THE SUBMARINE REVIEW

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EDITOR'S COMMENTS

We lead off this edition of **THE SUBMARINE REVIEW** with a brief tribute to two leaders of the submarine community whom we have lost in the past few months. Admiral Al Whittle and Vice Admiral Levering Smith were both widely respected for their wise counsel and strong support. They will be sorely missed.

Our features of this issue come from addresses given at the Technology Symposium held in May and the Annual Symposium in June, and also include Vice Admiral Roger Bacon's remarks at his retirement ceremony in March. The comments by Admiral Bruce DeMars and Vice Admiral Bill Owens both offer the cautious optimism of the challenge presented to the submarine operators and industry in the current environment of shrinking resources. Together with the address given by Mr. Ron O'Rourke, they are objective assessments of the issues being faced by the active-duty submarine leadership and what is being done to ensure that our nation gets the submarine future that it needs. As Vice Admiral Bacon left active service he reminded us of the professionalism in submarining and of the wonderful friends that all of us have made within the submarine family.

The menu of articles and discussion topics in this edition also cover a number of subjects of immediate interest to the community. One of the most important subjects facing us all is the complex issue of submarine forward presence during peacetime. The matter is treated in both its advantages and its difficulties, and the problem faced in pinning force level goals to general naval presence objectives is squarely presented.

We also welcome our first piece from the surveillance system part of the undersea warfare community. We know that there is more to be said out there on that vital subject so we look forward to hearing more from operators, engineers, scientists and manufacturers. We all have a lot to learn about the interaction of submarines and the sophisticated systems used for detection in both deep water and littoral shallows.

Several articles address the future of the Submarine Force from the standpoint of these currently serving in the Force, with view of both the big picture and the waterfront concerns. In addition, Dick Bloomquist, the Navy's expert on non-standard power plant designs, has given us an article with the historical perspective of

air-independent propulsion. He also brings us up-to-date on the developments in the field of AIP.

There is no World War II patrol report in this issue of **THE SUBMARINE REVIEW**, not because nothing happened in the summer of 1943, but because of an editorial mixup on the selection of an appropriate patrol. In its place, however, there is a great first-hand account of an incident on an American submarine operating in European waters during World War I. Not the least point to note is that the submarine of the story was on an anti-submarine patrol in the Irish Sea—looking for German U-Boats that were then working at the terminal ends of the North Atlantic resupply routes, after the convoys across the ocean had dispersed. We should all be reminded that, although submarining has never been easy, the early guys in those little 550 ton boats were hardy sailors as they went down into the sea in their ships.

Jim Hay

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FROM THE PRESIDENT

The April to June quarter has been busy. The national structure was enhanced by the stand-up of our Northern California Chapter with Joel Greenberg as President. Our May Submarine Technology Symposium at The Johns Hopkins University Applied Physics Laboratory was, for the sixth year, a sell-out success. The theme focused on technologies to enhance the role of submarines in the Naval Expeditionary Force/Joint Task Force. Five half-day sessions addressed Submarine Roles and Missions, chaired by Dick Chapman, Director, Undersea Warfare, Naval Undersea Warfare Center, Newport; Command, Control, Communications, and Surveillance, chaired by RADM Jerry Holland, President, Armed Forces Communications and Electronics Association Educational Foundation; Joint Littoral Operations, chaired by Dr. Craig Dorman, Director, Woods Hole Oceanographic Institute; Joint Strike and Strategic Deterrence, chaired by Dr. Dick Garritson, Department Head, Aeronautics Department, The Johns Hopkins University Applied Physics Laboratory; and Maintaining Battlespace Dominance Through Readiness and Affordability, chaired by Charlie Stuart, Director, Maritime Systems Technology Office, Advanced Research Projects Agency. I served as moderator of the concluding Roundtable, a very frank and open discussion among VADM Hank Chiles,

COMSUBLANT; RADM Tom Ryan, Director of Submarine Warfare, N-87; RADM Walt Cantrell, Commander, Space and Naval Warfare Systems Command; RADM Bill Houley, Director, Test and Evaluation and Technology Requirements, OP-91; Dr. Art Bisson, Director, Technology Directorate, Office of Naval Research; Tom Handel, Deputy, Office of Naval Intelligence; and Ed Zdankiewicz, Deputy Assistant SECNAV, Undersea and Mine Warfare.

The annual June NSL Symposium was likewise a great success, with participation from both Navy and Submarine Force leadership, and a great turnout from the membership. For that event, we selected as "Submarine Hero of the Year" our own Pat Lewis, an honor richly deserved. From its very inception, the League has been Pat's *baby*. For many years Pat's basement was the League's *office*. Until very recently, every issue of **THE SUBMARINE REVIEW** was typed and formatted personally by Pat. Her dedication to the League and her influence on the formation of its character are typified by a photograph of the charter Board of Directors, with Pat squarely in the middle. We are all beneficiaries of her enthusiasm and selfless support.

If, out in the provinces, you are actively pursuing our charter task to educate the general public about the need for a strong, modern submarine force, here are some words on "Why submarines?" that may be useful in your campaign.

DETERRENCE

The reliable and survivable sea-based Trident Weapons System provides our nation with a powerful strategic deterrent to any current or likely-emergent nuclear, biological, or chemical warfare threat.

By its very presence, or the perception of its presence, the nuclear attack submarine (SSN) represents a conventional deterrent of such magnitude to give pause to any potential aggressor. Precision strikes, launched covertly (the invaluable element of surprise), could destroy key features of infrastructure and disrupt command, control, and communications capabilities.

SURVEILLANCE

By virtue of its inherent stealth, only a nuclear submarine can collect and provide, covertly, to the National Command Authority and to the Joint Task Force Commander critical real-time, accurate

intelligence and early warning on a continuous and sustained basis, in advance of and during hostilities.

BATTLE SPACE DOMINANCE

Full-spectrum sensors, mobility, covertness and firepower combine to allow the nuclear submarine to serve as the eyes, ears, and first line of defense/forward offensive element of the Joint Task Force (JTF). From the open ocean to the confines of the littoral environment, the multi-mission nuclear submarine enables successful JTF operations. From the covert deployment of offensive mines to contain threat forces, to defeating the shallow water diesel submarine, the SSN is a versatile weapons system continuously on call and available to the JTF Commander.

POWER PROJECTION

As fully integrated units of the JTF, submarines provide the capability to conduct covert cruise missile strikes from remote launch positions, along approach tracks not otherwise available to the Force, without placing air crews at risk. Submarines may conduct short range launch from within the reaction time of air defense systems, targeted against those systems, to increase the survivability of follow-on launches from other platforms further at sea. And the covert insertion and extraction by submarine of Special Operations Forces may be key to the subsequent amphibious landing of a Naval expeditionary force element of a JTF.

FORCE SUSTAINMENT

The full range of timely logistics support is a key element of any military operation. Protection of the sea lines of communications by SSNs from load-out port to delivery ensures the success of strategic sealift.

CONCLUSION

The modern nuclear submarine is an extremely versatile and cost effective weapons system. It is unique among warfighting platforms for its high offensive-to-defensive weapons ratio. The capabilities of submarines to perform a wide range of tasks now recognized as integral to Joint Operations were always present, and are now available to the JTF Commander. The Fleet and Theater CINCs know!

Bud Kauderer

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THE SUBMARINE REVIEW

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

Articles for this publication will be accepted on any subject closely related to submarine matters. Their length should be a maximum of about 2500 words. The content of articles is of first importance in their selection for the REVIEW. Editing of articles for clarity may be necessary, since important ideas should be readily understood by the readers of the REVIEW.

A stipend of up to $200.00 will be paid for each major article published. Annually, three articles are selected for special recognition and an honorarium of up to $400.00 will be awarded to the authors. **Articles accepted for publication in the REVIEW become the property of the Naval Submarine League.** The views expressed by the authors are their own and are not to be construed to be those of the Naval Submarine League. In those instances where the NSL has taken and published an official position or view, specific reference to that fact will accompany the article.

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

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

IN MEMORIAM

ADMIRAL J. WHITTLE, JR., USN(Ret)

Admiral J. Whittle, Jr., USN(Ret), who helped develop the nuclear submarine service and ended his career as Chief of Naval Materiel, died of cancer May 18 at his home in Arlington, VA.

In 1982, Admiral Whittle was instrumental in the formation and organization of the Naval Submarine League and was its founding Chairman of the Board. His keen insight and vision was the major factor in establishing the structure and mission of the League. Today, this organization provides, worldwide, a recognized and credible dialogue concerning the issues surrounding submarine warfare through its quarterly publication and symposia.

Admiral Whittle was captain of the nuclear submarines SEAWOLF and ANDREW JACKSON in the 1960s, and in 1970 he assumed command of Submarine Squadron Six in Norfolk. In 1972, he took command of Submarine Flotilla Six in Charleston, SC.

From 1976 to 1978, he was chief of staff to the Supreme Allied Commander for the Atlantic with headquarters in Norfolk. His many Washington assignments included several periods in the Office of the Chief of Naval Operations.

In April 1978, he was named Deputy Chief of Naval Operations for Logistics, and in August of that year he was promoted to four star rank and named Chief of Naval Materiel.

His military decorations included three awards of the Distinguished Service Medal, three awards of the Legion of Merit and the Meritorious Service Medal.

After leaving the Navy, Admiral Whittle was a director of Sippican Inc. of Marion, MA, makers of oceanographic sensors, underwater vehicles and similar equipment. He also was chairman of the Bird Johnson Co., manufacturers of marine propulsion systems. From 1983 to 1985 he was a vice president of Lockheed Advanced Marine Systems in San Diego.

Admiral Whittle, who had maintained a residence in Arlington since the 1960s, was born in Mount Vernon, NY. He attended New York University before being appointed as a midshipman at the U.S. Naval Academy at Annapolis. He graduated in 1945.

He served on destroyers in the Pacific at the end of World War II and then shifted to submarines. In 1957, after duty on several other boats, he took command of the submarine STERLET.

In the early 1960s, he studied technical aspects of nuclear propulsion in Washington and at the National Reactor Test Site in Arco, ID. This led to his appointment as prospective commanding officer of SEAWOLF, which at that time was receiving a new nuclear power plant. From 1962 to 1966 he commanded one of the alternating crews of ANDREW JACKSON.

Admiral Whittle's next assignment was at the Institute of Defense Analysis in Arlington. After three years of study there, he served for brief periods in the Office of the Chief of Naval Operations and as chief of staff to the Commander of Submarine Flotilla Six.

A yachtsman, Admiral Whittle cruised the East Coast from Maine to Florida. He also sailed on the Chesapeake Bay and in the Bahamas and the West Indies. He was instrumental in setting up the U.S. Naval Sailing Association at the Naval Academy, and he was a past commodore and trustee of the organization. He also was a member of the New York Yacht Club and the Gibson Island Yacht Squadron. He had a winter residence in Naples, FL.

Survivors include his wife, the former Phyllis King Schneible, who lives in Arlington; two sons, retired Navy Commander Alfred J. Whittle, III of Millersville, MD, and Jeffrey King Whittle of Wayland, MA; and three grandchildren. ■

IN REMEMBRANCE

FTCS(SS) Francis J. Coffey, USN(Ret.)
Developer of the "Coffey Plot"

CAPT George F. Morin, USN(Ret.)

AS I REMEMBER VICE ADMIRAL LEVERING SMITH

by Dr. Werner R. Kirchner
Chairman of the Board of Directors
American Rocket Company
Ventura, CA

On April 5, 1993, Vice Admiral Levering Smith died in San Diego. His distinguished record of service in the United States Navy culminated in his extraordinary management of one of the most complex technical systems ever, namely the Fleet Ballistic Missile. As Aerojet's Director of the Polaris rocket propulsion system and as a member of the Navy Steering Task Group, I was the fortunate beneficiary of Levering's keen judgement and counsel, as he guided us through the arcane art of how to cope with the growing pains commonly experienced in rapidly evolving rocket technology.

Almost 40 years ago I walked into Admiral Raborn's conference room, that Sanctum Sanctorum of the Benevolent and Protective Order of U.S.N., Special Project Office, with the same feigned confidence I recall affecting upon entering the offices of my local draft board. The occasion was the introduction of Captain Levering Smith as Technical Director of the fleet Ballistic Missile Program. It marked the beginning of years of impeccable fidelity to the Polaris and its homologues.

My initial impression of Levering was of a man with immense reserves of calm wedded to a skepticism worthy of a Parisian Agent de Police. He could be as frosty as a Finnish winter or as dour as the second act of an Ibsen play. These characteristics were employed by their master with positively virtuosic effect, particularly when one stood up at a Special Projects briefing and had the temerity to deliver a *Regress Report*. The look thereupon elicited from the front row was capable of effecting a swift and devastating transfiguration of the speaker who, at that point, may well have envied a pillar of salt its conspicuous advantages.

When the outlook through the blockhouse window of a missile launch was at its bleakest, with a multitude of doubts then assailing our ambitious enterprise, Levering invariably provided a unique and essential cohesive strength. Our own knowledge about a compromised missile flight was usually incomplete, if not inaccurate, beclouded by ambiguous evidence and biased analysis. He always saw through the pseudo-confidence of the individual

who refused to deal with this kind of knowledge on its own terms. The bravado of the man who simplified, who had hastily assembled a manageable minority of facts, was fatally misdirected at this particular audience. And yet it was axiomatic with Levering that we must operate with partial knowledge, that we must be provisionally content with probabilities and that all rigid formulas are inherently suspect. He regarded with bemused tolerance attempts to force the behavior of a system into theoretical patterns or logical grooves, knowing they would play havoc with our generalizations, and knowing further that the truth, in all of its unanticipated baroque convolution, would eventually emerge to astound us.

And so we began to realize that the surface of our exploratory path was fluid form and, with the tentative steps of Peter upon the waters, did we make our perilous way. Having emerged relatively unscathed from the error-haunted woods of the early development stages, we somehow suspected Levering knew the potential ability and genius lurking in the chromosomes of the next generation of the system.

This quiet man sent many of us on various dangerous missions of defense, on uncertain explorations of the mysteries of the "off the shelf technological breakthroughs", and not rarely did we find ourselves left uncomfortably in the intellectual lurch. Requests for Pin Money to finance the Scientific Supporting Acupuncture usually met with a lean and negative response from this enthusiastic practitioner of Navy parsimony. His notes, models of brevity, clarity, and grace (such as "NO") often plunged us into vaporous doldrums while, on the other hand, his facility for describing in unsettling detail the liability of an approach usually called for mild rejoicing, particularly when he made us aware of present intimations of future catastrophe.

The impassive air that penetrated every corridor of the Byzantine edifice, called DDR&E never perturbed him. The ministers in that seraglio would, in the end, oblige him insofar as they had been granted the strength to do so by God and the Secretary of Defense. As an apostle of naval technical excellence, he preached a doctrine that was suited to the temper of the times and to the capabilities of the institutions, academic, industrial, and governmental. He always viewed the Navy as a durable horse, but he knew that even Bucephalus had to walk now and then.

Levering was never paralyzed by doubt or cynicism as he

listened to the sterile chant of competing technical liturgies. Utterly unshakable and armed with his remarkable retrieval function, his distilled wisdom invariably being followed by an information chaser, he succeeded in taming even the most obstreperous of our tribe.

Levering Smith will always be remembered as insisting upon what was narrowly vital, not necessarily what was broadly appealing. Constantly vigilant, he never permitted the Navy to slip into the easy state of conjugal bliss with a contractor without the benefit of clergy.

The memory of Vice Admiral Levering Smith occupies a particularly warm place in my heart and, as I look back over the old trials and errors, I recall not only the hard work and the challenges but also the comradeship and sense of shared excitement in pursuing what was one of the truly great technological adventure of our times. As we get older our memories become more and more cherished, and those I have of Levering will always remain part of my best.

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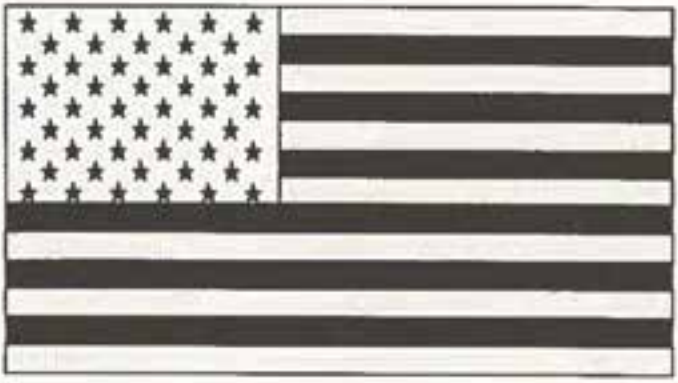

ADDRESS BY ADMIRAL BRUCE DEMARS, USN
at the
11th Annual Naval Submarine League Symposium
10 June 1993

I am privileged to routinely deal up close with a group of talented, hard working and dedicated people across a wide range of endeavors. They include the seagoing operators, tender support people, shipyard mechanics, engineers, logisticians, designers, instructors and trainers; to name a few. All are dedicated to support the operation of the nuclear powered carriers, cruisers and submarines in a manner that sets the norm for professional naval excellence. While this perspective provides a broad range of topics, because of today's venue I will focus on submarines.

In looking back on my remarks before this group last year—always a good idea since someone else may—I find myself guardedly optimistic at where submarines are headed today. I say headed not only because this is a period of great change for the entire Navy, and the country for that matter, but because of the long time line necessary for fundamental change in a capital warship centered Navy.

With new submarine class development times of 12 years, building durations of six years, eight years when long lead components are counted and ship lives of 30 years; the five year defense plan is not really a plan but only a point of departure for a plan.

First, and foremost, what do submarines do for the country and will they continue to make a valued contribution in the future? As is typical, the way is indicated by the strategic submarine. The stealthy, cost effective, professionally operated submarine launched ballistic missile subs became the country's premier strategic deterrent force years ago. A recent extensive GAO study highlighted these qualities and put to rest such arcane issues as space based detection systems, transparent oceans, unreliable communications, and a host of other fables that were the backbone of a Cold War cottage industry.

The GAO has produced a good report albeit one to two decades late. There is talk now of a strategic deterrent *DYAD* or even a *MONAD*. The great old line that strategic submarines provided 50 percent of the ready warheads in the country's strategic arsenal for 25 percent of the Department of Defense's strategic dollars loses something when the percentages go to 100 percent for 100

percent. But clearly it is in the country's best interests to put most of the strategic eggs in the submarine basket.

Similarly, the attack submarine's future is founded in stealth and mission cost effectiveness. Its role will increase in prominence for the same reasons as the strategic submarine; ever increasing risk to other weapons systems platforms. The world for surface warships is increasingly more dangerous due to the continued proliferation of relatively inexpensive surveillance and targeting systems and precision guided missiles. This availability to even Third World countries has been accelerated by the virtual garage sale atmosphere in the former Soviet Union countries including scientists, engineers, and entire sophisticated weapon systems.

This very real threat today can result in damage to bystander U.S. Navy surface ships due to misidentification by warring forces or, the obverse, an attack by a U.S. warship on a misidentified perceived threat which turns out to be an innocent bystander. Experience in the Middle East shows the difficulty of keeping ships on station in trouble spots; trying not to be provocative while at the same time defending against attack from seemingly innocuous sources. Given the short decision times involved and the ship threatening destructive force of today's missiles, it is difficult to envision this becoming a more relaxed situation.

This is not to imply that surface forces are obsolete and will be unable to continue their valuable contribution to the protection of the nation's interest worldwide. It is simply a recognition of the ever changing nature of naval warfare which must be accommodated by the Navy today. This accommodation opens new roles for the attack submarine whose offense to defense ratio is unmatched.

Other factors favor the selective presence of the attack submarine in hot spots. They include the worldwide modern media stage on which all crises are played out, the very real domestic political pressure provided by even small numbers of U.S. military deaths and prisoners, and the continued futility of massive amounts of iron bombs to solve anything—coupled with an increased abhorrence to civilian casualties.

The attack submarine provides a presence which can lurk unthreatened, deep in enemy waters for months, in disciplined communications, reporting all that's happening and ready to respond with an array of weapons effective against both land and sea targets. The unit can remain secure even if the mission is unsuccessful; and the mission need not be carried out under the glare of worldwide media coverage. Technology can only

improve these capabilities in the future.

It is ironic that the attack submarine, popularly viewed as only a Cold War weapon, inflexible, highly specified and useful only against a narrow threat has adapted to the new Navy realities so quickly and almost totally from within—no studies, no consultants, and no formal Washington direction. This rapid adaptability is evident in battle group commander accolades for newly acquired attack submarines, Commander Submarine Force Atlantic and Pacific regional warfare demonstration cruises for Congressional and Executive Department decision makers and the flood of writings in professional journals detailing the new direction.

I know of no other part of the Navy that has executed such a fundamental change so smoothly. It indicates, I believe, that the issue of attack submarine irrelevance to the new realities of the world was one of form and not substance.

But with the near total Navy focus on ...From the Sea, what about the blue water responsibilities of the Navy. Are they no longer important for our island nation? I believe the versatility of the attack submarine holds the answer. While the submarine focus has now broadened to increase the priority of other missions, that focus can once again be narrowed to sea control if that is what the national interest requires. While the broad ocean reaches are now calmer, it is not clear that they will remain so indefinitely. The relatively brief history of this country would indicate otherwise.

The decisions we make today will be critical two decades from now when our present front line attack submarines are going away at the rate of which they were built, three to four per year. So, the U.S. Navy attack submarines are capable today in regional warfare and are the Navy's most ready blue water fighters—the blue water ace-in-the-hole.

The Russians have not abandoned their nuclear submarine Navy. They are in the process of increasing the percentage of their strategic warheads at sea and have publicly stated they intend to build one to two attack submarines per year. There are indications that they have attack submarines at sea today, albeit in small numbers, that are essentially at the stealth levels of our best attack submarines. Another new class of attack submarine is expected before the end of this decade.

In spite of their pressing problems, the Russians continue to pursue a modernized underwater fleet. Why? Because it is a relatively cost effective way to exercise maritime power. Is this a defense problem for our country today? Clearly not. But recall at the start of these remarks I mentioned the long time line

necessary for this shipbuilding business.

In a recent OP ED piece in the New York Times, Dr. Igor Spassky, a Russian nuclear submarine designer, decried the U.S.' unwillingness to provide taxpayer dollars to the private Komsomolets Foundation. This group is expounding the dangers of the sunken Russian MIKE class nuclear submarine KOMSOMOLETS largely because of the presence of two nuclear weapons. They are looking for millions of dollars to study the sunken submarine and develop equipment to address the weapons concern.

Dr. Spassky, the designer of the MIKE, has a special interest in the loss of this submarine. Joint Russian/Norwegian environmental monitoring during the past two years has shown no significant contamination from the MIKE and no plutonium from the weapons. U.S. monitoring of the two U.S. nuclear powered submarines lost over 25 years ago, THRESHER and SCORPION, has also found no significant radiological impact. There has been no release of radioactivity from U.S. naval fuel.

It is odd that so much Russian attention is being given to this ship when there has been no call to action to address the Russian YANKEE class submarine that sank 600 miles off the coast of Bermuda in 1986 with 16 nuclear tipped missiles.

I do not believe there is an environmental threat from the MIKE submarine or from the weapons aboard. Based on currently available information, the best thing to do is leave it alone. If Dr. Spassky continues to believe there is a significant threat, rather than panhandling U.S. taxpayers, I suggest he convince his government to redirect resources from the continuing Russian nuclear submarine modernization program to deal with it.

Along the same line, some entrepreneurs, aided by Greenpeace, have been trumpeting the alleged dangers of Russia's decommissioned submarine fleet, again in an attempt to garner U.S. assistance and tax dollars. While the Russians have not been as diligent in taking care of the entire life cycle of their nuclear submarines as we have, they do not need technical assistance as they are fully conversant with what it takes to dispose of ships.

Anyone who can put together and operate nuclear submarines with titanium hulls and liquid metal reactors certainly can take them apart. The problem is one of resources and commitment, public confidence, and developing the governmental process and structure to deal with the waste issues.

There are only two parts of the problem the U.S. can really help with: assisting in the technical elements of waste disposal and providing U.S. tax dollars. EPA and NRC could possibly help

with the former; the U.S. Navy cannot. For the latter, Russian submarine disposal is not an effort we should ask U.S. citizens to pay for. The Russians continue to build modern nuclear submarines and have made clear they will design and build even newer classes, and this despite severe economic problems elsewhere. Just as we have done, they should divert some of these resources to deal with their inactive ships. U.S. tax dollars should not subsidize building a modern Russian submarine fleet.

That leads into a report on the U.S. submarine industrial base where, once again, the issue is not driven by today's force level but driven by the need to stay in business. Most simply put, this means establishing a low rate of submarine production. Much progress has been made over the last year and resolution is in sight. This issue continues to be studied to death but fortunately concurrent action has been underway with key suppliers to downsize, combine and, in some cases, leave the business.

Today we have a decidedly smaller nuclear supplier base than existed three years ago. These actions I believe are a model for other defense sections that continue to resist the inevitable; hoping for, who knows what.

For the submarine industrial base future, a consensus is emerging. At the risk of prejudging the conclusion, I see the consensus including one more SEAWOLF and the authorization of a new attack submarine in 1998, built initially at one per year. The new attack submarine is key as it represents a stable program around which to rally the industry.

The plan includes inactivating some of the early LOS ANGELES class rather than refueling when due. About one per year will be refueled to maintain a minimum JCS established force level in the face of the large number of end of life inactivations two decades from now. While the current aim point is an ultimate force level in the 50s, the most cost effective long term program as partially reflected in the five year defense plan is unchanged even for force levels down to the 40s.

Am I concerned with these attack submarine force levels? The answer is no. If there is a perception that there are too many submarines today, then it is far better to prematurely inactivate some units to bring force levels down while establishing a low new construction rate. The alternative is to place the industrial base in what, I believe, is a fatal shutdown position.

Additionally, these force levels must be viewed in the context of the size of the rest of the Navy. If you do the math for a 100 attack submarine force in a 600 ship Navy, or a 50 attack

submarine force in a 340 ship Navy, you will see what I mean. When you include 18 TRIDENT submarines, the percentage looks even better. Or you can go all the way back to the numbers when some of you in the audience came into this business. I don't know what the size of the Navy was when I came into the submarine force but I do remember there were only three nuclear submarines in commission.

Let me talk a bit about the new attack submarine development. I, of course, refer to the technical development, not the insatiable acquisition system paper chase which borders at times on the surreal. Naval Reactors has developed over 25 nuclear propulsion plants. We started development of this propulsion plant concept over three years ago and have been hard at work ever since. The philosophy that has guided this development has been to draw upon the accumulated four plus decades of naval reactors technology to simplify the propulsion plant while maintaining the quieting levels validated, and paid for, with SEAWOLF R&D. It makes little sense to build a noisy submarine. DB's are expensive to earn but return virtually no value if not used and turned in.

The goal is reduced acquisition and life cycle costs. Everything has been questioned, examined, and reexamined. We have, I believe, been successful to date. I emphasize to date. Compared to both the SEAWOLF and the LOS ANGELES propulsion plants, the new attack submarine propulsion plant will have considerably fewer major components and one-half the volume of engine room piping systems subject to submergence pressure. While we are reducing costs by literally reducing components; we, of course, have been conscious of the need to have a safe, reliable propulsion plant. This is not a stripped down model. This plant could power a submarine of LOS ANGELES class size at essentially tactically equivalent speeds.

Some of the more noteworthy features include what we expect to be a life of the ship reactor core, 30 years—no refueling; a new concept steam generator—significantly reduced servicing; and a new ship service electrical system concept with features that replace machinery with solid state devices. Much testing and many difficult technical decisions remain. I conclude this brief propulsion plant description with a quote from the renowned physicist, Richard Feynman: "For a successful technology, reality must take precedence over public relations, for nature cannot be fooled."

Work is underway to define the front end of the new attack submarine using a similar approach. While it appropriately lags

the propulsion plant effort, there is no technical reason to delay a 1998 authorization.

The bulk of our work at Naval Reactors is in support of the fleet. We are responsible for 50 percent more reactors than there are commercial reactors in this country. We are in the middle of the largest reactor servicing workload in our history and, while we have been inactivating and dismantling submarines for a decade, we are about to embark on a program which dwarfs previous efforts. By the end of this decade, we will have inactivated over 125 naval nuclear power plants.

While most of our resources are in support of the fleet, we do have some development effort beyond the new attack submarine propulsion plant. We are exploring advanced technologies which could potentially provide a better submarine by employing energy conversion concepts producing electricity directly from heat.

This program, assuming it is successful, and that is not a given, would provide a concept for the start of a submarine propulsion plant development program no sooner than several decades from today. While the funding is modest, in many key technologies we are leading the effort, certainly in this country if not the world. Our goal is not to allow anyone to get there ahead of us, assuming there is a there, there!

