, his first CO, and the 30-day Energy Embargo crisis of 2012 had changed that outlook, however. For the first time, he had felt the challenge of a job where sheer intelligence was not enough; where only total effort and involvement permitted survival; where one became so busy that it wasn't noticed that years went by, pay was inconsistent with energy expended, and self-serving selfishness was completely overwhelmed by the sting of responsibility. Perfection was impossible. Demands and standards continued to increase. You felt as though you were doing a terrible job with schedules and deadlines closing in unmercifully. You went a little beyond your native ability and *still* didn't quite meet all of the requirements. Then, to no one's surprise but your own, you found that by *almost* doing the *minimum*, by completely revealing your maximum capabilities, you had been judged outstanding, given a medal, and identified as a front runner.

Bill wouldn't ever forget his initial interview by Dave Cone,

Commanding Officer of USS NORTH CAROLINA (SSN 777) – then Ensign Townsend's first duty station. Bill had been aboard about a week, and had been seeking the lowest acceptable energy level—how to do a *good* job without donating too much of his time or thought—how to appear busy enough to avoid assignment of collateral tasks. In five minutes of small talk with CDR Cone, Bill realized that he was completely naked before the Skipper. Behind the disarming grin and the homey Appalachian mannerisms, the C.O.'s twinkling eyes said, "I know you're lazy, I know you're insincere, I know you're smart. I like you, and you are going to love this ship and your job in spite of yourself." That relationship had continued to grow through the years and Bill now counted RADM Cone among his closets friends, never ceasing to be amazed by his perceptiveness.

It was almost a year to the day later that they all were subjected to the test of combat. The Russians attempted to enforce their demands for a total West European disarmament and disestablishment of NATO by establishing an *energy embargo* against the European Union. Not only were the oil and gas pipelines to the West and such as Ukraine, the Baltic States and Georgia turned off, but as many as 50 Russian SSNs, SSGNs, and Air Independent Propulsion SS were quickly deployed in choke points from the Persian Gulf and other petroleum sources. As in nearly all conflicts, the preconceptions of peacetime tactical planning didn't match the situation. Our 25 SSNs (and another dozen or so EU and NATO boats) were individually superb, and far more than a match of the opposition, but because of the two decade one-a-year submarine building *holiday*, there were not enough of them to both *escort* tankers and *sanitize* their transit routes and choke points. First one, then several other tankers were attacked and sunk, propelling the crisis into a *submarine-only* confrontation short of General War between NATO and Russia.

Limited submarine and other ASW resources were allocated to direct support, or convoy protection roles. This accounted for some Russian losses, but did not substantially reduce the tankers sunk by submarine-launched missiles. Patrol aircraft found many, and successfully attacked a few submarines (of both sides, unfortunately). U.S. submarines deploying from New London, Norfolk, and Hawaii were being attacked in shallow continental shelf waters

before diving, which forced reallocating some scarce SSN resources to coastal defense roles. On arriving at Liverpool two weeks into the conflict, having provided direct support to a convoy from the Persian Gulf from which 4 of the 6 tankers were sunk at a cost of 1 Russian SSGN and one AIP SS, CDR Cone requested, and obtained permission to loiter 2 weeks in the northern Norwegian Sea en route to New London. Eight days and 19 torpedoes later, 9 enemy submarines had been sunk by the NORTH CAROLINA—not while they were transiting out to do battle, but while transiting home to replenish. Convoy protection and Direct Support operations were then terminated and virtually all friendly submarine assets were placed off Norway, Gibraltar, and South Africa in this reverse-barrier role. A week later the energy embargo ended as the Russians realized they could not recover their submarine assets without unacceptable losses.

The awards ceremony, at which CDR Cone received his Medal of Honor (and Bill his Silver Star), was still vividly remembered by all that had been there. In accepting his award, and the Presidential Unit Citation for the ship, Dave Cone, with a voice strained with emotion and frequent pauses to regain his composure, stressed to all how it was not he who had carried the day, but his men—his officers; that he would have been unequal to the task if it had not been for their tireless efforts—not only in the busy days of battle, but back through their years of training, the building of a proper ship, and the seemingly thankless and endless series of peacetime reports and routine maintenance. He was, he said, as more than one handkerchief came out of pockets and purses, far prouder to have been a member of the *crew* of NORTH CAROLINA, as forever indicated by the bronze NC authorized to be worn on the Presidential Unit Citation ribbon, than to have been singled out by an accident of rank and events for the Nation's highest award.

The Porsche idled into the Submarine Squadron 24 parking lot and coasted to a stop in a space marked *Reserved for Command Pilots*. He never ceased to be amused by the nomenclature of his position. It was strange after the years of restrained animosity between *Airedales* and Submariners that we should virtually copy their organization and terminology for the SSL's. It was very logical though. In fact, the SSL's were even built by traditionally aerospace-oriented companies—Boeing and Grumman—as an

immediate post-crisis corrective action to fill the *submarine gap* for the decade or more until a somewhat cold SSN production line could be reinvigorated. They weren't at all substitutes for *real* multi-purpose nuclear submarines, but had succeeded in easing some of the scheduling burdens, provided a degree of homeland-security-like coastal defense/anti-drug capability and provided marvelous training services for not only the Submarine Force, but also other ASW forces. When deployed in an expeditionary role with their ASN tender, they *showed the flag*, but also incurred some of the downsides always associated with foreign-based forces.

The SSL design incorporated the best of the low space and weight and modular replacement techniques of aircraft, but was also made to approach traditional submarine reliabilities. Lessons were also gleaned from the early 21st century's failure to affordably build Littoral Combat Ships—small surface combatants. Another aviation-inspired feature of the SSL program was that as a Command Pilot, he was not totally responsible for all operational, administrative, and maintenance requirements of specific vessels as he would be when he eventually progressed to command an SSN. In two successive missions, he would more than likely be placed in charge of two different vessels with two different five-man crews.

From the boat launching, Bill could see the tender, USS RICKOVER (ASN-41), anchored in the lee of Gardiner's Island. RICKOVER was a smart ship. It was rather ironic that *his* name be given a ship whose mission was the support of non-nuclear submarines, since throughout his career, The Admiral (capital "T" in "The" differentiating him from all other Admirals) had violently, and successfully, opposed any division of manpower, material, industrial or financial resources away from the development and perfection of an all nuclear Submarine Force. However, when it became apparent that the limited mobility and endurance of SSLs as compared to SSNs would require that the additional support required because of this missing mobility and endurance be just as expeditionary as the submarines themselves, several of these nuclear powered submarine tenders were authorized—the first of which recycled the name freed up when HYMAN G. RICKOVER (SSN 709) was decommissioned.

He had about a five minute wait for the next boat, and he could spend it speculating as to which of the 10 SSL's attached to the

squadron he'd be assigned today. SSL-12 had entered the tender's docking well yesterday for hull work, and SSL-8 wasn't due to come out of the well until this coming Thursday. SSL's 3 and 10 were providing submarine services in the Narragansett Bay OPAREAS and wouldn't be back for a week. Four others had just arrived at Rota, Spain after a trans-Atlantic direct support mission for some Sixth Fleet Auxiliaries and were refueling there alongside USS LONG (ASN-43). That left only the SSL-4 and SSL-13 available. He hoped it would be the 13 boat. In spite of the fact that some of the Squadron personnel were superstitious about the hull number, SSL-13 was Bill's favorite. Its Maintenance Crew Chief, Senior Chief Williams, was outstanding. He was a gruff old Auxiliaryman who had been Chief of the Boat on three SSBN's before being selected for the SSL program. He would constantly complain of how assigned crews would treat his boat poorly, just as he used to carry on about the opposite crew on his FBM's. When asked if his boat was ready to sail, Chief Williams would invariably indicate that he needed at least two more days of work on it, and he'd wanted to paint it out this time, and couldn't they assign the mission to the 8 or 12 boat. The Squadron Engineer had come to learn that if Chief Williams estimated the remaining maintenance were anything less than a week, then the boat was beautifully prepared, and was the most ready unit in the Squadron.

The launch had arrived at the dock, and a young sailor jumped smartly out to make it fast. He snapped to attention and popped Bill a very military salute, "Good Morning Commander Townsend, how are you today?" Bill smiled, returned the salute, and complimented the young sailor on the cleanliness of the motor launch.

En route to the tender, Bill again reflected on the wisdom of his deciding to remain in the Navy and the Submarine Force. *Deciding* was probably not the appropriate word he thought, amused. At first, he had been too busy to do the necessary paperwork to resign his commission, and all at once he had found himself too involved with friends, accomplishments and goals to consider it.

Bill was one of the fifteen command pilots assigned to the Squadron. The men who *flew* the SSL's enjoyed privileges and respect on the tender and in the Submarine Force reminiscent of World War II air groups on a carrier. His recognized title of *Commander* was one of these amenities. The officers and men of

the Squadron crews also had their own messing, berthing, and recreational areas aboard the tender. A pay differential existed for the crews above the normal submarine pay. Whether officer or enlisted, selection for a tour in this program was regarded as a high indication of performance and potential. To be considered for a tour of SSL duty, a man first had to excel in his duties aboard an SSN, SSGN or SSBN. Following a tour, the individual would return to the SSN/SSGN/SSBN community with a significant background in submarine sensors, weapons, and tactics – it was a variant of the way the old research submarine NR-1 had been manned. The program was still new enough that the full impact had not yet been felt, but all were agreed that it should prove to be the spawning ground of superlative Commanding Officers, a marked contrast to that one period in the late sixties and early seventies when it appeared that a Submarine Force was evolving with consummate engineering skills, and little more.

As the launch pulled alongside RICKOVER, Bill noted that the SSL-13 was alongside one of the hydrogen fueling stations, and, judging from the frost on the fueling line, was being topped off. The trim of the boat told his submariner's eye that the liquid oxygen tankage had already been filled. So, the 13 boat would be going out today. Bill waved to Chief Williams, topside on the 13, as the launch tied up at the accommodation ladder and received a barely subdued scowl in return—further confirmation Bill would take the Chief's boat from him today.

RICKOVER's OOD greeted Bill at the quarterdeck and informed him that his mission briefing would be in the Commodore's stateroom at 0900. Bill thanked him, and walked toward the Squadron ready room to check the duty roster and get a cup of coffee.

The 30-day Energy Embargo crisis both proved and disproved the validity of the Admiral's efforts. His products were an order of magnitude superior to the opponents, and a one-on-one contest was no contest at all. In the final week of the war, during the inverse barrier phase, no U.S. SSN was successfully attacked by a Russian submarine, while, counting NEW MEXICO's initial 9, 20 Russian submersibles were sunk. The cumulative kill ratio for all submarines committed during the war was about 10/3 for NATO/Russian forces and 16/1 for U.S./Russian forces. Even at that kill ratio,

however, the war was very nearly lost. A week or so longer of near zero European logistic support would have resulted in either an improbable escalation of the conflict, or incalculable damage to the western alliance. There simply had not been enough submarines to perform all of the missions, many of which did not require the speed and endurance of the nuclear boats. After the war, it was decided to continue to build the nuclear attack submarines to their planned level in numbers and excellence, but also to develop less expensive platforms capable of mass production and able to relieve the SSN's of the more mundane jobs of costal defense and convoy support. The result was the SSL. One hundred and nineteen feet long, displacing 508 tons, and with a crew of six, the ship was powered by fuel cells driven with liquid oxygen and liquid hydrogen. It was capable of crossing the Atlantic Submerged at 12 knots, and, due to its small size and titanium hull, could operate at more than a mile in depth. It was quite a technological achievement. Five 10-boat squadrons were now operational, and plans were to peak at a level of 10 squadrons by 2027, at which time they would begin to be decommissioned as the force levels of SSNs recovered. Serious consideration was being given, however, to leverage SSL technologies and experience to build small manned *adjuvant* vehicles that would piggyback on mother ship SSNs to extend ISR capabilities into much shallower waters and for other missions.

