THE SUBMARINE REVIEW

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EDITOR'S COMMENTS

The Submarine Roundtable which took place in June and is featured in this issue came about through the perceived need to address, in submarine terms, the various issues and questions arising from the seven month crisis and conflict in the Persian Gulf. As your reading makes the transition from the first article, which is the scene-setter of questions prepared by the committee, to the second piece which is a summary of the participant's responses, it is apparent that from that discussion **the sum will be greater** than the input of Gulf-related concerns.

In addition to the substance of the Panel's discussion, it would seem that there are at least two points of particular note. First, there was a real effort made to identify the **issues** facing the Submarine Community and not to dwell on potential programmatic solutions to those issues. Secondly, the **unanimity** as to the essential arguments for the Force, so often remarked by others about the submarine community, was in full evidence as sensitive issues of real importance to the nation, the Navy and the Submarine Force were raised and addressed.

In the first paper many questions are asked that are of interest to all of us. In the second paper answers are offered to those, and other, questions. In addition, opinions about related subjects are put forth. There are, no doubt, other aspects to consider than those taken up by the Roundtable. There may be additional points of importance that warrant notice and discussion. As always in the Submarine Community, **everybody has the right and duty to offer his opinion and be heard by his shipmates.** THE SUBMARINE REVIEW is meant to be the forum for your views and this is the time to address those issues that you believe to be important to the Submarine Community. The January 1992 issue will reserve space for your comments and additions to the Roundtable Discussion topics.

The hottest issue of immediate interest, of course, is the SEAWOLF program and its progress through the perils of a court contest, a major welding problem, those who fail to see the need and others who want to use the funds for different defense or civil purposes. The second section of this SUBMARINE REVIEW is given over to one such opposing opinion from a nationally known columnist, and to a rejoinder by Vice

Admiral Roger Bacon, the Assistant CNO for Undersea Warfare. The IN THE NEWS section, toward the end of the magazine, carries a number of clips from major public and trade press outlets which, together, tell the story of what has been happening over the past three months in the SEAWOLF program. Also included in that compilation are some interesting public comments regarding the future of the Submarine Force.

Among the five fine articles presented in this issue is one that is particularly recommended to the LCDRs and CDRs who are still in the boats but are nearing the day when they will be in jobs requiring policy-level knowledge about the acquisition and employment of nuclear forces. Robin Pirie, who is currently overseeing the activities of the SSG (Strategic Studies Group) at the Naval War College, is a submarine officer with extensive experience in the policy field and has offered his insights in the form of comments concerning a new book which covers most of the important issues of the nuclear age. This subject may well become of more importance to young submariners than to those in other branches if the current trend away from reliance on tactical nuclear weapons, and the reduction of strategic arms lead to the point that the Submarine Force becomes one of the nation's **only** nuclear forces as well as its dominant strategic force. The accompanying article by Jerry Holland focuses on one facet of that trend -- and that particular point has made a number of us realize for some time that **more submariners will be involved in nuclear force policy issues.** It seems appropriate, therefore, to urge the younger officers to make themselves more knowledgeable.

Jim Hay

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FROM THE PRESIDENT

The reality of life is that if you publish a quarterly magazine, you run the risk, because of poor timing, of missing some major world events; for example, the failure of an economic system, the collapse of an empire, and a realignment of world power. You might even miss a poorly planned and

executed coup (you just can't get a good coup anymore), and a successful counter-coup.

In fact, all that and more has transpired since our last issue. The *threat* has been declared to be no longer a threat (not universally accepted), the defense budget has entered free-fall, and the submarine acquisition programs required to sustain a modern and capable Force for the future are at risk.

Truly, these are perilous times. Decisions made in haste today, based on incomplete or inaccurate concepts of submarine capabilities will affect the Submarine Force well into the next century. Clearly, here is a role for the League (well within our charter). Educate and inform. Carry forward the nessage that submarines **are** cost-effective. And we are doing so!

Your Naval Submarine League produced a very professional video entitled, **SEAWOLF: The Inside Story**, with commentary by our Chairman, Admiral Trost. Some 900 copies were printed and distributed to the decision makers, our Corporate Benefactors, NSL Chapters, and so forth. We are hopeful the film will have a positive impact. Members may borrow a copy of the video from either their local Chapter or from NSL Headquarters. Similarly, we distributed a very detailed Fact Sheet package which sets the record straight on a number of contentious and little understood issues regarding SEAWOLF and several other programs. In addition, we have agreed to cooperate with Time-Life Books in the publication of a new volume about modern submarines and their operations; sponsored a publicity campaign to advertise the nation-wide broadcast of our movie, **SUBMARINE: Steel Boats, Iron Men** on PBS on 20 November; updated and distributed the 1991 NSL FACT BOOK; and have several other proposals under consideration to get the submarine story out to the public. This is an active program. We believe in advertising! We would welcome your ideas.

Bud Kauderer

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QUESTIONS ABOUT DESERT SHIELD/STORM and the IMPLICATIONS FOR SUBMARINES IN THE FUTURE

by B.M. Kauderer, D.L. Cooper, and J.C. Hay

The Applicability of Certain Concepts

As in any post-crisis era, we are awash in Desert Storm *lessons learned, lessons not learned*, and other analyses, some learned and valid, some self-serving, but all focused on the meaning of the Gulf Crisis of '90-91 and about the manner in which the U.S. conducted its operations. In the interest of bringing to our members a submarine perspective on the conflict, we prepared a menu of topics which served as the catalyst for discussion and debate among senior retired submariners conducted at League headquarters in June, 1991. For convenience, a number of the subject areas were condensed and categorized by major theme, or concept. As a starting point for comment and discussion, a brief introductory paragraph was offered, and for each general topic several specific questions were presented.

In addition to Desert Storm originated issues, the continuing Soviet threat and the recently published vision of the future by the Navy Department leadership were both offered as subjects of related interest.

1. Deterrence:

As we have defined and practiced it over the past thirty-some years, this cornerstone of our national security policy has meant that the U.S. must maintain the credible capability to inflict a level of damage to any potential aggressor which is unacceptable to him, and therefore keeps him from acting against our vital interests.

The world has changed from the Cold War days of bi-polar superpower confrontation to a more unstable multi-polar scenario. In fact, it may be a mono-polar world with the U.S. generally responsible for maintaining some semblance of order in situations where United States vital interests are involved. The question is whether or not deterrence is applicable to problems in the Third World.

a. Was deterrence applicable to the Gulf situation? If so, was it effectively employed?
b. If not, why didn't the Iraqis continue into Saudi Arabia when they had the chance? Why didn't they use chemical or biological weapons?
c. In general, is deterrence an effective premise for Third World situations?
d. How will the U.S. military organizational changes currently being discussed effect our reliance on deterrence? Will this impact on the role of the submarine?
e. Will there be an increased role for the strategic submarine (SSBN)? Or for an SSBN with non-nuclear weapons?
f. Is the submarine-launched cruise missile (SLCM) a credible/viable deterrent weapon?
g. What improvements to the SLCM system are technically feasable and required to provide a significant contribution to the Navy's striking force?

2. <u>Uniqueness of the Gulf War:</u>

The Persian Gulf War was unique in that several significant elements differed fundamentally from campaigns in our recent past, and from those for which we have been planning over the past several decades. Specifically, we had on scene an accessible and sufficient supply of POL; there were ready-to-use modern airfields and seaport facilities; there was no primary and active sponsor for the enemy, such as the USSR and the PRC had been during our Vietnam operations; we did not have to protect against a major outbreak elsewhere in the world; we had a known and overwhelming technological advantage; etc.

The question here is what lessons should we learn outright -- and what lessons are so dependent on that uniqueness that we should ensure they are not indelibly incorporated into our planning, our doctrine, and the lore which makes up the body of our corporate military memory?

a. Are there Third World situations (perhaps like Libya) which present circumstances such that the approach, mix and use of force would be much different from that employed in the Gulf?
b. How does the geography of Iraq (short coastline, location well inside a restricted seaway, major target sets at a fair

range inland, etc.) compare with other probable sites of Third World action for U.S. forces?

3. Submarine Threat:

There was no submarine threat (nuclear, non-nuclear, real or perceived) to either our combatant sea forces on station in the Gulf theater or to our sea lines of communication. Neither was there a submarine threat which had to be faced during our Vietnam operations.

Does our body of military experience (the general body, not the Submarine Force talking to itself) discount the threat of enemy submarines outside of the Soviet context? If not, does that same body recognize that the best counter to any enemy submarine threat is our own SSN force? Is it?

a. How would the presence of an Iraqi submarine force have effected coalition operations? How about the presence of any non-friendly submarines?
b. What if Libya (or Algeria, or India) had taken the same stance as Jordan in support of Iraq, and sent their submarines into the areas through which our insertion/resupply/reinforcement shipping had to pass?
c. What if the Soviets had, with unstated intentions, sailed six attack submarines into the Atlantic; or had put even one into the indian Ocean?
d. We have described in general terms the totality of the Third World submarine threat. Have we ever quantified the actual threat we would face in a specific instance?
e. How might the Third World submarine threat be described, characterized and/or quantified so that we can use it as a factor to justify force levels?

4. Cruise Missiles:

Although sea-launched cruise missiles have been present on ships and submarines for several years, they had not been used in a land-attack role until this conflict. Specific Weapons System Effectiveness conclusions await the completion of analyses.

The main question here seems to be whether or not these fairly expensive expendable weapons are to be used on relatively cheap targets.

a. Is it valuable to national defense planners to have the potential which a submarine can offer to launch a covert cruise missile attack from an unsuspected/unguarded azimuth?
b. Is the concept of strike by unmanned missiles (with follow-on satellite and RPV battle damage assessment) more acceptable than attack by manned aircraft flying in harms way? If the answer is one of scale, should we be investing in SSGNs loaded with hundreds of sub-launched missiles as recommended in the NAVY 21 study?
c. Are the planned improvements in SLCM sufficient to make this a viable weapons system, and are there any other improvements needed?
d. What is the role of the submarine launched land-attack cruise missile, both as a weapon in Third World conflicts and as a deterrent to big war? (Surgical Strike or shore bombardment?)
e. Can the SLCM system reduce the attrition of U.S. and allied aircraft ships and manpower in Third World conflicts?

5. Mines:

The Gulf forces were not prepared to handle the Iraqi mine threat. It is believed that Third World countries will likely use mines as an inexpensive and effective deterrent to naval operations in their regional waters. What mine warfare role can submarines perform in future Third World contingencies to counter the mine threat?

a. Will submarine launched unmanned undersea vehicles (UUVs) be helpful in countering the mine threat?
b. Could submarine-borne special operating forces (SOF) be useful in clearing shallow water and beach approaches for amphibious operations?

6. The Impact of Gulf Lessons on Force Structure:

Can the multi-faceted capability of the modern attack submarine gain credibility and recognition in the wake of this victory, as force levels are reduced, weapon stocks are drawn down and joint operations are heralded as the way of the future?

a. Will the presence of PGMs (Precision Guided Munitions) and unmanned vehicles such as the Pioneer RPV have a long-term effect on force levels? That is, will there be a force-offset for increased use of smart and remotely operated weapons systems? Will that offset be considered as part of the 25% drawdown now in the works or will it be in excess of that?
b. Will the man-in-the-loop be a mandatory requirement for the U.S. main strike force?
c. Can the submarine maintain a credible role in near-war embargoes, war-time blockades and/or non-crises presence?

7. Command, Control, Communications and Intelligence (C^3I):

There is a general perception among Fleet and Task Force Commanders that operations with submarines pose problems because of communications, safety, water management, targeting, mission planning, etc., and that submarines are not sufficiently responsive to Battle Group and Operational Commander's requirements.

Is this a real problem or a lack of understanding of the requirements and operational procedures that have been so successful?

What, in general, should be done to upgrade C^3I architecture to permit submarines to be more responsive to the operational commanders?

8. Submarine Value Added:

The Submarine Force can claim, justifiably, a multi-mission capability and platform cost-effectiveness as a result of a wide spectrum of utility in very diverse scenarios (with or without air superiority). Among those capabilities are Anti-Submarine Warfare, SOF delivery, mining, intelligence collection and surveillance, and increasingly, our contributions to Strike Warfare.

Could these have been better utilized in the Desert Shield and/or Desert Storm operations?

a. How useful are these current capabilities?
b. How should submarine capabilities be enhanced for use in Third World contingencies?

c. Which of the following add-on possibilities would warrant investment in full-scale development?
   - Submarine covert minefield neutralization.
   - Submarine launched and controlled Unmanned Air Vehicle for recon, RDA, comms relay, etc.
   - Soft-kill UUV for use in disabling ships attempting to run a blockade or breach a maritime exclusion area.
   - Large, long-range swimmer delivery vehicle that would give the submarine a stand-off capability to insert at least a squad-size force.
   - Enhancement of the submarine launched land attack cruise missile.
   - Other?

The real question is **how can the SSN make a major contribution to naval warfare in the future?**

The Importance of the Continuing Threat

The general perception in the U.S. is that the Soviet threat has been significantly reduced, in terms of intent if not in capability; a result of a lack of coherent leadership caused by preoccupation with internal Soviet economic and political problems. To the extent that trends in capability reflect underlying intentions however, it must be recognized that the Soviet submarine capability is continuing to grow: in 1989 they launched nine submarines and in 1990 they launched ten. No knowledgeable observer disagrees that by the year 2000 the Soviets will have a very modern, though slightly smaller, submarine force, most of which will have been built since 1970. They will have about 60 SSNs, 40 to 50 SSGNs, 40 or so SSBNs and 60+ diesels.

Although no Soviet submarines played a part in the Gulf War, should this force be considered a potential threat to our participation in Third World events for at least the next 10 to 15 years?

a. Is the assumption of an improvement in overall Soviet submarine capability (and therefore threat) valid? Is the threat to our vital interests great enough to continue to justify priority investment in ASW by the U.S. Navy?
b. How can this threat be quantified and explained to the U.S. public, media and Congress?

c. For a specific example, what would have been the effect on Desert Shield/Desert Storm if the Soviets had not been cooperative and their submarine force had been positioned in the vicinity of our sea lines of communication?

THE WAY AHEAD and the future of the Submarine Force.

The Secretary of the Navy, Chief of Naval Operations and Commandant of the Marine Corps recently published THE WAY AHEAD, their vision of the future based on the President's statement of the four major elements of our defense policy: deterrence, forward presence, crisis response and force reconstitution. They supported a Navy of approximately 450 ships, discussed reduced tensions, changed length and locations of deployments, and reduced levels of specific forces. They cited the near term requirements upon which they have to base decisions as: affordability, capability, industrial base, technology advantage -- and people (quality of life and morale).