A few words about people before I conclude. They are at the heart of this demanding program, and this is a period of significant personnel stress as the Navy gets smaller rapidly. This downsizing is particularly difficult for this program which is small and has so much quality in the base. I believe the troika of Admirals Chiles, McKinney, and Ryan are working this hard for the Submarine Force, so I will just mention a few points. Joint Duty—I can't say it better than did Jerry Holland in his recent prize winning article in the Naval Institute Proceedings—so I won't. Women on submarines—not supported by most because of severe privacy and medical issues. This issue won't and shouldn't go anywhere as the Navy works hard to fully integrate women into more appropriate sea-going jobs.

In my interviews and discussions with officers and enlisted, the single most pervasive reason they want to be in our line of work is their knowledge that it is demanding and they want to be challenged. No matter what happens to force levels and personnel drawdowns, we must never lose sight of what calls forth the best people and gets the best from them. You have been there, you know what it demands. Make sure they hear from you.

Thank you. ■

THE VIEW FROM OPNAV

by VADM William A. Owens, USN
DCNO for Resources, Warfare Requirements, and Assessments (N8)
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Submarine Technology Symposium

This should be a time of great optimism for submariners. From my viewpoint on the Navy staff, seeing what OSD and the Congress are thinking, I conclude that these are good times for our Navy and Submarine Force. This is a time when we will truly realize some gains, not in terms of numbers of submarines, but in the contribution we will make to our country.

There are three things that have happened in the last ten months that are important to remember. **The first is the "...From the Sea"** document that you are all familiar with. As you know, it talks in very real terms about joint forces regionally employed in littoral areas. The challenge this document asks of us is, "How is the Navy going to influence events ashore?". While I was SIXTH Fleet Commander, I was already forced by world events to start thinking in "...From the Sea" ways. The challenge is to totally adapt ourselves to this for the future, to determine what technology means for this new strategy, and then try to shift money toward programs oriented to the new strategy. Literally billions of dollars have already been shifted in the FY '94 budget for that reason.

The second thing is the OPNAV reorganization. The CNO made a brave decision to disestablish an organization that served the Navy very well over so many years. We had a marvelous Navy that came out of the system of three warfare barons, but he thought the time was right for a change. The reorganization has two primary elements. One was to realign the OPNAV staff, N1 through N8, to correspond with the joint staff, J1 through J8. Now I meet frequently with my J8 counterpart to determine how our resources and requirements fit with the joint staff resources and requirements. N1 to N7 have similar relationships with J1 to J7. The other element of change is within N8 itself, which subsumed the Deputy CNO for Naval Warfare, OP 07, as well as OP 02, 03, and 05. We also added a fourth platform sponsor, Marine Corps Major General Harry Jenkins, who is the Director, Expeditionary Warfare Division, N85. He is not a liaison officer,

but a full time member of the OPNAV staff; he is responsible for amphibious ships, mine warfare, special forces, riverine forces, and UAVs—this is a very real part of N8 and trying to bring expeditionary warfare to life. As an example, when we ask ourselves about the sufficiency of our mine warfare capability, the Marines used to shake their heads and say, "No, it's not sufficient." It is for that very reason that the decisions about mine warfare are now made by the Marine. Finally, there is another new flag billet on the N8 staff, N83, The Director, CINC Liaison Division. Archie Clemins is doing a marvelous job there. His only job, though a substantive one, is to keep us fully plugged in to the three four-star fleet CINCs. Whenever we are making decisions on a new airplane, 9mm pistol, or torpedo, we have an understanding of what these four stars think and need. This gives the CNO an input from his operational commanders so he can make the wisest decisions.

The reorganization has been notable and remarkable, but equally important is **the third element I would like you to remember, the new process.** We now have a new way of putting the Navy and Marine Corps budget up to the light and asking, "Does this make sense for this new world?" The central part of this new approach is the assessment process; we say to our resource sponsors and fleet commanders, "There are six mission areas and your program has to be relevant to one or more of these mission areas or you won't get any of the budget's money". The mission areas are joint strike, joint littoral warfare, space and electronic warfare, joint surveillance, strategic deterrence, and strategic sealift and its protection. I'm sure you noticed I didn't mention the traditional warfare areas, such as ASW, ASUW, mine warfare, etc. These warfare areas are still important, but not in themselves; they get their significance only as part of one of the six mission areas.

This raises some interesting issues. For example, consider littoral warfare in a cross-platform way. How do we support the amphibious landing force? In the future, this is an area where an SSN could be a player. Thirty or more days before the landing is scheduled, the submarine could already be there in the seventy or eighty feet of water. Is that possible? I believe it is. The submarine would already know whether or not mines were laid in the area where the amphibious landing is planned. That submarine may also be linked to other sensors, like an RPV under his control, an EP-3, an Outboard-equipped ship; the submarine may

be contributing to a crossed-bearing fix ashore. And so the solution for supporting the war ashore could very well be innovative features that include such things as submarines in wholly new missions.

We have spent hundreds of hours—we the twenty-five flag officers in N8 or associated with the process—in a group called the R^3B, the Resources and Requirements Review Board, reviewing the assessments and asking ourselves the hard questions. Are we going in the right direction? What is the role of submarines and all the other platforms in these missions? When we think we have the answers, we participate in war games and conferences, review analyses like APL's on airships, and listen to Defense Science Board Panels and Capitol Hill expertise. From this array of input, we put together a fiscally-disciplined budget. That fiscal discipline has allowed us to say we know what our requirements are versus how much money we have, and we know it fits inside a budget that we know is getting smaller. We got a little heads up on the last budget drill, so we knew that starting in FY 94 we were going to see a $60B reduction over the six-year defense plan—the SYDP. We, the N8 flags, were able to match where we were going with what we had. The measure of our success is that no one has been able to show us a better plan.

We have spent hundreds of hours working by this process. Just to let you know that bureaucracy does still exist, we did an assessment of the assessment process, which showed we are devoting 600 percent more flag time in building a budget than ever before. Is that the right way to spend our time? I think so. We are determining how to spend a $75B Navy budget, and it's important that we are prepared with a product we can sell our civilian leadership and on the Hill. I am optimistic about how well this works. We were successful at selling our '94 budget and our '95 to '99 plan to OSD with no changes. There was not a single PBD that was lost on the way. There were five written; normally there are about one hundred.

The three highlights of the last ten months, "...From the Sea," the reorganization, and the new process forecast a new way of doing business. We call our end product Force 2001. It is the Navy programmatics for the next six years that says how many ships, how many planes, how many submarines and torpedoes; it is our input to the Bottom-Up Review and it has been widely listened to.

I want to mention two issues that are crucial as we look to the

future. The two issues are **recapitalization** and **affordability**. These are big words for us. It means you cannot keep a force structure around if you cannot support it in the best way possible, so you better get rid of it if you can't afford it. There are lots of elements of the Navy, not the Submarine Force, that have not lived by that rule in the past. As a result we have wound up with some difficulty in our APN accounts, our aircraft programs, for example. We have bought a lot of airplanes, but we have not been able to maintain them, so we end up with a big backlog of repairs. Another result is we have not been able to afford the right kind of electronics for these aircraft, so they are not as updated as the Air Force aircraft. For those of you who have been around the Navy budget for years, this does not surprise you.

We need to recapitalize in all areas. We need to look at what size Submarine Force we can have for the future, and then we need to build to that level to maintain the force. This means we need to maintain the industrial base. The Bottom-Up Review is still addressing whether to maintain the submarine industrial base or shut it down for a later start up. There is no final decision yet, but my sense is that we have been listened to. Many of you contributed to that discussion. In the final analysis, I think the answer is going to be a positive one. There is wide acceptance at the level of Dr. Deutsch and Dr. Perry of the impact of shutting down the industrial base, so I feel confident that the outcome will be something we can accept. For now, pending outcome of the Bottom-Up Review, the Navy is committed to building submarines at a sufficient rate to maintain the integrity of the industrial base. But to do that, and with the rest of the Navy, we need to get rid of some of our force structure, some of our manpower, and some of our infrastructure.

We are heading for a Navy in 1999 of about 400,000 people; that is down about 140,000 from where it is now. We will go down in the number of escorts from about 150 to about 115. The Submarine Force in 1999 will be down to about 55 or 56. That's tough; that really hurts. We wish we could keep more, but we can't afford more and we can't recapitalize more. Since we can't afford it, let's *fess* up to it. Let's also make the political leadership *fess* up to the fact that the requirement may be there, but we can't meet it in a professional way unless we are at a force level we *can't* afford. That's the direction we've been undertaking in recapitalizing the Navy.

Affordability is a critical part of that. We looked at the Navy

in terms of the minus $60B DoD budget, taking our share of it in the '94 to '99 plan. Now it looks like there may be another decrement on the way, so it's not over yet. We will enter into the investment balance review, which is the closure of this assessment process, in the next three or four weeks. We have the fleet commanders, we have our group of admirals and generals together, and we try to do the best thing for the Navy in the context of the six mission areas. We are looking to a smaller Navy and a smaller Submarine Force, but it will be a very fine one, oriented to a whole new future.

I would like to mention a few items that have come out of our assessments as we look at the meaning of our Submarine Force. I thought these may be worthy of passing on to you for your comment. First of all, I think we need to reduce our emphasis on ASW. It is important now and it will continue to be, but there are other things that are also important. I'll mention just three of them. **Support of the battlefield.** What does a submarine do in support of the battlefield? And yet it is absolutely essential as we look for integrated capabilities to support our Marines and soldiers in a littoral battlefield. If you look at the world today, it is obvious that it is a very littoral place, meaning that almost all of the areas of military value are within striking distance of the Navy and Marine Corps. If you look at it in the context of what the submarine can bring to the picture, there is a lot of value. The submarine brings the ability to do effective indications and warnings (I&W) surveillance; in mine warfare, that can be critical. The submarine can link with unmanned air vehicles (UAVs), EP-3s, and Outboard ships to provide a lot of intelligence data for our ground commander so he knows the condition of his battlefield in advance. Maybe the submarine shouldn't work for the battle group or maritime action group (MAG) commander; maybe the submarine should work for the Marine general who will be going ashore. Can we think of that? Can we allow ourselves that mode of operation as we look at the future of the Submarine Force? How about the Advanced Tactical Missile System (ATACMS)? Has anyone thought about ATACMS and submarines for the future? The ATACMS developed by the Army, a ballistic missile that goes sixty to one hundred miles in about two minutes, may fit inside a submarine VLS tube. In the future, it may have a warhead of multiple anti-armor projectiles. Imagine being able to knock out twenty or twenty-five vehicles from seventy miles away from a VLS submarine with a single ATACMS. The source of

targeting data could be based on information the submarine collated from high-data-rate sources like MILSTAR. Is it out of our thought process to think about submarines in support of the battlefield? I think it should not be.

The second area is **stealth strike.** We have spent billions of dollars in our country to provide aircraft that are able to launch a few missiles in a stealthy configuration. Maybe they're stealthy. Are we totally sure in the future that these aircraft will be totally secure against advanced infra-red, low frequency search rate radars, etc.? Will they ever be as stealthy as we are in the Submarine Force? Shouldn't we get even more serious about this business of stealth strike? Are twelve VLS tubes enough? Does it matter to the fleet commander that you have twelve VLS tubes, maybe twenty TOMAHAWKs total aboard your submarine? Yes, it matters. Does it matter to the unified commander? It matters, but not quite as much. Would it matter to him if you had one hundred TOMAHAWKs? Now it would really matter. What does stealth strike really mean? If you are out there doing other missions like mine field surveillance or ASW against a diesel submarine, or ASUW, and you also have one hundred TOMAHAWKS, stealth strike becomes a very exciting concept. Why aren't we more serious about it? Why isn't that as important as ASW in this new multi-mission world?

And thirdly, **for special forces**, is there a submarine mission area there? This topic has generated a lot of discussion inside the Pentagon and the Submarine Force lately. I don't think it is a matter of just a few SEALs anymore. We are dealing with a crisis-conflict world that is much different than in the past. It is amazing how much we are doing with special forces. When I was the SIXTH Fleet Commander, we were either in Northern Iraq supporting the Kurdish people in the mountains, or we were exercising in the Adriatic Sea before the crisis arose in Yugoslavia, or we were in the southern rim of the Mediterranean. We were limited by the small number of special forces we had at hand. I came to know and admire this elite community, not just the SEALs, but the whole bunch of them, Army and Air Force as well. They can make an even bigger difference if we can get one hundred or more ashore in a coordinated way. Using the stealth platform we have, should we be looking seriously at facilitation of special forces as an essential element of our Submarine Force's future? Can this capability be made to fit in the submarine we are designing for the future?

There are a lot of capabilities we should be looking at. I've mentioned just three of them. To sum up, I think there are some things we should never lose sight of in the Submarine Force:

For the future, I think **stealth** is our most important commodity, though we don't sell it well enough. The Air Force talks about B-2s and the Navy about A/FXs or joint attack fighters (JAFs) as stealthy, but we are the ones who really have it, don't we?

In the years ahead, **power projection** will be very important, in whatever form, whether it's support of those Marines, TOMAHAWK or ATACMs, or sending special forces ashore.

Integrated is a word we should never forget. We should remain capable in the traditional missions, such as ASW and ASUW, but we may not need to be optimized for those missions. The *white water* character of the future is driving us to a true multi-mission capability.

A **data explosion** is about to hit us, and I wonder how many of us are thinking about what it will mean to have 1000 times more data flow through a periscope in 1999 than we have today?

We have some great submarines coming and we need to keep them coming, but sensors, weapons, and data links are more important than platforms.

Finally, we need to realize that it has to be an affordable, *recapitalizable* force for the future so we can maintain a strong industrial base and a credible Submarine Force.

So those are a few thoughts from inside the Pentagon. I have immensely enjoyed talking to you today. I look forward to some questions, if you have time.

Q. What is the likelihood of converting some TRIDENT hulls to launch TOMAHAWKs?

A. We looked seriously at a TRIDENT conversion program. APL and others have given a lot of thought to putting many TOMAHAWKs in each of the missile tubes. This would give us a really meaningful number of missiles, like the number I was talking about earlier. This option is attractive, particularly if we are determined to keep eighteen TRIDENT submarines, but if we didn't need them to be *full-up* SSBNs. We were studying a temporary conversion to TOMAHAWK, such that we could easily restore the missile tube to TRIDENT configuration. What shocked us was the budget constraints. The first $60B budget cut took all the fat out, and now we're searching for tens of billions

more to cut. To do the TOMAHAWK conversion, attractive as it is, meant foregoing many other important procurements. We would like to do it, but it is expensive. For now, it is an affordability issue, so I continue to keep it in the back of my mind.

Q. How will the Bottom-Up Review impact the plan the Navy is already implementing for the future?

A. We have some important issues in the bottom-up review. In theater ballistic missile defense the AEGIS cruiser and DDG 51 will be essential, so I think that will come out favorably. The most difficult issue is the future of TACAIR. Our first priority is F/A-18 E/F. Because that is our top TACAIR priority, we keep hearing that we are trying to give up our long-range strike capability. F/A-18 E/F equipped with stand-off weapons preserves that important capability. The next airplane is also under study. Whatever it is, we will buy it with the Air Force, meaning they will actually contribute funding. We want the next airplane to look as much like the A/FX as we can, but if the Air Force does not participate, it may not come at all. On the submarine industrial base, my sense is that we will be very satisfied with the judgement of Dr. Perry and Dr. Deutsch.

On the issue of the size of our carrier force, our position is that we need and can afford to keep twelve. We have nine nuclear carriers now with CVN 76 coming in 1995. CVN 76 is important for our force size and structure, as well as to maintain our nuclear industrial base. One of the conventional carriers, JOHN F. KENNEDY, will go through Service Life Extension Program at Philadelphia starting in September of this year. We have and can afford twelve, so we, the Navy, are not talking about nine or ten. In a littoral, regional conflict, it is important to have the carriers out there, particularly since the Air Force will have withdrawn a significant number of its airwings to CONUS. I am not sure how this will come out, but I think we are being listened to. Today we have thirteen carriers, but we are already having to consider either extending deployments or gaping a presence, such as the Persian Gulf. None of us want to break the personnel tempo or operational tempo criteria, certainly not the CNO. So our argument is, if we are held to the commitments we have now, then we can't be taken below twelve carriers. It is a very interesting discussion, and I am impressed at how Secretary Aspin and his entire team have been listening to what we have to say. It also helps our

argument that we have demonstrated discipline in our budget submissions; it helps our argument when we say we can afford the twelve.

Q. After so many years of difficulty in the acquisition process, do you foresee Dr. Perry and Dr. Deutsch reforming this system?

A. We are very fortunate to have those two gentlemen working that issue. No one knows more about it than the two of them, I think. Nobody I have met has more interest in focusing on fixing the system and has more know-how than the two of them. They have been very moderate in their approach, but they are devoted to making some changes so we don't have to spend ten years and a lot of the nation's wealth before we can get something out to the fleet commanders. There has been a lot of discussion about acquiring JAF using a new acquisition process. It would be a Navy, Air Force, and Marine Corps airplane, sharing concepts with both A/FX and MRF. They are looking forward to taking on a big project like JAF with a new approach to acquisition.

Q. As the Navy finds ways to save money, such as through the base realignment and closure (BRAC) process, does the Navy get to use some of the savings in some of its own programs?

A. That is not determined yet. We would like some of it to build carriers and submarines and other things, but that is a very difficult question. The immediate cost of closing a base has not been fully answered yet, like the cost of environmental restoration. We have some ideas about the cost; we're trying to be conservative, but if we are too conservative, we won't have any money left for ships and aircraft.

There are other problems that confuse this financial business, like the problems that arose from the Defense Business Operating Fund, or DBOF. We were concerned that we were going to get about half of our O&M,N for this year because DBOF was not paying out. I won't pretend to understand it all, but I am optimistic. We have some real expertise in our comptrollers and in our program office that I have come to appreciate. They have been responsible for ensuring our share of the budget dollars. ■


In the defense
of our nation, there can be
no second best.
716
Newport News
Shipbuilding

THE BUSINESS OF LIVING

Remarks by
VADM Roger F. Bacon, USN
at his Retirement Ceremony
26 March 1993

Today I would like to share with you my personal thoughts on my profession as a naval officer and, in particular, as a submariner. One definition of a profession is "a calling requiring specialized knowledge and often long and intensive academic preparation." The uniqueness of the high tech world of undersea warfare involving nuclear powered submarines certainly fits that definition well.

My roots stem from the formative years in a wonderful place called Bremerton, Washington; a Navy town where family friends and friendliness abound. I began my naval service on a destroyer, which was a great way to start. I was then lucky enough to become part of the early days of nuclear propulsion in our submarine force. In those days I was not smart enough to understand what this relatively new aspect of the Navy encompassed. Admiral Rickover had told me to work harder, my neck was too thick and I needed to lose ten pounds, and I was in!

Although I was aware of some of my father's experiences in command of the submarine PICKEREL in World War II, as a young LT(jg), I did not understand that this chosen field of endeavor was the beginning of an historic change in naval warfare.

CAPT Ned Beach, a WWII veteran and pioneer in nuclear submarines said it best: "Having made twelve war patrols in diesel submarines in the Pacific and experienced all their limitations, including being virtually stationary during depth charge attack, to me the prospect of a nuclear engine that could drive a submarine fast enough and long enough to overtake, or escape from, any surface ship then in existence was breathtaking. What could we not have done with such a submarine during the war!"

My first 20 years were spent mostly at sea. Joan raised our wonderful children and I went to sea. Although the technology leap over that period was remarkable, it was the people, the shipmates over those decades that made a difference. My early expectations of exciting submarine operations, new challenges and opportunities were all true. And on top of that it was great fun!

It is difficult to describe the inner feelings of a submarine crew. During the past six years I have written a congratulatory letter to

each officer who qualified in submarines. I said,

> "As a submariner, your contributions to our nation's security are magnified by the immense capability of the submarines in which you will continue to serve.
>
> As a first string player in this unique profession of submarining, you are part of a team that exudes confidence, does exciting and challenging things, and has fun along the way. Those dolphins on your chest symbolize the type of person who makes things happen and enjoys new goals and challenges. The personal satisfaction which you will gain as a submariner will be an uplifting experience that will last you a lifetime."

That is the way I feel about this profession. That is the way it has been for me and many of my contemporaries. That inner feeing about submarining was generated over many years at sea with super leaders. I was blessed to have skippers such as Buzz Cobean and Jack McNish on HALIBUT and Bob Dickieson and Mike Leddick on KAMEHAMEHA, and Executive Officers such as Arne Johnson, Bob Bell and Dick Lewis. All were the type of leaders who would assign a task, point you in the right direction, and let you get the job done.

I look to those new generations of young submariners like Butch Howard, Jeff Durand, and Dan Bacon to keep intact that tradition of high spirit and true professionalism in our great submarine force. But my reflections of submarining need to go beyond the camaraderie of a team living in a steel tube for months at a time.

In a speech, in 1970, entitled An Effective National Defense - Why?, Admiral Rickover reminded us that, unfortunately, few people study history; which accounts for the truism that history repeats itself. He said,

> "Today it is fashionable to advocate a reduction in defense and to use the money saved for domestic purposes. Those who do so do not test their theories or their deductions by events."

If we look at the history of the submarine force and its role in national defense since the early 1900s, one fact becomes evident.

The utility of the submarine has consistently been underestimated. Twice in this century the submarine has been a significant factor in world conflicts. Time and again the submarine has proven its worth, not only because of its stealth and multi-mission capability, but also because of its rapid adaptability. During the past few decades, because our maritime strategy was to fight forward and to contain the threat against our ability to resupply

Europe we, in submarines, focused primarily on anti-submarine warfare. We were also called upon to make important non-ASW contributions, such as reconnaissance in nearly every international crisis over the years.

Today we have shifted our focus from readiness for global warfare to regional crisis response in littoral warfare, in support of our new strategy ...From the Sea.

It is important to realize that the nuclear powered submarine has consistently adapted to the changing world situation and has consistently proven to be an invaluable asset in meeting the challenges of a changing world order.

Our strategy for employment of naval forces in the future can be summed up as conventional deterrence, ensuring that an adversary in some region understands that the costs and risks of a specific course of action outweigh its benefits. The nuclear submarine is a key player in conventional deterrence. Although expensive to build, **and we are working hard on reducing costs**, with relatively small crews, they are cost effective to operate. Considering what a few attack submarines can do on their own, especially with cruise missiles, they are one of the bargains in the defense budget.

Deployed covertly there is no need to justify each move with world opinion, the nuclear submarine is essentially invulnerable on station, reducing escalation risk and risk to the crew, and of course, a nuclear submarine requires no foreign bases, no escorts, no air cover and no replenishment.

Smaller countries, such as Iran, seek submarines because they provide more capability for the money invested. In the future, as in the past, submarines will count as power and influence in the chancellories of the world.

Through my experience, we have always been able to keep a superior U.S. Submarine Force...the best! The best in the world!! To ensure a credible **conventional deterrent** posture in the future, we will need to maintain that edge.

Today there are about 200 ships at sea, including over 24 submarines. Our all-American blue jackets are at sea, deployed in all oceans of the world supporting our national security objectives. We know there will be fewer ships at sea in the years ahead. As Admiral Rickover lamented 23 years ago, the question remains: "How far will we reduce our defense capability?" In my business, I submit that force structure is not the question. The fundamental issue is **whether or not** this country will maintain the industrial capability and technology to build nuclear powered submarines! Based on my admittedly parochial view of history,

a strong nuclear powered submarine force, with advanced technology, is essential to our nation's security. I have been asked on countless occasions: How do we solve this dilemma? **I believe construction of submarines at a slow production rate is the only way to ensure we retain the capability and experience to build in the future.** If you stop for a decade or so, you will lose a vital element of our defense posture.

Today our strategy, ...From the Sea states: The free nations of the world claim pre-eminent control of the seas and ensure freedom of commercial maritime passage. History indicates the reality of today can change radically in the future.

In that same speech in 1970, Admiral Rickover said the bearer of bad news is always punished. In ancient times, he might be put to death. Today he becomes controversial and unpopular. **Fortunately,** we have had leaders such as Admirals Rickover and Bruce DeMars who were willing to step forward and state their candid views based on logic and reason.

Their leadership and that of Admirals Kinnard McKee, Bob Long, Jim Watkins, Carl Trost, Frank Kelso, Dennis Wilkinson, Lando Zech, Chuck Griffiths, Bud Kauderer, Al Baciocco, Ken Carr, Ron Thunman and Dan Cooper have forged the solid foundation of my business of nuclear submarining, and improved every aspect of it over the years.

They were all willing to voice their opinions, some of which were not popular at the time. I am most indebted to all of these naval heroes for their guidance and support.

On a beautiful September morning at Groton, CT on the deck of USS PENNSYLVANIA during its commissioning, Secretary Larry Garrett answered those questions on the profession of nuclear submarining that I have posed: What has it been all about? And what does it mean for the future? He was talking about strategic deterrence, yet for some reason I translated his words into the meaning, **the essence** of our Navy and submarine force. He said that deterrence works; it is the sturdy bedrock of our national defense.

It is a strategy that has enabled mankind to avoid another world war **and get on with the business of living.**

The idea that those sailors on USS PENNSYLVANIA and other Navy ships at sea, then and now are engaged in the noble cause of allowing us, the people of this great country, to get on with the business of living, summarizes my adventure, my profession. I am proud to have been a part of that cause. ■

SUBMARINES AS AN IMPORTANT PART OF A DYNAMIC, NEW NAVY

by Ronald O'Rourke
Congressional Reference Service
Banquet Address, 12 May 1993
Submarine Technology Symposium

Those of you who were here last year, when I was one of the luncheon speakers, will recall that I started my presentation by announcing that I was convening the post-lunch indigestion club. I then proceeded to say some things that probably did make it a little hard to digest a meal.

Well, here we are a year later, you've just finished your dinner, and apparently the symposium organizers were concerned that you might enjoy it a little too much, because here I am again.

Are submariners masochists? Or are they just into that quote from Nietzsche about how things that don't destroy me make me stronger?

Of course, I realize I'm here only because Deputy Secretary Perry couldn't make it. I'm sure you were looking forward to hearing Deputy Secretary Perry speak at this banquet, and I would have wanted to hear his remarks as well. But perhaps it isn't too surprising that he was unable to appear before you tonight, given the press of work he must now face.

In fact, when I think of the many issues now facing the new Pentagon leadership and then consider the small number of people now in place at the Pentagon to handle this tremendous workload, I am reminded of the famous scene from the I Love Lucy show where Lucy and Ethel are in the candy factory, trying desperately to individually wrap the candies as they come down the conveyor belt at ever higher speeds. I just hope the new Pentagon leadership can get all their work done without having to resort to the kind of tactics that Lucy and Ethel had to employ.

I'm sure that Deputy Secretary Perry would have had many interesting things to say. But my guess is that he probably would not have been able to make definitive comments on the one issue that many of us are the most anxious to hear something definitive on—the Administration's plans for the future of the submarine industrial base. That issue, as you know, has been kicked into the Bottom-Up Review, and it would be very surprising if Deputy Secretary Perry could make any definite announcements about the Administration's plans while this review is underway.

More likely, at the end of his address, we'd all be in the position of trying to glean hidden meanings from his understandably limited remarks on the matter, like a fortune teller trying to read tea leaves in the bottom of the cup. We might be able to make various speculations, but in the end we'd be back where we started, and where we have been for more than a year now, which is waiting for the Executive Branch to come forward with a clear statement of its intentions.

For many who follow submarine-related issues, it is this situation of having to wait, and wait, and wait, for the official word that perhaps best characterizes the current situation regarding submarines.

We do know a few things. We know that there is no submarine in the FY94 budget submitted to Congress, and that fitting one into the FY95 budget could prove particularly difficult, given the plan to fund the remainder of the new aircraft carrier, CNV-76, in that same year. We know that defense budgets over the next several years will be very constrained, and that submarines will likely be procured at a very low rate. As a consequence, it's probably safe to say that, in the long run, there will only be one submarine builder, whether it's Electric Boat, Newport News, or some combination of the two. It may also be safe to say that the long-term attack submarine force level goal may wind up in the range of 40 to 45, but almost certainly not more than about 55. And finally, it appears that, for many in the submarine community, the hoped-for outcome from the Centurion cost and operational effectiveness analysis (COEA) would be a new-design SSN in the 6,000 to 7,000 ton range.

But that's about all we can be fairly confident of at this stage. A lot of the rest is up for grabs.

While the Bottom-Up Review is in progress, an important public discussion is occurring about the future of Navy force structure. In my remarks last year, I focused on the attack submarine component of that debate. This year, I want to step back a bit by placing the debate over the future of the attack submarine force in the broader context of the current debate over the future of Navy force structure in general. In that regard, I want to make three points.

Submarines and Eight Old Habits of Thought

The first point has to do with the ideas and concepts—the intellectual and to some degree emotional baggage, if you will—that is being carried into this new debate over Navy force

structure. One of my principal themes last year was that the attack submarine is viewed by many outside the submarine community as primarily a Cold War ASW platform, and that this stereotype had to be overcome if attack submarines were to be given a fair day in court.