The coffee pot was full in the ready room and Bill drew himself a cup. The duty roster was posted on the bulletin board and confirmed his speculations:

Underways for Monday, April 23, 2020

Hull #	Departure	Return	Assigned Areas
SSL-13	1000 Q	1100 Q 4/26	NBOA 19

Crew Assignment

Command Pilot-LT Townsend	Sensor Tech.-ET1 (SS) Jones
First Officer-LT(JG) Perkins	Weapons Tech.-FT2(SS) Barnes
Second Officer-LT(JG) English	Propulsion Tech.-MM1(SS) Bronski

Mission Brief

Proceed submerged to NBOA 19, rendezvous with *USS Hawaii* (SSN-776) at 231800 Q and conduct mutual exercise weapon runs in accordance with COMSUBRON 24 OPORD 15-84 until about 252300 Q.

Good, it had been awhile since Bill had made some approaches. Also, Jim Perkins was coming up for his Command Pilot board, and letting him make a run or two would help get him ready. Bill was glad to see that Ski would be his Propulsion Tech. They'd served together while Bill was Engineer of the old SSBN WYOMING, and had been friends since. He was, perhaps, the best equipment operator Bill had ever seen, and he'd managed to master the SSL's fuel cell plant, sensor, and weapon installation with the same thoroughness he'd exhibited with WYOMING's reactor plant. His good humor and quick wit were an added bonus. A little prone to getting into minor trouble on liberty, but a great guy to bring to sea. Bill was happy with the other crew assignments also, all experienced, all pros. It should be a good week.

It was about time for his Mission Briefing and Bill started up toward the Commodore's cabin. CDR Dolan was another individual Bill thought of very highly. As a young submariner, Bill had come to equate flamboyance with expertise among his seniors. So many of the *good* CO's had seemed to be colorful and very visibly self-confident. Bill had not met, nor had he initially been prepared for, CDR Dolan's personality. He was quiet, reserved, and a master of understatement. It wasn't until Bill had seen his performance that he realized that no flamboyance was necessary. CDR Dolan had gained his enviable reputation from results, and expected the same from his subordinates. He was also a first-rate humanist, and his

sincere concern for the problems of those working for him gained their complete respect and dedication.

Bill knocked and entered the Commodore's cabin at 0858. CDR Dolan was seated at the table with a cup of coffee and a copy of the OPORD in front of him, a cup of coffee and a copy of the OPORD at the seat to his right.

"Good Morning, Commodore."

"Good Morning, Bill, have a seat. How was your weekend?"

"Fine, Sir. I got a chance to do a little fishing with one of my neighbors. Would you and Betty like a couple of Blues?"

"We'd enjoy them, if you have some to spare. We're having some people over next Saturday afternoon. Why don't you plan to stop by and bring a date?"

"Thank you, Sir; I'll be there."

Bill envied the way in which the Commodore could put one completely at ease in the first few minutes of conversation. His direct, honest manner was the same regardless of whether he was speaking to an Admiral or a Seaman. Bill knew that he could, with equal ease and effectiveness, honestly and directly apprise an individual of his shortcomings. It wasn't too awfully long ago that a similar meeting in his cabin had begun with, "LT Townsend, your handling of the SSL-8 in last week's exercise was not what I considered satisfactory", and followed with a list of a half dozen specific examples. It was an emotionless and thorough confrontation, and had pulled Bill back from a temporary decline he'd been in. Lesser seniors would have let it ride, reflecting it in the next fitness report, or exploded in self-righteous rage.

"Bill, I'm sure you've checked the duty roster and seen you're taking the 13 boat out this morning. Do you have any comments about the ship or crew assignment?

"No, Sir, its fine. I hope to let Jim Perkins do most of the Command Pilot function to help get him up to speed for his board."

"Good. I was going to recommend that. I gave him to you since I consider you the best qualified to groom him up for the board. Drop up and give me a briefing on how he does when you get back."

"Yes, Sir." Bill felt a little uneasy. If it was embarrassing being called to task by someone this good, it was even more embarrassing being praised.

"Here's your OPORD, Bill. There's nothing unique about it. The HAWAII is leaving for six months in the Med next week, and this will be her last bit of work-up. Sam Macintyre's the skipper, and he's got a good ship. I think you'll find her a worthy playmate. Is there anything else the Squadron can do for you before you leave?"

"Not that I know of, Commodore. I'm going to look the boat over and talk to Chief Williams now. I'll call if anything comes up."

"Fine, Bill—see you Thursday."

Chief Williams was in the Control Room as Bill dropped through the access hatch. He and one of his maintenance crew were just completing the pre-underway check-off list on the weapon/sensor control panel.

"Morning Chief, the boat looks great."

"Well, Mr. Townsend, all the pre-underways check out, but I'd rather have had time to paint out the motor room, and the #1 fuel cell water pump has a squeak I wanted to square away."

"I'll tell Ski to watch the pump. Anything else I should know?"

"We loaded four MK-62 exercise weapons last night. The data on them had already been loaded into the weapons computer. An, Sir, tell that clown Barnes that if I find any more candy wrappers behind the ship control panel, I'll break his head."

"O.K., Chief – we'll take good care of your boat." Bill took the completed check lists from Chief Williams and couldn't help noticing that the Chief's expression was not unlike Bill's father's when he had first given Bill the keys to the family car.

Bill took the lists into the living spaces for review. Twenty-three pages of tests and checks, done and certified by two independent persons exactly in accordance with the latest revision of the Ship's System Manual. The biggest single thing contributed to the Navy by the first twenty years of the nuclear power program was the emphasis on precise procedural documentation and verbatim compliance with operating procedures. When the first mention of cryogenic submarine propulsion had been made, the operational community shuddered at the thought of liquid oxygen and hydrogen running around inside a pressure hull, even though the Germans and others had long since managed similar approaches with such as their Type 212s and 214s. There had, in fact, been some rather spectacular *events* at Grumman during the development

work, but during the three years since the first SSL had been accepted by the Navy, there had not been one incident involving inadvertent energy release on the boats or on the tender. Total Safety—another part of The Admiral's legacy.

It was 0935, and Bill's review had just been completed when Jim Perkins knocked on the bulkhead.

"Commander, I have the crew mustered topside, and I've briefed them on the trip. Would you like to speak to them?"

"Thanks, Jim, I will. Isn't your Command Pilot board scheduled for next week?"

"Yes, Sir – I'm not afraid to admit that I'm a little nervous about it. I hope I find some time to study this week out."

"Well, Jim, I don't think you will; but, I don't really think that it is bookwork that will do you the most good at this point. I intend to let you pretty much run the show as Command Pilot during this operation. I'll be looking over your shoulder, and I'll be here if you need any advice, but you'll be calling the shots. You'll be pretty busy, since you still have your First Officer duties to manage, O.K.?"

LT(jg) Perkins was somewhat startled by the news, and a few moments lapsed while he digested it.

"Yes, Sir—thank you—I hope I can justify your confidence."

"I wouldn't be doing it unless I thought you were ready. Has the Watch and Battle Bill been prepared?"

"Yes, Sir. It's posted on the bulletin board, and it's been promulgated to the crew. I gave you the 08-12 and 20-24 Pilot watches, as usual."

"Thanks, Jim, but go ahead and give me your watches, and you take the day watches. As acting Commander, you'll need the nights for rest while I watch the ship."

The two of them proceeded topside where LT(jg) English called the crew to attention.

"Good Morning, Commander. The crew is present and ready for sailing."

"Thank you, Mr. English. Put the crew at ease."

"Crew, at ease!"

"Gentlemen, you've already been briefed on our mission this week, and I've nothing further to add. There is one special aspect of this week's work, however. Mr. Perkins is due for his Command

Pilot board next week, and I've directed him to act in the capacity of Boat Commander for the next four days. All messages and reports normally made to me will be made to Mr. Perkins. He will pass on to me that which he feels is necessary for me to know. I've sailed with all of you in the past, and I'm confident that you will contribute the same effort and professionalism in Mr. Perkin's behalf as you've previously done for me. Thank you."

A nod to his second officer brought the crew back to attention, and Bill turned to go below decks. As he dropped down the hatch, he heard the order "Station the Maneuvering Watch – Crew, dismissed."

The last few minutes prior to the underway of a warship are generally hectic. Even as small, compact, and automated as it was, the SSL-13 was no exception. LT(jg) John English had manned his station as maneuvering watch Pilot at the ship control panel. Once the liquid oxygen and hydrogen had been loaded aboard, a certain minimum energy drain from the fuel cell stack had to be maintained to consume residual boil-off. This was accomplished by a small auxiliary cell. Now that higher demands for propulsion power were imminent, John was systematically bringing on more segments of the energy bank. Although he had accomplished these same steps dozens of times before, John was precisely following sections of the Ship's System manual which he periodically called up on the multi-purpose, touch-sensitive flat-panel plasma display immediately in front of the pilot's chair. This same display selectively presented stored intelligence information, ship system performance parameters, the current tactical situation, and any of the literally dozens of other functions. Petty Officer Bronski was in the machinery space, his maneuvering watch station, monitoring the performance of the remotely operated valves and breakers. Petty Officer Jones, the assigned sensors tech, was at his station, the Weapons/Sensor Control Panel, and was conducting final radio and underwater telephone checks with the Tender, Squadron, and accompanying tug.

Barnes, the weapons tech, stood his watch at the secondary controls for the Main Motor and control surfaces, in case of a failure. Bill was amused to notice that a candy bar wrapper of the type Chief Williams had mentioned was poking out of Petty Officer Barnes' shirt pocket. Men weren't supposed to eat on watch, but as

good a sailor as Barnes was, some minor infractions could be overlooked as long as they weren't too overt. If Bill ever was so careless as to *catch* Barnes eating on watch, he'd have to call him down on it. In the meantime, however, Petty Officer Barnes and the ship would work better if he was allowed to satisfy the same compulsion he had for chocolate that others have for tobacco or coffee. Jim Perkins, as first officer, was responsible for the navigation and piloting, and would normally be spending most his time searching for landmarks on the video display of the non hull-penetrating photonics mast. The boat commander was free to stand back and overview the entire proceedings, giving guidance and direction as necessary. Bill told Jim that he would accomplish the piloting this time out, knowing the weather was good enough to do that and still monitor Jim's actions as acting Commander.

"We have the Squadron's permission to get underway," reported Jones from the W/S console.

"Very well," replied the acting Commander, with just a trace of nerves in his voice.

"Control, Bridge, what is the status of underway readiness?" said a speaker at the Ship Control Panel. Jim looked at Bill and Bill nodded agreement.

"Helm, inform the bridge that the boat and boat Commander are ready to get underway." Stated Jim with a tone of rising confidence.

Bill had recognized Tom Norris' voice as the Duty Officer of the Deck. Command Pilots were periodically assigned as Duty OOD's, and this week it was Tom's turn. Surprisingly enough, the port egress and entry problem had been one of the most controversial issues of the whole SSL development program. The questions revolved around an OOD on the bridge, his safety if any significant seas were running, and the traditional CO/OOD/ship relationships. Proposals were made for the ship to be towed in and out of port, but very real problems existed in making up the tow in open waters. For awhile, it had looked as though the entire SSL program would collapse due to pressure on this one point. It was then that one of the Boeing human factors engineers assigned to the project spoke up. "I'm not that familiar with Naval tradition, and I've never been on a submarine, but is it really vital that the OOD be physically located on the ship? For years, a man on the ground has been 'flying' down aircraft in poor visibility by giving instructions to the

pilot over radio. That would seem to be a hell of a more insurmountable problem than what we've got. In any case, the individual steering the ship can't see where he's going. What difference does it make if he gets his orders from an OOD on his ship over sound-powered phones, or from an OOD on another, more seaworthy ship, via radio or underwater telephone?" Not so surprisingly, the concept worked. The OOD rode a tug several hundred yards ahead of the SSL, and gave maneuvering orders via radio or underwater telephone. He had no responsibility for the tug's position on maneuvers, but only those of the SSL. As any sailor knows who has second-guessed a ship's underway or landing from the safety of a pier, it is sometimes easier to judge the relative motion, wind, and current effects when you're removed from the ship itself. In addition, since the tug preceded the submarine, and had a deeper draft than the SSL, the OOD had merely to conn the SSL in the tug's wake and was pre-alerted to any navigational hazards along the track.