The Ultimate Question

Given this outline of the future, and the lessons emerging from the Persian Gulf conflict, how do you see the Submarine Force, its opportunities and its pitfalls, as it wends its way through the '90s and into the 21st century? As to:

Roles	Advanced Cruise Missiles
Missions	Sub Launched RPVs
Levels	Integration with other Forces
Capabilities	Perceptions

The ability of submarines to reduce attrition of friendly forces in Third World Conflicts

Any other points?

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THE ROUNDTABLE DISCUSSION

Submarines & Implications of Desert Storm
5 June 1991 at NSL Headquarters
by B.M. Kauderer, D.L.Cooper, and J.C. Hay

Given that the principal goal of the Naval Submarine League is to educate both our members and the general public so as to better support the Navy and the Submarine Force, we must continue to expand our understanding of the roles of submarines in a changing world. The recent experience of Operations Desert Shield and Desert Storm could influence those future roles and is worthy of review.

Also given that several League members are involved in a variety of activities that afford them unique insight to those dramatic events, it seemed appropriate to formulate a comprehensive index of top-level thoughts about the future. Accordingly, a Roundtable Discussion was held in early June. Admiral Trost sponsored the meeting. Vice Admiral Kauderer acted as the Moderator.

Attendees at the 5 June session of the Roundtable were:

ADM Bill Crowe	ADM Carl Trost
VADM Al Baciocco	VADM Al Burkhalter
VADM Dan Cooper	VADM Chuck Griffiths
VADM Bud Kauderer	VADM Ron Thunman
RADM Jerry Holland	RADM Sumner Shapiro
CAPT Jim Hay	CAPT John Vick

In addition, the following were unable to attend but have contributed to the conclusions of the Panel:

ADM Bob Long	ADM Al Whittle
VADM Jon Boyes	Dr. Doug Johnston
RADM Al Kelln	

The discussion focused on the thesis and questions posed in the paper Questions about Desert Shield/Storm and the Implications for Submarines which precedes this article.

Deterrence:

The Moderator asked, "Is Deterrence still a viable concept in the post-cold war era; and if so, will the Submarine Force continue to be a major player?"

The Panel strongly affirmed deterrence as a principal element of defense and asserted that submarines will continue

to have a unique role to play in both strategic and non-strategic deterrence. The distinction between the two types of deterrence should be made more explicit because the public perceives them separately.

The role of the SSBN force is preeminent among the several strategic systems. With, however, the significantly reduced number of SSBNs, it is extremely important to maintain both the superior professional skills of that force, and the training and logistics infrastructure which supports it.

In discussing the non-strategic (or theater, or perhaps the Third World) case, two major points were made: (a) the cruise missile has carved out a very important niche in the non-nuclear deterrence, particularly with the technological advances currently in development and (b) although arms control relative to SLCMs (sea-launched cruise missiles) has been somewhat ambiguous in the past, we can expect that nuclear and the non-nuclear missiles will be treated separately in the future.

The potential of the submarine launched cruise missile to deter aggressors in the Third World is based on the marriage of the stealth of the submarine with the demonstrated success of the cruise missile for both defense penetration and pinpoint accuracy. The Panel concluded that, in order to be effective, the ability to apply force which is unacceptable, with weapons that are invulnerable to countermeasures, has to be both published and demonstrated to the Third World in such a way that the full implications of a cruise missile-capable U.S. SSN force are clear.

Cruise Missiles:

The Panel believes that an advanced submarine-launched land-attack cruise missile weapons system will provide the U.S. Navy strike forces with a major increase in capability and could significantly reduce the attrition of our own air and surface forces by a Third World enemy that has received advanced-technology air defense and anti-surface ship weapons systems.

In discussing the specific subject of cruise missile employment from submarines, the present Tomahawk was acknowledged as quite successful in the Gulf War. The Panel believes that the cruise missile from a stealthy submarine is an ideal weapon for future naval warfare, however, system improvements are critical to realize this enhanced capability.

The optimum employment of sub-launched cruise missiles is

as PGMs (precision guided munitions), with the obvious implications for both the numbers required and the mechanics of targeting. Warhead improvements in an advanced technology version will greatly enhance effectiveness, while the ability to target cruise missiles autonomously on board submarines is a critical requirement. Command, Control, Communications and Intelligence (C^3I) for targeting can be handled by a submarine at periscope depth without appreciable risk. The location and acquisition of mobile targets remains a technological challenge, but one that might be solved by submarine-launched unmanned air vehicles (UAV) for surveillance or by more advanced space systems.

Submarines in the Third World:

With regard to the submarine threat posed by Third World nations, there was recognition of the potential risk to the U.S. for interference with operations at the least, and significant political damage at the most. In another Desert Shield/Storm operation the protection of U.S. sealift could require extensive participation by the SSN force. While the threat of Third World submarines must be addressed by the U.S. Navy, the fractionated nature of that threat makes the grand total an inappropriate factor upon which to base force level. That is to say, we do not expect all Third World submarines to rise against us in unison; therefore, we can be confident of the ability of a portion of our SSN force to take on and defeat the submarine forces of any potential enemy, or plausible group of enemies, in the Third World.

On the important issue of U.S. submarine involvement in Third World conflicts, it was agreed that our strongest suite is stealthy operations in littoral water. There was lengthy discussion of three aspects of naval operations in Third World littoral waters. The first, and by general agreement the most important, was the mine threat to be expected in any conflict with even a moderately sea-capable Third World country. A very promising counter to the perceived mine threat resides in UUV (unmanned undersea vehicle) technology, presently under development in both the Defense Advanced Research Projects Agency and the Navy. Secondly, was the issue of Submarine Force-Special Warfare Force integration and cooperation and the increased emphasis being placed on that capability. Lastly, the problem of incomplete understanding of submarine operations,

on the part of both our own and enemy forces, was recognized as important in considering submarine involvement in Third World conflicts.

Command, Control, Communications and Intelligence (C^3I):

The discussion focused on the need for an improved C^3I architecture in order to more fully utilize the submarine platform by the operating commanders. Elimination of any perception of submarine communication limitations is important.

The Panel demurred in defining *real-time* other than *that necessary to meet the mission requirements*, but noted that the most restrictive need for real-time communications is in strategic warfare. The Panel felt strongly that we do have that capability now in our SSBN force and a continuing effort must be exerted to correct any residual negative perceptions. However, in looking to greater use of submarines in Battle Group operations (Strike, Mine Warfare, Surveillance, Special Force Operations, etc.) this is most important for SSNs.

Real-time tactical communications is an issue in only a very narrow range of scenarios today, as when the submarine has a long term commitment below periscope depth -- during ASW search and destroy operations. It is for the future that an enhanced C^3I capability is needed.

Four conclusions which the Panel drew from its discussion of submarine tactical communications requirements and capabilities are:

(a) C^3I requirements are mission dependent. Degrees of capability can be made to fit those needs.

(b) Communications issues can not be resolved without taking into consideration the command and control circumstances.

(c) The Gulf War proved once again that in war, difficulties with C^3I are common to all forces.

(d) Submarine C^3I is adequate today for assigned missions, but enhancement will improve the contribution and responsiveness of submarines to operational commanders. This is particularly important to submarines conducting Strike Warfare missions, either independently or as part of a Battle Group.

The Soviet Submarine Threat:

The Panel was asked to comment, from the viewpoint of the U.S. Submarine Force, on the severity of the threat posed by

Soviet submarines in a future which may be dominated by concerns with the Third World. In general, there is a perception that the Soviets can not now wage a protracted war; and because they are primarily a continental power, they will not use their Navy in a sea war which does not involve the major strength of their armed forces. The intentions argument, therefore, says that a U.S./Soviet naval confrontation is *not likely* in the immediate future. The capabilities side of the Political-Military argument, however, says that because the USSR is still a superpower, they might not have to wage a protracted war in order to harm the U.S. and its Allies. Regarding the Soviet capability in general, a major caution was raised concerning the invalid belief which can arise from the Gulf War about Soviet equipment being inferior to that of the western forces.

SSN Force Level Concerns:

The Panel was asked to comment on the implications of decreasing force levels. One of the biggest problems to be faced in a smaller force, operating in a new security environment, will be providing the motivation necessary for the recruiting and retention of top-quality people. A closely related issue will be the balance of commitments and assets so as not to overload the remaining ships.

Summary:

The Panel believes we will need a robust submarine Research, Development and Shipbuilding Program to support future naval warfare. The Panel believes that SSBNs will continue to be the dominant factor in the nation's strategic deterrence and that SSNs are, and will be, major contributors to naval warfare. In addition to present missions, such as ASW, ASUW, Strike and Mine Warfare, the Panel believes that submarines will play an increasingly important role in Third World contingencies where stealth and reduced attrition of our own forces are important.

The national defense policy, as presented by the President, the Secretary of Defense, the Chairman of the Joint Chiefs, and as articulated for the Navy in the recently published The Way Ahead by the Secretary of the Navy, the CNO and the Commandant of the Marine Corps, was felt by the Panel to be a perfect fit for the versatility and multi-mission capability of the modern submarine. It was emphasized, however, that the

message has to be delivered to the public and to the planners and to the decision makers. **The warfighting potential of submarines is unlimited, and waiting to be tapped.**

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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.

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SEAWOLF SUB: A $2 BILLION BABY THE NAVY DOESN'T NEED

by James J. Kilpatrick

[Reprinted with permission of the Norfolk Virginian-Pilot from their September 12, 1991 issue]

Just before Congress began its August vacation, Senator John McCain, R-Ariz, brought a notable amendment to the floor. He proposed to kill the Navy's $2 billion baby, the submarine SEAWOLF. It was one of the two best ideas put before Congress this year.

The other superlative idea was to kill the Space Station Freedom, the $30 billion baby of the space program. Regrettably, the space station survived. Regrettably, under pressures of the rush to recess, McCain withdrew his amendment. Nevertheless he was right on target.

A good deal has happened since McCain made his aborted effort on August 2. A group of hard-line communist conspirators attempted to overthrow Mikhail Gorbachev. The coup failed. Responding in outrage, the Soviet parliament voted in effect to dissolve itself. The Soviet empire lies in autonomous pieces. The power of the Communist Party has been smashed. Leningrad will be known again as St. Petersburg. Otherwise it was a quiet vacation.

Meanwhile, here at home, the Electric Boat Division of General Dynamics, builders of SEAWOLF, has had to begin dismantling the partly assembled hull. Hundreds of cracked welds will have to be replaced at a cost running into tens of millions of dollars. The taxpayers will have to pay for the company's mistake.

McCain has the right idea. Instead of throwing good money after bad, let us stop now. At a certain stage in the funding of any major federal project, a point of no return is reached. The project gains an unstoppable momentum, but SEAWOLF is not yet at that point.

The Arizona senator cannot be brushed aside as a know-nothing peacenik. He is a graduate of the Naval Academy, a distinguished and courageous officer, the holder of every medal short of the Medal of Honor. As a combat pilot, captured in

Vietnam, he spent six years in a communist prison. If any member of the Senate has good reason to advocate a strong national defense, it is John McCain, last of the Cold Warriors.

Why does he want to sink SEAWOLF? In his view the supersub is not needed and the mind-boggling expenditure is not necessary. "We do not need to spend 25 percent of the Navy's Shipbuilding budget on a ship that is designed for threats to this nation's vital security interests that no longer exist."

It would be far better, in McCain's view, to invest the Navy's available funds in airlift and sealift improvements. Our amphibious forces verge on obsolescence. We especially need improvement in countermeasures against mines. For the foreseeable future, McCain sees no threat from a dismembered Soviet Union. Threats will come from other directions entirely.

"The SEAWOLF class submarine does not reflect these realities or the lessons of the gulf war. It is a class of submarine which is designed to counter a very sophisticated Soviet submarine and naval threat, which none of our potential adversaries in the developing world possess."

In testimony before the Senate Armed Services Committee on June 7, spokesmen for the Navy attempted to make a plausible case for saving SEAWOLF. It was a lame effort. Rear Admiral Raymond G. Jones, Deputy Assistant Chief of Naval Operations for Undersea Warfare, described his baby as "the key, the blue chip," to maintain undersea superiority. SEAWOLF can dive deeper, lie quieter and carry more armament than any submarine ever built.

The role of submarines is growing, Jones said, not diminishing. Thirteen submarines participated in Desert Storm, and several of them fired Tomahawk missiles. They also conducted surveillance operations and provided "valuable, real-time tactical intelligence while supporting the U.N. embargo against Iraq."

Vice Admiral James D. Williams, Deputy Chief of Naval Operations of Naval Warfare, told the Senate committee that many countries are striving to acquire a submarine force. He mentioned China, North Korea and India. These provide "a significant threat." While the U.S. submarine program barely coasts along, the Soviet Union is launching nine or 10 excellent submarines a year. It is imperative, said Williams, that the United States keep ahead of the Soviets in both strategic and attack capability.

Not surprisingly, Connecticut's Sen. Joe Lieberman supports SEAWOLF; his Groton constituents at Electric Boat are building it. John Chafee of Rhode Island also defends the project, but other senators have expressed strong misgivings.

Since the heyday of Adm. Hyman Rickover, the submarine service has functioned as the most powerful, privileged and promoted branch of the Navy. This overblown role never has been justified. Congress could begin to restore a better balance by killing SEAWOLF, a submarine whose time has passed before it began. ■

KILL THE SEAWOLF SUBMARINE ? THERE'S MORE THAN A BABY IN THE BATH WATER

by Vice Admiral Roger F. Bacon, USN

A response by the Assistant Chief of Naval Operations
for Undersea Warfare
to James J. Kilpatrick's article:
Seawolf sub: a $2 billion baby the Navy doesn't need
in the Virginian-Pilot, 12 September 1991

James J. Kilpatrick visited our aircraft carrier USS JOHN F. KENNEDY during Mediterranean exercises in 1987. He was enthusiastic about seeing our 18 and 19 year-old sailors engaged in complex and dangerous flight deck operations at night. The thousands of all-American bluejackets he saw that day inspired him to write a stirring column.

His genuine friendship and rapport with sailors aboard USS JOHN F. KENNEDY, and his strong support of our Navy, have made me one of Jack Kilpatrick's admirers. I respect his views, but his recent column of the SEAWOLF submarine deserves a response. He would expect that of me.

As the Naval Officer with more years of recent operational command of submarines than anyone else on active duty, let me explain the operational art of submarine warfare. It is a one-on-one event, involving technology and people -- the same 18 and 19 year-old sailors which inspired Jack Kilpatrick in 1987. But, most of all, undersea warfare is stealth -- the ability to

operate a submarine for months in ocean depths -- without detection. With true stealth, you will win. Without it, you lose.