Today, a year later, it has become more clear to me that this stereotype of attack submarines being primarily for ASW is only one example of a collection of oversimplified and outdated notions about naval forces, and naval force-structure planning, that can cause confusion and interfere with the process of identifying naval requirements and a corresponding naval force structure for the post-Cold War era. There are many old habits of thought, as I call them, including eight which I consider to be on the top tier because of their breadth and the frequency with which I have encountered them.

Some of these concepts had some value in naval force-structure planning during the Cold War, but some of them were incorrect even during the Cold War, and all of them today are outdated, oversimplified, or just plain wrong. I want to go through them for you briefly now.

- The first of these oversimplified ideas is that regional conflicts can safely be considered lesser included cases of the larger East-West war on which U.S. defense planning was previously based.

It would be more accurate to say that while the overall scale of regional conflicts will be smaller than a global war, regional conflict scenarios can in fact stress military forces along certain dimensions more than the big war scenario. Regional conflicts can feature compressed, complex battle spaces with a potentially complicating political overlay. Rather than viewing them as lesser included cases, it would be more appropriate, in my view, to simply view them as different cases. In some ways, they may stress those forces more.

- The second of these outdated concepts is that navies exist primarily to fight other navies.

Again, this is an oversimplification. It would be more accurate to state that navies exist in part to fight opposing military forces, both land- and sea-based, and that this has been particularly true since the development in the 20th century of amphibious forces, sea-based aircraft, long-range missiles, and improved communications.

- The third old habit of thought is that it takes three ships to keep one forward deployed.

This figure is far too low, because it fails to fully account for personnel tempo limits, overhauls, and transit time. It would be more accurate to state that for U.S. homeported ships, it takes 4 to 5 ships to keep one on station in the Mediterranean, 5 to 8 for the Arabian Sea, and 4 to 6 for the Western Pacific. A global average figure for attack submarines is 5.7.

- The fourth outdated concept is that the carrier battle group is the primary building block of the Navy.

Given the Navy's recent experimentation with new and innovative formations under the concepts of naval expeditionary forces and joint adaptive force packages, this concept is increasingly problematic. In the post-Cold War era, it may be more accurate and useful to conceive of naval forces as modular entities that may include varying combinations of ships.

- The fifth is that the number of carriers moves in tandem with the size of the Navy's budget.

This is a corollary of the idea that CVBGs are the primary building blocks of the Navy. Now that the cookie-cutter concept of the CVBG is breaking down, it is no longer as true that carriers *drive* the Navy's budget, and that a reduction in the size of the Navy's budget must therefore lead to a reduction in the number of carriers.

- The sixth old habit of thought is that an inability to fill out all the carriers' decks with full air wings of 80+ aircraft on a sustained basis is necessarily grounds for reducing the number of carriers.

This may have had some validity during the Cold War, given the potential need to fight a global war at sea on short notice, but it is less persuasive in the post-Cold War era, with its focus on regional conflicts.

- The seventh oversimplification is that carriers are primarily for the deep strike mission.

Carriers are simply a way of taking tactical aircraft to sea, and tactical aircraft perform a variety of missions, of which deep strike may not be the most important.

- The eighth and final oversimplification is that attack submarines are primarily ASW platforms.

I have encountered these eight old habits of thought frequently enough that I wrote a short report a few weeks ago discussing why they were oversimplified and outdated. It would do no good, after all, for policymakers to reexamine Navy force structure for the post-Cold War era, if the reexamination itself relied on outmoded Cold War concepts.

Now as you can see, most of these old habits of thought have to do with naval forces generally, or with parts of the Navy other than submarines, notably aircraft carriers. Nevertheless, because it establishes part of the broader setting within which the submarine community's voice is attempting to be heard, this complex of outdated notions has potentially important implications for the submarine community.

One potential implication is that the submarine community might not succeed in breaking out of the ASW ghetto if it confines its efforts to overcoming this single stereotype involving submarines. If the submarine community speaks up only to correct misconceptions relating directly to submarines, and not those relating to the Navy as a whole, then its arguments may come to be viewed as self-serving and therefore of questionable merit. And if most of this complex of outdated notions remains in place, then in the end it may make little difference for the submarine community if the one stereotype concerning submarines is overturned. The fortunes of the submarine force, in other words, will to a significant degree be influenced by the fortunes of the Navy as a whole.

Submarines and the Force 2001 Plan

The second point I want to discuss, which is related to the first, concerns the Force 2001 plan that has emerged from the work done in the assessment office headed by Vice Admiral Owens, yesterday's luncheon speaker.

This plan is important not only because of the influence it will have on the current debate over future Navy force structure, but because of the effect it may have on the Navy's standing with a variety of outside audiences. Even before Tailhook, the Navy had worked itself into a position where it was viewed by many in a number of unfavorable lights—as a foot-dragging, head-in-the-sand service that was unwilling to fully recognize and adapt to the changing strategic and budgetary environment of the post-Cold War era, as an arrogant, do-it-alone service that was unwilling to listen and work with others, and as an overly politicized organization that was gridlocked by jealous, competing internal interests.

This perception was in many respects unfair or an oversimplification, but it was fairly widespread. As a result, the advent of the Tailhook scandal only added to an already serious set of image problems facing the Navy.

The Force 2001 plan, and perhaps just as important, the new assessment process that led it, has the potential for contributing

significantly to the Navy's efforts to show how the various elements of this perception are either incorrect or are in the process of being redressed. From my own perspective, I can say that for the last two or three years, I had been telling various audiences about the political hole that the Navy had dug itself into. Now, in large part because of this new plan, and the process behind it, I am telling a very different story—a story of a service that seems to have made a dramatic turnabout, and which may now be ahead of the other services in adapting to the post-Cold War era and reconciling its program desires with realistic levels of future funding.

I can't say whether the Force 2001 plan is the best possible plan that might have emerged from the Navy's deliberations, or that it is without serious error. Nor can I say whether the submarine community was treated fairly in the deliberative process. Reportedly, there were at least a few heated arguments in the meetings that were held, and it is quite possible that at least some in the submarine community feel that their arguments weren't fully appreciated or acted on. But for better or worse, this plan is now emerging into the open domain, and so far, it has received generally good reviews. In many respects, it appears to be the best foot that the Navy has put forward in several years.

Like the old habits of thought I discussed earlier, this plan, though it deals with the Navy as a whole, and not just with submarines, has implications for the submarine community. The Force 2001 plan will be revised further in the months ahead, and if the submarine community feels it can make a case internally for a revision that would increase the attack boat presence in the plan, then it should consider doing so.

But by the same token, because this plan represents a strongly articulated future course for the Navy, the connection between it and the submarine community needs to be made clear and strong. In other words, the challenge now is not just to simply argue the merits of attack submarines in the abstract, but to explain how attack submarines fit into this plan; not just why submarines are valuable, but why attack submarines make sense as a component of a plan that includes a variety of different platforms, each with their strengths and weaknesses.

Last year, I said that I wasn't sure how many attack submarines the United States needed for the post-Cold War era, but that I didn't want policymakers to make a decision on this issue without hearing the best argument that the submarine community can make. I would still make that statement today. But the best

argument that the submarine community can make today, in my view, is not simply an argument about submarines themselves. A strident, self-absorbed argument about submarines made in isolation from the broader debate will serve the interests of neither the submarine community nor the policymakers who may make decisions affecting its future.

The best argument the submarine community can make, in my view, is something broader. It is an argument about naval forces, and of how submarines can form part of a Navy that makes sense for the post-Cold War era. It is an argument that says something about submarines, but at the same time is grounded in something larger than the submarine community. That is the kind of argument the submarine community should consider working toward.

The Manufacturing Process and Related Specifications

My third and final point has to do with acquisition costs and how they are influenced by manufacturing processes and the specifications related to them. The defense establishment is entering a period of low or very low procurement rates, which poses two basic problems. One is how to maintain the minimum essential elements of the industrial base for designing, producing, and maintaining various weapons. The submarine industrial base, as Secretary Aspin, Deputy Secretary Perry, and many others have remarked, represents perhaps the most difficult case in point. But though we are still waiting for the Administration to announce its plan for addressing this issue, the problem at least has been widely discussed in the Executive Branch, the Congress, and the press.

Less attention, however, appears to have been paid to the second challenge posed by the prospect of a low-rate procurement environment, and that is the challenge of producing at low rates in an economic fashion. Again, this is a problem for the defense establishment as a whole, but it is not clear to me that the submarine community has taken up this challenge as comprehensively as some other parts of the defense community.

To be sure, the submarine community has implemented modular construction, which was a significant change in the design and assembly process, and it is now exploring the potential of computer-aided design, on which there will be at least one presentation tomorrow. But it is not clear that these are the only two potential sources of significant improvement in the construction process.

There is one other area of potential improvement to investigate,

and that has to do with manufacturing processes and the specifications related to them. Last year at this conference, there was a fairly strong spoken presentation made on the topic of specifications, particularly how specifications have been layered on top of one another over time, and could potentially be much simplified through a long overdue process of rationalization. Unfortunately, you won't find a record of this presentation in the Proceedings of last year's conference, because this speaker submitted a formally prepared paper that doesn't go into the issue in quite the same way.

But since that time, I have raised the topic of manufacturing processes and specifications in conversations I have had with a variety of parties in the submarine community, and what strikes me is the sharply different responses my questions have prompted. Some of the people I have spoken to on this topic have reacted with a lack of interest, or with a defensive attitude. Others, in contrast, have expressed a strong interest in the potential of revised manufacturing processes and specifications to achieve substantial reductions in acquisition costs without a reduction in system performance or production quality.

As examples of the parties I have spoken to, one individual I spoke with expressed a view that the cost savings that can be achieved in this area are probably very small, perhaps just a couple of percent. This individual is a major player in this issue and I certainly have to give weight to his view.

But another party, in this case, the producer of a fairly significant component that goes aboard submarines, expressed a view, based on a study they had performed long before I raised the topic with them, that outdated specifications and other mandated aspects of the manufacturing process unnecessarily increased the production cost of their component by about one-third. It was also their view that a later step in the acquisition process unnecessarily added another 20 percent to the cost of the unit. That's a total of more than 50 percent additional cost. Moreover, the view of the managers and engineers at this firm was that outdated specifications and other unnecessary, cost-increasing features of the production process added similarly large and unnecessary premiums to the cost of other major components in the submarine as well.

I don't know if the correct view is that of the first individual I mentioned, of the component manufacturer, or whether the truth is somewhere in between. But what I don't detect is very much enthusiasm in either the Navy or parts of industry to explore this

issue vigorously, so that its potential benefits may be fully identified and more accurately estimated.

Clearly, the submarine community has a strong financial interest in identifying ways to reduce cost without reducing unit capability. In the long run, sustaining a 45 boat goal will require procuring about one and a half boats a year, and the savings that might be achieved in this area conceivably could help make the difference between being able to procure one boat versus one and a half boats.

But it is not just for financial reasons that the submarine community has a potential stake in exploring this issue more thoroughly. We are in an era of change, and credit goes to those who can show that they are meeting that change actively, in all its aspects, and are leaving no stones unturned in search of better ways of doing business.

The tactical aircraft and submarine communities are different in many ways. But they share a common post-Cold War problem of platform affordability. In the Air Force, General Loh, the commander of the Air Combat Command, is responding to the prospect of low procurement rates by investigating and energetically promoting the concept of lean procurement. In an address earlier this year, he stated that "developing a smart, realistic production rate strategy" requires "build[ing] the organization from the bottom up for low rate procurement, not try[ing] to fit them into what's left over from a large, high-overhead, big-rate infrastructure. But that's not easy...[It involves] overhead, organization, and the production line—in essence, the entire enterprise must change physically and culturally."[1] As part of their work in this area, the Air Force is exploring, among other things, the potential for incorporating innovations from auto manufacturing into the aircraft manufacturing process.[2]

In addition to General Loh's lean manufacturing initiative, flag and general officers in the Navy, Air Force and Army with responsibility for aircraft procurement have recently formed a

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[1] Speech by General John M. Loh to Air Warfare Symposium, Feb. 4, 1993, as reprinted in special supplement to Defense Daily, Feb. 10, 1993: S-1.

[2] Interviews with Barry Smernoff, consultant to the National Center for Manufacturing Sciences (NCMS), and Rebecca Racosky, Manager for Government Relations of the NCMS, Feb. 19 and 24, 1993. NCMS can be reached at (202) 544-9244.

Joint Aeronautical Commanders Group to explore the potential for achieving more efficient production processes through, among other things, changes in standards, specifications, policies, and procedures.[3]

And just a few days ago, the Advanced Research Projects Agency (ARPA) launched a comprehensive study on affordable aircraft acquisition that will involve numerous representatives from government and industry and will discuss a variety of topics, such as lean manufacturing. Deputy Secretary Perry was scheduled to give an address at the opening session to provide guidance for the study.[4]

Enthusiasm and coordinated effort of this kind are not equally apparent in the area of submarines. If comparable efforts are underway in the submarine community, they should be better advertised. If comparable efforts are not underway, this should be reexamined.

With defense funding heading downward, it is increasingly imperative for supporters of a given kind of platform to show not just that they intend to make a new and better platform, but that they have investigated the potential for making it in a new and innovative way. Supporters that present a plan to make a new item in the same old way will be at an increasing disadvantage.

Now there are many significant differences between aircraft production and submarine production, and many aspects of submarine production are unique. As a consequence, it may be that upon thorough investigation, it will turn out that the potential savings to be achieved in this area for submarines are indeed limited and perhaps not even worth pursuing. But if the submarine community cannot show that it has investigated this area in a comprehensive and thorough manner, then it risks looking poor by

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[3] Nordwall, Bruce D. Military Air Chiefs Lead Way to Efficient Procurement. Aviation Week & Space Technology, March 8, 1993: 44-46.

[4] As of April 20, 1993, the first session of this effort, aimed at setting the study's goals and themes, was scheduled for April 27-29, 1993. The second session, on general technologies, methodologies, and tools, was tentatively scheduled for June 8-10, 1993. The third session, which was to provide focus and synthesis on selected technologies, methodologies, and tools, was tentatively scheduled for July 20-22, 1993. The tentative master schedule called for the final report to be done by Sept. 39, 1993, possibly with a briefing to Deputy Secretary Perry about mid-September. As of April 20, the Chairman of the study team was to be Mike Francis of ARPA.

comparison to other parts of the military.

Deputy Secretary Perry, in his confirmation testimony, in effect said that if we can solve the industrial base problem for submarines, we can solve it for most any other part of the military industrial base. In that same spirit, it might be said that if the manufacturing process can be significantly improved for submarines, which pose a unique and difficult case, then it can be improved for many other defense products as well. Just imagine how views and opinions might be transformed if the submarine community could bring a new and innovative set of manufacturing processes to the table.

To date, the submarine community has showed some dynamism in terms of thinking about new kinds of submarine capabilities and missions, and how new technologies can contribute to them. Much of this year's conference is devoted to this theme. This effort is important, and it should continue. But conceiving of new capabilities and missions is not such a wrenching process, and by itself can come to be viewed from the outside as simply an expansive, self-promoting undertaking. This effort can be given more credibility, and the case for the submarine community being a dynamic community can be made much more convincing, if this effort is paired with the potentially more wrenching process of reexamining manufacturing processes and the specifications that relate to them.

In summary, my message is a basic one—that the attack submarine community can be an important part of a dynamic, new Navy, but that its chances for fully achieving that position are reduced if the issues facing submarines are viewed and addressed primarily within the confines of the submarine world. By helping to break down old habits of thought for naval forces in general, by showing how submarines fit into the Force 2001 plan, and by fully exploring all potential areas of acquisition reform, including the potentially wrenching ones, the submarine community can play on a larger field. In doing so, it can make a stronger case for itself, and a more useful case for policymakers facing very difficult decisions. ■

SUBMARINE FORCE STRUCTURE: PEACETIME PRESENCE OR WARTIME PATROLS

by Commander N. French Caldwell, Jr., USN

Today's U.S. nuclear submarine force is the result of tremendous national investment and effort. Together with the industrial base that supports it, the nuclear submarine force is an American crown jewel, as necessary to our security and superpower status as our arsenal of nuclear weapons. The recent Submarine Service fact book America's Nuclear Powered Submarines called the modern nuclear-powered submarine "the only naval platform that combines stealth, endurance, and agility in a single vehicle".[1] Despite the fact that the nuclear-powered submarine force is the most efficient, effective, and stealthy tool of American maritime combat power, a large portion of this precious national resource is being discarded through accelerated decommissionings to save the costs of refueling overhauls. The first LOS ANGELES class submarines to be scrapped are only 15 years old and are very capable, modern platforms with updated weapons and sonar systems. In view of the uncertainty of future geostrategic order, the budgetary requirements which cause this reduction in force structure seem extreme.

The Strategic Perspective: The National Military Strategy claims to be a strategy of deterrence.[2] "Regional threats of consequence to U.S. vital interests" are the strategy's focus.[3] Forward presence is called the "key to averting crises and preventing war."[4] As stated in The National Military Strategy, forward presence forces are "principally maritime;"[5] they are the "glue that helps hold alliances together, builds cooperative institutions, and helps regional countries work together, including some with historical antagonisms."[6]

However, despite the National Military Strategy's deterrence claim, evolving national security strategy puts the emphasis on contingency response. In other words, it is a strategy of readiness, not deterrence. Forward presence of the U.S. Navy and Marine Corps makes up for the fact that land based combat forces of the Army and Air Force will be more and more based in the continental United States rather than overseas. In a crisis, our land-based Army and Air Force must be able to surge rapidly from the United States to regional troublespots. To transport and

sustain these forces requires fast sealift, prepositioning and airlift. The success of this surge strategy presupposes command of the seas. It also depends on the peacetime, global deployment of American naval forces, Navy and Marine Corps, as "the leading edge of our crisis response capability."[7] These forward presence forces enable early and rapid entry of additional American combat forces when required in a crisis or major regional contingency.

Nuclear propulsion plays a major part in forward presence. Self-sustained, limited only by the amount of food carried onboard, nuclear ships can operate anywhere in the world's seas for extended periods. Their endurance and self-sustainability are legendary from the NAUTILUS' first Arctic patrol from Hawaii to Iceland, to the GEORGE WASHINGTON's first strategic deterrence patrol, to the undersea circumnavigation by TRITON. The presence of these magnificent undersea warships around the globe has given the United States true command of the seas, breaking once and for all the Mahanian limitations of the U.S. Navy on protecting sea lines of communication.

On the ocean's surface, a warship's projection of credible presence is limited by the range of her weapons and the speed of the vessel. However, nuclear undersea warships begin to spread their presence globally from the moment they submerge. The circle of uncertainty over the location of a nuclear submarine grows daily from the point of submergence and increases the uncertainty that opponents must face.

The Falklands Example. In the Falklands War, the British Navy, using three nuclear submarines, imposed a 200 mile maritime exclusion zone around the Falkland Islands only ten days after the 2 April 1982 invasion.[8] For the first several days, the British submarines may not even have been in the exclusion zone they were imposing. In total, the British Navy employed five nuclear submarines and one diesel electric submarine during the Falklands War.[9]

Throughout the Falklands War, because the locations of British nuclear undersea warships remained unknown, they were able to project power and influence in a much larger area than could have surface combatants. The HMS SPARTAN, the first British nuclear submarine deployed to the Falklands on 29 March 1982, spent 150 days at sea. Such endurance and stealth confronted the Argentine planners with a circle of uncertainty that included the

entire globe. However, on 2 May 1982 the sinking of the Argentine cruiser ARA GENERAL BELGRANO by the British nuclear submarine HMS CONQUEROR drove home the certainty that British nuclear undersea warships effectively controlled the seas off Argentina. For the rest of the war, Argentina restricted her surface combatants to operations in territorial waters.

In sharp contrast to the effectiveness of British nuclear submarines, the Argentine submarines in the Falklands were a failure. The British naval task force responded to numerous submarine contacts by taking ASW actions, but none of the suspected Argentine submarine contacts were ever really confirmed. The one Argentine submarine that actually operated in the vicinity of the task force, the German-built SAN LUIS, never got off a successful shot due to grotesque material deficiencies.[10] So despite British reactions to false contacts and the continuous psychological pressure of the suspected but unproven presence of Argentine submarines, the Argentine submarine presence was not credible. And without the credibility of a successful attack by an Argentine submarine, the effect on the British task force was minimal.

Limitations of Peacetime Presence. In peacetime, the credibility of submarine presence is even harder to effect, since the sinking of the targeted country's vessels is not allowed. A United States surface combatant or amphibious landing ship with embarked Marines just outside territorial waters is a much more effective and continuous reminder of American presence. A submerged warship does not have this same continuous presence. However, announced ASW exercises being conducted with surface combatants would multiply the uncertainty for the targeted country many-fold. Regular port visits by nuclear submarines to nearby friendly countries would also have an affect on potential adversaries. Flares launched from a submarine in the vicinity of the targeted countries' naval craft or other vessels going into the targeted countries' ports may also have a significant effect, although they would tend to give up the stealth advantage of the submarine. To retain stealth, a submarine could launch time delayed slot buoys that would broadcast detectable and detestable messages to the targeted country. However, in the peacetime presence mission, the continuous, long-term coercive effect of visible presence is much more effectively achieved by a patrolling surfaced warship

than by a submarine in the peacetime presence mission.

As mentioned above, port visits by American nuclear submarines hosted by friendly countries can demonstrate a regional presence to targeted countries. These visits also represent a more positive type of presence, i.e. naval diplomacy with the hosting country. Contrary to continuous targeted presence, the nuclear submarine is well suited to naval diplomacy. **Nuclear submarines are identified by most countries as capital ships,** the result of a national program and commitment. Foreign navies look forward to exercising and operating with modern, capable American nuclear submarines. Their small, elite crews and thoroughly professional officers also mean minimal local impact, few liberty problems, and they are a pleasure to host.

However, nuclear submarines do have drawbacks in naval diplomacy that conventional surface combatants don't. Restrictions regarding the reactor complicate port visits by nuclear submarines. For example, when the USS WILL ROGERS (SSBN 659) visited Rotterdam in the spring of 1991, only a handful of Hollanders really knew it was there. It berthed at a commercial dock without public access, unlike normal visiting warships that can tie-up next to a public park. In addition, the U.S. Navy restricts non-American citizens from touring nuclear submarines without very high level approval.

The politics of *greenism* are another significant challenge to the effectiveness of naval diplomacy with nuclear submarines. In the above example of the USS WILL ROGERS, there was a major demonstration by *green* activists at a local commercial nuclear power plant the very week that the submarine visited Rotterdam. Surely the activists would loved to have known that an even better target of their anti-nuclear venom was available! The most significant example of the politics of *greenism* is, of course, the prohibition of nuclear warship visits in New Zealand, a restriction that broke up the ANZUS alliance. That restriction is still in effect even now that all tactical nuclear weapons have been removed from those ships.

Warfighting Requirements. Like it or not, the reality is that nuclear submarines currently suffer handicaps as a peacetime force. As a warfighting force though, these handicaps are distinct advantages. The nuclear power plants, political handicaps in peacetime greenism politics, allow long, self-sustaining war patrols

and indefinite periods of submergence. While surface search radars and anti-ship cruise missiles can keep surface combatants far off-shore, submarines with their stealth can operate inshore for intelligence, warning, surveillance, early strike and special operations. As in the case of the Falklands War, they can severely restrict enemy fleet operations once their striking power is demonstrated by sinking enemy ships. Since the Falklands, the nuclear attack submarine has also acquired the role of a joint strike platform with precisely targeted, long range cruise missiles.

The nuclear attack submarine also remains the premiere anti-submarine warfare platform. Despite the increasingly quiet Russian nuclear submarines, and the silence of Third World diesel submarines operating on the battery, American nuclear submarines remain effective ASW platforms, especially with the advent of new communications and data links, in addition to onboard processor and sonar advances. It is quite likely that in future conflict, the enduring role of submarines in both sea-denial and covert operations will continue in addition to new roles in joint strike and task force operations.

How Many SSNs? A central question for the immediate future is how many nuclear attack submarines are needed in the U.S. Navy. Interestingly, recent papers out of the submarine branch of the Navy staff have tended to emphasize the submarine's role in *peacetime engagement* and regional deterrence but have minimized the important role of the submarine in major regional conflict.[11] Such is the importance attached to portraying the nuclear attack submarine as part of the peacetime presence Navy, that the attachment of submarines to carrier battlegroups has become a central part of any submarine force brief given to key decision makers.

With the Cold War over, the nuclear attack submarine is being touted for its regional crisis response capability and peacetime presence. Unfortunately, these arguments tend to tie the number of submarines to the number of other naval platforms. For instance, in the current Defense Department Bottom-Up Review, the Navy stance has been that daily peacetime presence and crisis response requires 12 aircraft carriers, which would also be enough for warfighting.[12] Given two submarines per carrier battle group, then algebraic logic would lead to a submarine force of only 24 nuclear attack submarines. This small submarine force

would hardly be effective for a single major regional conflict. So, while peacetime presence and crisis response may be effective arguments for visible forces, particularly with the high daily visibility of these forces in the Persian Gulf, the Adriatic Sea, and in humanitarian operations, the role of submarines in these type of operations is invisible, not apparent to force structure decision makers, and consequently a poor argument for determining the size of the nuclear attack submarine force.

The number of submarines needed for major regional conflicts, however, is another matter. While the number of aircraft carriers required for peacetime presence and crisis response is more than adequate to satisfy the requirements of a major regional contingency, the number of nuclear attack submarines required is much higher. In many major regional contingencies, airpower demands can and should be met by land-based air, and when sea-based air is required, it is hard to imagine employing all the carriers at once. However, even when carriers aren't required, the demands of the theater for maritime control of the battlespace will still put an emphasis on the endurance, agility and stealth of nuclear attack submarines. The joint task force requirements for sea denial, including anti-submarine and anti-surface warfare, joint strike, and covert operations will be much higher for many major regional conflicts than for the crises of the Persian Gulf, Somalia or the Balkans.

The renewed Russian naval building program and China's naval buying spree should give pause to those planners who call for further reductions in submarine force levels. Because of the uncertainty of the intentions of our recent Cold War competitors, Dr. William Kaufman of The Brookings Institution excepted attack submarines from general post-Cold War naval force reductions. In The Brookings Institution's most recent annual assessment of the defense budget, Kaufman called for an increase of the level of attack submarines over the base force level to 84.[13] However, current Navy plans call for accelerated decommissionings of LOS ANGELES class nuclear attack submarines below the base force level in order to save the costs of mid-life refueling overhauls. Such a strategy could reduce the attack submarine force to as low as 40 ships by the end of the decade.

Alternatives. Fortunately, the Secretary of Defense's Bottom-Up Review did not take the role of submarines in peacetime presence

to be tied as closely to carrier levels and called for a sustainable, warfighting force of 55 attack submarines.[14] The challenge is to get to that number intelligently. There are no 21st century submarines in the fleet today, so the nation and the Navy must make do for now with a larger force of 20th century nuclear submarines. Since the challenges that 21st century submarines must face are just now beginning to be known, it would be wrong to drop down in numbers rapidly, before the first SEAWOLF joins the fleet and before the CENTURION is even off the drawing board. The submarine fleet must not go down so rapidly that a challenger takes advantage of the interim submarine development period to challenge America's command of the seas and the Navy's ability to dominate the littoral battlespace.

The rapid reduction strategy, while increasing the risks to maritime battlespace dominance, has the perceived advantage of helping to justify the building of new SEAWOLF and CENTURION submarines. Without a doubt, building new nuclear attack submarines is the best way to preserve the nuclear submarine industrial base.[15] However, despite that justification, it is hard to rationalize the scrapping of good, modern LOS ANGELES class submarines in mid-life for a one year savings of approximately $200 million for each one scrapped. Surely, these capable ships can be laid up for less than the $5 to $7 million annual costs of operating each one, with enough fuel remaining to be valuable in the first year or two of a major regional or global conflict.

When the 21st century SEAWOLF and CENTURION submarines begin entering service, the laid up, surplus 20th century submarines can be scrapped. Meanwhile, though the missions for the naval service continue to increase, particularly in littoral areas, the bottom-up review calls for a much smaller force of surface combatants. Consequently, though submarines are not ideal for many missions that the surface Navy has in peacetime, the submarine service must learn to do them.

Already, submarines have proved valuable in international counterdrug efforts.[16] Counterdrugs is just one of many missions that, when the Soviet threat demanded that American submarines make ASW an exclusive priority, the submarine service just could not take on. Another potentially new mission for submarines, with ASW a lessened priority for now, is sanctions enforcement, including surveillance and boarding operations. Only 1 in 50 embargo challenges actually results in a boarding. Just as from a

surface ship, a rubber dinghy can transfer the boarding party from a submarine when it is necessary to surface and board.[17] Imagine the merchant that is interrogated by a submerged warship! The extra psychological factor might even reduce the number of embargo breakers.