"Control, Bridge; LT Norris has the deck and the conn. Rudder amid-ships – answer bells on the Main Engines, answer all stop."

Bill smiled. In its own inimitable way, the Navy had kept all the terminology exactly the same as if the OOD were actually topside. In the heat of a difficult maneuvering watch, even he, as Boat Commander, often subconsciously lost sight of the fact that this wasn't so. Only once, in eighteen months as a command Pilot, had Bill had to exercise his prerogative to assume the conn and direct the ship's motions using video periscope data. That had been when the tugs gyro had failed and the Duty OOD had ordered an erroneous course. It had been very foggy, and the tug had not noticed their heading reference drifting off. On their radar, due to the bad gyro, it looked as though the SSL had begun to turn out of the channel, and the duty OOD had ordered a large course change to bring it back in. Bill had seen the tug drifting out on his radar, and, based on his First Officer's excellent piloting skills, was sure enough of his own heading and position to answer back.

"Negative, Bridge. This is the Boat Commander – I have the deck and the conn. Be advised you are leaving the channel." Bill had stopped the SSL until the situation cleared, but the tug went aground 50 yards to the right of the channel. Bill had then continued in on his own, transferring the conn to another Command Pilot

on the tender for the final stages of the landing. It had been proof of the value of redundant piloting capabilities in restricted waters. If he had been in tow, it would have been a terrible mess.

"All back one third." Crackled the speaker.

"Answers All back one third," answer John, as he advanced the Main Motor power lever to the appropriate position.

The boat shuddered slightly as the astern bell came on. Ships, like people and organizations, seem to inherently protest against moving backwards.

"All back two thirds, left full rudder."

The boat moved out from the tender and began to swing its head to starboard. Through the scope, Bill watched CDR Marsh on the 0-3 deck of the tender. As he zoomed up to an X8 magnification, Bill recognized the look of mixed pride and envy on the Commodore's face. It was something only a seaman would understand. Proud to be a part of the mechanism that was getting a warship smartly underway, but envy of the Commanding Officer of that warship, who was about to re-enter the world of complete and total responsibility and authority. A man could spend 16-18 years at sea and when shore duty came, tell his wife and kids how great it would be not to be separated for long periods anymore. He would mean it, but that didn't mean he wouldn't feel a loss watching ships go to sea without him. If coming back from sea was the greatest feeling in the world, then by not going, you cheated yourself out of this euphoria.

The Maneuvering Watch went well. Bill enjoyed the chance to regain his piloting skills, and got the perfectionist's thrill when three bearings to landmarks on the beach would neatly intersect right on the intended track. The ship turned to the southeast and passed a line drawn between Montauk Point and Block Island. They were in International Waters now, and there were few visual contacts. It was time to assume local control and release the tug. Bill glanced over at Jim to see if he had arrived at the same conclusion. Jim was engaged in conversation with Petty Officer Jones at the W/S console. Jones was describing a minor problem in the passive video display, and what corrective action would be necessary before the rendezvous with SSN-701 tonight. Bill decided to give him a few more minutes. Jim finished that conversation and walked to the navigational plotting to review the boat's

position and intended track. Then to Bronski, to ask about the propulsion plant performance during the maneuvering watch. Jim was operating in top notch First Officer style – keeping his finger on the pulse of everything on board

"Jim, can I speak to you, please?"

"Yes, Sir."

Bill bent over the plotting table to get some measure of privacy without committing the overt act of calling Jim into the living spaces.

"What are your intentions on releasing the tug?", he asked.

"Oh, well, I guess we could release him now." Answer Jim.

"I agree – don't forget that there're half a dozen of people up there serving you. They're interested in doing a good job, but they're also concerned about not having too long a haul back to the barn. I'm sure it's apparent to them that they're not really necessary anymore, and not being released will result in one of two conclusions – we're either unprofessional or inconsiderate."

Jim flushed slightly, "Yes, Sir, I wasn't thinking."

"But you were, Jim. That's the point I want to make. You were totally thinking about the current facets of your job. Your mind was 100% task oriented. That's great as a First Officer or any other member of the crew. As a Command Pilot, it can lead to disaster. Never let yourself get more than 50% involved in anything. Keep the other 50% on a plane above the here and now – reviewing, thinking ahead, questioning yourself and others, and inventing solutions to yet to occur problems."

Bill smiled. "Others will call it ESP, but it's just good Command thinking. O.K., turn them loose now—there's no harm done. You're doing fine, but I'll keep nitpicking you on these fine points."

Jim grinned acknowledgement of his *under-instruction* status, and picked up the nearby communications mike.

"Bridge, Control: I'm ready to relieve you of the deck and the conn."

The rapidness of the reply confirmed Jim's intuition that the OOD and the tug personnel were anxious to be released.

"Bridge, Aye: steering course 131, all ahead standard, two visual contacts: one small fisherman bearing 235, range 5000 yards with a starboard 70 angle on the bow – he appears to be dead in the

water; one merchant, inbound, bearing 030, 6000 yards, port 130 angle on the bow. He is past CPA and opening."

"Very well, I relieve you of the deck and the conn. You are released—Thanks for the help."

"Glad to do it 13, and good luck to you this week, Jim."

"13 Aye, securing the net." Jim appeared a little surprised that Tom Norris apparently knew he was acting Boat Commander. He hadn't been around quite long enough to realize that nothing goes on in an SSL Squadron that escapes the grapevine.

"Commander Townsend, my plans are to dive at the 20-fathom curve, go on up to full and get to the rendezvous point an hour or so early in case there're any communication problems."

"Good, Jim – that's real Boat Commander logic."

Bill watched Jim's confidence increase by an order of magnitude simply on that one complement. It appeared that Bill was picking up a little of Cone's and Marsh's ability to manipulate subordinates' emotions at will. It was a powerful leadership tool, but Bill was still in awe of the dangers of using such a talent unwisely. It was just as well that it was hard to come by—hopefully, but the time one achieved it, he'd also achieved the maturity and wisdom to use it properly.

As the 20 fathom curve got closer, the sonic beacons from the off-shore fixed fishing installations and oil rigs were detected on the sonar. The devices were really ingeniously simple. An application of similar above water visual signals, such as red lights on radio towers or running lights on ships, each type of underwater obstruction in waters greater than 20 fathoms emitted a signal whose frequency modulation identified the type and depth of the hazard. Even deep draft ships had these devices. As with most safety devices, it had taken a disaster to father these innovations. In 2009, a Chinese SSBN coming to periscope depth had been struck and sunk unknowingly by a 200,000 ton tanker in the South China Sea. Charge and countercharge had been passed between Washington and Beijing when the loss, but not the cause, was discovered. Fortunately, a neutral deep diving Korean research sub located the hull, and by comparing commercial tracks with the position, and docking the suspected tanker, the truth of the incident evolved before national prides created a confrontation. Bill since had reason to be thankful for the beacons. When a ship drawing 80 feet is

pointed right at your position, not much noise gets through the 1000+ feet of hull between you and her engines.

Bill had the ship control panel watch as they crossed the 20 fathom curve. He slewed the video periscope to the East and could see a dozen wind turbines and three of the big oil rigs tailing off over the horizon. They hadn't been kidding when they speculated about the wind and oil resources southeast of New England. Maybe when he retired from the Navy, he'd get a job driving one of those SSL-like boats the oil companies used to check the wellheads and the pipeline runs into Long Island Sound.

"Sounding, 22 fathoms, Sir." Reported Petty Officer Barnes from the W/S console.

"Very well, inform Mr. Perkins."

"Aye, Aye, Sir." Replied Barnes as he rang the living spaces.

Jim appeared through the door to the living spaces, and Bill made the standard report, "Sounding is 22 fathoms, the boat is rigged for dive and 6 miles ahead of track, request permission to submerge to 80 feet and increase speed to full in accordance with your instructions."

"Very well, submerge the boat."

The main vents were opened, the video periscope and communications mast lowered, and the boat started down towards 80 feet. Bill advanced the main motor controls and watched the corresponding displays indicate increased RPM, speed, fuel cell amperage, and H_2/O_2 flow rates. Everything was working smoothly. A yellow warning light and an associated buzzer actuated at the common alarm panel. When interrogated, the readout indicated "HI H_2O."

"Better have someone take a shower, Jim," said Bill. "We're at 80% potable water, and will be making it pretty quickly at this full bell."

"I'll volunteer," laughed Jim. The characteristics *submarine smell* of the diesel-electric sailors was one bit of tradition no one had minded giving up. On a *normal* mission of 15 days or so, the ship would operate at more moderate speeds to conserve fuel, but on a short operation such as this, the boat was hardly constrained at all in the use of FULL or FLANK bells.

The transit to the assigned operating areas was uneventful. Depth was increased in several hundred foot increments to remain at about 75% of the corrected sounding.

"Officer of the Deck – sounding 1000 fathoms," reported Barnes. "We appear to be crossing this curve about 2 miles ahead of our SINS position. I recommend we get a navigation fix now before we move on over to the rendezvous point."

"I concur. I'll get Mr. Perkins' permission." Bill rang the living spaces and spoke to Jim who had just finished dinner and was getting ready to come on watch. "Mr. Perkins, OOD; we've crossed the 1000 fathom curve about two miles ahead of track. I recommend launching a Nav buoy to get a Global Positioning System satellite fix."

"Permission granted – launch the buoy. Please inform me of the results."

Jim was warming up to being in charge, thought Bill. He'll do all right.

"Petty Officer Barnes, launch a GPS Nav buoy."

"Aye, Aye, Sir," and Barnes programmed the master computer to calculate ship maneuvering constraints based on buoy rise rate and ship's depth.

"Sir, recommend 7 knots to assure the fiber optic tether lasts for the duration of the fix."

"Very well," and Bill dropped to shaft turns for 7 knots.

"Buoy away, Sir."

"Very well."

Again, Bill reflected on what tapping of other areas of state-of-the-art had brought to the Submarine Force. Submarines had always played with buoy-like devices fired from a miniature torpedo tube about 3 inches in diameter, but they had been extremely unsophisticated compared to what aerospace expertise had since given them. The signal launcher as such had long since disappeared, and the 13 boat's superstructure was literally honeycombed with externally stowed devices of every kind. Buoys to communicate via, the Nav buoys, evasion devices; some floated to the surface, some sank, some were rocket propelled and others served as an acoustic/RF interface which enabled the submarine to have two-way connectivity to aircraft or other entities with radios using acoustic transmissions. There were anti-aircraft missiles and other highly classified devices which would drive any potential adversary's radars or sonars wild. These were all programmed and controlled from the W/S console.

"Satellite reception indicated," reported Barnes, as both his plasma display and monitor speaker responded to a cryptic series of beeps and whistles from the buoy. After about 2 minutes of this data, the display flashed:

FIX COMPLETED –
FIX QUALITY 4.8 –
RESET 1.8S NM AT 136° -
INSERT? –
"Good fix, Officer of the Deck, recommended SINS reset is about 2 miles to the Southeast; shall I insert it?"

"Yes, insert the fix."

Jim had arrived in control and had monitored the conversation. He nodded approval and walked over to the Ship Control Panel as Bill returned to a Full bell.