Submarine crews are continually trained in the first principle of the art of submarine warfare: submarines must maintain stealth and surprise until ready to yield it. Submarine commanding officers and crews must keep the initiative to shoot first, undetected, and make each shot count.

Our capability to win in undersea warfare is a product of our people and technology. But the margin of superiority has been drastically reduced by major improvements in the stealth of potential adversaries. In fact, our remaining edge is more the performance of our people than the state of our technology.

"Kill the SEAWOLF." It seems simple enough to Jack Kilpatrick, calling for an end to a decade of research and development of the next generation of U.S. attack submarines. But, does he realize that if we take his advice the U.S. will surrender leadership in submarine warfare for little, if any, real savings. Indeed, we will threaten ourselves with becoming a second-rate submarine force, incapable of building modern submarines.

Mr. Kilpatrick's argument is rooted in weeks-old Soviet developments which, he says, have made the threat non-existent. But, we have yet to observe any changes in Soviet submarine operations. As he seems convinced we will never again be threatened undersea, he must be clairvoyant.

If we kill SEAWOLF, what kind of submarine force will we have? Today, our mainstay LOS ANGELES class (SSN-688) is the best in the world, despite its 25 year-old design. This is because we have stretched its capabilities since it first went to sea in 1976.

Why not scrap SEAWOLF and restart the LOS ANGELES class? Having stretched the class to the limit there is no room for further technological growth. It is as good as it will ever be -- we can't count on it being *good enough* a decade from now.

What would we really save? The last LOS ANGELES class sub was ordered two years ago. If we ordered one in Fiscal Year 1992, it would cost only 15% less than the budgeted SEAWOLF -- while providing one-third less warfighting capability. And we'd still be contractually obligated to pay for the first SEAWOLF, plus cancellation penalties. There are no savings: Canceling SEAWOLF would cost more.

The Navy and the Submarine Force have already been affected by changes in the communist world. A year ago, when change seemed inevitable and our country needed a more affordable defense, procurement was cut from three to one submarine per year. In 2004, the LOS ANGELES class will begin leaving service at the rate at which they were built - three per year. So, with SEAWOLF, we will have a net loss of two submarines from the force each year.

A submarine study project, named *Centurion*, is already addressing that eventuality. But submarine development takes 10-13 years. Today, the *Centurion* project is where SEAWOLF was over a decade ago. By the next century, *Centurion* can produce an advanced submarine in numbers to maintain our submarine force. However, if in the meantime, we have lost our technological and industrial capability to build submarines -- the LOS ANGELES may be our last submarine class. **This is the real cost of canceling SEAWOLF.**

American submarine builders, a very specialized breed, are employed by only two shipyards. If there is a hiatus in construction of high technology submarines, they will have to find work in other industries, and there will be no incentive for a new generation to learn the skills. If we stop building SEAWOLF, we risk losing our submarine industrial base. This would also remove competition as a factor in the price of submarines. Then we will certainly know real *sticker-shock*.

To be comfortable with Mr. Kilpatrick's vision of the future, I would like to be sure the Soviets will stop modernizing their formidable submarine force. In 1990 they launched 10 submarines and continue quiet submarine production. I would like to see a stop to both the proliferation of advanced submarine technology and the construction of capable diesel-electric submarines in the Third World. Today, 39 non-U.S./Soviet countries operate about 400 diesel-electric submarines worldwide, and significant advances in quieting, endurance and combat system capability are expected in the future. I would want a guarantee that no future power will seek to control access to the sea lanes which are essential to the economic and political survival of the U.S., our allies and friends. And, finally, Americans would have to be confident that their defense is secure -- without a high quality Submarine Force.

The construction of SEAWOLF is in the last stage of a decade of development and investment in a submarine which will enable the U.S. to maintain a clear technological edge well into the next century. If we scrap it now, we will risk our national security against the hope that the geo-political currents remain flowing in the direction they seem headed today. If they ebb, as well as flow, we will hedge our bets with the hope today's undersea technology is *good enough* in the 21st century.

Much has changed in the world since Jack Kilpatrick sailed with us in the Mediterranean. But, Soviet submarines are still there, and they are a generation better. Certainly, Jack Kilpatrick understands my goal of providing our submarine sailors with the winning advantage. Anything less is wrong. Desert Storm taught us we should provide the best technology to America's sons and daughters who will go in harm's way to defend the vital interests of the United States. SEAWOLF is that technology, and it is needed now.

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ON NOT CONFUSING OURSELVES:
Lessons from an Important Book

by Robert B. Pirie, Jr.

The recent appearance of a collection of essays in honor of two very notable American commentators on 20th century U.S. national security offers a rare opportunity to look back on the building of an intellectual basis for the superpower age just past. More importantly perhaps, it encourages reflection on the meaning of that work for the new world order with which the United States now has to contend. It is therefore with a view to the future, rather than the past, that a familiarization with the background and history of deterrence theory, as developed over nearly half a century, can be recommended. It is to be hoped that work such as described and commented upon here will promote the thought, analyses and exposition needed to help guide us into the next century.

ON NOT CONFUSING OURSELVES:
Essays on National Security Strategy
in Honor of Albert and Roberta Wohlstetter
by Andrew W. Marshall, J. J. Martin and Henry S. Rowen
(Editors) Boulder, Colorado
Westview Press, 1991. 331pp. $49.95

This book is a *festschrift*, that is, a collection of essays by colleagues and friends of the Wohlstetters to celebrate their 75th birthdays. It's a nice idea, and, as it turns out, a really excellent book. Even if your first question is "Who are Albert and Roberta Wohlstetter?" you probably will enjoy the book and learn something from it.

Albert and Roberta Wohlstetter are two remarkable Americans, a fact supported, among many other things, by the Medal of Freedom awarded to them by President Reagan in November, 1985. Roberta is perhaps best known for her 1962 book Pearl Harbor: Warning and Decision, which was in fact a declassified version of a 1957 RAND study. The study was prompted not by a desire to sort out the old mythology about how President Roosevelt got us into World War II, but by a more contemporary concern: How can the leadership of a nation correctly interpret the warning signals of an impending

attack in order to form an appropriate decision on defensive measures? In the dawn of the nuclear age it was an exceedingly important question.

Albert Wohlstetter has been an influential commentator on strategic policy since the early 1950s. One of his earliest contributions was a study for the Air Force of Strategic Air Command bases, done while Wohlstetter was at RAND. The study found that basing done to get the force as close as possible to the anticipated targets created serious vulnerability to surprise attack. The study ultimately led to the withdrawal of SAC bombers from bases abroad, and to the airborne alert and fail-safe concepts, all of which greatly improved the survivability of the force. Pursuing this line of inquiry Wohlstetter developed, in the late 1950s, a new concept of nuclear strategy: second strike deterrence. This notion, now, of course, very familiar, held that what really matters in deterring a nuclear adversary is not the forces in being, but what survives an enemy first strike. Many other contributions to the development of nuclear strategy have followed over the years. Professor Wohlstetter has been preeminent not only in the creation of new concepts, but in the debunking of bad ideas. A book of essays on national security strategy, reflecting the historical development of concepts and contemporary concerns is certainly an appropriate tribute to the Wohlstetters.

Readers will find that the essays in the book are generally quite readable -- something not always the case with authors as illustrious as those gathered here. Perhaps we should not be surprised. They are all people who aspired to influence policy through the clarity and persuasiveness of their ideas.

The book begins with an essay by James Digby and James Martin on the Wohlstetters' contributions to strategic thought, and another by James Digby on RAND in the 1950s. It must have been an exceedingly interesting time. The elements of nuclear strategy were being developed, including not only that dealing with strategic bombardment, but also tactical and theater use of nuclear weapons. The latter were necessary, it was thought, to counter overwhelming Soviet superiority in conventional forces in Europe.

In addition, an analytical technique called systems analysis was being developed. This brought mathematical methods of analysis to bear on military problems whose outcomes depended

on political, economic and technological factors as well as purely military ones. The names that float through the narrative will be familiar to many readers. Besides the Wohlstetters there was Bernard Brodie, Herman Kahn, Thomas Schelling, Charles Hitch, Henry Rowen, Andrew Marshall, William Kaufmann and Alain Enthoven. And, as Digby points out, the flowering of ideas in the late 1950s was well timed for the advent of the Kennedy administration, and the tenure of Robert McNamara as Secretary of Defense.

Secretary McNamara was open to new analytical methods and ideas on strategic policy. RAND and other think tanks like the Institute for Defense Analyses and the Center for Naval Analyses contributed ideas and people to the new administration. But even as the wave of the 50s was making itself felt in defense policy, new ideas were germinating to replace or modify the old ones. First, as Albert Wohlstetter took the lead in pointing out, were the deficiencies of an all-or-nothing retaliatory posture for the strategic forces. What if the Soviets struck first, damaging our retaliatory forces but leaving most cities intact? Should the President's only option be an all-out attack on their urban and industrial targets, knowing that their counterstrike would destroy our remaining cities? One answer to this dilemma is strategic defenses, about which more later. Another answer is to create flexible strategic options in order to retain escalation dominance. This demands well-designed systems, survivable command and control, and a carefully worked out doctrine of response. These themes are explored in the book in two excellent essays. The first one is U.S. Nuclear Strategy and Employment Policy by Henry Rowen and Richard Brody, and the second one is on strategic defense by Leon Sloss. Both essays do a good job of conveying a sense of the bind that policy-makers were in, and of explaining the logic of circumstances and policy development.

The arrival of Charles Hitch and Alain Enthoven in the Office of the Secretary of Defense led to the development of the Planning, Programming and Budgeting system, the creation of the Five Year Defense Program, and the adoption of systems analysis as the primary mode of illuminating decisions in defense matters. Meanwhile, back at RAND, people like Andrew Marshall and James Schlesinger were pointing out that systems analysis had some serious deficiencies. These involved the way

measures of effectiveness were developed and used, and the status of non-quantifiable factors in the analyses. As one harsh critic put it, systems analysis trivialized the measures of effectiveness and enshrined the estimates of cost. Marshall and Schlesinger sought modes of analysis that would help explain, as systems analysis never could, why the battle was not always to the strong, nor the race to the swift. How do we account for the great upsets in military history? Can it be that the non-quantifiables such as morale, leadership, tactics and training play an important part?

Efforts to deal with such questions led eventually to the establishment of an office of net assessment on the National Security Council staff. This story and subsequent developments are described in the book in a chapter called Net Assessment: A Historical Review by George Pickett, James Roche and Barry Watts. There is also an excellent chapter on Net Assessment as an Analytical Concept by Stephen Rosen. Readers who have been nagged by a feeling that net assessment is not a well-defined concept will be relieved to discover that its originators and practitioners intended to avoid a simple, fixed definition.

On the subject of strategic defenses, the main essay in the book is by Leon Sloss, and is entitled The Ambiguous Role of Strategic Defense in U.S. Strategy. It is an excellent survey of how we got where we are on the issue. Sloss sees four phases in the development of U.S. policy in this area. The first phase, 1945 to 1950, concentrated on air defense of CONUS. In the second phase it was recognized that the principal threat for the future would be from ballistic missiles, and so efforts were pointed at defense against them. This phase culminated in the 1969 ballistic missile debate in which the Senate, by one vote, agreed to deploy the Safeguard system. Phase three, 1969-1983, is the era of the ABM treaty, in which the U.S. and the USSR agreed on stringent limitations on ABM research, development and deployment. This era ended with President Reagan's March 23, 1983 speech calling for a strategic defense initiative. Sloss concludes this historical discussion with a section in which he explores the reasons that in his view account for the bias against defenses in U.S. strategic thinking. One senses in this, and in a later chapter by Fred Hoffman, a certain sensitivity and possibly defensiveness on the subject of defenses.

The serious proponents of the SDI have had a terrible time

in the years since 1983 because President Reagan's vision was technically naive but politically powerful, whereas the proponents want something that is technically sensible but politically unsalable. Hoffman, in his essay entitled Deterrence, Stability and Reassurance, complains that: "The assumption about the inevitability of unconstrained use of nuclear weapons, largely unchallenged by either side in the debate over the Strategic Defense Initiative (SDI), also channeled those arguments into a pointless dispute about whether essentially leakproof defenses were feasible or affordable." Pointless, maybe, but it can be argued that it was the vision of a leakproof defense that made SDI possible in the U.S. and the possibility of it that helped set in train the dissolution of the Warsaw Pact and the USSR. Also, as Hoffman notes, conditions are quite different now. Before 1990 one had to be concerned that if we deployed defenses the Soviets would respond in ways that would not serve our objective of limiting damage if deterrence fails. After all, we responded to deployment of the first Moscow ABM system with the development first of MRVs (multiple reentry vehicles) and then MIRVs (multiple independently targeted reentry vehicles). Today, however, Soviet responses are of less concern. We may even be able to persuade them that defenses against third country attacks or accidental or unauthorized launches are in their interest. And, as Hoffman also points out, in a regime in which both the U.S. and the USSR (or its successors) reduce the size of their strategic nuclear forces drastically defenses will be needed as insurance against cheating. Furthermore, major powers that are not military powers, such as Germany and Japan, may in the future want increased control over their own security. It would be very desirable that this take the form of strategic defenses rather than an offensive capability.

An important theme in the book is the development of people to be strategists in the future. People like those mentioned earlier in this review do not come along every day. Andrew Marshall explores this topic in a chapter entitled Strategy as a Profession for Future Generations. He notes "It is clear that some people seem more readily able to address issues of strategy...[t]hey have a willingness and a self-confidence to address larger, more basic issues than do others...[h]ow do they get this way?" He notes the importance of a stimulating

and supportive environment, such as that at RAND in the 50s and early 60s. Although successful strategists may come from a variety of educational backgrounds, Marshall believes that training in economics, business or applied technology is most likely to produce the cast of mind that is needed. Readers will find most interesting Marshall's description of how he and Herman Kahn puzzled over why economists played such a large and central role in the studies RAND produced in the 50s. Their eventual explanation was that economists are well aware that even experts can be wrong, and that many widely held views, even among responsible people are faulty. In the hard sciences and engineering there are real experts who are much more likely to be right than the others. Kahn and Marshall decided "Economists, therefore, were more intellectually comfortable in the situation that existed with respect to nuclear warfare, in which there were no experts."