Illegal immigration is another area where submarines can be extremely valuable. The recent grounding of a shipload of illegal Chinese immigrants highlighted the wave of maritime human smuggling that is washing on to American shores.[18] From China alone, the U.S. Coast Guard has detained more than 1600 illegal immigrants so far this year, and if drug seizures are any example,[19] more than twenty times that number may have successfully entered by maritime smuggling. Ships of illegals are extremely difficult to detect for several reasons: they often have the tacit approval of the originating country's government officials; they avoid normal shipping routes; they can transfer their cargo between feeder boats and mother ships without having to enter port; and when they suspect surveillance, they hide their illegal cargo belowdecks. However, a submarine can survey suspected smugglers without their knowledge, and can even electronically monitor the coastal areas of countries where the activity is suspected to originate.

Besides the above novel missions, submarines and submariners should get better at traditional naval presence. Regulations and restrictions designed for the Cold War must be reviewed and changed to fit new realities. Submarine commanding officers must learn how to make diplomatic port calls and be given the diplomatic tools and training to make each foreign visit shine. However, no matter how good the submarine service gets at peace, it must never forget that its primary justification is command of the seas in war.

Conclusion. In summary, it is better to be conservative and keep nuclear attack submarine force levels high to meet major conflicts, than to justify them for peacetime presence and crisis response and be satisfied with lower levels. Although the decline in numbers of surface combatants requires using nuclear attack submarines in new and novel ways, current restrictions on conducting port visits and the politics of *greenism* put nuclear submarines at a disadvantage compared to conventional surface combatants in many aspects of naval diplomacy. The inherent stealth and invisibility of

nuclear submarines also make them poor candidates for visible, coercive peacetime presence or conventional deterrence short of hostilities. However, once hostilities begin, the nuclear submarine proves its presence by forceful action. It becomes a powerful platform whose invisible presence, sea-denial, and striking power dominate the maritime battlespace.

■

NOTES

1.U.S. Navy, America's Nuclear Powered Submarines: Key Elements of U.S. Naval Power, (Washington, DC: Chief of Naval Operations, 1992), p.4.

2. Department of Defense, The National Military Strategy of the United States, (Washington, DC: GPO, 1992), p.6.

3. Ibid, p.6.

4. Ibid., p.7.

5. Ibid., p.22.

6. Ibid., p.22.

7. Ibid.

8. Falkland Islands Study Group, Department of the Navy, Lessons of the Falklands: Summary Report (Washington, DC: Department of the Navy, February 1983), p.15; Admiral Sandy Woodward, One Hundred Days: The Memoirs of the Falklands Battle Group Commander (Annapolis, MD: Naval Institute Press, 1992), p.81.

9. Falkland Islands Study Group, pp.8-9.

10. Ibid., p.8.

11. America's Nuclear Powered Submarines, pp.607; Assistant Chief of Naval Operations for Undersea Warfare, Submarine Roles and Missions (Washington, DC: Department of the Navy, 31 December 1992), pp.8-10.

12. Department of the Navy, "Carriers for Force 2001," a ...From the Sea update paper, Spring 1993.

13. William W. Kaufman, Assessing the Base Force: How Much is Too Much? (Washington, DC: The Brookings Institution, 1992), pp.86-89.

14. David A. Fulghum, "Pentagon to Kill A/FX, Retain F-22," Aviation Week and Space Technology (14 June 1993), p.26.

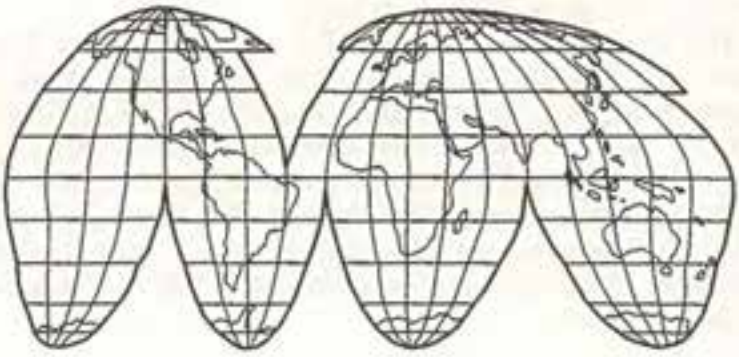
15. Admiral Frank B. Kelso, II, USN, Acting Secretary of the Navy and Chief of Naval Operations, and General Carl E. Mundy, Jr., USMC, Commandant of the Marine Corps, Department of the Navy 1993 Posture Statement (Washington, DC: Department of the Navy, March 1993), p.46.

16. VADM H.G. Chiles, USN, Commander Submarine Force Atlantic Fleet, Letter to Fellow Submariners, 18 May 1993.

17. CDR Ric Ruston, USN, Office of Program Appraisal, Office of the Secretary of the Navy, Interview with the author, Washington, DC, 1 June 1993.

18. "Alien-Smuggling Ship Beached," The Washington Times (7 June 1993), A1 & A8.

19. Louise and Tony Walker, "U.S. Fears Flood of China's New Slaves," Financial Times (7 June 1993), p.5.



THE FUTURE COURSE OF U.S. SUBMARINES

by LT Brian T. Howes, USN

The end of the Cold War has been a watershed in the U.S. national security environment. The Soviet Union no longer exists as a global threat to our vital interests. The uncertain threat of regional crises and contingencies has replaced that of global war as the basis for U.S. defense planning. This fundamental change, as enunciated in the National Security Strategy of the United States and the National Military Strategy, requires a reexamination of service strategies and programming. This examination is well underway as each service struggles to determine its contribution in the post-Cold War world.

The U.S. Navy has outlined its vision for the future in ...From the Sea: Preparing the Naval Service for the 21st Century. This paper develops a framework for the contributions of naval forces to the new regional defense strategy. What that paper leaves largely unsaid however, is the exact contribution of each element of U.S. naval forces. The Submarine Force, in particular, is striving to effect a smooth transition from a Cold War posture to a regional defense posture. This transition must include the specific delineation of roles and missions in order to determine the force structure, future submarine design, and institutional changes necessary to support this new strategy.

The discussion of evolving roles and missions for U.S. submarines is important for a number of reasons. First, it disproves the notion that submarines are an exclusively Cold War weapon. **The submarine is an effective weapons system for regional warfare and forward presence missions.** Second, the submarine is not solely an ASW platform. Even during the Cold War, the submarine was designed to have a multi-mission capability. Articulation and demonstration of this multi-mission capability is vital.

Roles and Missions

This articulation of the roles and missions of the Submarine Force cannot be perceived as merely a rationalizing of force structure, but rather as an honest, professional appraisal of submarine potential in the regional defense strategy. The National Military Strategy is based upon forward presence, crisis response, strategic deterrence and defense, and reconstitution. Although

these terms have been used to describe strategy in the past, their current use carries specific connotations.

The Navy probably will assume a greater share of responsibility for forward presence due to the rapid pace of ground-based force withdrawals and overseas base closures. With the declining numbers of ships in the Navy the submarine can be expected to assume a greater role in that forward presence.

The submarine has significant potential as an instrument of naval diplomacy. *[Ed. Note: See Submarine Diplomacy in the Falklands by LT Brent Ditzler in the April 1993 SUBMARINE REVIEW.]* In addition to its role in alliance building, the submarine can be used for signaling by the United States as either an independent platform capable of conducting cruise missile attacks, or as an element of an even stronger naval force, such as a Maritime Action Group (MAG) or Carrier Battle Group (CVBG). The submarine is valuable as a force multiplier for a MAG, and offers a U.S.-unique comparative advantage as a rapid response-capable forward element for a crisis response force.

The traditional dual role of the forward deployed submarine to enhance crisis response capability is especially useful for regional contingencies. This provides the operational commander with additional capabilities and significant flexibility in periods of rising tensions. The submarine's flexibility allows it to assume independent or joint roles in support of forward presence.

The submarine's unique and multiple capabilities make it a significant contributor to the national objective of crisis response. The submarine can have many roles in crisis response with the more important ones being 1) rapid response for selective strike and offense suppression, 2) joint task force and ground support, and 3) integrated strike operations. The submarine can arrive on the scene of a crisis faster than any other naval force due to its ability to conduct sustained independent high speed transits. The transit of a CVBG, on the other hand, is constrained by the slowest ship in the formation and the need to conduct periodic refueling of non-nuclear powered ships.

The ability of submarines to perform offense suppression of sea and land based threats helps the joint task force (JTF) commander in two ways. First, it can reduce the threat to follow-on U.S. forces by destruction or degradation of the adversary's capabilities. Second, it forces the adversary to divert his forces from operations against those U.S. follow-on forces to operations against the U.S.

submarines. The submarine is the ideal platform for these roles because its ability to remain undetected allows it to be inserted into a hostile region without the need for significant defensive support.

The submarine's role in joint task force and ground warfare support is complementary in nature. The submarine can be tasked with missions from either the joint task force commander or unified commander in chief (CINC), or the local battle group or naval expeditionary force commander. In both cases, this support would occur in situations where follow-on forces have arrived and established themselves in the region. Additionally, the submarine will continue its offense suppression efforts, using its ability to operate far forward. The submarine's unique capabilities also provide the operational naval forces and ground forces commanders with real-time covert intelligence that could prove invaluable to coordination and defense of follow-on forces.

In joint operations, the submarine can simultaneously support both defensive and offensive tasks as designated by the operational commander. ...From the Sea, the Navy's strategy paper, has articulated the joint missions of joint strike, joint littoral warfare, joint surveillance, and joint SEW (Space and Electronic Warfare) intelligence. These missions are supported by the submarine performing the fundamental tasks of anti-submarine warfare (ASW), anti-surface warfare (ASUW), strike, and mine and anti-mine warfare as well as the supporting tasks of special warfare, surveillance, combat search and rescue (CSAR), and intelligence collection.

The ability of the submarine to employ cruise missiles provides the operational commander with additional flexibility and strike capability. "Submarines will not replace traditional carrier aircraft heavy-strike ordnance, but submarine-launched cruise missiles could be the vanguard element that attacks air-defense, early-warning, and communications facilities to reduce the threat against follow-on aircraft."[1] These potential roles of the submarine in crisis response illustrate the applicability of the submarine to regional warfare and demonstrate that the submarine is not solely an ASW weapon.

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[1] Vice Admiral Roger F. Bacon, "Submarine Warfare - It's A-Changing", U.S. Naval Institute Proceedings, June 1992, p.53.

The submarine force has played a major role in nuclear deterrence, and that role will continue. With the recent agreements on nuclear weapons between the United States and Russia, the importance of the SSBN is growing as ICBMs are de-MIRVed and destroyed. The SSBN in this post-Cold War era will increasingly shoulder the entire burden of nuclear deterrence. One SSN role that may be unique among U.S. forces involves the ability to employ the nuclear variant of the Tomahawk cruise missile (TLAM-N). That SSN/SLCM nuclear capability appears to be well suited to deterring regional conflicts involving weapons of mass destruction.

The role of the submarine in strategic ASW has not yet changed nor should it as long as potentially hostile countries possess capable SSBN forces. Similarly, as long as the United States maintains nuclear arms control agreements with other countries, the submarine will have value as an irreplaceable national technical means (NTM) of verification.

Despite its inability to be reconstituted with 8-10 years from a standing start, the submarine is still a factor in the national objective of reconstitution. *[Ed. Note: See Submarine (Industry) Survival, by CDR Vernon Hutton in the April 1993 SUBMARINE REVIEW.]* The primary goal of reconstitution is to deter an emergent global threat. By maintaining a viable submarine industrial base and maintaining our technological advantages in undersea superiority, the submarine remains a significant contributor to this goal of deterrence. If deterrence fails, the submarine will provide a means of verifying the existence of an emergent global threat.

The submarine's unique characteristics of stealth, endurance, mobility and responsiveness as well as its multi-mission capabilities make it an important contributor to forward presence, crisis response, deterrence, and reconstitution. Table 1 summarizes these contributions.

In looking at these roles and missions for the submarine, one should realize that the hierarchy of the four foundations of the regional defense strategy is in a state of transition. During the Cold War, nuclear deterrence and forward presence were the high priorities. Now, with the focus on regional warfare, forward presence and crisis response are becoming the highest priorities. The changing emphasis for roles and missions requires a continuing reevaluation of submarine force structure and submarine

design.

TABLE 1. SUMMARY OF SUBMARINE ROLES AND MISSIONS

NATIONAL OBJECTIVE	THE SUBMARINE'S ROLE	RELATED TASKS AND/OR MISSIONS
NUCLEAR DETERRENCE and STRATEGIC DEFENSE	Strategic Nuclear Deterrence (SSBNs)	Strike Warfare against former Soviet Union using SLBMs
	Strategic Defense	ASW against SSBNs (Strategic ASW) Ocean Surveillance of SSBNs
	National Technical Means of Verification	Ocean Surveillance and Intelligence Collection to verify nuclear arms control agreements
	Regional Deterrence of Weapons of Mass Destruction	Strike Warfare against regional nuclear states using TLAM-N
FORWARD PRESENCE	Naval Diplomacy Alliance Building	Forward Deployments and Exercises Multinational Exercises Port Visits
	Enhance Crisis Response Capability	Forward Deployments and Exercises Ocean Surveillance Intelligence Collection
CRISIS RESPONSE	Rapid Response • Selective Strikes • Offensive Suppression	Anti-Submarine Warfare Anti-Surface Warfare Strike Warfare against missile facilities and airfields Mine and Anti-Mine Warfare Intelligence Collection Special Warfare
	Joint Strike Joint Littoral Warfare Joint Surveillance Joint SEW / Intelligence	Anti-Submarine Warfare Anti-Surface Warfare Mine and Anti-Mine Warfare Intelligence Collection Special Warfare Combat Search and Rescue
	Integrated Strike Operations	Strike Warfare I-SUAD
RECONSTITUTION	Deter Global Threat	Maintain Industrial Base Maintain Submarine Superiority
	Threat Identification	Intelligence Collection Ocean Surveillance

Force Structure

The issue of force structure is more contentious now than in the recent past. The debate continues in the Pentagon and in the halls of Congress. The debate over force structure, however, does not simply involve raw numbers of ships. It involves the question of how the Navy should utilize its diminishing assets. The Navy headquarters has been reorganized to respond to the changing national security situation. Similar efforts are being considered at the fleet level to better integrate a smaller Navy. These efforts have led to the strengthening of deploying battle groups by

integrating submarines into their operational organization. In addition, the ability of submarines to operate independently for fleet, JTF, and unified CINC disposal is being maintained using the current submarine organization.

The future size of the Submarine Force depends on short term and long term factors. In the short term, the concern will be how to effect the transition from Cold War force levels to regional defense force levels. The main factors that will affect the rate of force level reduction in the short term are primarily political or economic. Concerns over the effect of submarine industrial base shrinkage on local economies in New England and Virginia will be taken into consideration.

Three main factors will affect the size of the Submarine Force in the long term. Perhaps the most important of these is the submarine industrial base. Ongoing studies of this issue should determine a baseline below which submarine procurement cannot fall without affecting the viability of the industrial base. A second factor in long term Submarine Force levels will be the impact of declining resources on both the overall portion of the federal budget and the defense budget. Efforts to contain a persistent budget deficit, and consolidation of roles and missions to reduce inter-service redundancy may contribute to limiting submarine force levels. The third factor affecting long term force levels will be the input from the military, primarily based upon the requirements of the Navy and the unified CINCs.

Future Submarine Design

The issue of submarine design is currently a hot topic due to the decision to cancel the SEAWOLF submarine program. Besides the current political arguments, submarine design is important because it reflects the long term direction of the submarine force. The issue of submarine design also must be looked at from both short term and long term perspectives.

Submarine design in the short term will be affected primarily by the issue of the submarine industrial base. Since the current size of the Submarine Force exceeds existing requirements, the question of when the new submarine must be constructed will hinge on maintaining the viability of the industrial base. This time factor will determine the magnitude of change that can be included in the new submarine design.

A second related factor will be affordability. The need to

provide a submarine that is both capable and affordable is as vital as it is obvious. A third factor is the ability of the new submarine design to incorporate changes that increase the regional warfighting capability of the submarine.

These factors are distinct but interrelated. They reflect the critical short term requirement of maintaining U.S. submarine capability through the production of affordable submarines that ensure the viability of the submarine industrial base. The short term requirement is not to maintain submarine force levels which are shrinking. It is to retain a U.S. comparative advantage.

In the long term, the approach to submarine design must deflect criticism that it is stuck in the Cold War. Designers must concentrate on producing a regional warfighting submarine.

The regional warfighting submarine must have a design emphasis on those weapons that will be used in joint regional conflict. This translates into the ability to carry large numbers of cruise missiles and to fire them rapidly. Relatively few heavy torpedoes will be needed. One other consideration is the development of a proportional response weapon capable of disabling, vice destroying, vessels engaging in drug/weapon smuggling, minelaying, or piracy. *[Ed Note: See SSN's and Low Intensity Conflict by J. C. Hay in July 1990 SUBMARINE REVIEW.]*

To be an effective contributor in a regional conflict strategy, the submarine must be able to expand its battlespace and maintain contact with other forces. The current battlespace of the submarine appears to be platform limited. Further expansion of the battlespace can be done through the use of unmanned vehicles. These vehicles can be used both underwater (UUVs) or in the air (UAVs). The need for the submarine to maintain contact with other forces is paramount in this emerging era of joint integrated operations.

The submarine's best defense is its ability to remain undetected. As a result, the current stealth performance characteristics of the SEAWOLF should be maintained as a baseline, while research and development should focus on the means to maintain that performance while reducing costs.

Finally, in the rush to redirect the submarine design process towards a regional warfighting emphasis, it is important to note that the submarine always has been able to adapt to tremendous changes in the international environment. This is due to its flexibility in design. While additions were made in submarine

capability, old capabilities were maintained. The result has been a multi-mission capable platform that is flexible enough to respond to the demands of the post-Cold War world.

In designing the regional warfighting submarine of the future, there are three options to ensure that design flexibility is maintained. One is to continue current practice and design a multipurpose platform capable of operating across the spectrum of conflict. A second option is to design two classes of submarine, one to deal with the specific requirements of regional warfare, the other to maintain design flexibility and multipurpose, full warfare spectrum capability. A third option is to apply modular construction techniques to a basic submarine design.

Changing Directions

The individual issues of submarine roles and missions, force structure, and design are important and vital to the future of the submarine force. They are however, simply parts of a larger issue: **the justification of the submarine as an instrument of national security for the United States.**

Now that the Cold War is over, the focus of the defense debate is changing to the justification of specific forces. The Submarine Force has become the first subject of this debate, due to a perception of enormous procurement costs. The frame of reference for the entire submarine community has to be focused solidly on the larger justification of the submarine's contribution to U.S. national security, rather than on narrow reasons for the procurement of a particular type of submarine.

For the entire submarine community, uniformed and civilian, military and industrial, to participate fully in the ongoing defense debate, some changes will be very helpful. Declassifying some past submarine operations that demonstrate the utility of the submarine in regional warfare and crises will help to correct the misperceptions surrounding the submarine. Similarly, efforts to publicize the capabilities and missions of the submarine will help to alleviate misperceptions and strengthen the declarative role of the submarine in naval diplomacy. In addition, efforts must be made to emphasize the enormous comparative advantage that the U.S. has in submarine technology over potential adversaries. This advantage has resulted in the relative invulnerability of the U.S. submarine in regional contingencies.

Having begun to participate fully in the defense debates, it is

equally vital that the entire submarine community actively engage the Congress in the initial stages of the decision making process involving the future of the Submarine Force. This will ensure that Congress will make educated decisions concerning the future of submarines, and will also serve to develop and maintain the credibility of the submarine community in the eyes of Congress. Absent that total effort, Congress will still affect the future of the submarine force through decisions based not on the input of the submarine community but with a focus on individual issues vice long term vision. ■

REUNIONS

USS STURGEON (SSN 637) - For information about deactivation and a proposed reunion (later this year) for the Fast Attack Submarine USS STURGEON (SSN-637), please contact:

Gannon McHale
175 Pinehurst Avenue 5H
New York City 10033

USS BENJAMIN FRANKLIN (SSBN 640) November 1993 Decommissioning, Mare Island, CA. Contact:

Glen Bell
1709 Brentwood Drive
Mt. Zion, IL 62549
(217) 864-4157

USS BATON ROUGE (SSN 689) - Plankowners and Former Crewmembers are invited to attend the Inactivation Ceremony of the "Big Red Stick" at 1100, September 18, 1993; pier 21, Norfolk Naval Base. Contact:

STSC(SS) Richard A. Irelan
(804) 444-2837 or 468-3538

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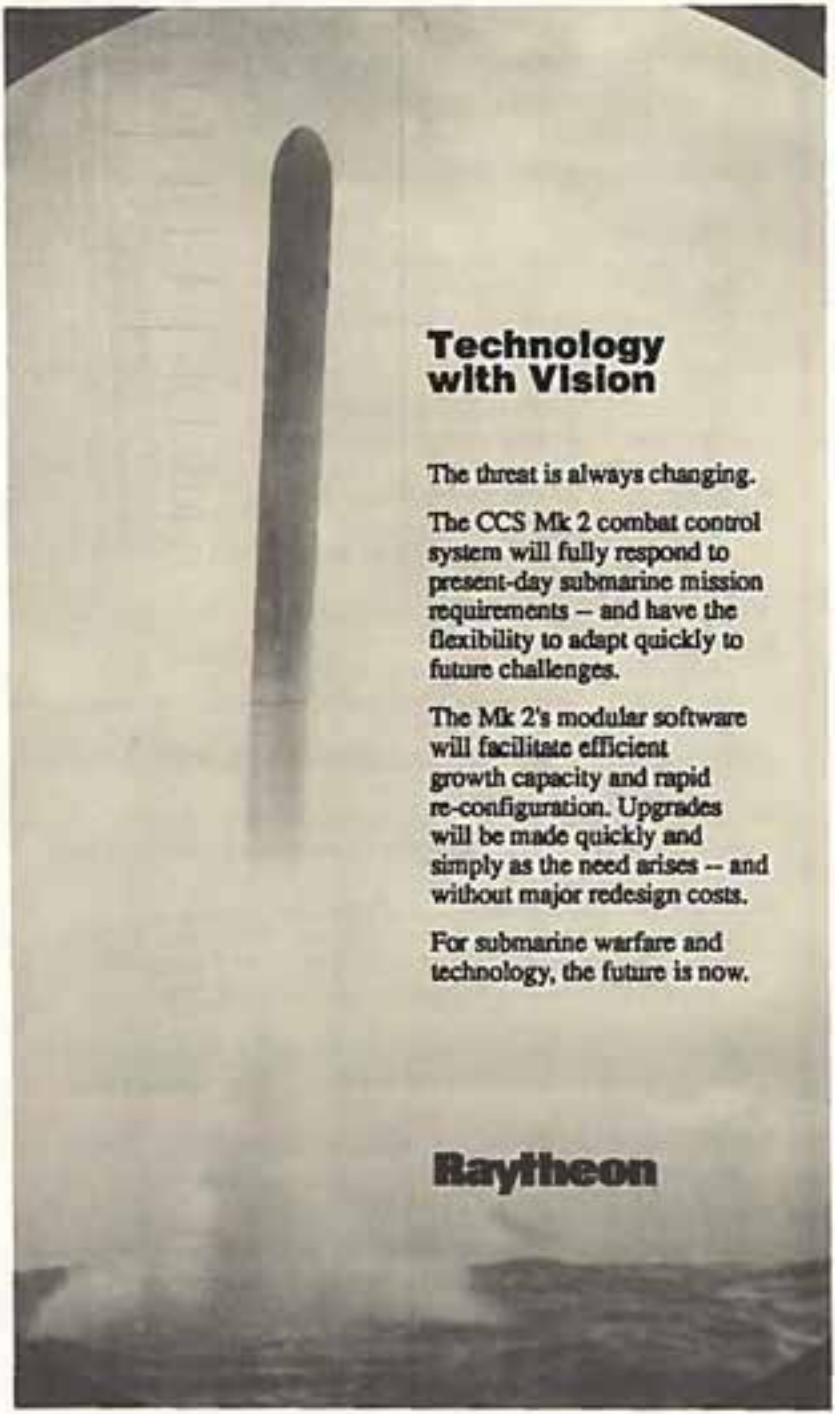
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For submarine warfare and technology, the future is now.
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CONGRATULATIONS

To the following winners of NSL Submarine Essay Contests:

- *NROTC/NSL:*
  1st Prize: Midn Paris Evans Crenshaw, III
  2nd Prize: Midn Timothy M. Sheehan
  3rd Prize: Midn Robert L. Herron

- *USNA/NSL:*
  1st Prize: Midn Joseph S. Gadzik
  2nd Prize: Midn Nubbin C. Galendez

- *USNI/NSL: LCDR Vernon Hutton, III*

- *NSL ACTIVE DUTY: LT Brent A. Ditzler*

- *NSL SUBMARINE REVIEW ARTICLES:*
  1st Prize: Jan S. Breemer
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To the following winners of the annual NSL Fleet Awards:

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  MMC(SS) Laurence M. W. Stonhill, USS TUNNY (SSN 682)
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- *Levering Smith Award for Submarine Support Achievement:*
  LCDR Steven L. Stevens, Naval Submarine Base, Pearl Harbor

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  CDR James R. Alley, USS SEAHORSE (SSN 669)

STAY ENGAGED THROUGH INNOVATION

by LCDR Michael J. Baumgartner, USN

Two questions that are implicit in the submarine debates of 1992 and 1993 are: (a) Why build submarines now that the Soviet threat is *gone*? and (b) What possible use could a platform designed to counter a Soviet nuclear powered attack submarine have in a multi-polar world? In today's austere fiscal climate, these are valid questions. Regardless of the end strength of the submarine force, they will have to be addressed. Ignoring political concerns, the answers must be based on how well the platforms fulfill current and projected military requirements. Submarines have historically satisfied enduring roles and have adapted their unique characteristics to satisfy emerging military needs as well. However, the common perception frequently supported by the media portrays the submarine as a cold war weapon of very limited modern utility. If the submarine is to remain a viable military platform in a competitive public arena, the community cannot rest on its laurels but must continue to innovatively support the demands of the national military strategy across the spectrum of conflict.

ENDURING ROLES

To establish the enduring nature of submarine roles, one need only examine past and present. On 24 June 1943, Commander, Submarines Pacific Fleet (COMSUBPAC) defined submarine precepts and missions in Operation Plan 1-43. They were:

(a) Inflict maximum damage to enemy ships and shipping by offensive patrol at focal points.

(b) Plant offensive mine fields in suitable enemy waters to destroy enemy ships and to force the enemy to adopt counter measures.

(c) Other tasks as may be required from time to time by the strategic situation, or based on intelligence which may come to hand. Such special tasks include supporting naval or land forces by attacks on shipping in threatened areas; reconnaissance; transport of troops for raids on enemy bases or installations; landing of agents for intelligence purposes in enemy held territory; evacuation of armed forces or civilians from enemy held territory; delivery of supplies to armed United States or Allied Forces; or to agents in enemy

held territory as may be necessary or desirable.[1]

On 18 January 1992, the Assistant Chief of Naval Operations for Undersea Warfare (OP-02) described future submarine roles across the spectrum of conflict.[2] That paper was presented in condensed form as the lead article in the April 1992 issue of THE SUBMARINE REVIEW. Comparison of the future roles with the precepts developed during World War II reveals missions which are, for the most part, identical. Peacetime engagement is obviously not present in both documents because of the wartime nature of the 1943 operation plan. Strategic deterrence and precision strike capabilities did not exist in 1943. Regional sea denial as stated in 1992 includes offensive mining. The bottom line is that submarine roles are enduring. They successfully contributed to the victory in World War II, the Cold War, and numerous operations in between.

The force has also been innovative. As previously mentioned, deterrence and precision strike did not exist in 1943. They also did not develop by accident. Instead, they were opportunities in which the Submarine Force employed its unique characteristics to satisfy military needs. In the case of strategic deterrence, it was the requirement to create a survivable second strike capability in order to improve the deterrent value of nuclear weapons. As a result, the nuclear powered ballistic missile submarine was conceived. In the case of precision strike, it was the need to inexpensively (measured in lives) roll back enemy defenses in support of follow-on attack. The result was the USS LOUISVILLE (SSN-724) launching Tomahawk cruise missiles in support of the Desert Storm air operation.[3] These examples emphasize what has been a consistent force strength—innovation in support of national military needs.

The Submarine Force cannot rest on its laurels, however. One might question, not being privy to classified operations or recognizing the current value of deterrence, the need to spend billions of dollars on submarines that had not fired a shot in support of U.S. operations for 45 years[4]—and then it was a cruise missile equally capable of being launched by a surface combatant or aircraft. Resting on past community achievements is a recipe for disaster. The submarine capability is based on a firm foundation of enduring roles but it must convince the doubters that it continually exercises its second strength—innovation. The force must be seen to continue its evolution in support of the National

Military Strategy. With the current fiscal climate, it must do so without requiring significant increases in funding. One area ripe for improvement through innovative and flexible application of existing submarine capabilities is mine warfare.