"Ready to relieve you, Sir."

"Very well," said Bill. "Steering 140°, depth 4000 feet, all ahead full. No ships alarms, no contacts evaluated as ships, obstruction beacons held on either quarter—opening. No unexecuted orders."

"I relieve you of the deck and the conn, Sir."

"I stand relieved," replied Bill, and he punched in the appropriate closing deck log entry into the computer's memory with the input deck on the front of the SCP.

The Navy would never get rid of logs and readings, but this was a lot less painful way to collect these mountains of data. Virtually every piece of equipment on board was sampled by a recording device with the capability of manual input, such as the Deck Log, of facts or opinions. Upon completion of a mission, a magnetic tape reel was given to the Squadron staff who could analyze to their heart's content and file for future reference. For example, a good deal of the work list for maintenance crews such as Chief Williams headed was automatically prepared by computer analysis of equipment parameters on these tapes.

Petty Office Bronski had already relieved Barnes on the W/S console as Bill left Control to conduct a traditional after watch tour of the ship. "Barnes, how about popping one of those fish and chip dishes into the microwave for me while I make my tour? I'll whip you at cribbage after dinner, if you feel up to it."
"Yes, Sir," Barnes smiles, "I feel up to it!"

Bill wasn't that good a cribbage player and knew Ski would probably win; but he enjoyed the camaraderie of the game, and the others got a big kick out of beating the Boat Commander.

As he entered the machinery space, Bill heard that squeak in the H_2O pump that Chief Williams had mentions. It was pretty loud, but the motor casing wasn't any warmer than normal. He made a mental note to get readout from memory on the trend since underway. He thought that Chief Williams would have taken a harder stand on its repair if it had been this loud before.

Bill finished his tour and returned to Control to report the results to the OOD. "Conditions satisfactory below decks, Jim; except that the fuel cell H_2O removal pump's a little noisy."

"I noticed that earlier, Sir. The first thing I did when I got on watch was to get a readout on its current and accelerometer readings. Here's a hard copy for your review. Notice that the current has been running only a few percent over normal load demand, but the vibration reading took a 5 db jump about an hour ago, and have since remained steady. Looks like a bad bearing, but it seems to be holding its own."

No flies on this guy, thought Bill. He's analyzed it perfectly.

"Good, Jim, you're way ahead of me."

The dinners were just coming out of the microwave oven when Bill returned to the living spaces. They were pretty good, as good as you would get on United Airlines, but were still a far cry from the steak and potatoes of the nuclear boats.

"Thanks, Barnes, What're you having?"

"Oh, I'm going to try the Lasagna."

"You mean, with an Italian wife, you've got to go to sea to get Lasagna?"

"You're right, Sir." Laughed Barnes. "She gets on a different foreign food kick every once in awhile and does it to death. The last month it's been German—knockwurst, liverwurst, this wurst and that wurst. I honestly don't know which is the wurst!"

Bill grinned and offered his condolences. He knew Barnes liked to kid about his wife and her gourmet cooking. He also knew they were a thoroughly devoted couple with two great little kids. Barnes was really sharp with a quick wit. Bill expected to hear any day now that Barnes had been accepted into a Navy sponsored college program leading to a degree and a commission. He really deserved it.

Dinner didn't last long, and the cribbage board appeared out of the game and library locker.

"Penny a point, Sir—double for skunks?"

"No way, sailor—you're hard enough to beat when it's just for fun! By the way, I intend to be up for this whole watch, if you want to get some sack time."

With a six man crew, there were three two-man watch sections. Both of the individuals on watch were pretty much constrained to their stations, the W/S console and the SCP. In order to be assured of having a free body to check a machinery space, or provide a head call relief, or wake someone up, the off-going watch was responsible for reaching a mutual agreement where at lease one of them would be up and about. Normally, they split the four hours into 2 hour segments, keeping the OOD informed of who the *ready* man was.

"Thanks anyway, Sir, but after a few games, I'm going to run a few more internal check on our exercise weapons. I checked with the Squadron Weapons Office this morning and found out that this series of MK-62's has been having a higher than normal rate of post-launch failure."

"O.K., but don't forget we've got a busy day tomorrow – don't burn yourself out."

"No. Sir, I'll....."

There's a premonition, a sixth sense that submariners develop concerning the General Announcing Circuit, or 1MC. It might be used a dozen times an hour, but there are times that the *click* preceding a message will cut through the fog of sleep, and will stop conversation in mid-stride. Such was the *click* that cut off Petty Office Barnes' sentence. An infinitely long half second later came:

"FIRE IN THE MACHINERY SPACE" followed by the continuing gong of the General Alarm.

From this point, the human responses of Bill and Petty Officer Barnes were Pavlovian in nature. As the *ready* body, Bill first moved to wake anyone in the bunkroom. John English and Petty Officer Jones had already rolled out, and were getting into trousers and loafers. Barnes, as the off-going W/S console operator had proceeded to the scene, to be followed shortly by the on-coming SCP watch, LT(JG) English. Bill moved from the bunkroom to control to relieve the W/S console operator of casualty control, and

Jones was right behind him to man the secondary motor/planes control station.

"Officer of the Deck, Machinery Space reports heavy smoke, recommend deploying Emergency Breathing Apparatus," announced Bronski from the W/S console, in a calm but forceful voice.

"Very well, deploy EAB"s."

Jim pushed a button on the SCP, and a dozen plastic masks dropped from the overhead throughout the boat, one not more than a couple of steps from any place a person might be. The arrangement was not unlike that of commercial airliners, and the transparent masks, which covered the eyes, nose, and mouth, were connected to the O_2 stowage through a system of tubing and regulators. It wasn't the most comfortable way to exist, but the ship could be operated for an entire mission in this manner, if the atmosphere becomes contaminated.

Immediately followed the casualty, LT(jg) Perkins had commenced other standard procedures. The boat was angled upward about 20° from the horizontal, and speed had been increased to maximum.

"Machinery Space reports fire was in #1 H_2O removal pump. Power to the pump has been secured locally, but the motor insulation is smoldering," announced Bronski through his EAB. "Fuel cell pressure increasing."

The casualty had gone well up to this point, and Bill had not felt to need to comment or offer suggestions. In accordance with standard practices, he would not relieve the W/S console operator of casualty control until either the initial problem was entirely in hand, or it was apparent his intervention was necessary for the safety of the boat. The last report had concerned him, however; with no H_2O removal capability, and the FLANK bell now being answered, cell pressure was building up. If it reached the point where internal reliefs lifted, there could be a serious explosion hazard with the smoldering motor in the same space. A glance at the SCP showed the boat at 800 feet and rising at about 600 feet per minute.

"Mr. Perkins, have you considered isolating and inerting the cells?"

"Sir, I think we can make it to the surface before the reliefs lift!"

"Officer of the Deck, isolate and inert the fuel cells!", barked Bill. "Aye, Aye, Sir," Jim lifted protective covers on two SCP switches and actuated them. Through the hull one could hear the main power breakers open and the H_2 and O_2 emergency supply valve shut. A hissing sound indicated that the cell's interior was being flooded with nitrogen. The lights blinked almost imperceptibly as the boat's service loads were picked up by the backup Lithium-ion battery pack and the ship's speed began coasting down. Depth was steadying out at about 500 feet.

Jim continued his direction. "Mr. Perkins, make minimum turns on the Emergency Propulsion Motor, make your depth 100 feet. Weapons/Sensor console, make a careful search and report all contacts."

The respective individuals acknowledged the orders and the EPM, a very small motor integrally built into the same casing as the main motor, was energized. This was capable of moving the boat at a few knots with very low power drain from the battery pack.

"No close contacts, Sir," announced Bronski.

Depth was now 100 feet and the SSL had been maneuvered through a large course change to insure a thorough search for contacts.

"Very well—Mr. Perkins, surface the boat."

This had been the hardest part of SSL operations for Bill to get used to—surfacing from a hundred feet. No slow approach to periscope depth followed by a visual look. The SSL was just not optimized to operate at periscope depth, and it was actually safer to just pop on up.

The sound of the high pressure air hitting the Main Ballast Tank had the same reassuring sound as it had back on the NORTH CAROLINA and WYOMING. It was one of the most pleasing sounds in the world at the end of a two-month patrol.

As the SSL-13 hit the surface, Bill raised the video periscope and swung it around the horizon. The full darkness of night hadn't yet covered the sky, and a clear horizon showed no visual contacts.

"Petty Officer Bronski, I'll relieve you of the W/S console. Where do we go from here?" Asked Bill.

Well, Sir, I think the water removal pump was the only problem, and I can just isolate it and line up #2 pump. We will need to purge the fuel cell, however, and I think we could all use a little fresh air

in the boat so these masks can be secured.

"Right, I relieve you. Go on up to the Machinery Space and take a look. Mr. Perkins, secure from fire; open the head valve and ventilate the boat."

"Aye, Aye, Sir." Jim appeared a little shook over the events of the past 5 or so minutes since the fire. Now that only he and Bill were in the control room, Bill faced the issue head on.

"Mr. Perkins, you endangered the boat by not isolating and inerting the fuel cell. Do you have an explanation of why you hesitated?"

"Sir, my plans were to get to a safer depth, 200 feet or so, then shut down the cell and go on the EPM while we squared the problem away. I felt if I could avoid inerting the cell, then we'd save ourselves a surfacing and cell purge, and not hazard reaching the rendezvous point late."

"Jim, you remember your reactor prototype training. Tell me, what was the biggest difference you noticed between operating that shore-based reactor and operating the reactor at sea on your first ship?"

"At the prototype we'd shut the reactor down for nearly any problem. At sea, a conscious effort would be made to resolve the difficulty while maintaining maximum propulsion capability."

"Exactly—always be sure of the factors on either side of the 'calculated risk' equation. If there is no overriding reason for continuing on, then act on the side of conservatism. If this casualty had happened in a battle condition, you would have been completely justified in trying to 'guts' it out. The chances are that there would have been no problem. However, right now we are in a peacetime situation with nothing exceptional to be gained by risking a complication of a minor problem. We'll be back down in an hour, and since you were prudent enough to stay ahead of track, we'll probably still make rendezvous on time. Even if we couldn't, it's just a question of sending a message to the Squadron, who'll notify HAWAII of our delay."

"Yes, Sir. I understand your point."

"O.K., Jim, let the Squadron know our status, and also ask Jones to relieve me at the W/S console so I can see how Bronski's doing."

As Bill had guessed, the plant was back on the line within an hour, and the 13 boat was back down and headed towards rendez-

vous at a Flank bell. They would still arrive a little early, and barring no communications problems, wouldn't lose any exercise time.

"Possible submarine target bearing 142, Sir," announced Bronski from the W/S console.

"Very well," answered Jim. "Start trying to raise her every three minutes on secure acoustic link. I'll maneuver to give you data for target solution."

Within 10 minutes, the 13 boat's fire control computer had solved for the target's course, speed, and range. Moving in on an interception course, acoustic comms were established in another 10 minutes, and the target identified herself as HAWAII.

"13, this is HAWAII. Glad to have you here. You're pretty quiet —all we've heard is your comms call-up. Can you make yourself a little noisier for the weapon runs?—OVER."

"HAWAII, this is 13—Roger—WILCO. 13 is ready to COMEX at any time following your exercise instructions—OVER."

"13, this is HAWAII—Roger. HAWAII firing ship on first run. Standard exercise run #6. I will open to South. COMEX without signal at 0100 local time—OVER."

"This is 13—Roger, OUT."

During the rendezvous, the SSL-13 had remained well beneath the maximum operating depth of HAWAII. Sonar performance at these great depths was exceptionally good, and gave the SSL-13 a tremendous acoustic advantage over any adversary.