To this prescription Fred Ikle, in his chapter The Role of Character and Intellect in Strategy adds that "Good work on national security strategy -- unlike most intellectual endeavors -- demands good character." Some readers may be thinking *where is Voltaire when we most need him*, but Ikle has several good points in the chapter, including the fact that a strategist must be a realist. He cannot afford to ignore inconvenient realities nor assume that a problem is simpler that it is in fact. Ikle points out that the consequences of bad strategy in the nuclear age may be appallingly catastrophic.

There are many other good pieces in the book. There is a chapter by Jasper Welch on Technology and U.S. Strategy which points out many of the current impediments to successful application of technology to our security problems. And there is a chapter by William Odom on why the Soviets build such large military forces, which may now be of interest principally in forming estimates of how successor regime(s) may behave. Not everything about the book is as we could wish. Certainly the price of just about fifty dollars will send interested readers to their local libraries rather than their bookstores. Some of the chapters are clearly dated. Given the pace of world events that isn't surprising, but, for example there is a chapter on Clarity, Arms Control, and NATO Strategy by Richard Perle that was adapted from a speech he made in 1987. The piece is characteristically crisp and lucid, but one could have wished for

something dealing with the more recent context. But these are nits. The book is successful as a tribute to the Wohlstetters, and successful as a most interesting collection of essays on contemporary strategic issues by some exceedingly bright and articulate people.

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HOLY LOCH REUNION, ANYONE?

The United States Government has made the decision to disestablish Submarine Squadron Fourteen and the Naval Support Activity at Holy Loch by June 1, 1992.

Captain Ronald D. Gumbert, the nineteenth, and final Commander of Submarine Squadron Fourteen, has advised NSL that a disestablishment ceremony for the U.S. Navy at Holy Loch will be held on February 21, 1992 at 1400 in Queen's Hall in Dunoon. Several U.S. Navy, Royal Navy and U.K. government officials have been invited to the event. A reception will immediately follow the ceremony at 1500 in Queen's Hall. Additional commemorative events are planned for that evening.

For additional information, contact the Squadron Public Affairs Officer at 011-44-369-6005; or write: Public Affairs Officer, Submarine Squadron Fourteen, Unit 50146, FPO AE 09501-5210.

There are many members of the NSL who have had the opportunity and special pleasure of serving a tour of duty in Scotland. NSL is looking for a volunteer to be the coordinator for an organized pilgrimage to Holy Loch. We will be happy to help with appropriate administrative details. We will start by maintaining a list of names of all those interested in attending this final U.S. Navy ceremony and Ceilidh on the Banks 'o the Clyde! Please call Pat Lewis by early December if you would like to go.

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While the air strike power of the SSN is far less than that of a carrier battle group, the cost is even further less. So, if you don't have enough carriers, send an SSN or two.

With SEAWOLF's much greater weapons payload, SEAWOLF's ability to handle larger, longer-range cruise missiles, and with more countries becoming able to attack our carriers with nuclear weapons, the SSN air strike option will become even more important in the late 1990's.


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

THE END OF THE TRIAD

by W. J. Holland, Jr.
Rear Admiral, USN(Ret.)

Where do U.S. strategic weapons' policy and programs go with the end of the Cold War?
To sea.

The United States has entered a period in which diminished tensions with the Soviet Union and powerful internal incentives at once permit and at the same time require thinking about nuclear forces suitable for the new world order. The TRIAD of bombers, land and sea based ballistic missiles poised to attack a large number of places in and around the Soviet Union, with many points targeted by several warheads to insure a very high probability of total destruction, and having the highest priority in the Department of Defense Budget, is a mastodon staggering from wounds which doom it.

The fundamental theses on which the individual and collective strategic forces are based are thirty to sixty years old; are premised on a world order which has changed radically in less than two years and do not take into consideration development of cruise missiles, space surveillance and strategic defenses. Concerns with the federal budget and U.S. political beliefs about a new more serene world order contribute to a climate in which the country is not willing to pay the costs of upgrading forces considered adequate against a threat perceived as vastly diminished.

These internal political costs are now the drivers of the strategic force structure; not international politics or intra-service concerns. Congress has capped modernization for large land-based missiles at 50 Peacekeepers. Monies for the Small Single Warhead ICBM and the Rail Garrison basing system for ICBMs have disappeared from the Air Force budget. The sacrifice of the funds to build these systems by the Air Force clearly indicate that service's priorities in times of budget decline.

Difficulties in funding the B-2 bomber make it very doubtful that a large force of these planes will be procured. Invocations about continued modernization of Soviet strategic forces fall on deaf ears where additional large sums of money are required to

complete the modernization of offensive forces planned ten years ago. Both of the last two Air Force Chiefs of Staff, Generals Welch and Dugan, acknowledging these realities, have planned to dismantle the oldest ICBMs and, faced with a tradeoff between missiles and airplanes, have recommended stopping all ICBM modernization.

This sets the stage for what could be a constructive analysis and debate. The questions to be addressed are straight forward:

- How many of what kind of warheads in what delivery systems are required to make deterrence effective and believable?
- What is the role and value of those strategic defenses which can be built at reasonable costs?
- How do defensive capabilities, improved reconnaissance, and treaty limits on the numbers of weapons influence the numbers and types of offensive systems which the United States should retain or plan to build?

Unfortunately, this debate is not taking place -- at least not openly. Proponents of the component forces remain singularly devoted and vociferous on the need for forces as large or larger than ever. These promoters, analysts and operators all seem to pretend that the primacy of strategic forces in defense funding will continue and that the vast sums of money available in the past for this purpose will continue.

The central fact of the coming era is that the American people don't believe there remains a need for strategic forces as large and capable as have existed in the past. They will not pay to modernize the TRIAD as proposed by this and the past Administrations. Journalists, congressional staffs and policy think tanks are not alone in voicing these opinions. Even the three past Chairmen of the Joint Chiefs of Staff, Generals Jones and Vesey and Admiral Crowe, have testified that they no longer believe in the need to modernize land-based missiles. In 1989, General Robert Herres, USAF, first Vice Chairman of the Joint Chiefs of Staff asserted that it was now "...time to organize a structured debate to focus our strategic goals." The challenge will be not only to determine the mix of warheads and delivery systems which will be useful but also to address the internal political problems associated with various systems. The United States must resolve where strategic forces fit into the

overall priorities of a greatly diminished Department of Defense in a world where there is only one superpower.

Present attitudes of the Congress and their constituents toward strategic forces mandate that the rationale behind the TRIAD be questioned. Scientific advances have yielded devices which substantially alter the individual character and expense of each leg. As Desert Storm so dramatically demonstrated, the development of highly accurate guidance systems make hardening a tenuous answer for survivability of any fixed target. At the same time environmental concerns and huge costs have prevented the deployment of mobile systems ashore. These same technological improvements have made possible submarine based missiles with as high a destructive power as any land-based missile. Finally, the original strategic weapons system, the penetrating bomber, has become too expensive to permit acquisition of a large force.

Arguments for maintaining the TRIAD ignore these changes. Also ignored are nuclear weapons designated nonstrategic and potential contributions to targeting and defense from space-based assets. As the total number of nuclear weapons is reduced, those now considered only as theater weapons become an increasingly powerful segment of the country's nuclear forces. Space reconnaissance coupled with cruise missiles, both sea and air launched (SLCM/ALCM), provide a capability with many of the attributes of the bomber at considerably less expense. Some defense against missile attacks may be feasible. Future forces should be designed to make these facets effective and cohesive contributors to the whole.

Having acknowledged these political and technical changes, fundamental to any equation relating to strategic forces must be the recognition that nuclear weapons retain their awesome power to dominate international relations. In spite of the dramatic changes in the political character of the world and in the costs and character of the weapons' systems themselves, the world should not expect the Soviet Union to give up the only instrument which made it a superpower. There is evidence that the Soviet strategic forces, unlike America's, continue to be modernized in the midst of the collapse of the rest of the Soviet Union. Americans must recognize that the Soviet Union remains the country which has the ability to destroy the United States. Even while the events since 1989 dramatically demon-

strate Western inability to predict Soviet behavior, the leadership and citizens of the United States count on cooperative behavior and long warning times in their future defense arrangements.

This wishful inconsistency between political thought and historical evidence must be accommodated in the design of future military forces. **Nuclear weapons, while no longer dominating acquisition monies, must continue as the umbrella under which all other forces operate.** Even more than the past, forces which have great flexibility, which are fixed as little as possible in time, space or mission will be of most value.

While nuclear weapons dominate international relations they do not confer on their owners the ability to control. As the need for the United States to control or limit Soviet behavior decreases, interest in and need to influence behavior of lesser states increases. Nuclear weapons were of prime importance in influencing Soviets. But they may not possess a similar value in all other situations. The value of force in international relations between major nations appears less than at any other time in this century yet hopes that violence would decline across the whole spectrum of relations were shattered by Iraq's invasion of Kuwait. In the new world order, ideas may become more important than weapons but weapons will enforce the limits of order. While possession of nuclear weapons is of no use in the drug war, they remain absolutely necessary to establish the limits of violence, even when facing only Iraq.

Of all of the operational and technical considerations which should make the force structure of the future markedly different than in the past, most significant is that there will be **fewer targets and fewer weapons.** The dissolution of the Warsaw Pact has already reduced the number of targets for offensive systems. As the numbers of weapons allowed for offensive systems first is capped and then reduced by the Strategic Arms Limitation Treaties, the target list will decrease dramatically.

As the number of weapons are reduced, allocation of the weapons remaining will be subject to serious competition. No longer will there be enough warheads to allow aiming several at single points in order to obtain a very high surety of destruction. Representative Aspin characterized this design as "...making the rubble bounce" and he espouses the widely held belief that this targeting method is neither necessary or believable. Whatever

the design or policy of the future may be, the resulting forces must be able to be rationally explained to the American people and their lawmakers.

Because there will be fewer weapons in the future, individual weapon utility, survivability and endurance will be of greater importance than in the past. When warheads are severely limited in number, the value of each is higher than when there are plenty. In a small force, survivability and endurance become much more valuable than in a large force where sheer numbers provide redundancy as a substitute for protection. Systems which are survivable become even more valuable as the numbers of weapons decreases.

Great benefits come when survivable forces comprise the larger portions of the strategic forces. The need to launch under attack, lest the weapons be destroyed, disappears. Command and control systems which support survivable systems do not have to execute forces rapidly and so are vastly less expensive and complex than those which must support vulnerable forces. Similarly, policy and procedures can be considerably less demanding when retaliatory forces are immune to a first strike.

Strategic defenses offer a powerful mechanism to limit damage. Although the present inability to design a totally effective defense against ballistic missile attack must be acknowledged, these defenses can affect usefulness of the offensive forces of all sides and could have some influence on proliferation of weapons by second order powers.

Defenses are only one aspect to the new strategic equation. Those trying to design forces for the next two decades must be careful to avoid cultural biases of the 1950's. Because the genesis of strategic bombardment was composed by airmen, most notably Douhet and Mitchell, most previous analyses of strategic forces have assumed the attributes first of bombers and then, after 1965, of ICBMs. Yet these forces will be less important in the future than they have been in the past. Not only have sea-based strategic nuclear weapons become more numerous than land-based ones, but the advent of cruise missiles, space reconnaissance, flexible command and control and strategic defense have added new dimensions to the options available in the designing of forces. Additionally, as the size of

strategic forces decrease, the importance of nonstrategic nuclear weapons grows to significant value.

Shaking off the shibboleths and breaking with the traditional analytical *truths* in this area requires recognition of these new conditions. Attributes of bombers and ICBMs in the past have driven plans, policies and operating procedures for all the offensive forces. To the extent that the assumptions associated with these forces are no longer valid or are valid **only** for those forces, the United States ought to change its policies and procedures. Survivability is, as ICBM apologists have come to recognize, a much more valuable and important characteristic than alert rate.

Within these general guidelines then, the characteristics which should be good measures of effectiveness of the offensive strategic forces of the future include:

- High survivability.
- Great targeting flexibility.
- Wide operational flexibility.
- Room for growth and change.
- Low stress on warning and command systems.
- Political acceptability.
- Economic Utility.
- Low vulnerability to future changes.

No single weapons system encompasses the best of all these features. But sea-based systems clearly possess these attributes to a far greater extent than systems based on land or in space. Systems at sea are not only survivable but essentially untargetable. Survivable and enduring systems present a deterrent threat regardless of the size, shape or nature of an enemy's offensive forces. Additionally, survivable systems permit longer warning and decision cycles. Vulnerable weapons, which must respond within minutes or suffer destruction, place severe demands on the supporting C^3 systems and decision makers.

Nonstrategic nuclear weapons dispersed in mobile platforms have similar characteristics. Insignificant when the total numbers of weapons were very large, nonstrategic nuclear weapons will become a major portion of the country's total nuclear force when strategic forces are capped. As these weapons are coupled to long range delivery systems, they provide discrete forces which can be very valuable in long term conflict management as well as serving to dissuade nuclear

blackmail. Targeting flexibility argues for single warheads and many discrete delivery platforms in most applications other than general war. Nonstrategic weapons have always possessed these attributes but long range cruise missiles have enhanced these virtues immeasurably. For missions requiring single warheads, cruise missiles represent a delivery system of great flexibility. Both sea-launched cruise missiles (SLCMs) and air-launched cruise missiles (ALCMs) complement the present bomber force and promise to extend the utility of B-52s through this decade and B-1s well into the next century regardless of developments in anti-aircraft and missile defenses.

When offensive forces can survive an attack, they do not need to be defended. Then defensive systems can concentrate on protecting national cultural and economic values from blackmailers rather than having to be devoted to protecting strategic forces from first strikes. This shift emphasizes the utility of defense against the irrational or terrorist threat -- a capability that even the most severe detractors of SDI admit is a realistic aim.

Finally, in determining new force structure, costs must be considered. In a world in which the Soviet Union is not the most likely threat, any large new defense investments will be made on conventional requirements, not strategic forces. In addition to the constraints imposed by economic costs, the domestic political costs associated with various systems will be a major consideration. While each system or set of forces has its political constituency, usually related to the system's construction or operation, new or expanded systems have to face the growing costs associated with basing schemes. As the threat decays, willingness to allow significant environmental damage to house nuclear weapons declines also. Both of these considerations add to the attractiveness of sea-based systems: presently the most inexpensive way to add modern warheads to the arsenal.

One sure outcome of the realignment of strategic forces in the future, whether the result of a rational analysis or simply the grinding of internal political considerations and the limitations of START, will be a diminished role for the Strategic Air Command (SAC) force of land-based bombers and ICBMs. Fifty percent of the present U.S. strategic missile weapons are carried on sea-based systems. As weapons are taken out of

service to comply with arms limitations treaties or simply because the weapons systems age without replacement, this ratio is likely to increase. As forward bases are closed, a similar shift in the ratio between land to sea will occur in deployed nonstrategic nuclear weapons.