MINE WARFARE

> "If, in the pre-war or early war days, anyone had the temerity to suggest that the way to determine whether an area had been mined by the enemy was to send a submerged submarine on an exploratory trip through the waters concerned, he would have undoubtedly have been referred to a psychiatrist for observation." COMSUBPAC, 1947.[5]

Today, as in the days prior to World War II, one might encounter a similar reaction when discussing mine warfare and submarines in the same sentence. Yet, by the end of World War II, seven submarines (BONEFISH, CREVALE, REDFIN, RUNNER II, SEAHORSE, TINOSA, TUNNY) had mapped Japanese minefields using high frequency sonar in support of Third Fleet operations.[6] Today, submarines have the same ability to detect mines and a significant potential to clear them as well. This is another area in which the Submarine Force could use innovation and existing capabilities to shore up a neglected but vital aspect of crisis response.

Mine detection and clearance capability rests primarily on high frequency sonar for detection and divers or remote platforms for neutralization.[7] An ideal mine detection and clearance platform could be the follow-on replacements to the USS JOHN MARSHALL (SSN-611) or USS SAM HOUSTON (SSN-609). These are special operations submarines capable of carrying a detachment of SEALS and two Swimmer Delivery Vehicles (SDV). Fitted with a high frequency sonar, they would have the ability to covertly map a minefield and then employ divers to clear them. (Australian divers cleared mines in the Persian Gulf in water less than 170 feet deep.[8]) If it was desired for the submarine to stay clear of the field, a remotely piloted vehicle, such as the AN/SLQ-48 Mine Neutralization System (MNS) installed in the old communications buoy location (after modifications—the MNS is 12 feet long), could be used to allow the submarine to map and eliminate the field at distances up to a half a mile away.[9] It should be noted that, although not ideal because of space constraints, any attack submarine would have the ability to carry a detachment of

SEALS, to locate mines, and, while submerged, to deploy the divers to neutralize the mines.

The ability to map and clear mines from a submarine would have a number of advantages. First, a submarine would be covert. It would not require escorts to provide protection while engaging in mine clearance operations. This would allow escort vessels to perform some other function and would also minimize the possibility of escorts inadvertently standing into danger as occurred to both the USS TRIPOLI and the USS PRINCETON during Desert Storm.[10] Also, by being covert, there would be a high probability that the enemy would not know that the field or a lane had been cleared. This would allow maximum time before he would try to reseed it, and it would also provide maximum security with respect to the intended location of an amphibious operation.

Another advantage would be the availability of the components to support the mission. Attack submarines are trained in both minehunting and in deploying divers submerged. All boats are fitted with highly accurate navigation systems. The AN/SLQ-48 is an off-the-shelf system. The SDV capability of specialized submarines is an operationally tested and deployable system. The net result is a capability awaiting the pieces to be put together through training.

Other submarine advantages are numerous. They are self-deployable at relatively high speeds and have long endurance on station. They operate *in the environment* such that, even without a remotely piloted vehicle, they are closer to the bottom than other platforms and are therefore less affected by thermal layers and are more likely to get a stronger return from camouflaged mines.[11] Submarines are constructed to be quiet and therefore are as safe as currently possible against acoustic mines. Finally, submarine equipment is shock mounted and submarines have a very robust hull by modern standards. They have been shock tested by driving (at a specified distance) by exploding mines. (The LOS ANGELES class SSN is the last class to have been tested.) Therefore, if a mine should detonate, although severe damage might be done to the superstructure, a submarine would be far more likely to survive the experience in circumstances where another vessel would not.

There are also disadvantages to this proposal. The biggest, of course, is the possible loss of a submarine. The next biggest

would be the environmental impact of a nuclear vessel being sunk close to land. Although data exists addressing the minimal release of radioactive contamination from sunken nuclear submarines (USS THRESHER and USS SCORPION), recent nuclear disasters and the parallel that would be drawn to them would be sure to generate concern from informed world opinion. Other than the minefield (which could be mapped and neutralized from a safe distance), the threat would probably be from the air by means of a visual sighting (a black submarine contrasted against a light, sandy bottom). With respect to this threat, the only immediate options would be to evaluate the enemy anti-submarine capability and live with the risk or to restrict submarine operations. A long term solution could be a long-range unmanned undersea vehicle (UUV) operated from an SSN. The UUV could then accept the risk and perform the mission with no radioactive contamination repercussions. In the final analysis, a submarine which stays covert would circumvent this disadvantage.

Another seeming disadvantage could be the operation of nuclear submarines in shallow water. Although submarines do suffer a significant lack of maneuverability at low speeds, an inability to operate in shallow water is strictly *apparent*. Submarines are capable of submerged operations in water less than 100 feet deep. This has been admitted by RADM Holland as having been there[12] and is recorded in the account of the USS NAUTILUS arctic experience. In several instances, the NAUTILUS was recorded as having 25 feet or less clearance to the ocean floor while having 25 feet or less clearance from the sail to ice keels.[13] Submarines operate where they need to operate. However, the ability to operate in shallow water would still restrict a submarine's mine clearance effectiveness to around the 100 foot curve depending on the ocean floor gradient, the endurance of the embarked divers, and the anti-submarine threat.

When comparing the advantages to the disadvantages, the ability to covertly clear a minefield or a lane is too attractive to ignore. The availability of components to support the mission, the inherent advantages of submarines in applications greater than 100 feet, and the need of the power projection mission for this type of support make it advantageous for the submarine community to take it on.

CONCLUSION

The necessity of the Submarine Force and its capabilities are based on enduring roles. However, in today's fiscal climate, that is not good enough. The Force must continue to provide innovative and flexible solutions to emerging needs if it is to continue to justify its existence. In the past, solutions of basing nuclear missiles on deployed submarines and of developing precision strike cruise missiles filled voids in the strategic deterrence and crisis response missions and will undoubtedly continue to do so. However, the community must look to the future if it is to continue to support the national military needs across the spectrum of conflict. Mine warfare support is an option which could do so. The bottom line is, in the existing multi-polar world, the submarine community must stay engaged through innovation and flexible application of existing capabilities if it is to remain a viable, necessary force. ■

NOTES

1. U.S. Navy Dept., Submarine Operational History, World War II (Washington: 1947), I, pp.41-42.

2. U.S. Navy Dept., Submarine Roles in the 1990s and Beyond (Washington: 1992), p.19.

3. Stanley Arthur and Marvin Pokrani, "Desert Storm at Sea," U.S. Naval Institute Proceedings, May 1991. p.83.

4. Charles A. Lockwood, Sink'Em All (New York: E.P. Dutton, 1951), pp.348-349. This account credits USS TORSK as the last U.S. ship to fire a torpedo in World War II on 14 August 1945. VADM Arthur credits USS LOUISVILLE to be the first U.S. submarine to fire a shot since that time.

5. Submarine Operational History, Vol. II, p.826.

6. Ibid., pp.828-830.

7. David K. Brown, "Damn the Mines!," U.S. Naval Institute Proceedings, March 1992, p.46.

8. .G. Rankin and R.G. Smith, "Australian Divers Clear Mines," U.S. Naval Institute Proceedings, July 1991, p.74.

9. Gregory K. Hartman and Scott C. Turner, Weapons That Wait (Annapolis, Maryland: Naval Institute Press, 1991), p.315.

10. J.M. Martin, "We Still Haven't Learned," U.S. Naval Institute Proceedings, July 1991, p.64.

11. Brown, p.46.

12. W.J. Holland, Jr., "SSN: Queen of the Seas," Fundamentals of Force Planning, Vol. II (Newport, Rhode Island: Naval War College Press, 1991), p.487.

13. William R. Anderson and Clay Blair, Jr., Nautilus 90 North (New York: The World Publishing Co., 1959), pp. 155, 163, 167.

SUBMARINE FLAG OFFICER MOVES

- VICE ADMIRAL HANK CHILES - From COMSUBLANT to Deputy CinC U.S. Strategic Command, Offutt, AFB
- REAR ADMIRAL HANK MCKINNEY - From COMSUBPAC to Deputy Chief of Naval Personnel
- REAR ADMIRAL MIKE BARR - From Commander Navy Recruiting Command to COMSUBPAC
- REAR ADMIRAL GEORGE EMERY - From COMSUBGRU 5 to COMSUBLANT

PACIFIC FLEET INTEGRATED UNDERSEA SURVEILLANCE SYSTEM – A STRATEGIC PLAN

by LT. N.A. Turl, Canadian Forces

In May 1992, then Secretary of the Navy, H. Lawrence Garrett, III and the Chief of Naval Operations, Admiral Frank Kelso, II, signed the United States Navy Policy Book. This publication provides a single reference for the Navy's Vision, Building Principles and Strategic Goals.

With the spirit of that document in mind, the Executive Steering Committee of Naval Facility Whidbey Island developed, during a three day TQL Retreat, the Pacific Integrated Undersea Surveillance Systems (PACIUSS) Strategic Plan for the year 2000.

Acknowledging the enormous changes in the world social, economic and military orders that occurred in recent years, orders that are still changing, the mission of IUSS had to be changed and redefined to meet the needs of its customers, both new and prospective, head on, and to tackle the challenges posed by these changes.

Through over four decades, IUSS, under its almost unparalleled cloak of secrecy, was vigilant in identifying and reporting submarines, naval surface vessels and aircraft to various fleet users. The needs of these customers were defined by the Cold War. As the Eastern Bloc dissolved and the Soviet Union was apparently not going to last, the role of IUSS was momentarily uncertain. The alleged disappearance of the traditional threat brought new attention to the long ignored potential threat posed by the quite extraordinary numbers of Rest of the World submarines. Many nations own and/or are building diesel submarines and are operating them in areas of U.S. and Allied concern where regional conflict is a real and ever-present danger. The potential threat posed by these combatants has been known but not as aggressively pursued as the threat posed by nuclear powered units. The role and mission of IUSS had to change to provide the best service to its customers, now concerned about the "new" threat. In addition to the technological and operational changes occurring to the System to meet the diesel threat, IUSS has recruited many new customers providing us with many non-traditional roles such as scientific research and law enforcement. These new roles have only recently been identified and are providing new and exciting challenges to the men and women in IUSS.

As our vigilance in both our traditional and newer roles

continues, the Strategic Plan and Goals, incorporated into System-wide use, provides a more focused framework than the USN Policy Book for our daily operations.

Our Vision

The PACIUSS will remain the world's premier initial cuing network for submarines in a potentially hostile global maritime environment. It will employ a high quality flexible force designed to meet a variety of the most likely contingencies. No submarine commander in the Pacific theater of operations will be able to operate without threat of imminent detection by PACIUSS.

In order to respond to the volatile and unpredictable nature of the world-wide threat, the PACIUSS must provide deterrence through highly effective tactical cuing. In an environment of increasingly limited manpower and fiscal resources, this will be accomplished by consolidating naval facilities while retaining system flexibility and redundancy. We will continue to work toward commonality, more secure facilities, and more reliable communications.

We will continue to develop systems and procedures which will provide information in form, accuracy and timeliness specified by our customers.

These and other supporting services, including operations, training, maintenance, logistics, administrative and fiscal support will be of a uniformly high quality because our leadership accepts responsibility for continuous improvement.

Our Goals

- Evolve into a strategic deterrent to potential adversaries
- Provide global, tactical cuing
- Broaden application of existing passive/active acoustic capability
- Achieve total commonality with operating forces
- Meet user needs and requirements
- Improve communications
- Maximize employment of resources

With the Strategic Plan and Goals in the forefront of our collective mind, the men and women of IUSS are meeting the challenges posed by the phenomenal changes that have confronted us in recent times and are meeting the needs of their new customers with unparalleled enthusiasm and efficiency. ■

AIR-INDEPENDENT SUBMARINE PROPULSION
A Historical Perspective from Walter to Stirling

By Dick L. Bloomquist
Naval Surface Warfare Center
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Since the TURTLE, Navies have explored power and energy systems aimed at extending the submerged endurance of submarines. These efforts include advanced battery technology, "closed cycle" engines, fuel cells, and nuclear power. The current potential market for superior performance in new and backfit submarine construction has prompted extensive foreign R&D on these Air Independent Propulsion (AIP) technologies. With reduced new construction there is a potential market for retrofitting existing conventional submarines for improved endurance and for use by Third World countries. The AIP technologies are also applicable to swimmer delivery vehicles and autonomous or unmanned underwater vehicles. This review presents the historical background of these technologies and briefly discusses several recent applications.

Introduction

The requirement to increase the submerged endurance of submarines was recognized in World War I, and has long been a goal of designers and operators alike. The idea for an air independent diesel engine started as early as 1901 in Germany. AIP is the production of power by the conversion of energy through combustion or chemical reaction without the use of air. Professor H.G. Walter began experiments in 1937 using hydrogen peroxide as an oxygen source. Damiler Benz (in an independent effort from Walter's) started the modification of several 1400 to 1500 horsepower diesel engines[1] for closed cycle operation in 1938. The Third Reich was the first to operate an AIP equipped submarine in 1940. Today this work is readily recognized in the submarine technology community as the Walter cycle turbine engine submarines.

There has been a renewed interest in AIP in the last decade for the application to the conventional and midget submarine. The latter includes manned and unmanned submersibles, most notably swimmer delivery vehicles, remotely operated vehicles, and tourist submersibles. This interest has been driven by the limitations of

batteries and nuclear power, and the potential for new business in new construction and overhaul. Companies, shipyards and countries are competing for the export market. A demonstrated submarine AIP capability may determine the successful bidder in a competitive environment; e.g., Kockums versus HDW for the Australian submarine contract. Today there is similar posturing for the potential Canadian submarine business. Sager[2] in 1990 projected a market potential of conventional submarine construction world wide for the decade of the '90s to be 100. Many of the countries he surveyed do not need the virtually unlimited submerged time as provided by the SSN, or cannot use nuclear power. Today Sager's forecast appears very optimistic due to the decline in world economics, and the realization of the cost of a submarine program versus the cost of a more defensive maritime posture. Baker[3] reported in 1991 that new submarines and new technologies will not proliferate at the rate predicted in many popular press treatments. The current geopolitical environment includes a focus on limited intensity conflict and regional warfare. This environment and the world economics have increased the interest in swimmer delivery vehicles and the midget submarine because of lower cost and tactical impact. This may be an incentive to Third World countries to buy or develop AIP systems.

At present we are experiencing *glasnost* and learning more each day about Soviet technology much like we did after 1945 in Germany. However, don't expect a similar type of resurgence of AIP interest or development as happened in 1945 due to this new access to Soviet technology. Since the advent of nuclear power, the requirements for an AIP system have changed, and the Soviet AIP technology may not be as revolutionary as the German technology was in 1945.

The following sections review the several AIP developments noting the status of development or availability of the candidate systems and associated technologies. The Swedish Stirling engine system now has been demonstrated operationally for three years. The success has resulted in a contract for three A19, GOTLAND class submarines with a fully integrated Stirling engine AIP system. Other AIP systems are well along in the development process but national economics (e.g., Germany and Dutch) have slowed most if not all of these projects.

Background

This background will help document the chronology and history of AIP technology. This historical summary is especially interesting when comparing today's developments with the high relative power levels and the high number of development projects in Germany from 1938 to 1945. Many of these old systems[4] are similar to today's without the benefit of advanced materials, sensors and computer control systems.

The German development included both closed cycle reciprocating engines and turbines; Kreislauf and Walter systems. The reciprocating engine projects included at least six known test beds ranging to 1500 horsepower. These engines used the Kreislauf engine modifications and auxiliary components to change from surface or snorkel operation to air independent or closed cycle operation. Cryogenic oxygen, LOX, was stored internally or as a high pressure gas (6000 psi) externally. External hydrogen peroxide storage was also in development. The peroxide was 80 percent concentration and was catalytically decomposed in an auxiliary component, or was directly injected (tried but never adopted for diesel engines). The Walter turbine design was selected for the higher horsepower and higher speed applications.

A prototype submarine, the V80, was completed in 1940, but AIP development proceeded slowly and it was not until 1943 that much work was done on the Type 17. The Type 26 was to be the main operational design but development was then too late for the Germans to complete and produce in sufficient numbers. They concentrated instead on the Type 21; the Walter designed hull for high submerged speed and conventional propulsion machinery.[5]

Walter's laboratory in Keil was inspected in 1945 and a complete submarine turbine propulsion unit of about 2000 horsepower was found intact with a partially completed unit for 6260 horsepower and the necessary ancillary test rigs, workshops and laboratories. This inspection was significant in learning the development status of applications using hydrogen peroxide which included submarine and torpedo propulsion, launching of V1s, and jet propulsion engines. It was also learned that much of the original German work on the snorkel had taken place there.

The valuable experience gained from these early German AIP efforts was transferred to the U.S., UK and the Soviets at the end of the war. The U.S. continued engine development at the Navy's Annapolis laboratory after the war until the mid 1950s.[6] Six new

power plants were in development at that time, including the first nuclear power system.

The Kreislauf diesel engine using hydrogen peroxide was also under development by the Japanese during World War II. By December 1944 they were building a hydrogen peroxide turbine powered "manned suicide torpedo", the KAITEN 2 and 4. A similar design was also being build using liquid oxygen.

The U.S. Navy operationally demonstrated a diesel engine system using hydrogen peroxide and diesel fuel on a dry swimmer delivery vehicle, the USS X-1, commissioned in 1956.[7] In 1958 she was classified "Out-of-Service, In-Reserve" due to a hydrogen peroxide leak and explosion. She was later refitted with a conventional diesel electric system and served as a research vessel until 1973 when she was retired.

The UK continued the Walter cycle turbine development and commissioned two submarines in 1956 and 1958, the EXCALIBUR and the EXPLORER (commonly called the "exploders"). These systems were experimental and were removed from service in 1963 due to a continuing problem with hydrogen peroxide leaks and fires. Most of the AIP work both in the U.S. and the UK was terminated to focus all development on the nuclear program.

The Soviets also experimented with the German technology and may have modified several M class submarines (250 ton) with a Kreislauf cycle diesel using liquid oxygen in the early 1950s.[8] This system recycled engine exhaust gases into the engine after removing the carbon dioxide with a soda lime absorber. This development continued and several of the QUEBEC class (750 ton) were originally fitted with this system on the center shaft. These submarines (lead ship launched in 1954) were called cigarette lighters or Zippos because of the explosions attributed to the AIP systems. The Soviet interest in AIP continued in parallel with nuclear propulsion development into the 1960s. The WHALE, a 1500 ton, 250 foot long submarine was outfitted with a Walter cycle hydrogen peroxide system from 1956 to 1961. There is speculation that AIP demonstrations were planned for a WHISKEY, ZULU, FOXTROT, the JULIETT cruise missile submarine, and the KILO.[9] [10] AIP was also being considered to augment nuclear systems as power boosters for high speed sprint operations. Lack of hard evidence indicates these demonstrations were not very successful.

During the 1960s there were several U.S. reviews of power

systems which provided the guidance and direction for R&D efforts of advanced non-nuclear and non-weapon (torpedo) systems; deeper diving submarines and submersibles. For 25 years the recommendations of these efforts received very little funding due to the focus on nuclear power. The exception was the development in the 1970s and 1980s of the closed Brayton cycle engine with a Li/SF_6 combustor. The laboratory development of this type molten lithium system was first reported by Phillips Research Laboratories around 1970 in the Netherlands.

The interest in non-nuclear power systems was renewed in the 1970s in the UK, Germany, Italy, Japan and Sweden in response to requirements in both the commercial (offshore oil) and submarine requirements. In 1970, Riccardo, a British company, worked on a 36 horsepower Perkins diesel engine as a diver power package.[11] In 1972 the Japanese company Hitachi worked on a recycle Perkins engine. Several U.S. patents were granted during the period from 1960 to 1980 but many did not have any experimental follow up. S.S.O.S. of Italy was granted a U.S. patent[12] in 1981 and subsequently demonstrated this approach in their Phoenix Project. Their PH 1350 vehicle used a 100kW closed cycle diesel engine operating on diesel fuel, oxygen and recycled exhaust. The foreign military requirements were for small coastal patrol submarines for which nuclear power was not available or affordable. Also recognized was the growing potential market for submarine export sales as reported in the U.S. Naval Institute Proceedings.[13]

Emerging Technologies

It is not possible to recommend or suggest a preferred AIP technology considering the variety of applications and the varying stages of development. The candidate systems NOT noted below are either in early stages of development or have been eliminated as not having serious potential.

Many developments were previously noted to have roots in Germany. Today's developments do not include any references on the German hydrogen peroxide systems for oxidant storage so important in the 1940s and 1950s. The safety problems appear to have eliminated the use of high test peroxide, HTP, >65 percent concentration, as a viable oxidant candidate.

Proton Exchange Membrane (PEM) Fuel Cell. This type of fuel cell is capable of operation on reformed methanol or sulfur

free diesel fuel, thereby considerably reducing the weight and volume required for energy storage. They can also be operated on air during surface transit, thereby saving oxygen for submerged operations. The results of the fuel cell prototyping effort in Germany are significant. The high cost, and the risk in power scaling for total propulsion power, are current limitations. The technology has considerable promise.

Stirling Engine. Two V4-275R engines are currently completing the third year of an operational evaluation aboard the Swedish submarine NACKEN. This engine design has also been demonstrated at high pressure and venting exhaust overboard reduces the size, weight and power requirements of an exhaust gas management system. A bubble trail is likely at very shallow depths. Multiple engines are required for higher power levels due to the limited available engine power, 75 kW. High structurborne noise, inherent to reciprocating engines and compressors, requires dampening for quiet operation.

Closed Cycle Diesel. These systems have been the subject of considerable and successful development for power levels to 500 kW. The system derives significant benefit from the advanced state of development of diesel engine technology and the variety of engines available. The engines have high structurborne noise levels. The major limitation is the large, noisy, and power intensive exhaust processing system for scrubbing and pressurizing for onboard storage or overboard discharge.

The submarine or submersible application of these candidate AIP systems is determined by the three major design factors. These are in addition to the mission requirements: system safety, stealth, cost, technology risk, etc. The design factors are:

1. The creative integration of the oxidant and fuel storage weight and volume into the submarine (e.g., using hydrides for both hydrogen storage and ballast).
2. The power capability of the energy converter or multiples thereof (suitable for auxiliary or total propulsion power; a surveillance or trailing mission requirement).
3. The exhaust system requirements (size, weight, power, etc.).

The potential of AIP use in the near term is high for midget submarines and submersibles. The potential for use on submarines is less for auxiliary power (>200 kW) and low for total propulsion power (>500 kW). The potential of the hybrid or auxiliary

power concept and backfitting is the highest potential. ■

LIST OF REFERENCES

1. R.W. Reynolds, "Kriesiauf (closed cycle) System on Damiler-Benz, Model MB-501c, Diesel Engine," U.S. Naval Engineering Experiment Station, Report 866/47, Annapolis, MD, 11 March 1948.

2. Hans Sager, "Submarines Made in Germany, Designs, Markets, and Trends," International Conference on Submarine Systems, Stockholm, May 9, 1990; and personal communication, 1991.

3. Arthur P. Baker, III, "The Third World Submarine Threat (U)," Proceedings of the Fourth Submarine Technology Symposium, The Johns Hopkins University Applied Physics Laboratory, Laurel, MD, 7-9 May 1991 SECRET/NOFORN.

4. Emil Kurska, Eberhard Rossler, and J.F. Lehmanns Verlag, Walter U-Boote, Munich, 1969.

5. C.M. Hall, et.al., "Report on Visit to H. Walter Kommanditgesellschaft Kiel to Investigate Underwater Propulsion of Submarines," (Unpublished Team Report), June/July 1945.

6. J.H. Reinertson, L.E. Alsager and T. Morley, "The Submarine Propulsion Plant Development and Prospects," Naval Engineers Journal, May 1963.

7. Richard Boyle, "USS X-1 Power Plant, 1956-57," Naval Engineers Journal, April 1972.

8. M. Voyenzidat, Underwater Mosquitos, 1969. (A Soviet book on midget submarines, their development and military use.)

9. Jan Breemer, Soviet Submarines, Design, Development and Tactics, Jane's Information Group, 1989.

10. Norman Polmar, "Soviet Closed Cycle Submarines," The Submarine Review, July 1990, p.80-83.

11. J.R. Pattick, "Recycle Diesel Underwater Power Plants," Ricardo & Co., Ltd SAE 710827, October 1971.

12. U.S. Patent 4,286,565 Sep 1, 1981 (filed Jun 30, 1979) Giunio G. Santi, assigned Sub Sea Oil Services S.p.A. Milan, Italy.

13. J. Fitzgerald, and J. Benedict, "There is a Sub Threat," Proceedings, August 1990.

SUBGUIDE: DOWN TO ONE NUCLEAR SHIPYARD

by Norman Polmar

As U.S. political, military, and industrial leaders debate the possibility of going to only one nuclear-capable shipyard, that decision has already been reached in Russia. The government of the Russian Federation had decided that in the future all nuclear propelled submarine construction—and probably aircraft carrier building—will take place at Severodvinsk. Recently given the name *Sevmash* and more formerly known as the Northern Machine Building Construction Enterprise Production Association, the Severodvinsk shipyard No. 402 is the world's largest submarine construction yard and the world's northernmost major industrial facility.

Russian President Boris Yeltsen announced in November 1992 that nuclear submarine construction now taking place at four Russian yards would be concentrated at Severodvinsk. The three other nuclear-capable submarine yards are the combined Admiralty-Sudomekh yard in St. Petersburg (formerly Leningrad); the Krasnoye Sormovo yard at Nizhny Novgorod (formerly Gor'kiy), some 200 miles east of Moscow; and the Komsomol'sk yard in the Far East, about 280 miles south of the mouth of the Amur River.

Further, Russian officials have told the author that with the breakup of the Soviet Union and because the carrier-building yard at Nikolayev South is located in Ukraine, future carrier construction would probably take place at Severodvinsk. However, the Baltic shipyard in St. Petersburg, which has built the four 28,000 ton, nuclear-propelled cruisers of the KIROV class, could possibly be enlarged for carrier work.

Also, it is likely that non-nuclear submarine construction (currently the Kilo class) will continue at Admiralty-Sudomekh. Current Russian planning is for a minimum of two Kilos per year, one for the Russian Navy and one for foreign sale.

A town was founded at Severodvinsk about 1750; there had been a monastery on the site since some 350 years before that. A major shipyard was begun in the early 1930s to help make the Northern Fleet independent of the shipyards in the Baltic and Black Sea areas. The yard's remote location was also chosen to reduce the vulnerability to enemy attack in time of war.

The yard is located on the banks of Nikolskoye Ustye in the delta of the Northern Dvina River, about 30 miles across the delta

from the city of Arkhangel'sk (located to the east). The river opens onto the White Sea. The yard is connected to St. Petersburg by the White Sea-Baltic Canal system, completed in 1933, as well as by rail lines. (The canal has permitted nuclear attack submarines built at Leningrad/St. Petersburg to be moved to Severodvinsk for completion and trials.) After World War II a highway was constructed to permit road traffic between Severodvinsk-Arkhangel'sk and Moscow.

As part of Soviet dictator Josef Stalin's plan to build a big ship navy, the original building hall at Severodvinsk was to permit the simultaneous, side-by-side construction of two battleships. (A similar facility was erected at that time at Komsomol'sk in the Far East.)

An estimated 120,000 political and criminal prisoners were brought to the Severodvinsk in the 1930s to construct the shipyard and adjacent facilities. The yard, officially founded about 1938, was initially known as the Molotovsk yard for V.M. Molotov, a leading politician and diplomat in Stalin's regime. (The name was changed in 1957 after Molotov fell from favor in the post-Stalin era.)

Stalin had envisioned the yard becoming the largest in the world. The eventual work force when the yard was completed was projected to be 35,000 to 40,000 men and women. The building of the yard was, to quote a recent Soviet article,

> "Great and tragic. Thousands of boys and girls who considered it their duty to contribute to strengthening the country's defense capability gathered on the marshy banks of the Northern Dvina. Here under the stern gaze of the escort, GULAG [prison camp] victims built roads across the marshes and erected the building that housed the first ships. Here during the Great Patriotic War [1941-1945] children manned the machine tools, replacing their fathers who had gone to the front."[1]

The main building dock, now known as hall No. 50, was erected under cover to permit work to be carried on year round despite the arduous weather of the region. This original building dock measures some 1,100 feet in length and 452 feet in width to permit the construction of two SOVETSKIY SOYUZ class battleships. One of these ships was laid down at Severodvinsk in November 1939, being named SOVETSKAYA BELORUSSIYA; possibly, albeit unlikely, a second of the dreadnoughts was also

begun at the yard. The components and materials for the ships were brought to Severodvinsk from shipyards and factories in Leningrad and Nikolayev.

But all work on capital ships in the Soviet Union ceased in October 1940 as shipyards were directed to emphasize turning out smaller combat ships and craft.

The first submarines to be completed at the Molotovsk/Severodvinsk yard were the L-20 and L-22, begun at the Baltic/Ordzhonikidze yard in Leningrad, but after World War II began they were moved via the inland river-canal system to the new Arctic yard. The L-20 was completed in September 1942 and the L-22 in August 1942. In addition, three submarines of the S class that had been built at Leningrad and Gor'kiy were brought to Severodvinsk through the canal-river system for completion and fitting out. Destroyers were begun at the Severodvinsk yard during the war, but none was completed until after the conflict had ended. During World War II the yard had a peak work force of about 5,000 men, women, and children.