"Petty Officer Bronski, what are the conditions of standard exercise run #6?" asked Jim

"I'm calling it up now, Sir," replied Bronski as he manipulated the input panel for the ship's computer. In a few seconds, the W/S console's multi-purpose display flashed up an alphanumeric display describing the exercise.

"Target ship 100 to 300 feet, speeds up to 12 knots, course changes of up to 30° no less than 20 minutes apart. We have to pass within 20,000 yards of the initial point. Attacking ship must remain below 400 feet. If an encounter doesn't take place within 2 hours of COMEX, both ships return to the initial point in assigned depth zones to communicate."

"Very Well," replied Jim. "They're starting off with an easy one. I'll open another 5 miles to the North, then get on up into our

zone. Be ready to augment our noise level to that of a Virginia class."

"Aye, Aye, Sir," and Bronski again turned to his display to call up the appropriate control settings for the boat's acoustic augmentation equipment.

By 0100, John English and Petty Officer Jones had relieved the watch, and the boat was in its depth zone. John swung the ship around to the South and Jones energized the equipment which made the SSL sound like a much bigger, more powerful target. This additional noise would make it harder for the SSL-13 to hear HAWAII, but it was the SSN-776 who was receiving the services on this run. The 13 boat would get its chance to play attacker later on in the day.

"Looks like we may have gotten past them, Ski," said John at about 0245. The 13 boat had gone right over the initial point, something Jim thought HAWAII wouldn't expect, and had since been opening to the East. With any kind of luck, HAWAII was muddling around somewhere to the Southwest wondering where her playmate had gone. It was almost as much fun being a good target as it was being a good attacker.

Jim had hung around the control room after being relieved savoring the *in-charge* feeling as acting Boat Commander. He would be going back to the initial point and communicating with HAWAII as the *winner* in this exercise.

"High speed screws bearing 270!" reported Jones from the W/S console.

Just then the secure acoustic comms speaker crackled.

"Mark. Weapon in the water."

Petty Officer Jones pressed a button on the W/S console which put all pertinent ship parameters such as position, speed, course, etc., at that instant into computer memory. At the same time, an acoustic ping was put into the water which would be answered by a transponder on HAWAII to give the computer an accurate range at time of fire. Bearings to the torpedo were also being recorded constantly. With all this data on magnetic tape, Squadron Operations would be able to completely reconstruct the entire engagement with minutes.

"Weapon closing, zero bearing rate," announced Jones.

"Very well." Answered John English.

Standard exercise #6 did not provide for post-launch evasion on the target's part, and John maintained course and speed as required. In a real engagement, the Control Room would be hopping at this time, and the master computer would be recommending evasive maneuvers and types of countermeasures to be released.

An audible *thump* was heard through the hull and on the sonar speaker. If it had been a real MK-62 torpedo, that thump would have meant that the weapon had sensed it was 200-300 yards from its target, and had released a circular pattern on 17 rocket-propelled shaped charge projectiles. Even though each projectile carried only a few pounds of explosive, they traveled at over 150 knots and would penetrate several inches of even the toughest pressure hull. During the weapon's development, there had been skeptics who thought that a one or two inch hole in a submarine pressure hull would not be an effective kill mechanism. These skeptics did not include, however, any submariners who had seen even a ½ inch pipe carry away at any kind of depth. When the immediate effects of uncontrolled flooding and its associated disastrous effect on electrical equipment was combined with the jet of molten metal which immediately precede the water, it was enough to ruin anyone's day. Furthermore, it was likely that the target would be hit by not one, but two, three, or four of these projectiles. Even given the possibility of surfacing after such a hit, a submarine on the surface, unable to dive, and probably without propulsion, is really as good as sunk. In any case, it's no longer capable of performing its mission.

"Warhead release, Officer of the Deck."

"Very well, Jones. Establish secure acoustic comms with HAWAII and get the exercise instructions for the next run," replied John.

Bill was up and about now, getting ready to relieve for the 04-08 watch.

"How's it going, Jim?"

"Fine, Sir. We just finished the first run. John and I thought we'd given him the slip, but he put a pretty good shot right up our kilt."

"Squadron told us they were pretty good. We'd better not underestimate them. Have you written any Night Orders yet?"

"No, Sir, I got interested in following the exercises, and just stayed on through the watch."

"Well, even though it's not always the most fun thing to do, a Boat Commander owes it to his crew to keep well rested. You'd better write some and turn on in. Besides," Bill grinned, "what about John's morale, would you have liked it as SCP watch if the Boat Commander hung over your shoulder for the whole watch on a routine exercise?"

The start of a grin on John's face told Bill that he'd hit pretty close to the mark.

"Yes, Sir," smiled Jim in return, "Good point. I just wanted to make sure everything went as well as possible."

"I understand, Jim. I'd probably be doing the same in your position. But, seriously, tuck away in your memory bank that your success as a Boat Commander will be determined not by how well things go in your presence, but how well they go in your absence."

"I'll remember that, Commander. Thanks!"

They got another three exercises off uneventfully during the night, each of increasing difficult for HAWAII. In only one of them did the SSN 776 fail to make a near perfect approach. She apparently had gotten off on the wrong target, and by the time she'd discovered the mistake, was unable to find and attack the 13 boat before the 2 hours from COMEX had elapsed.

At 0930, after another good run by HAWAII in which the 13 boat had successfully countermeasured and evaded HAWAII's first weapon, only to turn into a second weapon, HAWAII had driven out at slow speed and loitered at a point towards which she had felt the 13 boat would turn in evading the first unit. It had been a beautifully executed attack. When the 13 boat did, in fact, turn as HAWAII had expected, the second weapon was speeded up and headed at the 13 boat. Bronski had heard the increasing torpedo noise only a few seconds before the sound of warhead release.

"HAWAII, this is 13; great shot. Ready to copy instructions for the next exercise run—OVER."

"13, this is HAWAII; it's your turn now. What are your desires for services?—OVER."

Jim glanced over at Bill. "Commander Townsend, I'd like to do a long range interception problem. It'll take quite a bit of time, but we're well ahead of schedule, and I think the crew needs the practice. Standard exercise #12 best fits this type of approach."

"I concur, Jim. Besides, the 776 would probably enjoy the rest

after being at Battle Stations most of the night."

"HAWAII, this is 13; thank you. Request you open to the East for Standard Exercise Run #12. Barrier front North-South centered on rendezvous point. Comex when ready. Finex in accordance with run #12 instructions or at 2400 local time – OVER."

"13, this is HAWAII; Roger-WILCO-OUT."

This exercise would allow the 13 boat to practice one of her primary missions—that of denying passage of an enemy submarine across an imaginary 50 mile long line in the ocean. HAWAII would open out at least 50 miles from this line, and would be completely unconstrained in her tactics to cross it, except that she must remain between 0 – 400 feet in depth. The 13 boat would have to remain below 500 feet. The exercise would terminate if the 13 boat successfully attacked, was attacked itself, or if HAWAII succeeded in crossing the line. If no encounter was made, both ships would return to the rendezvous point at 2400 tonight to communicate.

"Bronski, track her on out as she opens, even though I'm sure she's smart enough to keep that from helping us guess how she'll be coming back," said Jim from the SCP.

"Aye, Aye, Sir—she's building up speed now, and on course 083."

"Very well, we'll be establishing a North-South track with 30 mile legs 5 miles to the East of the barrier line. What does the computer advertise as best speed and depth to detect a 15 knot VIRGINIA at 300 feet?"

"Aye, Sir. Calling it up now."

Petty Officer Bronski fed the target data into the W/S console. Sensors had been continuously monitoring such things as seawater temperature as a function of depth, and the computer had built up quite a knowledge of local oceanographic conditions.

"Recommend 4500 feet at 5 knots, Sir. Most probable detection range computes as 43,000 yards."

"Very well, W/S console," answered Jim.

Now start the waiting. It would take quite a while for HAWAII to open out and start back. There were interfering contacts to sort out. It might be 4 – 8 hours before HAWAII was heard, and then there would be anywhere from 2 – 6 hours of maneuvering to safely close the target to weapons range without being counter detected. It had been an astute observation when someone had descried

submarining as "Days and days of sheer boredom punctuated by moments of stark terror."

It was about 1430 in the afternoon and the 13 boat had just swung back to the North when Petty Officer Jones turned to John English:

"Officer of the Deck, twice now in the last hour, this merchant ship we've been tracking now at bearing 045 has seemed to break into two contacts for a few minutes, and then remerge. I thing it's very suspicious."

"I agree, Jones. I'll get a hold of Mr. Perkins. Keep tracking the merchant and see if you can get a good solution."

Bill came out to Control with Jim to observe his tactical logic. LT(jg) English explained what they had seen.

"HAWAII could very well be riding on in under the cover of that merchant's noise," Jim thought aloud, "but I'd sure hate to get sucked on up to the North and let her slip by behind us! Jones, do you have a solution on the merchant yet?"

"A pretty good one, Sir. She's at about 12 knots, and on her present track should pass out of our area about 20 miles to the Northeast of the barrier line."

"Then, if the 776 was with her, she'd have to break off and dash for the northern end of the line before she left the area! How long do we have before she'd make her move, if that's the case?"

"About 4 or 5 hours," answered Jones. "We'd have to make about 10 knots good to get within weapons range before she takes off. I don't think we'll have enough signal level to track her if we go much more than 8 knots."

Bill watched Jim turn over the alternatives in his mind. If that was her, he'd have to move now. If it wasn't her, then he'd be giving away the ball game by breaking off from this search plan.

"It's the only dope we have at the time, and it sounds like the thing HAWAII would do," Jim said decisively, "Officer of the Deck, start an approach on the contact. Run at Flank Speed for 30 minutes followed by 10 minute periods at 4 knots to get good looks at the target."

Bill was pleased. It was a calculated risk, well thought out and firmly taken. It might be the wrong one, but it was less bad than vacillating, and if one is to do the wrong thing, he should still execute it with élan and style.

The boat surged ahead and Jim and Bill returned to the living spaces. They'd both be returning to Control for each of the slow listening periods.

"Are you as sure of your decision as you sounded?" asked Bill. "Not at all," answered Jim, "but I've got a gut feeling that it's the best move at this point."

"Me too, Jim; except that 'gut feeling' you refer to is based on more than just a statistical probability. That's why it takes five or six years to train one of you gents up. If every decision a Command Pilot or Commanding Officer had to make was completely backed up with factual data, then we could just program that binary beast in the basement to fight one of these things. I like to see you trusting your intuition on an ill-defined problem. An awful lot of time and effort has gone into making that intuition pretty dependable."

Jim smiled, "Maybe you should save your Kudo's until after we shoot?"

"We'll see," replied Bill with a grin.

The 13 boat proceeded up towards the merchant on this fast/slow pattern. The first three *listening* periods gave no further clues to the HAWAII's whereabouts, except that a good solution was obtained on the merchant—12.5 knots, course 285, obviously headed into New Your harbor. On the fourth look, however, after Bill and Petty Officer Barnes had relieved the watch, the target had definitely split into two contacts.

"I think that's her!" announced Barnes, as he cycled through different modes of the sonar systems to aid in identifying the type of target heard. "If it is, it looks like she's broken off to the southwest and is building up speed."

"Very well," answered Bill, and he turned towards Jim, standing behind Barnes, in expectation of some further instructions.

"Officer of the Deck, man Battle Stations. Start maneuvering to separate the contact of interest from the merchant and pin down the solution."

"Officer of the Deck, Aye."

Battle stations were manned in minutes. John English relieved at the SCP, Bronski went forward to monitor the Machinery Space, and Barnes and Jones manned the respective Weapons/Sensors portions of the W/S console. Jim was directing the approach with

Bill filling the first officer role of providing tactical backup to the Command Pilot.

"Sensor station, what's your best solution?" asked Jim.