The Air Force, freed of the burden of SAC as its raison d'etre and a major resource claimant, will naturally shift attention to missions in space and theater warfare. Devoting more intellectual energy and material resources to space may be the most important outcome of the force realignments in the long run. Better use of space for defense, reconnaissance and other military purposes, now neglected because of overriding concerns with strategic offensive forces, would be sure to result.

With the end of the TRIAD, the strategic offensive force mantle will fall on the Navy. Sea-based forces not only provide capabilities equal to those based ashore but possess endurance and a natural flexibility which cannot be matched by systems which must be launched on warning to avoid destruction. And since sea-based forces can move about the world, their potential attack azimuths are so diverse that defense against them becomes very difficult. At the same time, cruise missiles on a large number of maritime platforms augment the bomber force, giving the country even greater flexibility than can ever be achieved in bombers alone which, based in fixed locations, must make their approach along easily determined paths.

The Navy's greater role in the construction and operation of offensive strategic forces will have a number of effects. As a body, the Navy not only has little emotional investment in or commitment to strategic forces, historically it has been opposed to the concept of strategic bombardment and reluctant to spend money on such forces beyond that mandated by higher authority. There is no organizational entity or officer community which owes its existence to strategic forces since command of these forces is organized by warfare specialty (submarine) vice mission. With Mahan as its prophet and not Douhet, the philosophical roots of the Navy are in control of the sea and not in shore bombardment. The institutional pressures which have been responsible for proliferating strategic weapons in the Air Force do not exist in the Navy.

Public analysis and debate about our future strategic forces seems to offer significant opportunities for substantial improve-

ment. A politically acceptable basis for strategic forces would be a very desirable outcome not only for the United States but for the world. If there is no public debate the force structure will be determined entirely by Congressional willingness to authorize and fund forces put forward in the Defense Budget. The outcome of that effort, now going on in Congress, appears easy to predict: a small bomber force of some B-52s, 95 B-1s and a handful of B-2s, 50 ICBM Peacekeeper (MX) missiles in silos and eighteen TRIDENT submarines carrying the bulk of the U.S. offensive forces. The potential contribution of cruise missiles, of nuclear weapons assigned to theater forces, of defensive systems, of improved reconnaissance, would continue to be ignored in strategic planning.

If and when addressed, it seems likely that the new strategic forces of the United States will be at sea. The TRIAD will be replaced by a more sophisticated and diverse set of armaments which will cost less, deter better and be more comfortable to live with.

[Ed. Note: W. J. Holland, Jr. is President of the AFCEA Educational Foundation. He is a retired naval officer and a former Director of the Strategic and Theater Nuclear Warfare Division in the Office of the CNO.]

■

IN REMEMBRANCE

Captain Philip Edwin Burcher, USN(Ret.)

Captain Robert J. LaBrecque, USN

Robert L. Tanner
(NSL Corporate Representative for
Pacific Fleet Submarine Memorial Association)

Douglas P. White

CANADIAN SUBMARINES - "ON-AGAIN, OFF-AGAIN"

by Pieter L. van Ewijk

On Wednesday, April 24, 1991, Canada's top naval officer, Vice Admiral Charles Thomas, resigned from his post as Vice Chief of Defense Staff. His resignation was accepted by Chief of Staff, General John de Chastelain, who said "I find it particularly unfortunate that you choose this moment ... to make this unhappy gesture." Although this incident, as you can well understand, shook up the Canadian Armed Forces, it did not come entirely unexpected.

The view most Canadians hold is that with the changing global political situation, strong armed forces are no longer a necessity. Indeed, the end of the Cold War, the dissolution of the Warsaw Pact and the re-unification of Germany spell good news for citizens all over the world.

The correlation between Admiral Thomas' resignation, this global stability trend, and a submarine related issue is not readily clear. There is more to this issue than a difference in opinion between a top military officer and a government department. The root of this problem goes deeper than just a few budget cuts. Since Canada has developed a burdensome national debt, as have practically all other western nations, the onus is on the government to balance its budget and reduce this debt.

This, however, can be done only by drastic cuts in the various ways the government spends its revenues, one aspect being the Armed Forces. As Canadian military leaders now re-formulate the tasks, force strengths, equipment levels and various programs, it is becoming increasingly difficult to maintain the present strength, or a smaller force where updating is feasible and possible. Under these terms, although not yet official, the Canadian Army stands to lose the most. It is likely some domestic army bases will close, as well as cuts to staffing, if not outright closure, of the overseas bases in Germany. Although it appears that the Navy will not be faced with direct cuts as such, it does look like some planned acquisitions will either be postponed or canceled altogether. There is speculation that three of the twelve patrol frigates that have been planned or ordered to replace older, outdated destroyers, may not be built.

When we look at the Canadian Submarine Force, however, the picture is even bleaker. The current re-structuring plans would shelve proposals for the replacement of Canada's ageing OBERON class submarines. At present, Canada has three operational subs on its fleet roster: HMCS OJIBWA, ONONDAGA and OKANAGAN. These subs were commissioned between 1965 and 1968, and are to be decommissioned in 1993, 1996 and 1997 respectively, after about thirty years of service. The 1987 white paper on Canadian Defense proposed a grand total of ten to twelve nuclear powered attack submarines, costing at least $8 billion, to replace these three old subs. This force was to give the Canadian Navy the power and freedom to patrol in Pacific, Atlantic and Arctic waters, and enforce Canadian sovereignty in these areas. The 1989 Federal budget, however, torpedoed the planned purchase of these subs, citing budget constraints and a lessening of east-west tensions. Since the 1989 budget there has not been another white paper, nor has there been an official review of the Canadian Armed Forces or its roles.

At this moment, though, the future of the Canadian Navy's submarine arm is uncertain. At best, if plans to replace the subs with *off the shelf* diesel-electric designs is announced within the next few months, the Navy will have a continuation of its submarine branch. As this is highly unlikely, both as far as time of the announcement and type of design required, the Navy will have a gap of several years between scrapping its old subs and acquisition of new ones. This will have serious consequences for the navy, for as Captain Jay Plante of the 1st Canadian Submarine Squadron in Halifax stated "If there is a gap, then you lose submarine expertise. How do you maintain the expertise to man the boats?" The worst scenario, however, is what Admiral Thomas envisions will happen. He charged that Canada plans to scrap its three subs, and simply not find replacements for them.

Unfortunately, if this prediction comes through, it would not be the first time in Canadian history that there is a discontinuation in the submarine arm of the Navy. In fact, many times during the past eighty years that Canada has had its own naval forces, the submarine branch has been in the position of *on-again, off-again*.

The Royal Canadian Navy was officially established on November 9, 1910. Previously, Canadian interests were protected by ships of the British Royal Navy, until it was mutually decided Canada should look after its own defenses. Canada's first involvement with submarines was July 29, 1914, shortly before the start of World War I.

The first two submarines in the Naval inventory were CC-1 and CC-2. These submarines were built in Seattle for the Chilean Navy. The deal fell through, however, and these subs were for sale. With the threat of a world war looming close on the horizon, the premier of British Columbia, Sir Richard McBride, purchased the submarines. He felt that the West Coast was not well protected by the Canadian Navy in case of hostilities, and the boats were secretly transferred to Esquimalt Naval Base. On August 6, 1914, the purchase was approved by the federal government, and the submarines, originally named IQUIQUE and ANTOFAGASTA, were commissioned as the CC-1 and CC-2. The subs resembled the British "C" class, hence their CC designation.

After three years of training off the BC coast, conducting torpedo attacks and aiding destroyers in ASW practice, the subs were ordered to the European theater of operations. On June 21, 1917, the two subs with their support ship, HMCS SHEARWATER, set out for Halifax. They were the first warships ever to travel through the Panama Canal flying the White Ensign. When they arrived on the East Coast, much in need of repair, maintenance and engine overhauls, it was determined they were unfit for further duty, let alone cross the Atlantic Ocean, and remained in Halifax until they were scrapped in 1920.

During World War I, ten British "H" class submarines were built at Quincy, Massachusetts. As hostilities ceased, two of these subs were rerouted to Bermuda, and presented to the RCN in February, 1919. They were commissioned at Halifax in June of that year as CH (Canadian "H" class)-14 and CH-15. With the election of a Liberal government in December 1921, however, and the subsequent re-evaluation of Naval requirements, these subs were paid off in the summer of 1922, and sold for scrap five years later.

Then came a period of time that the Canadian Navy did not employ any submarines. The four above mentioned submers-

ibles, all roughly 300-350 tons, with a crew of 20-25, did not receive a fair chance to prove their worth for various reasons. One was that Canada did not have any submarine expertise among its ranks; instructors and advisors had to be brought in from Britain. Also, these submarines were only employed for a few years each, with no planned follow-up construction or purchases, in which changes could be incorporated. So every time new submarines were acquired, the Canadian submarine branch had to be re-organized, and new officers and men needed to be found to staff boats and support positions. With the decommissioning of the two "H" class subs in 1920 came a temporary halt to the sub service again. Please note that Canada was the ONLY major navy which did NOT have any submarines in service during the Second World War.

The next two submarines employed in the service of the Canadian Navy came from a rather unlikely source. They were the U-190 and the U-889, both of the IX-C type, built in Bremen in 1942 and 1944 respectively. These boats surrendered to Canadian ships at sea May 12 and 13, 1945, a few days after the war was officially over. On January 12, 1946, after extensive testing and evaluations, U-889 was turned over to the USN. She was sunk by the USN in torpedo tests off New England the following year. U-190 was also used for evaluation and ASW training until she was paid off July 24, 1947. On October 21 of that same year, she was sunk by Canadian naval aircraft at the exact location U-190 sank her last victim, HMCS ESQUIMALT in April of 1945.

Both during and after the war the Royal Navy provided submarines for ASW training in the Canadian Navy. As the number of anti-submarine ships in the fleet increased, it was felt that a submarine should be stationed at Esquimalt for use on the West Coast. USS BURRFISH (SS-312), (fifth in the BALAO class) was borrowed from the U.S. Navy, and commissioned in the RCN January 12, 1961, as HMCS GRILSE. She served for about eight years, and was then returned to the USN.

Just before HMCS GRILSE was returned from the fleet, another sub was borrowed from the USN. The USS ARGONAUT was modified to *GUPPY* configuration in 1952, was purchased from the U.S. for $150,000 and commissioned December 2, 1968, as Canada's eighth submarine, HMCS RAINBOW. After a distinguished and long career, she was

taken from active duty December 31, 1974. During her career, she made over 10,000 dives.

Presently there are three active OBERON class submarines on the fleet roster. They were all built at H. M. Chatham Dockyard, UK, between 1962 and 1966. At that time they were the quietest subs available, and now, after almost thirty years of service, they are still rated among the quietest. These subs have six torpedo tubes in the bow, while the two stern tubes were removed during the SOUP (Submarine Operational Update Program) in the late eighties. This included a complete overhaul of the interior, updated sensors and an upgrade from obsolete Mk-8 free-running torpedoes and Mk-37 initial wire-guided torpedoes to a 21 in. Mk-48 mod3 torpedo capability. As everyone is well aware, though, a life extension can only prolong the operational life for a certain period of time, and these subs will reach the absolute end of their operational life soon. Furthermore, with a top surface speed of 17 knots, and only 12 knots submerged, and very limited armament options, these subs are not up to the modern-day high speed chases and extended endurance patrols.

The latest addition to the Canadian fleet is also an OBERON class sub: it is the former HMS OLYMPUS. On September 18, 1989, she was commissioned in the RCN as HMCS/HTS OLYMPUS, in the capacity of harbor training school-vessel. She was originally commissioned in the British Royal Navy in July of 1962. She has no operational capabilities, and is only used for floating classrooms and diving instruction platform.

This summary spells out the history of the twelve submarines that Canada has had or still has in the fleet. When we compare this to the 700 or so submarines the U.S. Navy has had in commission since it developed its Submarine Service, it is quite insignificant. Now, with slashed budgets, staffing levels that are lower than in the last decade or so, and an ever changing political and economical scene, military officials on both sides of the 49th parallel are faced with the same prospects. In the case of the U.S. Navy, these prospects mean (among many other things), a cutback in the number of OHIO class TRIDENT submarines, and with the new USS SEAWOLF (SSN-21) finally ordered, a cut in acquisition from three a year. In the case of the Canadian Navy this means a future in which

anything can happen, including the phasing out of the Canadian Submarine Service in its entirety.

It is, however, a very frustrating picture that we see here in Canada. At a time when many smaller nations are making the move from expensive, labor intensive surface ships to operationally considered equally capable submarines (refer to several South American and Asian countries), Canada may be moving away from that option. To complicate matters even further, it may mean the downscaling of an already undersized fleet.

What exactly the future will hold as far as any Canadian Submarine Acquisition Plans are concerned, only time will tell. We may know in a few months, if the government acts quickly to replace the old OBERONs. It may be a year or two (and we will see a federal election in that time also) before any decisions are made. And these decisions may not necessarily bring on a new design or new purchase for the Navy. Unless we can get the Canadian government to act now, this will mean the Canadian Submarine Force will lapse for yet another period of time.

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MEMBERSHIP STATUS

	Current	Last Review	Year Ago
Active Duty	1004	992	1010
Others	2771	2841	2970
Life	230	225	181
Student	28	28	30
Foreign	72	70	69
Honorary	23	24	24
Total	4128	4180	4284

PLEASE RECRUIT 2 NEW MEMBERS FOR 1991!

THE RAN COLLINS CLASS SUBMARINE COMBAT SYSTEM

by J. R. Drugan

In 1981 the Royal Australian Navy (RAN) initiated a program to procure a new construction submarine and combat system to replace their aging OBERON class. This combat system development represents a top down approach which has been unconstrained by most of the normal administrative restrictions or specialized commercial interests. The system architecture has followed a basic design rule that *form should follow function*. This has lead to a federated submarine combat system with smart work stations. A primary design philosophy is one of *one console all functions, any console any function*. Each operator work station is in effect a mini-combat system. The following note outlines the development background, the system functional organization and architecture.