Subsequently, the yard began the construction of surface warships of the postwar programs—SVERDLOV class light cruisers and SKORYY class destroyers. Two of the graceful but already obsolete 17,200 ton cruisers were constructed, the MOLOTOVSK (later renamed OKTYABRSKAYA REVOLUTSIYA) and the MURMANSK, and 18 of the 3,100 ton SKORYYs.

More consequential, the Severodvinsk yard made preparations to construct advanced submarines and in 1953 completed the first of eight Zulu class (Project 611) diesel attack submarines built at the yard. Three Foxtrot class (Project 641) diesel submarines were also built at Severodvinsk (most of that large class was constructed at the Sudomekh yard in Leningrad). In this period the Severodvinsk yard also produced 16 of the 23 Golf (Project 629) diesel-electric ballistic missile submarines. These were the last conventional submarines build at Severodvinsk, after which the yard produced only nuclear-propelled undersea craft. Significantly, the yard did not participate in the massive Whisky (Project 613) submarine program, in which 215 submarines (plus sections for 21 assembled in China) were completed at four shipyards between 1950 and 1957.[2]

Preparations to construct the first nuclear submarine began at Severdovinsk in 1953—a year after the first U.S. nuclear submarine, NAUTILUS (SSN-571), was laid down. The lead November

class SSN (Project 627) was begun at Severodvinsk in 1954 and completed in 1958, four years after NAUTILUS. The Severodvinsk yard built all 13 of the November class SSNs, the last unit going to sea in 1964.

Lagging slightly behind the November SSNs were two other nuclear submarine classes built in this same period at Severodvinsk, the Hotel ballistic missile submarine (SSBN Project 658) and the Echo II guided or cruise missile submarine (SSGN Project 675M). Severodvinsk built 16 of the Echo II class SSGNs (the other 13 and the five Echo I SSGNs were built at Komsomol'sk).

Production of the Hotel SSGN class was halted prematurely. Only eight units were built at Severodvinsk; they were completed between 1959 and 1962. Soviet leader Nikita Khrushchev ordered a halt to work on ballistic missile submarines in 1959-1960 when he established the Strategic Rocket Forces (SRF) as a separate service with full responsibility for the country's nuclear missiles.

It is likely, had Hotel SSBN construction continued, that additional units would have been build at Komsomol'sk; indeed, one U.S. intelligence analyst had posited that the five Echo I SSGNs built at Komsomol'sk had been intended for another configuration, probably Hotel SSBNs, "and converted during late design or early construction stages to a cruise missile submarine" as the Echo I design.[3] Also, there may have been a cutback in the Hotel program as details of the more advanced U.S. Polaris SSBN design became available and the Soviet leadership realized that their design was already far outdated by its American counterpart.

Subsequently the Severodvinsk yard became the principal SSBN building yard, producing most of the Yankee and Delta SSBNs (Project 667 variants), and the six giant Typhoon SSBNs (Project 941). Although the yard shared Yankee and Delta I class SSBN construction with Komsomol'sk in the Far East, beginning with the first Delta II class SSBN which was completed in 1974, all strategic/ballistic missile submarine building has been carried out at Severodvinsk because of the shallow depths of the Amur River. Accordingly, Severodvinsk has build all of the Delta II/III/IV and Typhoon submarines.

Also built at Severodvinsk were the single Papa (Project 661) and all Oscar (Project 949) cruise missile submarines; three of the advanced technology Alfa (Project 705) SSNs; and the one-of-a-kind Mike SSN (Project 945). With closing of the Krasnoye

Sormovo yard, construction of the Sierra SSN was also initiated at Severodvinsk. In addition, those nuclear submarines built at Admiralty/Sudomekh in Leningrad and at Gor'kiy were moved on transporter docks through the inland waterway system to Severodvinsk for completion and sea trials. There appear to be separate fitting-out areas for the submarines produced by those yards.

The battleship building hall begun in the early 1930s has been supplemented by two other large submarine construction halls. The original facility, generally referred to as building Hall No. 1, built the November, Hotel, Yankee, and Delta submarines; Hall No. 2, about 1,100 yards north of the older hall, was used to construct the Golf SSBs and was then upgraded for the advanced technology (titanium hull) Alfa, Papa, and Mike programs. Hall No. 3, adjacent to No. 1, produced the large Typhoon SSBNs and Oscar SSGNs. These halls are fully enclosed and heated for year round work, and all undertake horizontal construction. Hall No. 2 has special atmosphere welding areas for working with titanium.

The submarine repair and overhaul portion of the Severodvinsk yard is located on the adjacent island of Zaganay and is known as the Little Star shipyard. This is where the major conversions of Yankee SSGNs to attack (SSN) and cruise missile (SSGN) configurations as well as submarine overhaul work is undertaken.

Some commercial ship work was done at the yard into the 1950s, although details are unknown. Like other Soviet military industrial facilities, Severodvinsk has long produced consumer goods, mostly for local consumption. According to Soviet data, 20 years ago the yard produced approximately 2 million rubles' worth of consumer goods; today its output is tallied at over 30 million rubles (calculated for Soviet-era rubles, i.e., just over one dollar per ruble). This effort includes upholstered and kitchen furniture, gas stoves and other kitchen equipment, sports and physical training equipment, garden buildings, and vacuum boilers for processing animal wastes.

The yard has also built commercial excursion submarines called IKHTIANDR and NEPTUNE for the tourist trade, with a 20 year contract having been signed with an Italian firm for producing several more tourist submarines for operations in the Caribbean. Also under construction at Severodvinsk are several ore-carrying barges for a Dutch firm.

While some commercial work will continue, surface warships and submarines will be the yard's primary products. Yu. I.

Soldatov, a deputy chief of the Ministry of Shipbuilding Industry, has said,

> "This plant is now fully adapted to the output of nuclear submarines, as they say, 24-hour and very large-scale output. To change its profile would cost billions, and this is not permissible because the shipbuilding production base would be almost completely undermined."[4]

Still, construction at the yard has slowed. Soldatov has noted that some of the submarines are not being worked on, while sections for new submarines are not being assembled;

> "The hull processing shop, which is capable of handling many thousands of tons of metal per year, today processes half as much as before... There is less than a year's work left for the assembly and welding shop."

Meanwhile, the Zaganay/Little Star facility appears to be heavily engaged in defueling older nuclear submarines and preparing them for scrapping, an effort that will provide considerable work for the foreseeable future.

The current employment of the yard is not publicly known. However, the yard is the principal employer for Severodvinsk's population of 280,000 while the yard uses components produced throughout European Russia as well as procuring material from more than 1,000 firms in Ukraine, Moldova, and the Baltic and Transcaucasus states.[5]

Mention of Severdovinsk has rarely appeared in the Western press or military journals. Admiral H.G. Rickover, USN, longtime head of the U.S. Navy's nuclear propulsion program, had often cited the yard in his testimony before Congress as having more nuclear submarine building capacity than all U.S. shipyards combined. But the lack of discussion of Severdovinsk in the Western press obscures the fact that it remains the largest nuclear submarine yard in the world, easily exceeding the combined capacity of the two yards that still build such craft in the United States, Newport News Shipbuilding in Virginia, and General Dynamics/Electric Boat in Groton, Connecticut.

According to the head of the Russian Navy's Shipbuilding Directorate, Vice Admiral Veniamin Polyanksiy:

> "Severodvinsk...is today not just the most advanced Russian plant in this specialist area, but also the enterprise that has achieved the lowest prime cost for nuclear-powered vessels. In terms of the level of its equipment, *Sevmash* is on par with and

in some respects is ahead of similar plants in the United States and Europe. For example, the degree of mechanization of hull assembly and welding work at *Sevmash* is 97 percent, which is at present out of the reach of any other shipyard in the world."[6] ■

NOTES

1. Capt. 3rd Rank Uy. Gladkevich, "How Nuclear Submarines Originate," Krasnaya Zvezda (29 June 1991), p.4.

2. The Whiskeys were built at Gor'kiy, Nikolayev (south), Komsomol'sk, and the Baltic shipyards. Details of these and other Soviet submarine programs are provided in N. Polmar and J.S. Noot, Submarines of the Russian and Soviet Navies, 1718-1900 (Annapolis, Md.: Naval Institute Press, 1991)

3. John T. Funkhouser, "Soviet Carrier Strategy, "U.S. Naval Institute Proceedings (December 1973, p.30.

4. Gladkevich, op. cit.

5. Andrey Naryshkin, "Where the Submarines Are Produced," Rossiyskiye Vesti (20 November 1992), p.3.

6. Naryshkin, op. cit.

THE PERSONAL COMPUTER AND SUBMARINE ON BOARD TRAINING

By LCDR Charles Church, USN
and LT Tim Allen, USN
Director and Project Coordinator of
Submarine On Board Training

Submariners believe in training. Tactical and technical training for officers and enlisted, damage control, firefighting, and more are provided at submarine training facilities. But training doesn't stop when the submariner steps aboard ship. On the job training which includes duty section, officer, team, and general military training (GMT) are all important. The Submarine On Board Training (SOBT) Office at Commander, Submarine Group TWO is the fleet manager of training products intended to make on board training easier, better and more interesting. The training products include self study workbooks, video and audio tapes, slides and computer based training (CBT).

CBT is a fairly new medium for submarine on board training. SOBT has fielded products in combat systems, navigation, team training and submarine qualifications areas with increasing degrees of sophistication.

The first product distributed to submarines in 1989 was the Rules of the Nautical Road CBT, a program produced by Naval Education and Training Personnel Management Support Activity (NETPMSA). This training uses color and some animation. The program forces the student to interact with the subject which was a change of pace from the passive mode of paper-based training. While the state-of-the-art of CBT has advanced since this was made, it is currently the most popular SOBT program.

The first CBT produced by SOBT was Mental Target Motion Analysis (TMA) Techniques. This teaches fire control symbology, bearing theory, line of sight computation including mentally computed bearing and range rates, different ranging techniques, and torpedo geometry computations. Mental TMA has a small amount of simulation to help the student understand difficult relative motion concepts, good graphics presentations, and extensive drill and practice sections for each training area. This training was focused on officers but is also valuable training for sonar technicians, fire control technicians, quartermasters, and contact coordinators.

Produced by USS INDIANAPOLIS in response to the need for on board attack party training, the INDY personal computer based simulation/stimulation provides the AN/BQQ-5 or AN/BQQ-6 sonar systems with a single towed array contact, allowing the entire combat team to train in prosecuting sonar contacts. Besides costing the Navy virtually nothing, INDY has filled a real need.

The RAY program, written by CDR John Fisher (former Commanding Officer of USS RAY), allows the personal computer to simulate the sonar system broadband display. This has been used for training a variety of personnel. For example, to keep his engineering officers of the watch (EOOW) current in forward watchstanding, CDR Kevin Leahy, Commanding Officer of USS ARCHERFISH, used this program to test off-going EOOWs on interpretation of the broadband display to safely come to periscope depth.

The Mk48 ADCAP Post Launch Trainer is in production for distribution in 1994. The program allows the personal computer to simulate the Mk81-2 Weapon Control Console in a post launch situation. This feature allows the operator to train on how to best employ the Mk48 ADCAP torpedo. The software uses data collected from actual firings and has embedded tutorials.

Combining a computer with a video disc player has allowed video and computer software to be integrated into a more effective training package. Using this technology, Cruise Missiles Project fielded a system called Tomahawk Interactive Learning Center (TILC) that teaches loading, handling, physical and operational characteristics, employment and maintenance of cruise missiles with full motion video to enhance understanding and sustain interest. The TILC uses a 80286 based PC, a touch screen and a laser disc. The training is well received by those who use it, but the system in general did not receive much use at first. This is because systems were initially installed in training centers and submarine group and squadron offices. This meant the sailor had to find time to leave the ship to complete the training courseware.

Recently, TILC systems were placed aboard three submarines (with all available courseware) to determine if easy access to the system would increase usage. During the evaluation, the system received extensive use under a variety of shipboard conditions. "The average user found the system easy to operate and the software provided to be educational and entertaining", said CDR Bruce Miller, Commanding Officer of USS CITY OF CORPUS

CHRISTI. "Users were primarily TMs, FTs, and officers, but other ratings such as QMs and MMs demonstrated an interest as well." Current plans are to distribute this system packaged with a CD-ROM player to all Tomahawk capable submarines on a voluntary basis.

Trident submarines are now being issued computer systems to enhance qualifications training for new personnel. Sponsored by NAVSEA (PMS-396), Trident Interactive Courseware Training Systems (ICWTS) come with 44 lessons on 39 laser discs. Each lesson represents an individual subject area as defined by the Enlisted Requirements for Submarine Qualification (COMSUBLANT/COMSUBPACINST 1552.16A). This training system has made available a pool of knowledge and testing from all Tridents, standardized the knowledge presented, and provided a single source of information for a trainee. "It has become a vital part of both the initiation of newly reported officers and the enlisted submarine qualification program", exclaimed CAPT Richard D. Raaz of USS GEORGIA (BLUE).

In response to requests from submarines, SOBT is producing two new computer based courses on Division Officer of the Watch and Submarine Surfaced Shiphandling. These will present technical training on the dynamics of submarine maneuvering and depth control, and will offer drill and practice on these watch-standing skills tailored to SSN 637, SSN 688, or SSBN 726 classes.

SOBT is also cooperating with Program Executive Officer, Ships Defense (PEO-417T) to produce a number of electronic warfare computer based courses on employment and maintenance of specific submarine ESM equipment and suites. These products will help increase submarine ETs' proficiency in an area which is receiving increasing emphasis.

What's in the future? As one example, Newport News Shipyard has developed a SSN 688 class Auxiliary Machinery Room (AMR) Watchstation Course which allows the trainee to *tour* the AMR on the computer screen, using multiple stored video images of the AMR to learn equipment layout and watchstanding. This virtual reality approach has been evaluated by Newport News Shipbuilding and is shown to significantly increase task knowledge and skills within a short time, especially for those with little or no previous experience. This course at present requires specialized computer hardware to play. SOBT is evaluating the need to

distribute the computer hardware or modify the courseware to eliminate that need.

On board training courses are also being used by submarine training facilites. For example, Naval Submarine School, New London, is using the AN/UYK-44 computer course to fill in during students' waiting periods during the formal AN/UYK-44 computer maintenance course. During a test period, students using the computer based course had average scores up to ten grade points higher than a control group.

OPTEMPO is decreasing, therefore inport schools and on board training are becoming much more important. On board training materials will continue to provide training while in port or at sea. Based on fleet feedback, computer based is the most popular medium for on board training. As the modern computer hardware on board submarines becomes more accessible, the ability to use CBT products will expand. ■

FAST ATTACK INPORT CREWS

by LT Rick E. Dansey
NROTC Unit, Northwestern University

The article "Fast Attack Refit Crews" in the January 1993 **SUBMARINE REVIEW** posed a realistic option for the submarine force. There is a multitude of benefits to this program. Our Congress and military structure would be well advised to listen to the many ideas that are *brainstormed* by all ranks. In massaging the above mentioned proposal other possibilities arise that should be contemplated and debated. Obviously, any idea must be fiscally responsible and easy to implement.

As our 154 submarine crews dwindle to 100 crews, approximately 6000 submariners will be left without a future in the Navy. One benefit of the downsizing is that we will be able to reduce expenditures on personnel. However, let us assume that the Department of the Navy can keep 1 out of every 6 submariners that faces the chopping block. That will still reduce our force down to 70 percent of present personnel levels and leave 1000 extra submariners. That equates to 10 more crew members for each ship. The following scenario applies specifically to fast attack crews, so spread the 1000 submariners over 80 SSNs and each ship will have about 13 qualified and trained bodies. (Even more as the 80 SSNs drops to 60.)

The supplemental crew will be assigned to fast attacks with the intention of keeping 13 crew members ashore for <u>every</u> underway. Essentially, this happens periodically anyway when additional 'riders' depart with the ship. Some crew members stay ashore and either are required to take leave or spend unproductive time with the squadron. The crux of this proposition is to implement a method to allow this time to be beneficial. This time will be supervised by a chief and an officer off the ship. Specific goals will be tasked. Thirteen personnel can accomplish significant amounts if given proper direction.

This is a list of some of the positive aspects of this proposal:

- <u>Administrative tasks performed</u> efficiently by personnel that are not 6 on and 12 off watchstanding with drills, training and maintenance to perform. These tasks include: ordering parts and having them available for scheduled maintenance when the ship returns, having work packages written and ready to go, preparing

training outlines, having tagouts for maintenance in standby, etc. This allows the crew at sea to concentrate on drills and qualifications.

- Incentive to qualify. Only those *Qualified in Submarines* can be left ashore for the underway.
- Forces watchstation quals and rotation. As different members of each division are left inport the rest of the division will be exposed to different watchstations. Instead of being a lower level engine room watchstander for a year, MM3 Smith will get a chance to rotate to the upper level watch and will be pressured to qualify on additional watchstations. This applies to officers and battlestation responsibilities. In over three years, I only stood two different battlestation watches. This system will inherently force the ship to be a better war fighting machine.
- Exposes all division members to all aspects of the division. If the petty officer staying inport for a certain division is required to order parts, then he must learn how to be a Repair Parts Petty Officer (RPPO). The same is true for quality assurance (QA) packages, etc. All collateral duties will soon be easily passed between divisional members. The dilemma emerges when 2 RPPO logs are required. One log is on the ship and one is on shore. That is a minor issue.
- Forces responsibility downward. Commands are always reluctant to let a chief stay inport especially the Machinery Division or Auxiliary Division chief. This systems ensures that everyone will eventually be left on the pier. This forces the first class Leading Petty Officer (LPO) in every division to test his leadership and management ability. This can only better prepare him for being a chief. Overall, the entire ship will be better prepared for the next rank.
- Forces the managers to plan ahead. All paperwork will still need to be routed through the chain of command. This forces the division to plan one underway period in advance. The inport section will be working on the projects for the next inport period. The packages and tagouts for the current upkeep will be routed through the chain while the boat is underway.
- Allows flexibility for leave and schools. This is primarily for inport periods or it defeats the purpose of having an inport section.
- Additional crew for inport periods. Inport periods are the most labor intensive. This system will add bodies to the watchbill

allowing for at least a four section duty rotation which will immediately improve morale. I know a nuclear trained ET2 that never was better than 1 in 3 duty over a 4 year sea tour. That was his primary reason for leaving the Navy.

- Provides a measure for evaluation purposes. This system gives the CPO and department head an excellent method to gauge his division/department. He assigns specific tasks to the inport section and the tasks will either be completed or not completed when the boat pulls in.
- Improves morale. For all of the above reasons morale should improve. If the XO and COB rotate personnel in each division properly, then the inport section proposal will make sure everyone is better trained and able to 'get away' from the ship periodically.
- Better retention of well-rounded personnel. As morale improves, retention will improve proportionally. This is not necessarily a goal, but no one can refute keeping highly trained sailors as a benefit.
- Easy to implement. No transition period or added cost is required for the system as stated.

The only aspect not mentioned is where does the inport section perform the assigned tasks. This is the part than can cost money. Some possibilities are available without additional cost. Allocate current classrooms off the tender or a base complex to the boats. The most preferable solution will take a capital outlay.

Buy a series of trailers to be put on base for the boats to use. Close to the pier is optimal, but not essential. One or two boats could be assigned to a trailer. Those ships would 'own' that space and be accountable for it. The added benefit of having a trailer gives the ship flexibility of having more space. While the ship is inport, it can be another location for divisional training. An off-hull trailer is a much better location for training than crew's mess during a weapon loading evolution. A trailer will also give the engineer more room to store the multitudes of publications that are required.

Boats in the shipyard already utilize trailers (or barges). This is essential due to the condition of the ship at the time. A barge has, however, proven to be very useful regardless of the state of the ship.

Overall, this system provides a method of maintaining a well-

trained crew with higher morale and better integrative knowledge. That seems to be what every service is going to be striving for in these lean years.

This may not be the answer to helping the submarine force downsize through the 1990s. There are many benefits, but Congress may want to put all 6000 submariners on the unemployment line. A point that transcends this proposal is that this idea and others like it discussed in wardrooms and periodicals must be debated at the proper level. Our service is known for its intelligence. Intellect and creativity are what we are going to have to rely on in order to make the best from what will be a challenging future. ■

STS-94

The Naval Submarine League and The Johns Hopkins University Applied Physics Laboratory will hold a Seventh Submarine Technology Symposium (STS-94) May 10-12, 1994. The theme for the Symposium will be:

Shaping the Submarine Force for the 21st Century:

Enabling Technologies for Transition from the Sea to the Littorals

Technology areas to be addressed will include:

Advanced Weapons
Artificial Intelligence/Intelligent Systems
Automation
C^2: Fusion, Planning, Resource Allocation
Communications and Information
Foreign Developments
Manufacturing
Materials
Sensors
Ship/System Design
Simulation

The Symposium will be held at The Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland and will be at the SECRET NOFORN level.

Abstracts and ideas for papers are encouraged; papers should have a high level of technical content. For more information please call Mr. David Restione (STS-94 Program Chairman) at (301) 953-6480. Early abstracts (UNCLASSIFIED) may be faxed to (301) 953-6667; CLASSIFIED abstracts should be faxed to (301) 953-1093.

This early announcement will be followed by a final Call for Papers and invitation letters. However, early response for paper abstracts is desired to ensure the high level of technical content of the Symposium. ■

Submarine Technology in a League by Itself.

General Dynamics Electric Boat Division has been designing and building nuclear submarines for more than 40 years. We are the sole designer and builder of Trident ballistic missile submarines, and we build SSN688 class attack submarines.

The Navy has awarded us contracts for the first two Seawolfs, America's most advanced attack submarine. And, we are now developing concepts for Centurion, the next generation attack submarine.

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SUBMARINERS MUST SUPPORT BASE CLOSURES

by LT David C. McDonnell, USN

The submarine force consisting of 100 SSNs and 36 SSBNs is a dream of the past. The preparations needed for this large submarine force, including the submarine bases and the associated infrastructure required to support it, were completed during the 1980s. With the current cuts being implemented and with the threat of even more cuts looming on the horizon, it appears that the actual submarine force will level off at only half of the projected size mentioned above by the year 2000. The submarine force has a choice to make on how it can save money. It can either close submarine bases or stop building submarines and stop employing those who operate them.

Closing submarine bases and their associated infrastructure will have a huge impact on the economies where they are located. Enormous sums of money will cease to flow into the local economy surrounding the submarine bases which are closed. Many small businesses will go bankrupt and the unemployment rate in the area will undoubtedly increase. Housing prices will fall and many people, including those in the military who must relocate, will have to take a loss when they sell their homes. These facts are not pleasant to consider when deciding to close a submarine base.

The most important consideration for closing submarine bases is there will be less money flowing into the infrastructure and more money left over to build more submarines, pay the submarine crews, and support the submarine fleet's operational obligations. The submarine force is being asked to maintain its significant obligations with fewer submarines and less funding. By closing submarine bases we can redirect the costs of operating those bases into operating our submarine fleet. If submarine bases are not closed, the Navy will be forced to cut funding for new construction submarines and reduce the number of personnel in the service. This could lead to the hollow Navy which resulted when indiscriminate cuts were made following the Vietnam War.

The submarine force currently has four submarine bases on each coast. With only half of the planned submarine force on hand by the year 2000, only half of the submarines needed to support them should remain operational. Therefore, two submarine bases on each coast should be closed by 2000. Operating

more than two submarines bases on a coast will place drain on the funding which could be directed toward the operational fleet.

The decisions regarding which submarine bases to close are difficult. These difficult decisions will be made by the powerful politicians in Washington, DC and the country will have to accept the results. Everyone, including submariners, wants to protect their own homestead, and rightly so. Submariners must look ahead for the future of the submarine force and encourage the closure of submarine bases. By doing so, we will increase the potential of the operational submarine force.

The United States has won the Cold War, but the world is still a dangerous place. We must maintain the current level of readiness in our military forces so that we may be able to cope with any circumstance which may arise. This includes maintaining the excellence of our personnel and their quality of life. Closing submarine bases will aid in providing the required funding needed to ensure the capability of the submarine force to meet these and any other future demands. ■

MEMBERSHIP STATUS

	Current	Last Review	Year Ago
Active Duty	981	982	992
Others	2763	2737	2841
Life	244	243	225
Student	28	27	28
Foreign	75	76	80
Honorary	20	21	24
Total	4111	4086	4180

TO THE BOTTOM OF THE SEA – AND BACK

By LCDR Garnet Hulings, USNR (Ret) and Ted Olson

*My good friend Norman M. Hulings, Jr. Aviator LCDR, USNR (Ret) recently gave me the original of an article entitled, **To the Bottom of the Sea – and Back**, by Lieutenant Commander Garnet Hulings, USN and one Ted Olson of the **Casper, WY Herald**. Garnet Hulings was the commanding officer of the submarine AL-4, which patrolled between Ireland and England sometime in 1917-18.*

Norman found the article, which has yellowed with age, while reviewing personal belongings of his uncle, Garnet Hulings. I know you will find this article to be most interesting!

Having served on the USS O-10, which was constructed during the years 1917-1918, for a few weeks prior to attending Submarine School during World War II and thereafter on the USS Spot (SS 413), I readily relate to the experiences encountered by LT Hulings and crew!

B. Hayden Crawford, RADM, USNR (Ret)

"They never come back."

That grim epitaph, inspired by the fortunes of the sport world, has served often enough to chronicle the fate of the men who go down into the sea in submarines, and there encounter misfortune. The tragedy of the S-51, over which divers are pawing even as this is written, is the most recent reminder of the hazards which the men of our Navy's undersea service face hourly on duty.

Yet now and then they *do* come back. The AL-4 did, after an involuntary dive to a depth far beyond the maximum limit for which undersea craft are designed, the greatest depth ever attained by an American submarine without disaster. The story of that plunge and of the wafer-thin margin by which disaster was averted is a dramatic episode in the war-time history of the United States Navy.

The AL-4 *[Ed. Note: The A was added to USN submarine class designations while serving in European waters to prevent*

confusion with Royal Navy boats.] was on patrol duty in the waters between Ireland and England; the first morning of one of many eventful eight-day trips. She was conducting a dog-eat-dog sort of campaign, submarine against submarine, a type of warfare always notorious for elusiveness, surprise encounters, and sporting chances not provided for in the routine experience of the naval tactician. Her mission was to patrol certain areas in search of enemy submarines, and to attack and destroy at every opportunity.

It was a slippery game of hide-and-seek. Danger or opportunity might approach from any direction. A speck on the heaving sea horizon might resolve itself into an enemy submarine, or at any moment the eye of a hostile periscope might emerge from the waters close at hand. Surface craft were a menace, whatever flag they might fly, for there was always a chance of being mistaken for an enemy by an American destroyer and sent to the bottom torn half in twain by depth charges, *ash cans* in the parlance of the navy. No submarine officer relished the thought that some classmate might be decorated for *doing in* an enemy U-boat which in real fact was one of the American craft that eventually were chronicled *lost - cause unknown*. It was wisest to spot destroyers first and get under before they did any spotting on their own account.

This particular morning had been uneventful enough. For long stretches patrol duty may be a drab level of monotony, aptly described by the comment of the greenhorn who was asked, on his return from his first trip, how he liked submarine duty.

"Oh, it's all right," he drawled, "but they're all the time waking you up to eat."

The commanding officer had gone off duty at four o'clock that morning, relinquishing the bridge to his executive officer. As dawn began to wash the eastern sky and filter across the gray empty waste of the Irish sea, that officer prepared to submerge to run a listening patrol, in accordance with previous orders. A touch on the button that looses in the cavernous abdomen of the big submersible the soul-scarifying blast of a klaxon is the signal that turns the nose of the monster bottom-ward. In an emergency what is known as a crash dive is executed. Engines are stopped, clutches shifted and motors driven ahead full speed, diving rudders set at hard dive, kingston flooding valves and air vent valve opened. The boat takes a slight angle, which rapidly approaches fifteen degrees, and the bow starts under. The officer of the deck

and the lookout, meanwhile, come down through the conning tower, closing the hatch as they descend, and in a matter of 30 to 50 seconds the watch officer has ordered the motors stopped and instructed his diving rudder man to level off. The bubble in the gauge swings back to zero.

Everything this time went according to schedule. The man at the listening device adjusted the microphones to his ears to grope out into the blind subaqueous darkness for the betraying throb of a distant propeller. The other men on duty relaxed to comparative comfort at their respective posts. The low whine of the motors, random scraps of gossip from the galley, and occasional low-toned orders and reports alone broke the silence. Officers and men relieved a half hour before were in their bunks.

It was there, as the AL-4 cruised uneventfully on her way, that the officer of the watch noted that the boat was a trifle heavy. To correct this, he gave the order, "Blow adjusting," thereby intending to clear the adjusting tank, which held about 600 pounds of ballast. It is a routine procedure, requiring no particular care, since the tank is of such small capacity that even should it be flooded completely by mistake, there would be no grave consequences.