"Target bears 032, course 262, speed 20 knots, range 28,000 yards," replied Jones. At the 13 boat's extremely deep depths, the target's sound rays were arriving at the sonar significantly displaced from the horizontal. Just how much displaced they were was an excellent indication of range.

"Very well. Attention in Control Room. We have a target to the Northeast, classified as USS HAWAII. I intend to shoot one MK-62 exercise torpedo from a position about 10,000 yards on the target's port quarter. Weapons station, make unit #2 ready in all respects."

"Aye, Aye, Sir," and Petty Officer Barnes performed the necessary evolutions on his panel to *cock* the torpedo.

"Sensor station, what is the optimum approach vector to arrive at the firing point?" asked Jim.

Bill remained silent, impressed by Jim's expertise in manipulating his party. It was quite the same as watching an accomplished director bringing the best out of a symphony orchestra.

"Optimum own ship course and speed is 318 at 8 knots. Closet Point of Approach will be on the target's port beam at 800 yards, well outside counter detection range. Firing point will be reached in 38 minutes."

"Very well. I intend to pass on through CPA to the desired firing point only if the target continues on its present track. Be prepared to shoot earlier if any change in target course or speed is noted."

Bill thought he'd have played it a little differently. He didn't like getting any closer to a target than was necessary to get a shot off. However, Jim's logic was pretty solid, and if he wanted to play it this way, it was his run.

HAWAII tracked right on down its track as solved as CPA was approached. Suddenly, the sonar monitor chirped and the sonar display flashed an alphanumeric message.

ACTIVE TRANSMISSION
PROBABLE U.S. VIRGINIA CLASS SSN
COUNTERDETECTION PROBABILITY – 0.3

Knowing how difficult a passive target the SSL-13 was, especially with HAWAII at 20 knots, the 776 had wisely chosen to echo range on the last few miles of her dash to the barrier line. The computer had given HAWAII a 30% chance of detecting the 13 boat, but that was assuming nominal sonar operators, and nothing they'd seen of the 776 so far would indicate she was nominal in any respect. Bill was interested in watching how Jim would handle this development.

"All stop, right 10 degrees rudder, steady course 355. Firing point procedure," barked Jim.

Good, thought Bill. He was slowing to reduce any relative speed, or Doppler, clues of any echo returned to HAWAII; he was pointing the target to reduce to cross-sectional the size he was presenting for an echo; and he was going to get his weapon off before 776 evaded or counterfired.

"Weapon ready," announced Barnes.

"Solution ready," announced Jones.

"Boat ready," announced John English.

"Final bearing and shoot," ordered Jim, and a second later the 13 boat shuddered as the weapon left its external stowage tube.

"Target has slowed and turned towards," reported Jones. This probable meant that the first shot would miss.

"Make unit #3 ready in all respects," countered Jim, "All ahead Flank."

Bill gave Jim a mental upcheck for getting the second unit ready, but he was curious about the Flank Bell. Range was now about 6000 yards, and if HAWAII hadn't detected the 13 boat actively, this increased speed would make passive contact likely.

"High speed screws, bearing 000—closing," reported Jones.

"Very well—weapons station, release target simulator, set course 180."

HAWAII had counter fired. The target simulator on course 180 was a good move. Hopefully, it would run the 776's weapon on out to the South without it's detecting the 13 boat.

"The first unit should have hit by now," reported Barnes. "Evaluated as a miss."

"Very well," replied Jim. "Jones, what's range and bearing to the target now?"

"Range 4300 yards—bearing 359."

Very well, come right steer course 359. Weapons Station, I intend to pass directly beneath the target. As we do, I'll release unit #3 in circle search, 30 second delay in acoustic enable."

"Weapons Station, Aye, Sir," replied Barnes.

Bill now saw what Jim's intent was. By pointing at HAWAII at maximum speed, he'd probably gotten inside of her weapon's enabling range. Sonar had since confirmed that the unit was chasing the target simulator down to the South. He was also taking advantage of what surely was a tight situation aboard the 776. They were tracking the first unit shot at them, surely heard the target simulator and probable evaluated that as the 13 boat trying to outrun their unit. Jim was giving them no time to discover their mistake. With both ships pointed at one another, the range was closing at more than a mile every 3 minutes. In another few minutes he'd pass directly under them, and essentially mine that part of the ocean. The 13 boat would be well clear before the weapon came alive acoustically, and it would be looking right up HAWAII's stern.

"Range, 800 yards," announced Jones.

"Firing Point Procedures," barked Jim.

"Weapon ready."

"Ship ready."

"Final bearing and shoot."

Again a shudder, then the sensor station indicators seemed to go wild for a minute as the 13 boat passed under HAWAII.

The next 30 seconds would be long ones as the 13 boat opened the firing point. Did HAWAII put it all together? Was she maneuvering astern of the 13 to evade the weapon and get another shot off? A minute passed, then a *thump* but a much more subdued, distant thump than they'd heard when they were target.

"Good show, Jim!" exclaimed Bill, "a bit swashbuckling, but a solid hit!"

"Thanks, Commander—I think I was pretty lucky!"

Before it seemed possible, the exercises had been completed and it was time to head back in. HAWAII released the 13 boat with thanks, and the crews of both vessels left better prepared to operate their ships and with a profound professional respect for the other's abilities. It had indeed been a good week.

Jim was looking a little drawn from the events of the past few

days, and managed to get some well earned rest on the transit into the 20 fathom curve. When the boat surfaced, the sun had just risen on another beautiful Spring day. Everyone's fatigue dropped from their shoulders as they headed in. No one is ever too tired to be fired up for an inbound maneuvering watch.

The tug met them just outside the *slot* between Montauk and Block Island, and in short order they were back alongside the tender. Bill owned the crew until the start of the next working day, and he told the First Officer to shove them all off until the next morning. One of the biggest aggravations used to be having the duty on the first day in, and having to grub through all the official mail which had accumulated during the ship's absence. This didn't happen in the SSL Navy. One, the maintenance crew took responsibility for the boat as soon as it tied up, and, two, virtually all the administrative work for the entire Squadron was done by a part of the staff who existed just for that reason.

The first person aboard the 13 boat after it tied up was Chief Williams. Bill watched the Chief's eyes dart around the control room —probably in search of candy wrappers.

"Hi, Chief, we had a pretty good trip except for that H_2O removal pump. I'm getting ready to run the monitor tape up to the Squadron now, and you'll probably have a complete readout early this afternoon."

"Yes, Sir, Commander. If you're going to be leaving, I'll get my crew on down and start on some of the obvious stuff. It's going to take me a month to get this thing back in shape, so I can't sit around waiting for a work list."

"O.K., Chief, we'll get out of your way. Thanks for the use of your boat."

Jim was waiting for Bill topside. He'd helped supervise the hookup of the defueling rig until the maintenance crew arrived.

"Thanks, again, Commander, for letting me get into the thick of things this week. You were right, nothing I could have studied would have helped me more."

"No problem, Jim, I think you did pretty well. Why don't you get on over to your bride now. I saw her car at the boat landing as we were mooring. See you tomorrow."

"Yes, Sir, see you tomorrow."

Bill dropped the monitor tape off at Squadron Operations, then

briefed the Squadron Engineer on the material problem before going to Commodore Marsh's cabin.

Bill knocked on the Commodore's door, and quietly opened it. "Come in, Bill—have a seat—how did everything go?"

"Fine, Sir, except for the one problem we sent the message on. I'm sure Chief Williams will have that squared away in a day or so, however. Jim Perkins ran just about the whole show. He's very talented. Still a few rough edges in implementing a good command philosophy, but all the necessary ingredients are there, and I noticed a tremendous rate of improvement as the week progressed. He has a superb tactical sense, and his overall grasp of the hardware is as good as I've seen."

"Thanks, Bill, I appreciate the objective viewpoint. I've got good feelings about him too. Barring his having problems on his board, which I think unlikely, I'll probably have him fill your place in the Command Pilot roster."

"I don't understand, Sir; what do you mean 'fill my place?"

Commodore Marsh grinned, "Well, Bill, while you were out there shooting the tail off of HAWAII, things were happening here too. When you get to look at the mail tomorrow, you'll see that, one, you've been selected for Lieutenant Commander, and two, you've got orders as Executive Officer on MASSACHUSETTS."

"I thought I'd have another 4-5 months here at Squadron 24. This is a real surprise."

"That's the trouble with you hot shots, Bill, if you're too good they snatch you back away from me. Seriously, congratulations. You deserve the promotion and MASSACHUSETTS deserves you. The XO billet opened up on it and I put your name in the barrel as a prospective relief."

"Thank you, Sir, I only hope I'm up to it," replied Bill sheepishly.

"We'll talk about it tomorrow. Get on home now and relax. I know what kind of strain it is to let someone else do your job on board without interfering. Thanks again for the briefing on Jim Perkins. See me tomorrow and we'll settle out the details on when you want to leave and all."

Bill's drive back to his apartment was a little more subdued than his trip out four days ago. He took the highway instead of his favorite back roads. His mind was too busy with the news the

Commodore had given him to really enjoy the working of his car. In the monotonous four-lane drone of traffic, he could try to assimilate everything. He wasn't sure that he was pleased or disappointed. It would be nice being promoted, of course, but he'd just begun to feel he had a handle on being an SSL Boat Commander. The MASSACHUSETTS was one of the new VIRGINIA class variants which picked up a lot of the functionality of the old Ohio-class SSGNs, and whose advanced modularity even allowed her to be quickly reconfigured for deployment as an SSBN if necessary. She had only been commissioned a few months, but already had an envious reputation due to the manner in which her skipper and crew had built here and handled her on shakedown. It would be a real challenge to step in as XO and help maintain the momentum. Maybe he could inject a little of the SSL philosophy into the organization. Bill had come to realize that SSLs had not turned out to be much of a warship for a nation that aspired to maintain its position as the world's dominant seapower without extensive foreign basing—as opposed to one that only needed to protect its own shores. However, they had managed to free up otherwise insufficient numbers of SSNs for the more important missions that only larger, more capable multi-mission submarines could execute until the negligent post-Cold War *SSN gap* began to be corrected. Perhaps most importantly though, they had given Bill and countless other young submarine officers the opportunity to acquire priceless tactical and professional skills and better perpetuate the flow of Submarine Force culture to those apprenticed to them.

By the time Bill arrived at the Westhampton Beach exit, he had become totally enthused about the forthcoming adventure. He could hardly wait until the morning to find out where and when he would report to the ship. Again, Bill had subconsciously risen to the lure of the Submarine Force. The better an individual, the more important it is to keep him working above his head. Never let the competent stagnate in a comfortable position of complacency. Keep the challenge intense, the demands high. From a distant past, the ideological teachings of The Admiral again reached out to touch Bill's life.■

THE SUBMARINE COMMUNITY

VICE ADMIRAL CHARLES E. WEAKLEY AWARD PRESENTED TO VADM J. GUY REYNOLDS, USN (RET.)

During a career spanning more than five decades, Vice Admiral J. Guy Reynolds has distinguished himself as a visionary leader and a consummate technical expert with a unique ability to forge cooperative working relationships across institutional bounds. As an active duty officer, VADM Reynolds tirelessly championed undersea warfare technology from science and technology to research and development, production and in-service improvement, becoming the "Father of ADCAP" and moving submarine combat systems into the digital age with BSY-1 and BSY-2. After retiring, VADM Reynolds has continued to foster government-industry communications as president of the Naval Submarine League and as a consultant to numerous companies involved in undersea warfare. In all endeavors, he possesses an unparalleled ability to communicate with personnel at all levels, from admirals to ensigns, and from CEOs to shipyard workers, which has helped ensure that the Navy acquires the most effective and efficient capabilities for today and tomorrow.