Historical Background of Combat System Development

Submarine combat system development in the U.S. and abroad over the past 30 years has been dictated by the Navy Department/Laboratory organizational structure and the fragmentation/specialization of the industrial base. Thirty years ago there was some technical basis for this division. The primary system elements, sonar and fire control, used very different technologies. Governmental and industrial organizations grew up around the application of these technologies. In the U.S., Bureau of Ships and Bureau of Ordnance were separate organizations looking over the sonar and fire control/weapon development and procurement. Communication between these divisions was less than optimum as would be expected with organizations having their own objectives, and more importantly, funding. Other elements of the combat system; ESM, navigation, communications, countermeasures, etc. were likewise distributed among the various organizations. In Europe, specialist companies, often with governmental interests, also developed along specialist lines. The U.S. Naval Laboratory organization was structured to support this type of development. The Fire Control System Mk 113 and the Sonar system BQQ-1/2 were products of this environment. These sonar and fire control systems, while individually capable and of high

quality, tended to be myopic with little consideration for one another or the overall platform mission needs.

Over the years the underlying, supporting technologies have changed, with high speed digital processing being central to all of the combat system development. Likewise we have seen changes in the Navy procurement organization in Washington and with the Naval Laboratory structure in recognition that a combat system is more than the integration of specialist products. Unfortunately, our first attempts along these lines have produced less than satisfactory results, cost overruns, and program cancellations. The focus seemed to switch from integration of specialist system elements to overall system elegance and complexity without the required intermediate step of a top down look at the fleet needs and a realistic appraisal of what is obtainable.

The RAN COLLINS class combat system is being developed based on a top down, function driven organization consistent with the objectives and needs of the RAN. The result has been a hardware-independent functional organization and a greatly simplified system architecture.

COLLINS Class Combat System Development Design Drivers.

The COLLINS class combat system is functionally organized to address the submarine's mission requirements. The key drivers for the combat system development were:

1) Types of patrol areas and mission duration,
2) Weapon types,
3) Traffic density,
4) Crew size and capability, and
5) Cost and Schedule.

Patrol areas/Mission duration. While the details of the operation of the RAN submarine fleet are considered sensitive, it is apparent from a view of a map of Australia that they have a very large sea area with a 20,000 km coastal boundary to defend. Within the limits of that boundary are found a wide variety of ocean conditions. The RAN operations are based on a 70 day patrol which makes them very much a blue water submarine navy and places a high premium on system reliability and maintainability.

Weapon types. The basic weapon inventory for the COLLINS class is the Mk-48 torpedo, the UGM 84 Harpoon anti-ship missile, and selected mines. The system is designed for potential expansion capability to more advanced weapons. The range of the UGM 84 and anticipated future advanced weapons is sufficient to dictate the employment of long range sensors, such as low frequency hull mounted flank arrays and an Australian designed streamed towed array.

Traffic density. The traffic density in the region to be patrolled ranges from very low (Tasman Sea) to very high (Indian Ocean). With modern towed array technology it is not difficult to project environments in which the submarine platform will be required to deal with tens or even hundreds of simultaneous tracks. This observation dictates a track management system which is capable of automatically sorting, localizing, and classifying with a minimum of operator interaction. The impact of this is to move the man-machine interface forward in the processing chain to reduce the potential for data overload. This effect is shown in **Figure 1.**

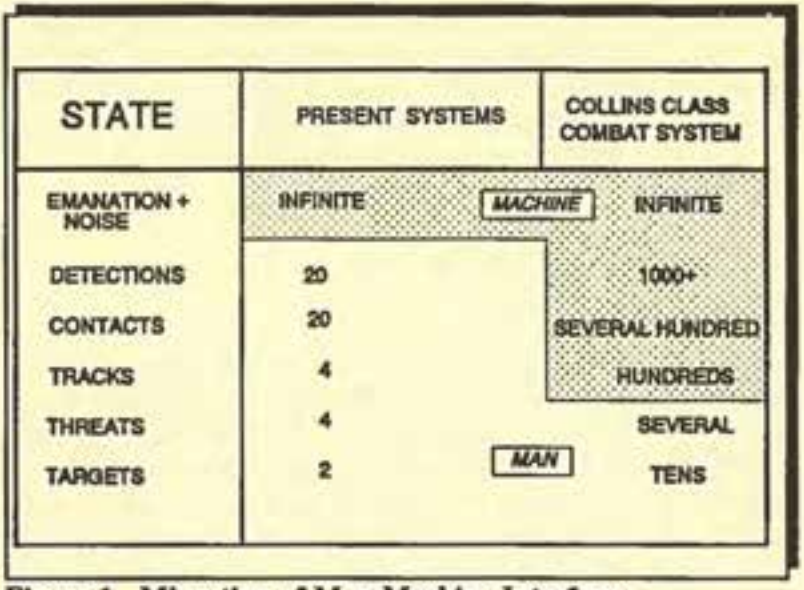

Figure 1. Migration of Man-Machine Interface

Crew Size. The crew on the OBERON class was 63, consisting of 7 officers and 56 sailors. The RAN directed that the new

construction submarine be designed to be operated by 42 men comprised of 7 officers and 35 sailors. This limitation on crew size dictates a system which is flexible and provides a high degree of automation.

Cost and Schedule. Cost is always a constraint on the design. The RAN combat system procurement is a fixed price contract. This brings with it certain restrictions in the development process, but on balance is likely a guard against excessive complexity, the number one enemy of good design. The development schedule is six years from contract award to beginning of harbor acceptance trials.

COLLINS Class Combat System Functionality.

The functionality of the combat system is matched to the RAN mission requirements and is divided into three top level functional areas; surveillance, track prosecution, and support (see **Figure 2.**). These functional areas are implemented consistent with an operational philosophy of management by exception for system tracks and management by consent for system threats and targets (the higher priority tracks).

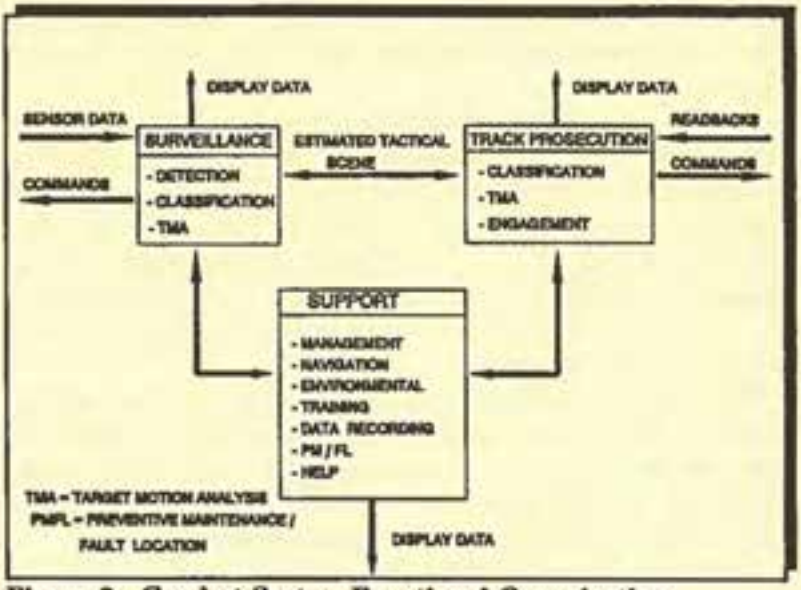

Figure 2. Combat System Functional Organization

The surveillance functional area allows the operator to review the tactical situation on progressively refined levels of data processing. The first of the series of surveillance functions is detection. The operator can review the automatic detection process as being carried out by the various sensor subsystems or become directly involved by reviewing detection information from a single sensor or combination of sensors. The operator can cause information from multiple sensors to be displayed simultaneously at a single workstation (Multifunction Common Console (MFCC) or the Command Plot (CP)). He can review the data from up to 8 different sensors simultaneously at a single workstation. He is also provided with audio stereo over high fidelity headsets at each workstation. The headsets also provide command team communication on either manual selection or automatically on a function dependent basis.

Another important difference here from previous systems is the order of reasoning which takes place to select a display. For example, the top function or operator task is detection and subservient to that is processing type and then finally the particular sensor providing the information. Previous systems which were integrations of hardware elements forced the operator to first be an equipment operator and then address the mission important function, i.e. he would be a hull array sonar operator focusing on the hardware (hull array) not the function (detection).

The second of the surveillance functions is classification. Again fully automatic parameter extraction and classification processing is provided working off multiple sensors. The operator would be expected to become involved as the track priority increases or as he is alerted by the system. Three modes of classification are provided, manual, computer aided, and automatic. The first two are contained within the track prosecution functional area.

The third surveillance function is target motion analysis (TMA). The system uses a modified maximum likelihood estimation technique as the primary background TMA process. TMA may be performed on tracks being held by multiple sensors using a priority sensor assignment scheme.

Included within the TMA function are automatic contact and track association, which work on kinematic, spectral, and

classification information. It also includes data conditioning, and zig detection.

The next of the three functional areas is track prosecution. Where the surveillance functional area is largely accomplished in the background, track prosecution is by definition operator interactive. Track prosecution is viewed as a natural progression of information from surveillance which allows the operator to focus more directly on a single track of interest. The three functions under track prosecution are TMA, Classification, and engagement. While two of these functions are the same as in surveillance their application as focus is quite different.

TMA, under track prosecution, allows the operator to review the input data set, select and/or edit the source data stream from multiple sensors associated with the track, apply constraints, use the MATE mode, and review any detected track zigs. He will also assign the source of the system from this function.

Classification allows the operator to review the automatic classification solution and underlying reasoning, to work with a modification of a RAN developed computer aided classification technique to perform a directed classification library data base search, edit the track signature, and assign special resources to a particular track of interest.

Engagement provides the operator with the displays and controls necessary to target, preview and conduct an engagement with the Mk 48, the UGM 84, or selected mines. Automatic weapon guidance is provided for the Mk 48 wire guide as are daily and situationally dependent tactical preset recommendations. Under the UGM 84 engagement mode the salvo tube assignment and firing interval calculations are automatically computed to maximize simultaneous missile arrival on target.

The final of the three functional areas is Support. Support contains those functions critical to the mission yet out of the direct tactical mainstream. Functions included in this area are System Management, Navigation, Environmental, Training, Data Recording, PM/FL, and Help.

Architecture. The COLLINS class combat system architecture is best viewed as a federated one with each workstation operating as an independent, yet coordinated, mini-combat

system. The system has a form of central processing housed in the System Supervisory Units (SSU). The processing contained in the SSU is that which would be necessary to cause system initialization and maintain background data if all of the workstations were turned off. It also provides for mass storage, the primary sensor interface, control for the data recording activity, and the distribution of common data to all workstations. Should both SSU's fail, one of the operator workstations would be designated to take over and function as an SSU for degraded mode operation. Data communication is over a Rockwell International fiber optic data bus using a hub architecture.

Each of the operator workstations is designed to have a full load of tactical software to allow the operator to operate in any or all of the functional areas.

Operator interface. The primary operator interface is via a computer labeled keyboard. The operator may also communicate with the system using trackball, encoders (4), keypad or by touch interaction with the colorgraphic CRTs. To assist him in his operation he is also provided with both a key sensitive help function, and a function oriented help (the on-line system training manual).

The optimum organization and use of the 8 operator workstations is still open at this time and remains a most interesting training and operational issue. Since any workstation can do any or all functions, command has more staffing flexibility that he may initially know how to deal with.

The initial approach will likely be to staff the system with a similar organization as is presently done with the OBERONs, modified only as necessary to access the increased capability. I would expect that this would be replaced shortly with staffing along the system's natural functional lines. However, the path is open to explore other dimensions of crew organization and training. One could organize by sector as is done in air traffic control systems and provide handoff from sector to sector. Under that arrangement one operator could deal with a single track from detection through weapon launch and control. A more natural handoff might be along functional lines. It is expected that many of these issues will be studied and evaluated using the Combat System Simulator located in the Land Based Test Site.

Software. The program for the COLLINS combat system is being written in Ada to Mil Std 1679 and 1815. It is comprised of around 2,000,000 source lines of code. It uses object oriented design (OOD) to reduce the cost of development and maintenance, and to increase the reusability of the resulting code. The requirements documentation was produced using Cadre Teamwork.

Summary. This paper has attempted to provide an overview of a submarine combat system development which is being accomplished independent from most artificial restrictions potentially caused by administrative boundaries. The design is the result of a top down, requirements driven approach. This has resulted in a different functional and physical architecture which seems to offer some operational efficiencies and development economies.

The resulting system promises to provide data access and system control from each operator workstation contributing to a high degree of flexibility and manning and operation.

This is thought to be the first submarine combat system to depart from the classic hardware driven design which had resulted in an artificial separation of function by company product line rather than user need. The RAN combat system integrates sensor input at the **data** level and allows the operator to display sensor information independent from the source.

The combat system is modular and therefore scalable to other platforms and user applications. This modular nature makes it easily matched to different sensor types and weapon complements while retaining the *feel* and operability of a functionally organized system. The structure is largely sensor and weapon independent in that the emphasis is on function e.g. detection, engagement, etc. rather than hardware e.g. type *xyz* sonar.

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UNDERWATER FIREFIGHTING

by George McQuiston Hughes Jr.

In the past few years a profound change has been taking place in submarine firefighting tactics. The addition of new fire simulators in San Diego and New London has markedly improved the ability of shipboard personnel in the handling of fire emergencies quickly and efficiently.

This program is the direct result of a shipboard firefighting renaissance that has effected every navy in the world. It began in the Falklands War and has gained momentum with the USS STARK and Soviet Mike submarine fire disasters. *[Ed Note: see SUBMARINE REVIEW, April 1991.]* *Glasnost* has had a very positive result in this area. The U.S. submarine service has been able to gain much in the way of adopting preventative practices, upgrading methods of operation and learning how not to do some things.

We are not, however, without our own disasters. The classroom at the Naval Submarine Training Facility in San Diego displays artifacts from our Navy's last major submarine fire, USS BONEFISH. *[Ed Note: see SUBMARINE REVIEW, October 1990.]* On April 22, 1988, the diesel powered BONEFISH experienced a serious fire while operating off the coast of Florida. A simple class C fire spread to the combustible hull insulation and was extinguished only after considerable effort. The prevailing wisdom was to discharge as many portable extinguishers as the crew could assemble and hope the fire could be contained.

Many of us remember the firefighting episodes in the days of diesel boats. Drills were mainly play acting and fire training situations were often the division engineer holding a red flag. Seldom was an extinguishing agent discharged and fire hose was never used for anything but taking on potable water.

In actual fires, two or three men in dungarees, OBA's and tee shirts groped through the compartment on fire. This was usually an engineroom with oily diesel-soaked rags burning in the bilge. The Purple K or CO_2 contamination was as bad as the products of combustion. The only advantage was the ability to draw a vacuum if snorkeling. Those crew members outside the fire compartment cycled back and forth bringing every available fire extinguisher to the adjacent hatch. There was

plenty of incentive to be aggressive in the attack on the fire, but the equipment was just not up to the job in a large involvement. For years it was assumed that submarine fires could be handled by portable extinguishers -- sometimes as many as twenty were discharged in futile attempts to control a blaze. It is now policy to deploy 1 1/2" fire hoses when two hand-portable extinguishers have not completely controlled a fire situation.