In response to this order, the man in charge spun the valve. He was a novice, and to make sure that the operation was performed properly, the watch officer stepped to the gauge to note how much water was being blown out of the adjusting tank. He was puzzled to observe that it showed no change. He stepped to the air manifold gauge to make certain that sufficient air pressure was being applied to the adjusting tank to expel the water. Everything was as it should have been. He turned again to the adjusting gauge.

It was then it first became apparent that the boat was slowly settling. The downward motion was not fast, but it was sufficient to demand more motor speed to maintain proper depth. The motors were running at the minimum speed, and the electrical control was so connected that to increase speed it was necessary to stop the motor completely, shift the switches to another combination, and then go ahead. This also was a routine procedure, used to correct minor deviations in buoyancy without the necessity of blowing overboard large quantities of water. It is important, however, that it be executed swiftly, so that the motors may be stopped for the shortest possible interval.

Unfortunately, it happened that the third class electrician stationed at the switches was also a new man, and the watch officer, not confident of his ability to execute the order properly, jumped through the door to the next compartment and threw the switches to full power, with the accompanying order, "Full speed both motors".

At that instant there came a slightly nervous call from the diving rudder man. "She's settling fast, sir."

Something was wrong, it was evident. Back into the control room, the watch officer leaped. The needle of the depth gauge told the story. With the sped of a bullet it shot past the 90 feet mark, past the 100, and there ceased to register, for the gauge reads no further.

There was little time and little need, however, to speculate what depth the AL-4 was plumbing. There came a shock along the keel. Every waking member of the crew knew that the craft was resting on the bottom of the Irish sea.

No time was lost then in fixing blame or responsibility, but the explanation was simple. Alongside the adjusting tank valve is another, the flood valve of the auxiliary tank. The man in charge was a novice to the task. In complying, as he thought, with his chief's orders, he had spun the wrong mechanism, opening the flood valve to gulp in an enormous quantity of water and send the AL-4 diving like a plummet.

Consternation there must have been in the hearts of officers and men, but there was no confusion.

"Stop both motors; secure everything," came the first order. It was obvious the boat could go no deeper; the course of logic was to stop and consider the best method of escape.

The captain, asleep or nearly so in his bunk, had not missed the significance of the bump as the big craft struck bottom. With a bound he emerged from his bunk and was in the control room to take charge. After him came a tottering, waxen faced, but intrepid ghost of a man. It was Lieutenant K.R.R. Wallace, USN, the third officer, deathly sick with influenza for two days past, but too good a man and an officer to remain idle in the grim fight that all knew was ahead.

There was little need to expound the extent of the disaster. The AL-4 was at the bottom of the Irish sea, 300 hundred feet below the surface, and a full 100 feet beyond her designed safety limit. Every waking member of the crew had caught the import

of the situation. There was no need to caution each man to perform his duties with the utmost care and precision. They knew only too well that the slightest mistake might spell further, irremediable disaster, and they stood at their stations with grim determination.

There was no trace of terror on a single face; no whimper of fear from officer or man. Rather, in the teeth of supreme peril there broke forth the irrepressible humor of young America in bantering exchanges that furnished a valuable complement to the quiet encouragement of the captain's low voiced instructions; the reassuring weight of his hand on some subordinate's shoulder.

A thorough inspection of the boat for signs of crushing in was the first step. As one man after another reported back, relief and revived hope became audible. The stout hull of the AL-4 was proving equal to the tremendous pressure. But there was a disconcerting number of leaks. Every angle iron and valve flange, virtually every rivet was jetting its needle of spray into the interior. Around the flange of the three inch gun came such a shower that men sleeping five feet away were drenched into gasping wakefulness. The most serious leaks of all were around the glands where the propeller shafts went out through the stern. Here the sea was veritably pouring in, and it was impossible to tighten the flange sufficiently to stop the flow.

Another spot that gave grave concern was a place in the side of the boat abreast the engine room, recently damaged in collision and repaired by placing a patch some nine feet square over the plates. So doubtful was the integrity of this spot that a man was stationed there at once to give warning in time for the engine room door to be closed off should the patch start.

"Full speed ahead."

With this order began the first desperate attempt to extricate the big craft. The hull quivered to the frantic thrust of the racing propellers. Eyes scanned the gauges in an agony of anxiety and hope for some sign that the boat was lifting. There was no response, not even a tremor of change. From the men stationed at the bow rudders came a report that caused the captain's jaw to set a bit more grimly. The combined exertions of two husky seamen sufficed to move the rudders only a few inches up and down.

"Which means", a veteran growled for the benefit of newer members of the crew, "that we're bogged down in about 13 feet

of good Irish mud."

In the hope that the swirl of the propellers might loosen the suction of the mud, one motor was driven ahead full speed, one astern full speed, and then both astern full speed, while at the same time the vertical rudder was twisted right and left. Again that tense inspection of the gauges for some quiver that would reveal the breaking of that deadly, inert clutch in which the ocean bottom head the boat and the lives of those in it. Again the chill fingers of incipient despair at every heart as neither depth gauge nor compass needle gave the slightest response.

It would have been suicidal to prolong that attempt, for the protracted drain on the storage batteries was rapidly sapping the precious power that must extricate the AL-4 if anything could. And time was equally precious. If anyone was to escape alive, escape must be effected before the inrushing water reached the level of the motors and storage batteries. Death when it came would be sudden and comparatively merciful; not drowning, not slow smothering as the oxygen was exhausted, but swift green asphyxiation. Once the water reached the batteries chlorine gas would billow chokingly through the interior, snuffing out every life in a handful of minutes.

In every step of that fight every man was conscious of that inexorably climbing pool. It was a veritable water glass telling one by one the dwindling moments of life and all the precious things that life meant.

Under the pressure of that desperate need for haste, efforts with the motors were temporarily abandoned and attention was turned to the pump, a small, high-powered contrivance designed to pump against a depth of 300 feet. Once more failure. It merely churned the water with no positive effect whatever.

"How about the main ballast pumps?" someone suggested.

A brief consultation resulted in agreement that no harm would be done, other than a slight expenditure of electricity, though it was known that they were made for no such pressure. The instant they were started the electric fuses blew. It was apparent the electric control was not strong enough for that purpose.

The hand pumps were the next resort. The instant the valves were opened, they leaked so disastrously that they had to be shut off and the attempt abandoned.

Five times now failure had mocked at every effort. But there was no yielding to despair. After all, these were only the

preliminary steps. The real hope lay in the 2,200 pounds of air pressure with which it was now planned to expel the anchoring weight of water in the ballast tanks and release the boat.

The adjusting tank is a very high pressure, low volume tank, designed for exactly such contingency as that which the AL-4 was now facing. It can be filled from the larger, less strongly built tanks and then emptied by expelling the water with compressed air. By repeating this process the adjusting tank may be used to bail out the other tanks.

Now the adjusting tank was filled from the auxiliary tank, the flooding of which had precipitated the disastrous plunge. After an air pressure exceeding the outside pressure had been built up, the adjusting tank the sea valve was opened. This should empty the tank for another trial.

The process was performed with the utmost precision. The sea valve was shut again. And the gauge showed the tank to be just as full as at the start!

There was no time for curses or despair, though this unaccountable failure was the sixth checkmate, and far the most serious yet encountered. Again and again the attempt was made. Each time the result was simply nothing. Rather, it was all on the debit side. To refill the adjusting tank each time it was necessary to release the air, and it could be freed only into the living quarters. It soon became evident that not only was compressed air being squandered to no purpose but that the living atmosphere was climbing to an unendurably high pressure.

In the hope of releasing the excessive pressure, the air compressor was started. The instant the sea valve was opened to the circulating system, the piping was broken by the sea pressure and the valve had to be closed instantly to prevent flooding the engine room. That ended attempts with the air compressors. And the steady influx through every leak continued. The water glass that measured inversely the expectation of life of officer and man was creeping steadily higher.

One by one every effort had been frustrated. Time was growing very short. But cooly, imperturbably, the captain gave orders for still another attempt. The bubble which measured the inclination of the boat showed an angle of about two and three quarters up by the bow. If water could be blown out of the forward tanks and the bow lightened sufficiently, it was just possible that with the motors driving full speed ahead the bow

might rise and the boat be driven loose.

Going forward to supervise, the executive officer found a half dozen men still asleep in the bow compartments. All this desperate struggle with impending death had been conducted so quietly that they had never been awakened. Roused now, and informed briefly of the situation, they were sent back to the shaft alley as far to the stern as it was possible to go, and other men unoccupied at stations were consigned to the same quarters.

"Ready for blowing forward", reported the executive officer. He stationed himself by the door leading to the forward compartment, ready to close it instantly should anything adverse happen.

Nothing happened at all. The relief valve on the air line to the tank popped at 90 pounds pressure, the designed limit of the tank, and 37 pounds short of the 127 pounds pressure outside.

One recourse remained; a doubtful one at that. The relief valve could be plugged, and pressure increased to the necessary amount. But what would happen when a tank designed for only 90 pounds was subjected to a pressure in excess of 127 pounds? It was anybody's guess. It might well prove his last guess, although it was hoped that even if the bow bulkhead did carry away, the man stationed at the door would be able to close it and cut off the flooded bow compartment from the rest of the boat.

But a glance at the rising water showed that the time for strenuous measures had arrived. Its level had climbed to within four inches of the main motors. The seams were widening, the sea pouring in, in constantly increasing volume. The end was not far distant unless success crowned this next effort. There was no disagreement with the decision to give the bow ballast tank the air and take the chance of its bursting.

Chief Machinists Mate Williams, better known as "The Air King", was stationed at the high pressure air control.

Hughes, chief gunner's mate, went forward to stand by the air relief valve and the door of the bow compartment. "Indian Joe" Marsh, gunner's mate, was told to take his place by the bow ballast kingston valve. And thus all hands were ready for the order that would spell either finish or escape.

"Blow bow ballast! Full speed ahead! Hard rise rudder!" In staccato succession the commands came.

Williams spun the valve releasing 150 pounds pressure into the bow ballast tank. Adams, chief electrician, threw full power to both motors. Anderson, cool as ever, spun his stern driving

rudder to hard rise, since the bow rudders were imbedded in mud.

It was a breathless instant, a moment fraught with hope and despair and all the chaotic impressions and emotions that cluster at the edge of eternity. Would the tank hold? Would the "bubble" show at last that the bow was breaking loose?

"God! She's coming!"

Which man breathed that half-prayer, half-paean, it was never recorded. But the bubble had moved. It was almost imperceptible at first, but now a quiver of the depth needle confirmed it. And for the first time in that hour and a half fight for life, confusion broke out among the crew.

Greater and greater became the inclination of the boat as the bow broke loose and the full power of the motors drove her skyward. The water in the bilges rushed aft and the men imprisoned back in the shaft alley caught a sudden contagion of panic.

"We're gone! The stern glands have carried away!" they yelled.

Adams, in the control room, gave every spark of voltage to the motors. Anderson gave the diving rudders all they would take. This, together with extra human weight in the shaft alley, and the quantities of water pouring aft, made the boat almost stand on end.

It was impossible to climb forward, but who cared? The AL-4 bounced toward the surface like a runaway whale. Ballast tanks were blown on the way. And thus the boat shot back into the peaceful sunshine of a May morning after 90 minutes of intimate converse with the grinning skeleton of death, and turned back to port for a thorough examination of possible damage and a report of supreme danger and almost insuperable odds bravely met and triumphantly mastered.

For sometimes they *do* come back.

■

PERISCOPE OPERATIONS FOR THE UNINITIATED

by Richard D. Lanning, Jr.

Few experiences compare to that of bringing a submarine to periscope depth. It is one of the unique evolutions which separate submarine operations from that of surface craft. Even though periscope operations are performed with great regularity, they are, by far, one of the most dangerous routines conducted on a submarine. Yet, bringing a submarine to periscope depth is certainly one of the most rewarding and memorable experiences a submariner will carry with him over the rest of his life.

Having to share the oceans and seas with a great many surface craft makes coming to periscope depth a period of anxiety for all members of the submarine crew. The ship is transitioning from a relatively stable environment to one of many unknowns. During the transit, and while at periscope depth, the submarine is being placed in a very vulnerable position. The submarine hull is now close enough to the surface to be struck by most ocean going vessels. Sea pressure has been dramatically decreased, changing the stresses on all internal seawater systems and piping. The outside water temperature has likewise changed which also affects internal seawater systems. Crew members are kept busy monitoring and adjusting equipment to ensure vacuums are maintained, discharge rates are kept up and the integrity of seawater systems are preserved. Going to periscope depth also means valves and dampers are being manipulated to line up systems for use while at periscope depth. A valve in the wrong position could result in seawater entering what is affectionately known as the *people tank*.

The lives of every man onboard a submarine depends on the sound judgement of the Officer of the Deck (OOD). Unless surfaced, the submarine is always the burdened vessel and rightly must give way to all other vessels. This requires the utmost vigilance of the OOD. It also means he must be able to react quickly. While a surface ship has many eyes to scan the horizon for other vessels, there is but one eye on the periscope. An eye that is hampered by having a very limited horizon in which to search for approaching vessels due to the small distance the periscope extends above the water's surface. Even maneuvering at periscope depth is greatly restricted due to structural limitations of the extended periscope. Additionally, rapid changes in ship

speed or abrupt control surface movements raises concerns over the possibility of cavitating which would send a telltale message of the submarine's presence.

A surface craft has a decisive advantage over a submarine which is proceeding to periscope depth in that a surface vessel can scan the surrounding waters for visual, acoustic and radio frequency emissions that reveal the presence of other craft. Until the submarine reaches periscope depth, the OOD can only count on acoustic energy to warn of nearby vessels; the presence of which may be hidden from the ship's sensors due to the physical characteristics (temperature, pressure, salinity, presence of biologics) of the surrounding waters and the bottom conditions (hard, sand, smooth, rough, etc.) which can bend the sound energy away from the submarine. It is certainly disconcerting, but not uncommon, to have sonar report contacts where none existed before as the ship rises towards the surface.

Coming to periscope depth is always a dangerous and stressful time, but even more so when it is done at night. Ironically, the night watches onboard a submarine are sometimes relegated to the most junior qualified OOD; clearly a testament to the excellent training our submarine officers receive and the confidence their Commanding Officers have in their abilities. While a submarine operates twenty-four hours a day, the operational tempo is typically relaxed during the evening hours with fewer crew members up and about. The late night watch OOD has no one to turn to for advice. His watchstanders have never personally taken a submarine to periscope depth. He must rely solely on his own skills and judgement. His only solace is that before anyone brings a submarine to periscope depth, they must first receive the Captain's permission to do so, providing an opportunity to express any concerns with the one most experienced to answer them. Yet, many an interesting story can be told of the late night difficulties in arousing the Captain to obtain his permission. Even more interesting stories can be told regarding the ensuing conversations.

Certainly nothing can be more frightening for an inexperienced OOD than to go to periscope depth on an overcast night. On such nights, even after the Diving Officer, who is responsible for depth control, has brought the ship to the proper depth, one cannot be sure the scope is even out of the water. The eye can simply find nothing on which to focus. The OOD's first instinct is to question the Diving Officer's abilities. He frequently calls out to him to

"Mark your depth"; to which the Diving Officer replies with the appropriate numbers. There is this urge to raise the scope just a little higher just in case the depth gauge is inaccurate. Unfortunately, even if the ship is brought up a foot or two, there will still be no discernible difference in what is viewed through the periscope. The yearning for something to focus on only intensifies. The OOD begins to question his own eyesight, wondering if maybe his one eye was not properly adjusted for night vision. A switch is made to the other eye on the scope and again nothing is seen but pitch blackness. At this point, a decision is made to rig the control room for black in hopes that making the surroundings darker might improve one's chances of being able to catch a glimpse of something on the surface. Still there are few times when even this helps. The darkness of the control room only heightens the loneliness the OOD feels. If the ship is equipped with a low level light intensifier on the periscope, it is switched on as a last resort, hoping the sophisticated electronics can pick something out of the blackness. The typical result is a quivering, eerie green image that reveals nothing, but which has ultimately destroyed the OOD's night vision. Tensions are magnified when onboard sensors indicate that there is something out there on the surface nearby, yet the OOD reports no contacts in sight.

The clear nights can prove just as alarming. On many an approach to the surface, looking though the scope for any dark shapes or shadows overhead, the OOD is startled by bursts of light caused by the phosphorescence in the water. Other times, as he nears the surface, he may see some flickering light shining back down through the sea at him that he realizes is not caused by the phosphorescence in the water. His first instinct is that it may be the light of a ship overhead. Before he can even react, the scope is clear of the water and he finds himself staring at a huge bright object. Many an inexperienced OOD has quickly returned the submarine to the safety of the depths only to learn that the bright object he so feared was nothing more than the moon. Even the stars can be a hindrance for a submariner on a dark night. As the OOD conducts his periscope scan, he finds himself wondering as to whether he is staring at stars or the running lights of some vessel on the horizon.

Being on the scope at night gives one an appreciation of how lonely it is to be at sea on a submarine. Each second seems like hours. The eyes begin to play tricks on you as you begin to see

lights and objects that do not exist. The OOD is anxious to get all the chores that must be done at periscope depth over with as soon as possible. It is at these times that the true difference between the surface sailor and submariner come to light, for while the surface sailor only feels secure in the safety of a harbor, the submarine sailor longs for the safety of the depths.

With time each OOD will come to appreciate and long for the presence of a full moon and cloudless night. For even at night the sea has a special beauty about it. For those truly fortunate, they might get to witness the awesome fury and magnificent light show of a thunderstorm at sea. As the submarine slips back into the murky depths, each OOD can feel content knowing that they have done something few other people will ever experience in their lives. ■

STATUS OF SUBMARINE HISTORY BOOK

Turner Publishing has stopped accepting biographies and are proceeding with typesetting. The book will contain the biographies of almost 600 submariners/submarine enthusiasts as well as the corporate histories of a number of corporations that have played important roles in the development of the modern submarine navy. Rear Admiral Mike Rindskopf has begun working on the introductory section of the book. The projected date for mailing the history books is December 15, 1993.

SUBMARINE BIBLIOGRAPHY
Part III

Editor's Note: This installment of the Submarine Bibliography covers the books reviewed in THE SUBMARINE REVIEW from 1987 to the present. Also included are several works suggested by Dick Boyle and Ted Gaillard. Two future parts of the bibliography will be devoted to fiction and to Naval Institute Proceedings articles. We recognize that there are many books on the non-fiction list still to be included and work is being done to gather the publication data necessary to include those that we know about. There must be many books that we do not know about, however, and any additions by readers will be gratefully accepted.

I. OVERVIEW

Compton-Hall, Richard, Submarine Warfare: Monsters & Midgets. Poole: Blandford Press, 1985. ISBN 07137-1389-5. U.S. Publisher—New York: Sterling Publisher Company.

Gabler, Ulrich, Submarine Design. Koblenz: Bernard & Graefe Verlag, 1986. ISBN 3-7637-0124-9 (in English).

Gray, Edwyn, Submarine Warriors. Novato, CA: Presidio Press, 1988. ISBN 0-89141-325-1. SUBMARINE REVIEW, July 1990.

_____, The Devil's Device. Annapolis, MD: Naval Institute Press, 1991. ISBN 0-87021-245-1. SUBMARINE REVIEW, October 1992.

Keegan, John The Price of Admiralty. New York: Viking, Penquin Editions. ISBN 0-670-81416. SUBMARINE REVIEW, July 1989.

Lipscomb, F.W., Historic Submarines. New York: Praeger, 1970. LC-77-77304.

Miller, David, Submarines of the World. London: Salamander, 1991. ISBN 0-86101-562-2.

United States Submarine Data Book. Submarine Force Library & Museum Association, Inc., 1984.

II. EARLY YEARS

III. WORLD WAR I

Messimer, Dwight, The Merchant U-Boat: Adventures of the DEUTSCH LAND 1916-1918. Annapolis, MD: Naval Institute Press, 1988. ISBN 0-87021-771-2.

Sokol, Anthony, The Imperial and Royal Austro-Hungarian Navy. Annapolis, MD: Naval Institute Press, 1968.

IV. BETWEEN THE WARS

V. WORLD WAR II

Alden, John D., U.S. Submarine Attacks During World War II. Annapolis, MD: Naval Institute Press. SUBMARINE REVIEW, April 1989.

Buchheim, Lotar-Gunther, (translated by Gudie Lawaetz), U-Boat War. New York: Alfred A. Knopf, 1978. ISBN 0-394-41437-3.

Chapman, Paul, Submarine TORBAY. London: Robert Hale Ltd., 1989. SUBMARINE REVIEW, April 1992.

Drea, Edward, MacArthur's ULTRA: Codebreaking and the War Against Japan 1942-1945. University Press of Kansas, 1992. SUBMARINE REVIEW, July 1993.

Hessler, Capt. Gunther, The U-Boat War in the Atlantic, 1939-1945. London: Her Majesty's Stationary Office, 1989. ISBN 0-11-772603-6. SUBMARINE REVIEW, April 1990/October 1992.

Lambert, John and David Hull, The Submarine ALLIANCE: The Anatomy of the Ship. Annapolis, MD: Naval Institute Press, 1986. SUBMARINE REVIEW, January 1987.

Mallmann, Jak P., U-Boats Under the Swastika. Annapolis, MD: Naval Institute Press, 1987. ISBN 0-87021-970-7.

McCue, Brian, U-Boats in the Bay of Biscay. Washington, DC: National Defense University Press, 1990. SUBMARINE REVIEW, April 1991.

McLeod, Grover S., Sub Duty. Birmingham, AL: Manchester Press, 1986. SUBMARINE REVIEW, April 1987.

Meigs, Montgomery C., Slide Rules and Submarines: American Scientist and Subsurface Warfare in World War II. Washington, DC: National Defense University Press, 1990. SUBMARINE REVIEW, January 1991.

Sheffield, Richard G., Sub Commander. Greensboro, NC: Computer Publications. SUBMARINE REVIEW, April 1988.

Wingate, John, The Fighting Tenth. London: Leo Cooper, 1991. SUBMARINE REVIEW, April 1992.

VI. THE COLD WAR

Berg, John, The Soviet Submarine Fleet: A Photographic Survey. London: Jane's, 1985. ISBN 0-7106-0361-4.

Breemer, Jan, Soviet Submarines-Design, Development and Tactics. Jane's Defense Data, 1989. ISBN 0-7106-0526-9. SUBMARINE REVIEW, April 1989.

Compton-Hall, Richard, Submarine versus Submarine. Newton Abbott: David & Charles Publishers, 1988. ISBN 0-7153-9178-X. U.S. Publisher—New York: Orion Books. SUBMARINE REVIEW, April 1990.

Gerkin, Louis, ASW versus Submarine Technology Battle. Chula Vista, CA: American Scientific Corp., 1986. ISBN 0-9617163-0-4. SUBMARINE REVIEW, October 1988.

Hill, RADM R.J., Anti-Submarine Warfare. Annapolis, MD: Naval Institute Press, 2nd Ed., 1990. SUBMARINE REVIEW, July 1990.

Kaufman, Steve and Yogi, Silent Chase. Charlottesville, VA: Thomasson-Grant, Inc., 1989. ISBN 0-934738-38-6. SUBMARINE REVIEW, October 1989.

Khiyaynan, RADM L.P., The Development of Foreign Submarines and Their Tactics. Moscow: Voyenizdat, 1988.

Miller, David and John Jordan, Modern Submarine Warfare. London: Salamander, 1987. ISBN 0-86101-317-4.

Moore, John E. and Richard Compton-Hall, Submarine Warfare Today and Tomorrow. Bethesda, MD: Adler & Adler, 1987. SUBMARINE REVIEW, July 1987.

Schwab, Ernest Louis, Undersea Warriors. Lincolnwood: Publications International, 1991. ISBN 0-517-03585-5. LC 91-65676.

Stefanick, Tom, Strategic AntiSubmarine Warfare and Naval Strategy. Lexington, MA: Lexington Books, D.C. Heath and Company, 1987. SUBMARINE REVIEW, July 1988.

V'yunenko, RADM N.P., Capt 1st Rank B.N. Makayev, and Capt. 1st Rank V.D. Skugarev, edited by ADM. Sergei Gorshkov, The Navy: Its Role, Prospects for Development and Employment. Moscow: Voyenizdat, 1988. SUBMARINE REVIEW, January 1989.

Zimmerman, Stan, Submarine Technology for the 21st Century. Arlington, VA: Pasha Publications Inc., 1990. SUBMARINE REVIEW, October 1991.

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April 8, 1993

President William J. Clinton
The White House
1600 Pennsylvania Avenue
Washington, DC 00000

Dear Mr. President:

I recently had the opportunity, as a guest of the United States Navy, to make a half-day cruise aboard the Trident missile submarine USS FLORIDA (SSBN 728)(BLUE). I was so favorably impressed by the captain and crew of the FLORIDA that I feel compelled to write to you, their Commander in Chief.

Without question, the technology of the Ohio Class ballistic missile submarine is impressive. However, it was the crew of the FLORIDA that I found to be particularly extraordinary. As one might anticipate, they were extremely polite and professional in their interactions with the visitors aboard that day. What was unexpected, to me at least, was the intellectual capability of the sailors with whom I spoke. Each one, officer and enlisted man, was able to succinctly describe their job or duty, and each was extremely articulate in responding to questions.

It is clear that the blue crew of the FLORIDA is especially excellent based on their efficiency evaluations. However, I am told by a colleague, Dr. John Scott who served as an enlisted man aboard a missile submarine in the 1960s and who arranged our trip, that nuclear submarine crews are, in general, comprised of unusually bright and capable people. I am a university professor by profession, and I don't mind admitting that I was a bit envious of the FLORIDA's captain. I would that the average university student were as mature and intelligent as the young men I encountered on that boat.

In closing, I'll be frank in admitting to you that the military doctrine of Mutually Assured Destruction scares me terribly, in spite of the fact that it seems to have worked over the last 40 or so years. I have two young children, and for them and all of the children of the world, I dream of a day when weapons of mass destruction will no longer exist. In the interim, I honestly sleep

a little sounder as a result of my trip aboard the FLORIDA. It is clear to me that Armageddon is not likely to start as a result of human error or evil intent on one of our missile submarines. I know that you are exceptionally busy, but should you ever feel that you have the time, I would encourage you to schedule a visit to one of our submarine bases. I predict that you will be most impressed by what you find. Thank you, Mr. President, for your time.

Leon E. Hallacher, Ph.D.
Professor of Marine Biology and Ecology
University of Hawaii at Hilo

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DOLPHIN SCHOLARSHIP FOUNDATION

Dear Members of the Naval Submarine League:

As Hank and I prepare to leave Norfolk I want to update you on the Dolphin Scholarship Foundation. We welcome George and Pat Emery.

When we came in December 1990 the Foundation had just been incorporated. At the present time the Foundation has seven member clubs. Dolphin Scholarship hired the company of Craver and green to audit our books and make recommendations. As a result, we bought a computer financial program to keep our records and to write the tuition checks sent to the colleges each semester. Barbara Maas, our wonderful former bookkeeper, was instrumental in accomplishing their recommendations. Regan Jennings, our new bookkeeper, is a highly qualified and talented submarine wife who truly understands computers. As a result Regan is doing a study for the Board of Directors that will track where the scholarships are going, what areas are growing in fund raising and other trends. This study was requested as a result of concern by the Board for the military downsizing. Our financial situation continues to be healthy.

Two years ago we began a program to honor larger donations received in Memorium. If more than $1,000.00 is donated in memory of an individual, we create a scholarship in that person's name for the following year. We ask all our special scholars to correspond with the family of the deceased, and they have done so.

The transfer of management of the U.S. Submarine Veterans of World War II Scholarship to the Dolphin Scholarship Foundation was completed this spring. They will continue to monitor the program until there are no more eligible candidates and at that time their funds will be used to create new scholarships honoring Submarine Veterans of World War II.

Requests for our application have gone up tremendously. We received approximately 2000 requests last year. This is a direct result of the computer age and the proliferation of programs to help people search for scholarship aid. The numbers of actual completed applications have stayed about the same; an average of 230 for the approximately 25 places created yearly by graduating students. Our newly installed FAX machine is popular for last minute application bits that are needed to beat the deadline. (One family even FAXed us three applications on deadline day for their triplets.)

We are revising the application this summer to be effective next fall.

I hope you are all familiar with the cartoon book, Thirty Years of Submarine Humor 1963-1993, created for the 30th anniversary of the Dolphin Cartoon Calendars. They are great gifts!

Pat Emery will relieve me as a Director of Dolphin Scholarship Foundation. I know you will all give her the same wonderful support you have given me. It has been most rewarding for me to work with the students and the volunteers in the Submarine Community that make it all happen.

Respectfully submitted,
Katy Chiles
Dolphin Scholarship Foundation
405 Dillingham Boulevard
Norfolk Naval Station
Norfolk, VA 23511

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IN THE NEWS

Submarine Industrial Base

• Inside the Navy, April 12, 1993

"The Clinton administration appears ready to protect the submarine industrial base through additional production even if that production exceeds the Navy's stated requirement. Deputy Defense Secretary William Perry told an industry group last week that President Clinton's defense conversion plan will not work with some defense programs such as submarine production. Perry said the Navy is expected to show that their nuclear submarine inventory is greater than what is needed to sustain the industrial base. "We will have to take some action to keep the submarine industrial base [healthy] in spite of [the Navy's] inventory needs," Perry said. Perry's comments came before a Cruise Missile Association luncheon last Monday (April 5)."