In recognition of VADM J. Guy Reynolds USN (Ret), for his numerous unsurpassed contributions to maintaining the U.S. Navy's superiority in undersea warfare (USW), the National Defense Industrial Association (NDIA) is proud to present the *Vice Admiral Charles E. Weakley Award* to VADM J. Guy Reynolds for his lifetime dedication and commitment to undersea warfare.■

Mr. Bruce Spear presents the Award to VADM Reynolds.

A MEMORIAL TRIBUTE:
Mrs. Martha Grenfell & CAPT Harry Caldwell

Two members of the Submarine Community, with special places from the history of the Submarine Force, passed away earlier this year. THE SUBMARINE REVIEW is privileged to offer here the obituaries of Mrs. Martha Grenfell and Captain Harry Caldwell both to honor them individually and also as representatives of several groups within the heart of the community.

Martha Grenfell was a Navy Wife in the finest sense of the title, and for the longest portion of her married life she was a caring and committed Submarine Wife. She represented all the women who work so hard to maintain their families and their communities while their husbands man the submarines so vital to our nation's security. She knew of the burdens faced at every level; her husband was a wartime skipper and later, as an Admiral, he became the Commander of both the Pacific and Atlantic Submarine Forces. She is remembered especially as a Founder of the Dolphin Scholarship Foundation.

Captain Harry H. Caldwell represented the professional submariners of the World War II and post–War years. As with most of that generation, his sea stories were genuine legends, and as plentiful as one could want. He was in DACE for the action with DARTER (SS 227) off Palawan in the lead up to the Battle of Leyte Gulf when the two boats caught the Japanese main battle fleet heading for the site of the US landings. They sank two cruisers and heavily damaged a third. DARTER ran hard aground trying an end around to catch more of the enemy force and DACE came in to pick up the entire DARTER crew in the midst of the action. Harry served on several submarines after the war, and was Repair Officer at Subase, New London and all those tours provided more stories. Just a few years ago he was an Editor of the book United States Submarines, published by the Naval Submarine League. In that book he wrote the story of his father, who was the US Navy's first submarine skipper. Twenty seven year old Lt Harry H. Caldwell took command of HOLLAND when it was taken into the Navy. That was just one of the truly unique aspects of Harry's association with the Submarine Force.

Martha Fronk Lindsey Grenfell

Martha Fronk Lindsey Grenfell, 92, passed away peacefully on July 26, 2008, in Virginia Beach, VA. Mrs. Grenfell founded the Dolphin Scholarship Foundation in 1960 when her husband, VADM Elton W. (Joe) Grenfell was COMSUBLANT.

She was born in 1915 at Fort Sill, Oklahoma, a state so new to statehood that her birth certificate still read "Territory of Oklahoma". In 1920 her family moved to Honolulu, where her father, Dr. Clarence Fronk, an Army surgeon, was stationed at Tripler Army Hospital.

Mrs. Grenfell's first husband, Eugene E. Lindsey, was a Lt(jg) when they married. He later was the Commanding Officer of Torpedo Squadron Six from USS ENTERPRISE against the Japanese fleet at Midway and was lost on June 4, 1942. The young widow then met and married Commander Joe Grenfell, who had commanded USS GUDGEON (SS 211), the first submarine to leave on combat patrol after the attack on Pearl Harbor.

Mrs. Grenfell took a lifelong active interest in the Dolphin Scholarship Foundation and watched it grow from one $350 scholarship in 1961 to the current 137 awards of $3,400 each per year. Her family requested that memorial donations be made to the Dolphin Scholarship Foundation, www.dolphinscholarship.org.

Obituary by Mrs. Randi Klein, Exec. Dir., DSF

Captain Harry H. Caldwell USN (Ret.)

Harry H. Caldwell, 86, passed away on July 8, 2008. His home at the time was in Sagamore, Massachusetts. Harry was born in Hempstead, NY on April 11, 1922 and was raised in New York City. His father was a retired naval officer who had graduated from the Naval Academy in 1891. Harry worked for Electric Boat Company for a year before entering Annapolis himself in1940. He graduated from the Naval Academy in 1943 with the Class of '44 and went directly to Submarine School thence to the Pacific in DACE (SS 247). He married Mary Deane Hilliker in 1948.

In 1946 and 47 Harry was assigned to USS SENNET (SS 408) for Operation High Jump in the Antarctic. He went on to command USS SPIKEFISH (SS 404), SubDiv 22 and a fleet oiler. He served

with the US Naval Forces, Europe and commanded the Fleet Training Center in Newport, R.I.. Harry retired from the Navy in 1973 and worked for General Dynamics in Groton for several years. He was also active in municipal affairs at his home in East Lyme, CT.

Harry is survived by his wife of 60 years, two daughters, a son and seven grandchildren. The family has requested that memorial donations be made to the Submarine Force Library and Museum Association.

Obituary adapted by CAPT Jim Hay USN (Ret.)

ETERNAL PATROL

CAPT Robert G. Black, Sr. USN (Ret.)
CAPT Harry H. Caldwell, USN (Ret.)
CAPT Richard M. Clark, USN (Ret.)
Mr. George Hagemeister
CAPT John L. Jensen, Jr., USN(Ret.)
CAPT Ralph B. Johnson, USN (Ret.)
RADM Ralph M. Metcalf, USN (Ret.)
CAPT Robert M. Morrison, USN (Ret.)
CAPT Harry C. Rockefeller, USN (Ret.)
RADM Edward F. Welch, USN (Ret.)
CAPT John F. Whelan, Jr., USN (Ret.)
CAPT Edward L. Willever, USN(Ret.)
CAPT William P. Willis, Jr., USN (Ret.)

DOLPHIN TRANSFER

by The Staff of San Diego Maritime Museum

On May 21, 2002, one hundred miles off the coast of San Diego, the Navy research submarine USS DOLPHIN (AGSS-555) was cruising on the surface and recharging its batteries when a torpedo shield door gasket failed. The boat began to flood. High winds and eleven-foot swells drove seventy to eighty-five tons of seawater inside the ship. The volume of water reached an amount perilously close to the boat's reserve buoyancy. Flooding shorted electrical panels and fires broke out. Only decisive and heroic actions of the crew could save her.

The rest of this story and many others chronicling DOLPHIN's long, productive life will soon be told at the Maritime Museum of San Diego as this remarkable vessel moves into the next phase of her career and joins the fleet of historic ships on the San Diego's Embarcadero. DOLPHIN's history is unique and significant. She is the first US Navy vessel to be included in the Museum's collection, and her many accomplishments mark major waypoints in underwater research and the development of the United States' modern submarine fleet.

Launched in 1968 and decommissioned in 2007, the last diesel-electric submarine in the Navy was responsible for many *firsts*. DOLPHIN's unique, extreme deep-diving capability set her apart and continually placed the vessel at the forefront of undersea naval research during her entire career. In November 1968, she set a depth record for operating submarines that still stands. In August 1969, she launched a torpedo from the deepest depth that one has ever been fired. The boat was designed to be easily modified both internally and externally to allow the installation of special military and civilian research and test equipment. This unique adaptability to various tasks at extreme depths made DOLPHIN a superior platform for many successful projects, including development of a Laser Imaging system of photographic clarity, the first successful submarine-to-aircraft two-way laser communication, development of a new Obstacle Avoidance Sonar system, development of a highly accurate target management system, and the first successful submarine-to-aircraft optical communications. She is presently

outfitted consistent with her last active service: extensively deep water acoustic research, oceanic survey work, sensor trials, and engineering evaluations.

Transfer of the vessel from the Navy to the Maritime Museum was celebrated on September 18 with a Signing Ceremony in Washington DC, hosted by Congresswoman Susan Davis. The Museum was represented at the event by President Ray Ashley, Trustee Steve Mueller, and staff members Mark Montijo and Maggie Piatt-Walton. Other attendees included Congressman Brian Bilbray, Captain David Tungett and other Navy representatives, and Tim Runyon of NOAA.

Acquisition of USS DOLPHIN marks the culmination of an application and review process that has spanned more than a year and a half. Now the physical work begins. The vessel will be towed to a local repair facility where Museum staff, volunteers, and outside contractors will begin to adapt the boat for safe public access and interpretation. The Museum anticipates that DOLPHIN will be in place and open to the public by year's end.■

BIRTH OF A NAVAL SUBMARINE LEAGUE CHAPTER

by CAPT Don Ulmer USN(Ret.)

The retired submariner had barely settled into his new job at Boeing Aerospace, Seattle when summoned by his boss to attend a special meeting downtown. "Someone who understands Anti-Submarine Warfare is needed, and yours is the only name that comes up on the computer. Sound like something you can handle?"

Torn between a lifelong penchant, *volunteer for nothing*, and the need to get off on a good foot, *retsub* reluctantly agreed. "What else can you tell me about it?"

The boss had already re-submerged into the paper stack on his desk. Raised eyebrows furrowed in annoyance. "You know everything I know. Got a call from PR and that's all they told me," and he rebusied himself with the paper task.

Retsub mounted his trusty steed, an aging International Scout pickup, color fading, a door hanging limply and rust threatening to send the other to oblivion. He got it for his part in building a new home and figured correctly that on the day his family took occupancy, the Scout breathed its last gasp. But in the interim, it provided reliable, if not comfortable passage to and from work, admitting much of the weather that accounts for Washington's nickname, the Evergreen State.

A newcomer in Seattle, significance of the Four Seasons Hotel had not yet settled in for him and *retsub's* astonishment on pulling up to top of the line valet parking service can only be imagined. Surely this was not the place, but a check of the address showed it to be so. He was conducted to the meeting room, plushiest section of the most plushy hotel in the city, further confirming a gut feel the company had sent the wrong man to the wrong place. Upon entering, *retsub's* feelings of dismay were akin to those felt when as a junior officer he brought his boat too quickly into a finger pier at New London and knocked over a phone booth. Seated about a mahogany table were Washington State's senior political figures, the Governor, a Senator, and a well-known Representative, all of

whom he recognized immediately. The rest included insignificants he'd later learn to be CEO's of Honeywell International and United Air Lines. The late Admiral Jack Williams retired and living in his boyhood hometown of Long Beach, WA presided over the affair.

The advice of Abraham Lincoln came immediately to *retsub's* mind, "Better to remain silent and be thought a fool than to speak out and remove all doubt." This counsel sustained him well. His advantage; he knew everyone, but no one knew him, and the others could only make speculation on the mistaken belief that Boeing had sent one of their true heavyweights.

Admiral Jack cleared up the Boeing Company perceived need for an ASW person. USS MISSOURI, mothballed and a significant tourist attraction at nearby Bremerton had been reactivated. Something was needed to fill the void. He promoted the idea of what later became the Naval Undersea Museum at Keyport, Washington. The effort required funding able to be committed by all meeting attendees except *retsub*, however only he knew that. It's more than likely Admiral Jack saw through him like a newly washed window pane, but ever the gentleman, said nothing.

The meeting ran its course, and all assembled at valet parking area, to retrieve vehicles and exchange good byes. *Retsub's* prayer that his ride would be the last to show went unanswered. The rule of *last in first out* prevailed, and the tired International Scout rattled into view before any of the others. He climbed into the truck, gave a sheepish wave to his astonished onlookers and drove off.

Several days later, a secretary shared by four level one supervisors stood in *subvet's* officer door and announced through an anxious expression that an Admiral was on the phone for him. It was Admiral Jack, of course. The two swapped pleasantries and the usual repertoire of sea stories. At an appropriate pregnant pause in their conversation, *retsub* made the mistake of his life. "What can I do for you, Admiral?" he asked. A moment later he was founding secretary of the NSL Pacific Northwest Chapter.■

LETTER

FELLOWSHIP IN PHYSICAL OCEANOGRAPHY AT SCRIPPS

Our parents, Fred and Sally Spiess, had two families: the five of us and the succession of young graduate students they *raised* in the world of science. They enthusiastically supported many of these students in the course of Fred's more than 50-year career as a professor and researcher at Scripps Institution of Oceanography and those students are their legacy to the scientific world. We are working with Scripps to honor their unique contribution by establishing the Fred Noel and Sally Spiess Fellowship in Physical Oceanography at Scripps Institution of Oceanography. The fellowship will provide support to first-year graduate students in physical oceanography.