The vast majority of submarine fires are electrical in origin. Regular maintenance and thorough training of every crew member in isolating effected equipment are the major preventative measures. Several serious fires on the older boats were caused by battery charging hydrogen explosions and while these are still possible, their limited use of batteries in modern SSNs, and the consequent minimization of the charging intensity, has reduced this hazard.

Considering the hazardous materials, combustible metals, hydro-carbon liquids under high pressure, high explosives, pyrotechnics and pressurized vessels all in a confined area, nuclear submarines are possibly the toughest firefighting environment in the world today.

Class A and B fires occur with much less frequency but account for the majority of serious fire incidents. The newer fast attack LOS ANGELES class submarines have about 1.5 acres of combustible hull insulation. Even with fire retardant paint this represents a formidable threat in the closed environment. It was found that relying on the traditional surface ship damage control methods was not effective and that special firefighting tactics and equipment were necessary. Tests have shown that only two gallons of diesel fuel burning in the closed environment of the submarine would raise the pressure in the vessel over two atmospheres in just one minute. This fact, the effect of the products of combustion and close proximity of other potential hazards mandate a fast, aggressive, well coordinated fire attack.

Aggressive tactics were exactly what the submarine community has always practiced in wartime and this approach had to be adapted to the development of new methods of firefighting methods, operation and thinking. Realistic training to replace the old extinguisher drills was vital in this effort and could not be practiced aboard an operating vessel.

Today's submarines are equipped with up to date firefighting tools such as AFFF hand extinguishers for bilge fires, thermal imaging devices (NFTI) and state of the art protective clothing. Some of these items were adaptations of civilian gear and not equipment developed by the surface navy. The heat resistant Navy Firefighting Ensemble is an excellent protective envelope for the fire crews. The incorporation of new fiber technology greatly reduces the danger of flashover and burn injury. Fire helmets as used on surface ships were found too cumbersome for the confines of the submarine and only nomex protective hoods are worn. Every submarine now has an emergency air breathing system, not unlike the systems used by civilian fire departments, this is backed up by the old OBA. Every compartment has many connections and the men are well schooled in its use.

The standard emergency firefighting crew consists of a man in charge with the thermal imager, nozzleman, hoseman and plugman all wearing the protective fire fighting ensemble. The crew has a choice of CO_2, AFFF and Purple K hand-held extinguishers or 1 1/2" hose flowing about 60 GPM. The hose used is a derivative of National N-Dura municipal hose coupled in 25 foot lengths. Firefighting water is pressurized sea water from the trim system. This has delayed the implementation of the new navy variable pattern fog nozzle now seen throughout the surface navy and Coast Guard. The pressurized fire water system is not set up for the 40% increased volume and pressure necessary to make the new nozzles perform properly. Many submarines are being upgraded to enable this very effective replacement to be used. Some boats had to have ship alterations to enable the fire hose connections to be accessible in an emergency.

As all firefighting professionals know, the only way to insure effectiveness and guarantee efficient operations is to conduct lifelike training drills. The Navy began to design and install Submarine Firefighting Training simulators utilizing environmentally safe, live burn, heat and non-toxic smoke generating equipment. There are now two, of a planned four, facilities complete, one on the east coast in New London, Connecticut, and the newest in San Diego, California. The simulators incorporate the latest in solid state controls and provide a very lifelike and safe training situation.

In the summer of 1991 the Submarine Training Facility, San Diego, began conducting basic firefighting classes. The two-day course begins with a day in the class room followed by a day in the live burn trainer. The classes have received very favorable comments, fire schools heretofore considered the realm of nonquals are now enthusiastically attended by seasoned veterans. In keeping with the philosophy that everyone on board is a firefighter, the instructors are from a variety of rates with both engineering and operations backgrounds.

The class room portion covers the research conducted on the various submarine fire incidents through the years and an intense review of all firefighting equipment carried onboard submarines. There are about 15 students in each class from several different commands and care is taken to explain the system differences in the various types of ships to which the men were assigned. The basics of fire behavior and extinguishing agents are covered in detail. The Chief Petty Officer in charge of the training explains that the basic class is the first of three levels of training. It is primarily for equipment familiarization and an indoctrination walk through, emphasizing communication skills. The main purpose of the simulator is the operational evaluation of ship's firefighting crews in emergency situations. This is called team training and involves three exercises for groups from the same ship. The crews are run through progressively more difficult scenarios that test and evaluate their organization, communication and ability to handle unexpected problems such as equipment failures. The exercises also have progressively reduced visibility requiring the use of the thermal imaging device (NFTI). The crews are graded on their performance and reports sent through the operational chain of command. These exercises are taken very seriously.

The most sophisticated training conducted in the simulator is Advanced Firefighting School for senior enlisted men and officers. This course is designed to develop emergency scene leadership for the person in charge at an incident. Several men from the same ship attend and alternate as crew and leader through a series of complicated live burn evolutions. The participants are evaluated on how the command and control of the situation and casualties is conducted.

Every class is followed up with a comprehensive critique and the courses are improved as suggestions from the teams and the

fleet are received. The Training Centers, by the nature of their expertise, have assumed a collateral function as clearing houses for information on fires, fire prevention and specific problems encountered by the different classes of boats.

The Submarine Force has spent a great deal of time, energy and money to upgrade this very important facet of its war-fighting role. The preliminary indications are that it is working very well, and that will help all of us sleep a little bit sounder both ashore and at sea.

A special thanks to the men and women of the Submarine Training Facility, San Diego, especially Captain Raaz, his relief Captain Lattig, LCDR Reickenberg, Chief Lewis and Petty Officer Moore.

[Ed. Note: Also a special thanks to Captain Joe Taussig, USN(Ret.), Dr. Homer Carhart of NRL and many others who have been on the never ending quest to find new ways to provide fire safety and bring these revelations to the movers and shakers of the U.S. Navy.

Mr. Hughes is an experienced Training Officer for a municipal fire service and served aboard diesel submarines during the Viet Nam era.]

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MISSIONS AND ROLES FOR U.S. SUBMARINES IN THIRD WORLD OPERATIONS

Presentation at the Naval Submarine League's Ninth Annual Symposium, June 1991

by John R. Benedict, Jr.
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The U.S. attack submarine force has actively participated in Third World contingencies and conflicts in the past and can expect an expanded role in such operations in the future. To assess that role, nearly twenty primary SSN missions related to Third World operations were evaluated. SSN utilization is more likely if a Third World adversary has any of the following:

- A moderate-to-large naval force including mini-subs or submarines and *capital ships* that it highly values.
- Integrated air defenses and anti-ship capability able to place U.S. aircraft and surface combatants at significant risk.
- Militarily valuable fixed land targets within submarine launched cruise missile (SLCM) range of water navigable to SSNs.
- Vulnerable coastlines that warrant clandestine operations off their coasts by submarines, e.g., related to surveillance, special warfare, etc.

SSN attributes that provide advantages over other platforms include the following:

- Mobility/Speed: During a 1989 Lebanon crisis, a U.S. SSN underwent a complete change in weapons load-out overnight and then transited from the East Coast to the Mediterranean in 6 days.
- Self-Sustainability/Endurance: SSNs can operate independently and unsupported for months.
- Covertness/Stealth: SSNs are capable of high tactical surprise or can provide a non-provocative presence.
- Survivability: SSN inherent stealth combined with lack of ASW proficiency of many Third World adversaries enhances SSN survivability.
- Offensive Firepower including lethal torpedoes makes an SSN an **Effective Deterrent.**
- The Flexible, Multi-Mission Capability that an SSN can bring to far forward areas (denied to other forces) makes

it a **Cost-Effective** investment, particularly in view of its relatively small crew compared to other warships and the fact that no other units are required to protect an SSN.

SSN utilization (past and future) can be addressed in seven broad mission/role categories:

1. covert intelligence collection/real time surveillance / indications and warning (I&W);
2. combat search and rescue (SAR)/non-combatant evacuation operations (NEO);
3. offensive mining and mine defenses;
4. anti-surface warfare (ASUW);
5. special warfare force insertion/support/withdrawal;
6. covert land attack missile strike (STK); and
7. anti-submarine warfare (ASW) and ASW defenses.

In addition, two special topics must be addressed to complete the SSN/new world picture: SSN vulnerability in very shallow/confined seas and SSN coordination in battle group operations.

COVERT INTELLIGENCE COLLECTION / REAL TIME SURVEILLANCE / I&W.

The stealth of an SSN and its array of sensors make it an ideal platform for many surveillance/intelligence missions. The British used their SSNs for coastal surveillance in the Falklands, providing tactical I&W against Argentine aircraft raids. U.S. SSNs have been employed to perform port/harbor surveillance operations or to track individual units during contingencies.

COMBAT SAR / NEO.

The stealth and covertness of SSNs and their normal deployments in forward areas make them well-suited for combat search and rescue operations, usually on an ad hoc basis, e.g., with a report of a downed aircraft at sea near a hostile coast. More than 500 aviators were saved by submarine SAR operations in the Pacific theater during WWII, including the USS FINBACK (SS-230) rescue of LT(jg) George Bush.

In a related role, submarines can be used to extract individuals from ashore in cases in which clandestine non-combatant evacuation operations (NEO) are required.

OFFENSIVE MINING AND MINE SELF-DEFENSE.

Submarine offensive mining was done extensively in the Pacific theater in WWII. SSNs provide a safe and effective method of laying mines in areas defended by adversary forces.

[Ed. Note: Mines are deployed today for use in Third World contingencies if necessary.]

Conversely, ASW mines are a potential *Achilles Heel* to U.S. SSN operations in shallow coastal and littoral seas. Minefields could either make coastal regions inaccessible or, by funneling SSN movements, enhance other ASW force operations. Adequate SSN signature reduction/control and effective means of detecting and avoiding mines are key.

ANTI-SURFACE WARFARE (ASUW).

The classic mission for submarines is ASUW, primarily due to the inherent lethality of anti-ship torpedoes and submarine ability to survive when making attacks on adversary warships and shipping in heavily defended coastal regions. Other SSN advantages in ASUW are the ability to identify warships (vice commercial ships) in congested seas, and covertness that allows plausible denial if waging *guerrilla warfare*.

The commerce warfare conducted by U.S. submarines in the Pacific in WWII was a spectacular success, but applicability to limited conflicts is uncertain, e.g., the legality of unrestricted submarine warfare on merchants. Additionally, other means of neutralizing shipping exist such as blockades/quarantines. It is not clear to what extent submarines would participate in these operations. *[Ed. Note: Many senior submariners feel that SSNs are a valuable deterrent to Blockade running.]*

A clear ASUW role for SSNs was demonstrated by the British submarine HMS CONQUEROR sinking of the Argentine cruiser BELGRANO. This served as a deterrent to keep the remainder of Argentine's surface navy largely in territorial waters for the rest of the conflict.

Another ASUW role could involve U.S. submarines employed in a *gate guard* role. For example, they could provide the first line of defense against fast patrol boats (FPBs) attempting to attack U.S. surface combatants, i.e., providing early warning and locating information to allow aircraft and surface units to prosecute these targets as required.

SSNs have a variety of ASUW weapons available, such as the MK 48 torpedo, Harpoon, and the Tomahawk anti-ship missile (TASM). In the latter case, the SSN requires timely over-the-horizon targeting (OTH-T) for long range attacks.

SPECIAL WARFARE FORCE INSERTION, SUPPORT, AND WITHDRAWAL.

Submarines have an extremely covert capability to insert and extract special warfare forces. Covertness is often essential either to avoid mission compromise or to allow plausible denial. Small numbers of special purpose troops inserted into enemy territory from the sea are capable of performing a host of functions including surveillance / reconnaissance / intelligence tasks, targeting support (including naval gunfire spotting), and attacks on shore facilities or ships in port, e.g., using limpet mines.

Numerous examples of submarine special warfare operations have occurred in both general and limited conflicts. In WWII, 298 *special missions* were performed. In both the Korean War and the Vietnam War, coastal surveillance/reconnaissance and landing of special forces were conducted. This included the use of three specially configured transport submarines (USS PERCH, USS TUNNY, USS GRAYBACK) in Vietnam for various operations including covert beach contour reconnaissance prior to amphibious operations.

In the Falklands War, both sides used submarines for special operations. In future U.S. contingencies, an SSN could be used to insert SEALS, employing 2-man *wet* mini-subs or 6-man *dry* mini-subs (carried in compartments atop the SSN). Two former SSBNs have been converted for special warfare by the addition of two dry deck shelters (DDS) to each platform. Selected SSN-637 units have also been fitted with special DDSs.

COVERT LAND ATTACK MISSILE STRIKES.

Without question, the evolving strike role for submarines will be an enduring one for Third World contingencies and conflicts. As long as there is a need for covert, surprise, close-in cruise missile strikes (e.g., for air defense suppression), submarines will have a key strike role -- operating either independently or as part of a coordinated and distributed force of a carrier air wing, surface combatants, and submarines. Use of SSNs for land attack missile strikes reduces the risk to ships, aircraft and airmen. A leading argument for the use of missiles, vice manned aircraft, in such strikes is that the risk of loss of airmen is avoided.

Recent examples of U.S. Navy strike operations are instructive. In the 1986 strike on Libya, a massive air strike was

conducted despite difficulties in securing overflight rights for USAF stationed in the U.K.. Tomahawk, although available on SSNs and surface combatants at the time, was not employed. Nearly five years later during the 1991 Persian Gulf War, over 200 Tomahawk land attack missiles (TLAMs) were used by various warships including two attack submarines, one from the Red Sea and one from the Eastern Mediterranean.

Various fixed point targets are appropriate for TLAM including command/communication centers, dams, bridges, airfields, air defenses, ports, industrial complexes, etc. According to Vice Admiral Metcalf's article in the March 1991 U.S. Naval Institute Proceedings, "The most significant shortfall in today's Tomahawk system is mission planning. It is awkward, overly complex, and unresponsive, and it cannot meet the battlefield's flexibility requirements." It can take months (days in the best case) to plan TLAM missions if terrestrial mapping is not available. Furthermore, the current guidance systems (TERCOM map-matching and DSMAC scene-matching) can only attack known, fixed locations. There is also a lack of Tomahawk at-sea replenishment capability for both surface combatants and submarines.