"Aspin's bottom-up review of the nation's defense will examine acquisition and industrial base issues and the Navy's nuclear-attack submarine program will be the focus of a special review as part of that, according to a memorandum from Frank Wisner, the under secretary of defense for policy (Inside the Navy, March 15, p1). During the budget briefing Aspin told reporters there is enough work in FY-93 and FY-94 for the nation's two submarine shipyards, Newport News and Electric Boat. "The question is how do we keep the submarine industrial base alive until the CENTURION begins production?," Aspin said. The CENTURION is the next nuclear attack submarine the Navy plans to build. Production is expected to start in FY-98."

• Defense News, June 14-20, 1993

"WASHINGTON — Concerned that construction of the U.S. Navy's next aircraft carrier may be postponed too late in this decade, a major American shipyard is calling for a new review of the nation's nuclear shipbuilding base.

"Officials from Newport News Shipbuilding, Newport News, VA, and parent company Tenneco Inc., Houston, last week charged the Pentagon's ongoing high-level review of weapon systems is biased because it focuses exclusively on preserving nuclear submarine industrial capabilities and ignores the nuclear-

powered aircraft carrier industry.

"Building carriers preserves the shipbuilding base for carriers and submarines," Michael Walsh, chairman of Tenneco, said in a June 10 news conference in Alexandria, VA. "Building submarines does not preserve the carrier industrial base."

"The Pentagon review, launched by U.S. Defense Secretary Les Aspin in February, is assessing weapon systems and industrial base concerns and what is affordable for the future. Aspin was expected to be briefed on initial recommendations from the review on June 12, Pentagon sources said.

"To reduce near-term budgets and still preserve the nation's capacity to build nuclear-powered warships, Pentagon officials are studying a number of proposals, including delaying production of the Navy's next aircraft carrier, CVN-76, from 1995 until later this decade, Pentagon sources said."

New U.S. Submarine

- Defense News, March 8-14, 1993

"U.S. Navy planners are looking at as many as 12 submarine alternatives as part of a Pentagon-directed review to determine the most effective design to pursue under the CENTURION program, service sources said March 4.

Navy sources said they expect the review to be complete by midsummer but caution that the review may be delayed since it takes a great deal of time to assess each alternative. A separate Pentagon-directed study assessing the future of the submarine industrial base should be complete next month, the Navy sources said.

The two studies will be used to guide development of CENTURION, a lower-cost replacement for the SSN-21 SEAWOLF submarine that was canceled in 1992 for being too expensive. CENTURION is expected to begin construction in 1998."

- Defense News, May 3, 1993

"Navy officials bracing for the Pentagon's *bottom-up* review of the submarine industrial base are pushing for building a lone SEAWOLF in fiscal 1996 followed by a low-cost successor in 1998, according to Pentagon sources.

The preferred Navy option, along with others that the Pentagon is considering, also would construct one SEAWOLF successor,

known as CENTURION, annually thereafter.

Pentagon officials said the recommendation has gained a key endorsement from ADM Bruce DeMars, the director of nuclear propulsion.

One Navy official described the position as the service's *baseline going into* the submarine industrial base bottom-up review discussions with Pentagon civilians."

- Inside the Navy, May 3, 1993

"While there is support in Congress and in the administration for building a third SEAWOLF as a way of protecting the fragile submarine industrial base, congressional sources said last week that adding funds to the FY-94 defense budget is unlikely. "There is no room for it in the [FY-94] budget, and no one is up for a floor battle," a congressional source said. The sources agreed that a third SEAWOLF may be considered for FY-95 or FY-96.

Defense Secretary Les Aspin and Deputy Defense Secretary William Perry have been thinking about the overall industrial base over the last few weeks, the sources said. The sources said Aspin and Perry have developed a *short list* of unique items that need to be protected. Attack submarines are one of the items included on the list."

- Inside the Pentagon, June 3, 1993

"Pentagon officials are considering a plan to build a third SEAWOLF attack submarine modified for special operations in FY-96, which would help preserve two shipyards and meet legitimate defense needs, according to informed sources. These sources say the plan to modify the SEAWOLF for special operations, shallow water, and littoral warfare is emerging as the leading alternative in the bottom-up review of the submarine industrial base by the Office of the Secretary of Defense.

The new boat, the SSN-23, has a pricetag of about $2.5 billion, but it will require new funding of only $1.6 billion because portions of the boat have previously been funded by Congress. The boat's nuclear reactor and combat system have already been purchased, and lawmakers appropriated an additional $540 million that can be used to buy the third SEAWOLF, numbered SSN-23."

- Navy News and Undersea Technology, May 3, 1993

"ADM Bruce DeMars, director of naval nuclear propulsion, did not testify last week before the House Armed Services Committee's military applications of nuclear energy panel, but did release a statement to the group.

"Within my declining budget, reactor development ($316.5 million, up 3% from FY 1993) and plant development ($124.9 million, up $19 million from FY 1993) increase due to work on a new reactor plant components/systems, which will progress into test hardware development in FY 1994," said the DeMars statement.

"This plant is intended initially for a new, more affordable attack submarine class, planned for FY 1998 authorization. Work includes the full-scale new concept steam generator, next generation reactor, and power and control systems."

The new steam generator for CENTURION, DeMars said "will allow greater ship design flexibility and decreased construction costs due to its smaller size, spatial orientation, and improved heat transfer efficiency which reduces coolant flow requirements.""

- Defense News, March 1-7, 1993

OTTAWA — Canada will proceed with advanced studies into air independent propulsion technology to eventually equip a new submarine fleet with significantly enhanced underwater capability.

Within the next month Canada's Defense Department will announce a 10 million Canadian dollar contract ($7.95 million) for the study of two types of air independent propulsion (AIP) for submarines.

The money would be used to design and build a scaled-down version of a fuel cell AIP device. The system would be capable of producing 40 kilowatts of energy, Canadian Navy LCDR Leo Clarkin, research and development project director for Air Independent Propulsion, said in a February 22 interview.

- Navy News and Undersea Technology, March 15, 1993

"American attack submarines built two decades from now could be smaller and stealthier than SSN 688s by using superconducting electric motors.

But first the Navy has to find one or more contractors to

develop the high-tech motor and generator. It issued a broad agency announcement last month for a 3,000-horsepower proof-of-concept or technology demonstrator, and has $15 million to spend in the first year of the project. If all goes well, the Navy hopes to be able to use design data in ship concept analyses in the next 10 years, and fit them in a new boat within 20 years, according to the announcement.

The money for electric drive is just a small part of the Advanced Submarine Systems Development, funded at $133 million this year. But it could face trouble in Congress since its long lead time disqualifies it from use aboard the CENTURION, or whatever submarine the Navy builds next. In its FY 1993 authorization conference report, the two armed services committees said, "The Navy must place priority on efforts supporting the first flight [of CENTURION] and must assign lower priority to those affecting later flights.""

• Navy News and Undersea Technology, May 31, 1993

"Thyssen Nordseewerke's closed-cycle diesel (CCD) submarine propulsion system exceeded "even the most optimistic expectations," according to a company report on the test.

The report outlining details of the installation and sea trials indicates Thyssen Nordseewerke (TNSW) officials are extremely pleased, and are intent on developing larger CCD systems for air-independent submarine propulsion (AIP). The tests, which concluded in late April, used a 150 kW diesel truck engine, coupled with a 120 kW DC generator, aboard a former German submarine called the EX-U1.

The key to Thyssen's CCD is an exhaust gas management system patented by Carlton Deep Sea Systems of Kettering, England. The document described the noise produced by the gas management system as *negligible*. The Carlton system is now in its third generation.

The Carlton device extracts carbon dioxide from the diesel exhaust and dissolves it in seawater, eliminating the need for power-robbing pumps to expel the exhaust at depth and pressure. To operate the diesel, small quantities of Argon gas are injected into the intakes to replace atmospheric nitrogen, which is consumed slightly during combustion. The entire CCD kit is dubbed the Argo-Diesel."

Russian Submarines

- Inside the Pentagon, April 15, 1993

"The Russian Navy continues to pour money into its submarine fleet, and is expected to launch five new submarines in 1993, according to RADM Edward Sheafer, head of the U.S. Navy's intelligence office. In addition, Sheafer expects Russia to launch its next-generation attack submarine in 1997 with quieting performance that in some respects will surpass the U.S. Navy's SSN-688 improved submarine. "They have already developed and tested all the fourth-generation quieting techniques that they intend to employ in their next-generation submarine," he said. "That will make them quieter than the 688I across many acoustic domains, [though] not across the board."

Speaking at an April 12 press luncheon, Sheafer previewed his likely testimony before Congress near the end of this month, telling reporters that the Russian Navy will remain highly capable during the coming decade, despite the nation's economic and political unrest. He said that while Russian ground forces are in decline, the Russian Navy wants to modernize its submarine fleet and continue building aircraft carriers. But Sheafer said it will be hard to convince lawmakers that the Untied States still must worry about the Russian military.

"Selling the Russian threat on Capitol Hill is like selling used underwear," he said. "It's just something nobody has ever found a way to do."

Sheafer also said the Russians have exported wake-homing torpedoes with a range of 20 kilometers to India and probably to Iran. This allows submarines to stand off at about 10 kilometers and fire the wake-homing torpedoes at ships just over the horizon, which makes the U.S. Navy's antisubmarine warfare (ASW) task even more difficult when facing nations that possess these torpedoes. "You don't have to be the most capable mariner in the world if you've got the right kind of weapon," Sheafer said." ■

OUR NEW NATIONAL SECURITY STRATEGY: America Promises to Come Back

by James John Tritten
Westport, CT Greenwood Publishing Company, 1992
208pp. $45.00

Reviewed by Robin Pirie

It is tribute to the dizzying pace of events on the international scene that this exceedingly comprehensive and well-researched book, up-to-date as of mid-1992, already shows signs of being dated. For example, there is mention of neither Bosnia nor Serbia in the index. There are two references to Yugoslavia, both in the context of speculation about a resurgence of Russian power. And there is one reference to Somalia, but it is to the 1991 noncombatant evacuation, Eastern Exit. What a difference a year makes!

We should not criticize the author for not being clairvoyant. This is a most interesting book, doing a fine job of giving us a picture of the way our national security strategy had started to evolve in response to the unforeseen, dramatic and revolutionary events of 1989-1992. It is exhaustively researched. For example, chapter one contains eight pages and has 83 footnotes. Perhaps we shouldn't be surprised by the wealth of sources. After all, when the chairmen of the Senate and House Armed Services committees start calling for new strategies and inventing their own, there is bound to be a stir of activity and speculation. In any case, Tritten traces the evolution of new security policy from President Bush's August 1990 Aspen speech, (given on the day Iraq invaded Kuwait, and thus not accorded the attention it should have been given) to Chairman Powell's Base Force concept, to the National Military Strategy of 1992. He discusses the Base Force at length, and relates it to ideas that emerged in 1992 concerning the realignment of the Unified and Specified Commands. These ideas, which appear to be an initiative of Chairman Powell, are still in play, although the Base Force, kept alive by the political imperatives of the 1992 election year, is a dead letter.

Following the opening chapters on the emergence of the new strategies, Tritten provides chapters on the two burning issues of 1991-1992: Whither NATO? and Will Russia Come Back? While he has some interesting things to say on both subjects, these chapters are perhaps the most outdated in the book. Once again,

not the author's fault. He couldn't have foreseen the immense effect of Bosnia on Europe, NATO and the U.S. Nor the impact of the struggle between Boris Yeltsin and the Russian Parliament on the prospects for Russian armed forces.

Even without the benefit of foresight and access to the vigorous internal debates of late 1992 that led to the promulgation of "From the Sea", Tritten hits a home run with his speculation on how the Navy and Marine Corps will be affected by the strategic changes in prospect. He says:

"The Navy of the future, and perhaps the Marine Corps, will be "enabling forces." Without the need to engage major hostile forces at sea in most future contingency operations, the Navy's role is to ensure the arrival of equipment and supplies, maintain blockades, ensure local and limited area sea control, and contribute to the projection of military power ashore. The Marine Corps may serve in this capacity by its arrival as the first sustainable force while awaiting reinforcement by heavier ground and air forces.

The battle spaces for the Navy are shifting from the deep blue oceans to the littoral where the major missions involve the direct influencing of what happens ashore. The Navy cannot stay out of joint doctrine development any more than a future AIRLAND battle doctrine can ignore the contributions of the sea services." Readers will have difficulty in finding a more succinct expression of the current strategic outlook for the Navy.

Perhaps the most interesting chapter in the book is entitled "Issues for Discussion". In it Tritten speculates on the further evolution of the national strategy. He seems to think that the questions involved transcend purely military analyses, and thus will necessarily involve extensive resort to civilian experts and think tanks. His speculation on whether SDI nicely adumbrates Secretary Aspin's recent statements. He wonders, further, about U.S. strategic targeting policy now that we are not dealing with a tightly integrated USSR. He points out, quite rightly, that a major challenge will be the reorganization and reorientation of the intelligence community to new dangers that will call for new sources and methods. Most significantly of all he wonders what it means to have eight to ten years of strategic warning of the emergence of a challenger to the U.S. for global supremacy. His concerns seem to be mainly over a resurgent Russia, but they are not misplaced in general. For example, ten years before Nazi armies marched into the Rhineland in defiance of the Treaty of Versailles, Hitler had only recently been released from jail, and was regarded as a bad political joke by informed observers.

Given the ravages that we see being wreaked on the defense budget, the possibility that the defense industrial base will be largely laid away, and the present spongy nature of the concept of reconstitution, we had best look to how we will deal with emerging threats in the future. The idea that we should conduct ourselves in such a manner as to remove incentives to either friends or enemies to build up their armaments seems to have been discredited. Similarly the notion of armed forces as a general capability and insurance policy against an uncertain future seems to have given way to a flaky threat-based methodology that assumes strawman opponents and wildly optimistic logistical capabilities for own forces. It is true that global competition for supremacy is now focused on economic strength, but it is not true that military power is irrelevant either to sustaining the conditions for global growth and prosperity or to getting a seat at the table in regional councils that determine access and influence.

In his penultimate chapter, Tritten states four critical factors for success of future U.S. national security policies. First, Russia must follow a path toward becoming a democracy and liberal market economy, or at least remain passive on the international scene. Second, the U.S. intelligence community must respond to the challenge of the New World Order, dealing effectively with acute conditions that herald the emergence of regional threats, and also with chronic problems that may signal the emergence of a global challenger. Third, our allies should continue to support us, and Congress must refrain from raiding the defense budget for short term political gains. Fourth, U.S. industry must retain the ability to reconstitute. These seem like quite a tall order, especially the last two. But as suggestions for where to start in building security policies for the future, they aren't bad, and the new administration could do worse than to take them seriously.

The last chapter of the book examines the question of whether it can be assumed that in spite of all the changes, it will be defense business as usual. He points out that given the dramatic declines in expected defense budgets, the services cannot afford to indulge in the kind of self-serving debates about which should get the lion's share. Doing so, and peddling the phoney strategies that go along with such activity, Tritten feels, runs the risk of leaving us with emasculated, irrelevant forces, and setting the country on a course toward "splendid isolationism". This is pretty strong stuff, but the author has done an impressive job of marshalling facts and arguments. Whether or not one agrees with his ultimate conclusions, there is a good deal to be learned from a careful reading of the book. ■

The Rickover Effect
How One Man Made a Difference

by Theodore Rockwell
Naval Institute Press
Annapolis, MD 1992
ISBN 1-55750-702-3

Reviewed by
CAPT William R. Anderson, USN(Ret)

[Ed Note: Captain Bill Anderson commanded USS NAUTILUS (SSN 571) on its historic voyage to the North Pole in 1958.]

In the author's own words, "This is the story of a man who changed the world". Rockwell goes on to say, "He did most of it in about ten years, by the sheer force of his will and his wit... And he did it as a low-level bureaucrat, with little power and authority other than what he had created himself."

Ted Rockwell was a key member of the Rickover team. An outstanding engineer-scientist, he had one of the closest offices to HGR at old Main Navy. That helped because he wore out more than his share of linoleum responding to the multitude of summons from Dixie Davis, Rickover's number one secretary, to "come up."

Rockwell was immensely respected by Rickover. The Admiral admired his technical competence as well as his good judgement and versatility in a host of other problem areas, including political. Because of this, and blessed with the ability to track and report events in detail, he was the ideal person to write this book.

Encouraged by a number of people to write the Rickover story, Rockwell at first set about doing it as a play in which all but the very central characters would not carry their real names. Why? Rockwell was sensitive to any hurt feelings of those staff or others who might feel offended by too little attention, or perhaps too much. Hearing from critics, he abandoned the play approach, applied a mid-course correction and landed right on target with this exceptional book.

The author's sensitivity to human factors adds greatly to this book. For example, it relates how young HGR at age six had arrived in New York from Poland with his mother, the family having been called to join his father, an earlier immigrant.

Evidently, the ship's purser of the crowded liner that had brought them pocketed or lost the money, the very last they had, to send a telegram to the father advising him to meet them at Ellis Island. In any event, they waited in desperation almost the full ten days they were allowed to await being *claimed* before the steamship company was obligated to return them to the port of departure.

Thus, The Rickover Effect is much more than the story of a great technological achievement. It is the story of a remarkable man and the many persons that were drawn into his sphere, and how they interacted with him and each other. Further, it brings to light the very basic Rickover qualities that were the foundation for that success.

In deciding whether to weld or bolt the top of the reactor pressure vessel, Rickover opted to do both, saying on something so important he wanted to use both belt and suspenders. The author further explains by quoting Ed Kintner, another Rickover principal, "He had certain basic principles that he lived by and taught. Absolute technical honesty was one; he never tried to compromise with Nature."

This philosophy is brought forth throughout the book and helps the reader to appreciate, for example, why the land-based prototypes were such a wise decision, and why the dual development approach was called for, the liquid sodium project represented by SEAWOLF in addition to the pressurized water plant, represented by NAUTILUS and all subsequent. It also explains the great attention given to crew selection and training, to safety standards, and to guides and operating manuals. All of these facets are carefully detailed.

This is a very readable book. The writer has a fine ability to describe technical things in easily understood ways. Just a mundane example: his description of how a submarine head works does so in as few words as I have ever known to be used for that purpose.

Rockwell does an especially good job of telling about the many technical problems encountered—problems that could have caused a less focused and intent leader to be sidetracked. Not enough stainless steel existed in the entire country; Rickover cornered what there was. No industry produced the absolutely key metals, hafnium and zirconium. Rickover caused these industries to develop. Even the smallest components had to be designed from scratch.

The author also recounts quite well the famous Rickover

interview procedure, if something so unpredictable and varied could be called a procedure. But what comes through Rockwell's very thorough treatment of the selection process is that it just didn't pay to try to fool HGR. As in technology, absolute honesty was best.

I do not want to leave the impression that this book is just a Rickover puff piece. Laudatory as it is of the man, by faithfulness to detail and fact it makes no pretense of hiding those Rickover qualities that made him less than revered in some circles. After all, his ego was perhaps a bit too prominent; his repartee a bit too strong; his patience certainly thin. But the question, of course is, could he have succeeded as well or as quickly had these qualities been suppressed? Rockwell leaves it up to the reader to make this judgement. The material upon which the reader can base a conclusion is indeed rich.

This is a good book for many persons. I think first of the Navy men, particularly submariners, who will find this a very excellent part of the history of our service. I think too of the engineers who will be inspired by a man who had the courage to face engineering problems squarely, without compromise or equivocation. I also think of business and engineering and really all sorts of students, who will learn how one man went about creating his own road in the face of seemingly overwhelming obstacles and with little support except that which he orchestrated himself.

Rockwell brings in a number of dividends. One is his first hand observations of the strange atmosphere at Oak Ridge during the dawn of the atomic era. Another is his very excellent time line of key dates inside the front and rear covers that add to the understanding of the sequence of events surrounding the Rickover projects. Another is his description of the noise and seeming confusion of the shipyard where a massive mix of materials, technology and talent interact to build a modern nuclear submarine. Another dividend and a favorite is the section where Rockwell tells of a Pacific war patrol experience as related by Jim Calvert.

"This insider's closeup of this very complex individual", as Admiral James D. Watkins describes the book in his Foreword, not only contains a lot of interesting dividends, it will pay dividends to all who choose to enjoy it. ■

MacArthur'S ULTRA: Codebreaking and the War Against Japan 1942-1945

by Edward Drea
University Press of Kansas, 1992

Reviewed by Prescott Palmer

It has been generally recognized that almost all submarine damage to Japanese shipping in the Southwest Pacific area was useful support to the island-hopping campaign of General MacArthur's forces. It has remained, however, for the book MacArthur's ULTRA: Codebreaking and the War Against Japan, 1942-1945, by Edward Drea, to delineate just how specifically and effectively SUBPAC's submarines were focussed on interdiction of Japanese attempts to cope with MacArthur's amphibious landings. It thus identifies another dimension to submarine exploitation of ULTRA intelligence, so interestingly set forth by John Alden in THE SUBMARINE REVIEW of April 1992.

Previous books on the U.S. Submarine Force exploitation of communications intelligence generally have been content with showing how the boats were deployed to their kills from decryption of Japanese routing instructions. The importance of the amphibious support role has been little recognized or emphasized.

Drea's aim is somewhat different. First, he describes how the communication intelligence was obtained. Then, he proceeds to show how this intelligence was used to serve the amphibious campaign from Australia to the Philippines.

General MacArthur and his staff are shown using ULTRA to determine the most propitious strategic moves up the island chains. Based on what could be determined about the deployment, strength, and timing of Japanese ground, air, and naval forces, (including shipping) Japanese strength was avoided and weaknesses were exploited.

The same approach was followed by MacArthur's air commander, General Kenney, who astutely used ULTRA in the deployment of his land-based air forces (extremely marginal in strength, early on.) Then, once strategically well-situated, this air power also employed ULTRA, repeatedly, to surprise Japanese Army air power, particularly on the ground.

Lastly, and this was where submarines entered the picture, ULTRA enabled American air and submarines, time and again, to help interdict the Japanese shipping that sought to throw troops,

equipment, and supplies at the landings of MacArthur's forces. The American expeditionary forces needed the support of those submarines and like Willy Sutton hitting banks because that's where the money was, the landings were where the Japanese sent shipping, destruction of which contributed to the strangulation of the Empire. It was sort of the obverse of the Atlantic ASW strategy of deploying ASW forces to convoy routes, the better to kill U-boats.

It seems to the reviewer that Drea's excellent book makes evident this submarine aspect of SOWESPAC amphibious strategy precisely because its focus is not on submarine operations. As the eponymous title might suggest, MacArthur's ULTRA details the intense, two-year effort needed to penetrate the major Japanese Army code (untouched at outbreak of war); the interim exploitation of call-signs, direction-finding, shipping and lesser codes; and most especially (from earliest days) MacArthur's use of Navy-supplied decryptions of Imperial Navy messages (ever-useful in an amphibious arena.)

MacArthur's American, Australian, and British cryptanalysts (initially at Melbourne), called the Central Bureau, worked closely with the U.S. Army Security Agency (ASA) at Arlington Hall, Virginia. In close mail and radio coordination they doggedly proceeded from success with lesser Japanese systems, crypto errors, and captured coding material assiduously collected from jungles and sea-floor. Breakthrough finally was achieved in early 1944, from a buried cypher library unearthed by Australian mine-detectors at Sio, in New Guinea.

Connoisseurs of MacArthur's generalship and the competence of his staff will have a field day second-guessing the use, misuse, and even non-use of intelligence set-forth in MacArthur's ULTRA. Revisionist historians will have difficulty disputing the need to drop the atomic bombs after reading what ULTRA revealed about the herculean effort to ready Kyushu for the anticipated American invasion.

This well-written book is a must for both the serious student of the Pacific war (land, sea, air, and intelligence) as well as the casual reader of naval and military history. Perhaps it will even move some submariner to pursue in greater detail the submarine contribution to interdiction of Japanese Army operations. It all left this old battleship sailor wondering if maybe the Army didn't owe some overdue battle stars to the boats and the crews involved. ■

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28. KOLLMORGEN CORPORATION, E-O DIVISION
29. LIBRASCOPE CORPORATION
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32. LORAL CONTROL SYSTEMS
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34. MARTIN MARIETTA AERO & NAVAL SYSTEMS
35. MARTIN MARIETTA CORPORATION, BETHESDA, MARYLAND
36. MARTIN MARIETTA OCEAN, RADAR & SENSOR SYSTEMS
37. NEWPORT NEWS SHIPBUILDING
38. NOISE CANCELLATION TECHNOLOGIES, INC.
39. PACIFIC FLEET SUBMARINE MEMORIAL ASSOCIATION
40. PLANNING SYSTEMS INCORPORATED

41. PRC, INC. (formerly Advanced Technology)
42. PRESEARCH INCORPORATED
43. PURVIS SYSTEMS, INC.
44. RAYTHEON COMPANY, SUBMARINE SIGNAL DIVISION
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46. SCIENTIFIC ATLANTA, SIGNAL PROCESSSING SYSTEM
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NEW ASSOCIATES

Christopher G. Messer
RADM Sumner Shapiro, USN(Ret)

NAVAL SUBMARINE LEAGUE

BALANCE SHEET

AT MARCH 31, 1993

Current Assets	$283,663
Fixed Assets	236,792
Total Assets	$520,455

Liabilities and Fund Balance

Liabilities	$250,916
Fund Balance	269,539
Total Liabilities & Fund Balance	$520,455

The Headquarters Office Mortgage balance was paid in full in June 1993. A "burning of the mortgage" ceremony was held during the annual business meeting on June 9, 1993.

MEMBERSHIP APPLICATION

Individual Membership Rates:

Regular (including Retired Military)

☐	1 year	$25.00
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Active Duty, students, and naval Reserve Active Status (Drilling)

☐	1 year	$15.00
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Life Membership Rates: (ALL)

☐	34 years and under	$585.00
☐	35-50 years old	$475.00
☐	51-65 years old	$320.00
☐	65 years and older	$175.00

NAVAL SUBMARINE LEAGUE

Corporate Membership

1 - 50 employees	$ 400.00
51 - 100 employees	$ 800.00
100 - 500 employees	$1,200.00
over 500 employees	$1,600.00

Donor/Corporate Contribution

(in addition to dues)

☐	Patron	$1,000.00
☐	Sponsor	$ 500.00
☐	Skipper	$ 100.00
☐	Advisor	$ 50.00
☐	Associate	$_____

Persons residing outside the U.S. please remit an additional $15.00 per year for mailing costs

The Naval Submarine League is a tax-exempt, Virginia not for profit corporation.
Two-thirds of Memberships Dues and 100% of donations are tax deductible

NAVAL SUBMARINE LEAGUE
P.O. Box 1146
Annandale, VA 22003
(703) 256-0891

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I hereby apply for membership in THE NAVAL SUBMARINE LEAGUE. I certify that I am a citizen of the United States or a citizen of an allied country _____

_____
Signature

Name _____
Rank, Service, if applicable

Address _____

_____

Phone (Business) _____ (Home) _____

Employer and Address _____

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Position/Title _____

I was introduced to the Naval Submarine League by _____

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See Reverse Side for Rates

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- Avenue to keep current on submarine issues
- Ability to contribute to public awareness of submarine capabilities
- Association with a dedicated group of people
- Invitation to Annual Meeting
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over 500 employees	$1,600.00

Donor/Corporate Contribution

(in addition to dues)

- ☐ Patron $1,000.00
- ☐ Sponsor $ 500.00
- ☐ Skipper $ 100.00
- ☐ Advisor $ 50.00
- ☐ Associate $_____

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Two-thirds of Memberships Dues and 100% of donations are tax deductible

NAVAL SUBMARINE LEAGUE
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Your membership will bring you ....

- The Submarine Review
- Avenue to keep current on submarine issues
- Ability to contribute to public awareness of submarine capabilities
- Association with a dedicated group of people
- Invitation to Annual Meeting
- Forum for Exchange of thought on submarine matters

Entering Littoral Waters With Greater Confidence

"From the Sea" articulates a shift in the Navy's priorities from open ocean global conflict to regional contingencies in littoral waters. The AN/BQG-5 Wide Aperture Array (WAA) enhances the submarine's posture in support of the Navy's changing missions. The technology is mature and the system is in production, currently being installed on USS Augusta (SSN-710).

By providing significantly improved performance against a diesel submarine threat in littoral waters, offering greater acoustic advantage, better targeting solutions, quicker reaction times, and superior high speed performance, AN/BQG-5 will enhance submarine survivability.

With decreasing submarine force numbers and a change in the Navy's focus, AN/BQG-5 is the right investment at the right time.

MARTIN MARIETTA

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OCEAN, RADAR & SENSOR SYSTEMS
Syracuse, New York

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