After his submarine service in World War II, Fred and his wife Sally were part of a supportive graduate community at UC Berkeley. Many of the professors and grad students they met at that time became lifelong colleagues and friends. Building on this camaraderie, our parents considered it a duty and privilege to mentor others. A tribute published by The Oceanographic Society described Dad's "effectiveness as a mentor of young scientists...Fred's students remember him for his quiet manner, his wry wit, and his steadfast support." He understood the difficulties associated with funding research; much of his time and effort over his long career in oceanography was devoted to securing funding for projects—many of which supported graduate students. Our mother helped students make the transition into full membership in the scientific community. She included grad students in the many gatherings at the Spiess home and provided guidance as students and their spouses coped with the pressures of the academic world. Later, they both enjoyed thinking of themselves as grandparents in the academic as well as biological sense, as grad students became professors and mentored students of their own.

Our parents were firm believers in the importance of getting a good start. With this fellowship we hope to continue their legacy of

positive support for ongoing generations of graduate students at Scripps.

We invite you to join us in remembering our parents by contributing to the Fred Noel and Sally Spiess Fellowship in Physical Oceanography. To encourage participation in creating this endowment, we are offering to match gifts, on a dollar-for-dollar basis, up to a cumulative total of $100,000.

If you would like to join with us in creating the Spiess Fellowship, please contact Lawrance Bailey at the Scripps Institution of Oceanography Development Officer (858) 534-7171 or lbailey@ucsd.edu.

Sincerely,

Kathy Spiess Dallaire Mary Liz DeJong Morgen Spiess
Helen Spiess Shamble Peggy De Ligio-Spiess

BOOK REVIEWS

WEAPONS, EQUIPMENT AND INSIGNIA: SUBMARINE SERVICE, PT BOATS, COAST GUARD AND OTHER SEA SERVICES

Published by Schiffer Military History, Atglen, PA.
ISBN 978-0-7643-2922-7

Reviewed by: Bill Kreher, Naval Submarine League

This is the sixth and final volume in the *U. S. Navy Uniforms In World War II Series* by Jeff Warner. This coffee table size book contains some heavy reading. Weighing in at four ounces shy of six pounds, it contains over 1000 photographs of uniforms, equipment and insignia from WWII. Most of the photographs are in color and are of exceptional quality.

Of particular interest to the submarine community are the pictures of the Enlisted Submarine Qualification Mark (Dolphins) which when first authorized, was a cloth patch worn on the right sleeve of the jumper between the wrist and elbow. The metal qualification pin was not authorized for enlisted men until 1950.

Also of interest is the fact that *sea ratings* i.e. Torpedoman and Boatswains Mate, were worn on the right sleeve while engineering and other ratings, Machinists Mate and Cooks/Bakers were worn on the left. Some of the more obscure insignia depicted are Expert Lookout, Mailman (the original Postal Clerks) Seaman Watch, Seaman Guard, Firefighter and Shore Patrol.

One photo, in particular, stands out in my mind: a picture of a LT Samuel D. Trusty setting out flare cartridges for a training class on the Very pistol with a lighted cigarette hanging from his lip. In today's world, this most likely would bring the immediate wrath of the *safety police.*

There is a wealth of very interesting information in this book. Way too much to list here. For instance, the *Other Sea Services* in the books title include the Coast Guard, Merchant Marine, Public Health Service, U.S. Coast and Geodetic Survey and a very

interesting chapter on the FITA FITA, an elite Samoan Island guard force organized by Capt. Benjamin Tilley, the first CO of the U.S Naval Station on Samoa.

This is a great book filled with fascinating facts and photos of the Navy during WWII. It will be a great benefit to Naval Historians and especially libraries and military museums as a valuable reference book.■

THE SUBMARINE REVIEW

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

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

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

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

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

ESCAPE FROM THE DEEP
BY ALEX KERSHAW

A BOOK REVIEW FROM THE SUBMARINE RESEARCH CENTER

Mr. Kershaw, in his book, Escape from the Deep, (Da Capo Press, 2008, ISBN 978-0-306-81519-5) has brought into focus the ordeal of USS TANG's (SS-306) fifth patrol better than any previous description. The story of the boat's remarkable successes is the story of its crew and in particular, its captain, LCDR Richard H. O'Kane. After single-handedly destroying an entire convoy in the Formosa Strait, TANG shot its last torpedo. A circular run brought it back into the maneuvering room. Every submariner who reads Escape from the Deep will feel a frustrating fury at the rotten luck of ending the Second World War's most aggressive and successful patrol by a defective torpedo rudder.

For most of TANG's crew the story ends in the few minutes it took the after compartments of the boat to flood. For others, their desperate attempts to reach the forward torpedo room with its escape hatch was a nightmare of darkness, smoke and confusion. About twenty crew members reached the compartment, but the saga continued as the strongest and most self-confident managed the Momsen Lung procedure of rising slowly from 180 feet. Four men on the bridge and in the conning tower slid out of the boat as it sagged to the bottom. In all, nine men kept themselves afloat by remembering the loved-ones at home and clinging to hope. They swam to each other and survived long enough for a Japanese gun boat to pick them up.

While O'Kane's exploits on TANG are well covered in several publications, including those of SRC, the experiences of TANG survivors on board Japanese ships, on Taiwan and finally in the infamous Ofuna and Omori prisoner of war camps have never before been so accurately and comprehensively portrayed. The fierce comradeship and loyalty of TANG survivors remained throughout the terrible days of captivity and into the post-war years when they returned to the United States. President Harry Truman

pinned the Medal of Honor on Richard O'Kane while other survivors received medals including the Silver Star. TANG had received the Presidential Unit Citation during the war.

Kershaw's thorough research rises above the norm including numerous personal interviews with TANG crew members. Additionally, he uses written resources as a basis for his description of submarine events which ring of authenticity. Those diesel sailors who have ridden out storm-driven, mountainous seas can relate to Kershaw's description of the 1944 typhoon which kept TANG and much of the US Pacific Fleet in its grasp for days.

From pulling open ballast tank emergency vents to running a clandestine gillie still in the pump room, the story of TANG is a story every diesel submarine veteran will recognize. Like skipping across a stream on stepping stones, previous TANG narratives have touched only the high spots. Kershaw wades through the stream of momentous events in descriptions of elation at success to uncertainty of capture, to inhuman torture and finally, to release and recuperation. He does so with the sure-footedness of the professional historical writer. Escape from the Deep is a must read for any submariner, but particularly so for veterans of Fleet Boats and Guppies.■

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1ST PLACE: JEREMY LAMBERT
Demonstrating Pacific Fleet Aloha Fighting Spirit

2ND PLACE: PETTY OFFICER FIRST CLASS(SS) JEFFERY GREEN
USS NORTH CAROLINA (SSN-777) in Wilmington, N.C., at sunset just before colors

3RD PLACE: LT. JUSTIN HLAVIN
Crewmembers of USS MARYLAND (SSBN-738)(B) take in sunset while on deployment

HONORABLE MENTION: WILLIAM KENNY
Naval Submarine School student, MMFA Andrew Rollins, at the Submarine Veterans Memorial, Groton, CT before the 2008 Memorial Day Observances.

NAVAL SUBMARINE LEAGUE

COMPARATIVE STATEMENT OF FINANCIAL POSITION

	31-Mar-07	31-Mar-06
ASSETS		
CURRENT ASSETS		
Cash	$ 82,498	$ 121,023
Cash Equivalents	164,744	39,564
Accounts Receivable	35,228	24,229
Investments at Market	355,030	373,437
Prepaid Expenses	6,596	7,447
Total Current Assets	$ 644,096	$ 565,700
FIXED ASSETS		
Furniture & Computer Equipment	36,359	36,359
Office Condominium	251,021	251,021
	287,380	287,380
Less Accumulated Depreciation	(145,999)	(154,155)
Total Fixed Assets	141,381	133,225
	$ 785,477	$ 698,925
LIABILITIES		
CURRENT LIABILITIES		
Accounts Payable	$ 0	$ 0
Accrued Expenses	4,144	4,930
Deferred Income	66,112	66,162
Deferred Membership Dues	65,693	63,160
Rental Deposit	675	675
Total Current Liabilities	136,624	134,927
LONG-TERM LIABILITIES		
Deferred Membership Dues	201,999	210,076
Total Liabilities	338,623	345,003
NET ASSETS		
UNRESTRICTED		
Undesignated	425,704	332,772
Board Designated for Equipment	21,150	21,150
RESTRICTED	0	0
	446,854	353,922
	$ 785,477	$ 698,925

NAVAL SUBMARINE LEAGUE

COMPARATIVE STATEMENT OF ACTIVITIES
For The Year Ended 3/31/2008

REVENUES	Restricted	Unrestricted	31-Mar-07 Total	31-Mar-08 Total
Contributions			$189,002	$151,839
Dues			68,272	64,415
Annual Symposium			130,197	138,543
Subtech Symposium			227,000	269,760
History Symposium				3000
Bank Interest			29	0
Interest & Dividends			25,897	31,848
Advertisements			13,700	24,075
Rent			8,590	8,840
Realized & Unrealized Market Gain (Loss) On Investment			23,997	(39,891)
Royalties			3,993	194
CB Days Receipts			29,675	30,480
Other			1,608	2,114
Total Revenue			721,960	685,017
EXPENDITURES				
Awards and Grant			18,349	7,178
Publishing			76,712	83,230
Promotion			64,624	63,702
Annual Symposium			174,238	171,422
Subtech Symposium			144,276	223,356
History Symposium			2739	6877
Chapter Support			2,487	13,822
Total			483,425	569,587
SUPPORTING SERVICE			185,735	208,362
Total Expenditures			669,160	777,949
INCREASE (DECREASE) IN NET ASSETS			52,800	(92,932)
NET ASSETS, BEGINNING OF YEAR			394,054	446,854
NET ASSETS END OF YEAR			$446,854	$353,922

NAVAL SUBMARINE LEAGUE

COMPARATIVE STATEMENT SUPPORTING SERVICES
For The Year Ended: 3/31/2008

Detail of expenses for Supporting Services in the Statement of Activities follows

	31-Mar-07	31-Mar-08
SUPPORTING SERVICES		
Accounting/auditing	$ 6,211	$ 6,400
Bank Charges	9,293	10,404
Depreciation	8,155	8,155
Equipment rental & repair	6,176	10,300
Miscellaneous		1,320
Office Supplies	7,796	6,969
Payoll Taxes	12,639	12,822
Other Taxes	32	98
Postage	6,749	8,666
Printing	82	3,685
Fees	9,015	5,266
Telephone	3,180	3,216
Transportation	1,005	1,331
Wages	95,451	110,984
Memberships & Subscriptions	1,397	1,232
Office occupancy	5,403	6,522
Computer install/Training	6,450	4,606
Investment expense	2,385	2,070
Insurance	4,316	4,316
Total	$ 185,735	$ 208,362

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The growth and success the Naval Submarine League has experienced has been made possible by the support of its generous members and Corporate Benefactors. The annual appeal to the membership has usually been forwarded with the Symposium mailing. This year the League has initiated a more personal means of soliciting the membership for contributions to support League initiatives and to meet increased operating costs. The President is sending personal letters to each member requesting their participation in this annual appeal and so far it has doubled the receipts we have received in any previous year. We hope to challenge every member to participate in this opportunity to participate in a once-a-year tax-deductible program to underwrite the League activities. We will report the results quarterly in the Review. The following listing reflects contributions received by the League from June through the end of September.

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