Current submarines have additional constraints; they have only a modest payload (8-16 per SSN). Submarines that rely on torpedo tube launch vice vertical launch systems at present suffer a significant launch range constraint (500 versus 700 nmi). Increased connectivity with the Commander in Chief in a crisis or conflict may also impose speed and depth restrictions on the SSN that could impede simultaneous prosecution of other missions, such as ASW.

ANTI-SUBMARINE WARFARE (ASW) & ASW DEFENSES.

The February 1991, SECNAV Posture Statement remarks that "...the proliferation of submarine technology in the Third World adds a new challenge. We will have to counter quiet, modern non-nuclear submarines in shallow and littoral waters to support power projection operations. It will be one of our toughest problems in the future." Twenty Third World countries have submarines greater than mini-sub size, for a total of more than 200 worldwide. By the year 2000, approximately 40% of these are expected to be relatively modern.

Several factors magnify the Third World submarine threat. First, anti-ship torpedoes are lethal and will likely cause sinking

and high casualties. Submarines present an ubiquitous threat to surface forces which are at risk during contingencies and conflicts because of that lethality and stealthy nature as well as the difficulty of conducting ASW (particularly in shallow water). This was apparent in the Falklands by the high leverage of a single Argentine submarine on British force deployments and asset allocations. The success of the SAN LUIS Type 209 submarine in surviving British ASW defenses, along with the complete neutralization of Argentine surface forces, may have encouraged other Third World countries to acquire submarines.

A comparison of anti-ship torpedo lethality to other weaponry in various Third World conflicts points up the catastrophic potential of the submarine threat to surface ships in a Third World conflict. The combined U.S. combat deaths in Grenada, Libya, Panama, and the 1991 Persian Gulf War totaled 133. The British lost approximately twice this number in the Falklands (air, land and at-sea engagements). By comparison, a single Pakistani Daphne submarine attack on an Indian warship, KHUKRI, in the 1971 Indo-Pakistani War, resulted in 191 deaths. The BELGRANO sinking in the Falklands killed 368 Argentine sailors.

These are startling numbers compared to experience with other anti-ship weapons. No deaths occurred in either the USS ROBERTS or USS PRINCETON hits by contact and influence mines, respectively. The USS STARK lost 37 crew members after two Exocet missile hits. .

SSNs should be a large part of the solution to the Third World submarine problem. SSNs have several attributes that enhance their ASW utility including the fact that **there are some places that only SSNs can conduct ASW** and expect to survive, such as in far forward regions in which air superiority in contested. Their covertness also enhances operational security in certain roles such as the conduct of area clearance prior to the arrival of an amphibious assault force.

The covertness and sustainability of SSNs make them ideal for ASW tracking operations during crises. Surface ships are either overt by using active sonars, or if relying on passive sonars for close-in tracking, are easily exposed by periscope checks from the diesel submarine being tracked. ASW aircraft are not as sustainable. In addition, *effective* ASW tracking by

submarines should be non-provocative but if suspected, allow for plausible denial.

The purpose of SSN tracking operations of potentially hostile Third World submarines during contingencies would be to establish their location and intent against U.S. surface forces in the region. This is particularly demanding if operations are protracted and rules of engagement are restrictive. In addition, all non-adversary submarines in the contingency region need to be accounted for (possibly by similar tracking operations against these neutral targets). Sustained close-tracking operations could be required to provide prudent risk for surface forces on the scene.

In addition to the tracking operation, a number of other ASW roles are evident for SSNs in Third World operations. **Forward presence off an adversary submarine port (possibly announced) could serve as an ASW deterrent** or, if that fails, would allow the SSN to act in a *gate guard* role to initiate tracking/prosecution against an egressing diesel submarine. An SSN could maintain a barrier or attempt to control a choke point for the same purpose. Defensive ASW operations by SSNs could include area clearance in an intended operating area prior to task force arrival; or protecting a designated *haven area* for surface forces from submarine perpetrators; or defending a port/coastal facility.

INCREASED SSN COORDINATION / CONNECTIVITY WITH BATTLE GROUP (BG) -- PROS/CONS.

Increased coordination/connectivity capability with battle groups in Third World operations allows SSNs to be more responsive to the CINC/BG Commander, and to be used in more robust roles by avoiding the need for strict geographic separation as occurred in the Falklands. It also affords an opportunity to develop a more coherent ASW tactical picture.

Third World operations may be more amenable to increased SSN coordination/connectivity than was the case in a general war scenario with the Soviets. Also, Third World operations are characterized by protracted Battle Group Operations in a fixed location. This has the advantage of less time-criticality and less dynamic force movements, making it more feasible to get the needed C^3I (Command and Control Communications and Intelligence) and tactical doctrine in place.

SSN MANEUVERABILITY ISSUE IN VERY SHALLOW / CONFINED SEAS.

Waters like the Persian Gulf are an ideal environment for mini-subs. It is unclear whether a CVBG would venture into these waters during a contingency (1986-1988 escort operations) or a regional conflict (1991 P.G. War) if a heavyweight torpedo threat was present, particularly if location and intent was uncertain.

From the previous discussion, it is clear that SSNs require **high mobility/readiness** for Third World crisis response. They must be able to respond rapidly and effectively, often in a *come-as-you-are* mode. It is desirable for SSNs to be able to operate effectively and with prudent risk in shallow/confined seas. Future SSN tactics development and technical/operational training need to focus on Third World operations in addition to Soviet only situations.

Third World contingencies/conflicts reinforce the need for **high covertness/survivability** for the SSN. Improved self-defenses (active/passive protection measures) may be warranted to counter a variety of ASW mine and torpedo systems to be consistent with the high survivability goals for limited objective operations in Third World contingencies. Adequate signature reduction and control is essential if SSNs expect to operate in shallow/confined seas with coastal threats such as ASW mines and ASW aircraft employing a variety of acoustic and non-acoustic sensors. Off-board systems are required to increase the surveillance horizon for the SSN **and** as a means of increasing SSN stand-off distance from hostile, littoral waters.

Finally, **high flexibility/multi-mission effectiveness** is required for SSNs that expect to be valuable participants in the diverse and often unpredictable Third World contingencies and conflicts in the future. **Flexibility is the key** -- SSNs that can operate independently without forward basing or in close coordination with other forces via the requisite C^3I. It also includes flexible off-board system and weapon load-out/reload capability to enhance SSN effectiveness in assigned missions. In addition, SSN sensor, weapon, and other combat system features may need to be adapted to adverse Third World threats and operating environments to avoid unacceptable degradation in mission effectiveness. SSNs must be able to *go in harm's way* (e.g., mine infested waters) and conduct difficult operations

(e.g., close ASW tracking). They must also be capable of calibrated response capability (in addition to target destruction) to neutralize various threats under restrictive Rules of Engagement.

In summary, U.S. attack submarines have a significant background in Third World operations performing a variety of roles. Enhancing SSN contributions in future contingencies and regional conflicts will require continuing emphasis on high technology solutions. Many of these solutions such as those related to improved mine defenses, utilization of off-board systems, flexible targeting techniques, and ASW tracking of stealthy targets in shallow seas will be beneficial in Soviet as well as Third World conflicts. **Our challenge is to focus more on Third World contingencies and emerging threats and still account for the Soviets, including their possible involvement on the opposite side of a future regional conflict.**

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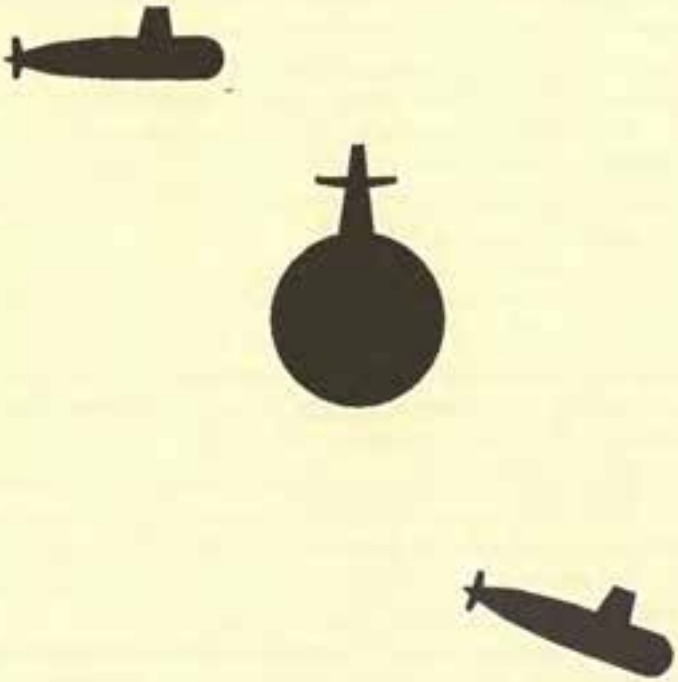

NON-NUCLEAR SUBMARINE DEVELOPMENTS

Presentation at the Naval Submarine League's Ninth Annual Symposium, June 1991

by Hans Saeger

Considering the fact that Germany is responsible for about half of the total number of conventional submarines constructed in Europe over the past 30 years, it is not surprising that the main improvements and developments of non-nuclear propulsion systems for submarines have also been made in Germany.

There are two submarine yards in Germany, one being Thyssen Nordseewerke (TNSW) in Emden and the other, and predominant one, being Howaldtswerke-Deutsche Werft AG (HDW) in Kiel. HDW is not only involved in naval ships and submarine building but also, and mainly, in commercial ship construction. Only one shipyard is now left of the former five HDW shipbuilding places in Hamburg and Kiel. The reduced number of employees (about 5,000 down from 19,000) and the offices have been concentrated at this main yard. The massive investment required for such concentration was aimed at bringing about a dramatic increase in productivity, which it has indeed. The HDW submarine construction moved from a single-purpose yard into the new hall. A new headquarters and office building provides short distances and has intensified internal communication remarkably.

The HDW business base for the business year 89/90 had a turnover of approximately 750 million Deutsch Marks (DM), which is 25% below the 5-year average but still within the annual fluctuation in shipbuilding. Commercial shipbuilding and naval shipbuilding were approximately equal in turnover, while the production hours totaled about 4.2 million hours and are attributed much more to commercial shipbuilding than to naval activities. This difference results from the high portion of subcontracted value in prime-contractor-type naval contracts, or, as others may address it, from the relatively smaller portion of value-added by the prime contractor's own production.

There are at present seven European shipyards engaged in the construction of conventional submarines. (Kockums, in Malmo, Sweden; HDW and TNSW in Germany; VSEL at Barrow-in-Furness, U.K.; RDM in Rotterdam, NL; DCN in

Cherbourg, France; and Italcontieri at Monfalcone, Italy). The international submarine market environment for the various European submarine yards and design capacities is about the same. Differences, however, exist in regard to each nation's industrial structure and degree of governmental involvement in:

- technical developments, general layout or detailed design
- marketing activities,
- ownership of production-infrastructure or even personnel,
- financial guarantees or financial aid,
- assistance in the field of training and logistics,
- and many other areas of governmental involvement or interference, etc.

All European submarine builders, in whatever combination of private enterprises and governmental activities, endeavor of course to:

- increase in general their submarines' performance, (quieter, smaller crew, etc.), thus creating more attractive boats, and
- get a bigger share of the market beyond their own navy's requirements by selling to other countries.

Success, if the number of classes developed or of submarines built is to be used as a measuring scale, is, however, distributed unequally among the European contenders.

Two thirds of the German submarine production have been exported. The total number is comprised of boats from HDW and TNSW, who now cooperate with each other, sharing internally the work which they might be able to win in the competitive international market.

Since 1960, the German submarine shipyards have been involved in the production of 109 submarines: HDW in 71 and TNSW in 38. The distribution of submarines that HDW has contracted for over the past thirty years has been to fourteen different countries. TNSW has provided submarines to four governments. It is significant that the German government has not ordered submarines since 1969, and that the relevant industrial base has been maintained during the last 22 years in the export market.

The prime-contractor principle was applied for the first time in Germany to the class 206 submarines in 1969. This means that the shipyard as the prime-contractor became responsible not only for the detailed design and construction of the

platform/hull but also for the overall performance of the weapon system. The yard had to specify and guarantee performance of the combat system, the sonar and other sensors, the navigation system, radiated noise under a spectrum of operational conditions, etc. The engineering capability for optimized integration of the payload had to be developed **within** the shipyard. Since contractual delivery was conditioned to take place only after successful proof of the submarine's performance at sea (including wet firings) submarine test crews had to be established by the yard to man each boat for its four to seven months' period of sea acceptance trials. The yard did not like such conditions at the beginning, but it soon learned about the tremendous advantage this presented.

The ability to offer, internationally, turn-key submarine projects, which means fully tested submarines including logistics, training, support of any kind etc., obviously was attractive for a lot of countries with or without submarine experience. It was also unique in Europe when compared with the more traditional distribution of responsibilities and capabilities and planning/purchase/design/construction procedures in the other countries.

The regularity of orders for 209 class submarines in small quantities in conjunction with the extremely close loop and feedback of experience gained during the operation at sea -- from the captain of the yard's trial crew to the head of the yard's engineering department -- has proven extremely beneficial and has contributed greatly to the maturity and success of the 209 class submarine. Notably, customers were satisfied and came back with repeat orders.

The widened spectrum of the yard's capabilities and the resulting market success allowed for the continuous development of submarine equipment and subsystems (e.g., batteries with ever higher energy density, or acoustic developments on submarine diesels) at the numerous specialized subcontractors in Germany and elsewhere in Europe, which represents an industrial base indispensable for a high quality product of this kind, and not easily challenged.

Nearly every one of these boats has also some U.S. equipment onboard:

- a broad variety of mostly Air Force communication gear;
- one has a U.S. fire control system built in Glendale;

- several have ESM systems built in the Silicon Valley;
- and they carry U.S. weapons such as the Mk37, Mk48 and Harpoon.

HDW has continuously invested in optimizing the performance of diesel submarines over the last thirty years and has enjoyed a good return on that investment. One of the critical parameters for a diesel boat (besides radiated noise) is the amount of energy/battery stored or carried onboard. The development in Germany of the relative battery weight

Battery Weight ÷ Surface Displacement = %

from the last U-Boats of World War II to the submarine classes under construction or contracted for today has been steady and is now about 15-23% vice the earlier value of 7-10%. The **amount** of energy available onboard for prolonged submerged operation has been a decisive design and performance criteria during the last nine decades of submersibles and submarines. Non-nuclear boats do not have a chance (and do not intend) to compete with SSNs in this regard. They follow a different pattern in mission types and deployment principles. But it may well turn out that the question of **efficient use** of the available energy will dominate the game in less than two decades from now.

Since self noise is of such concern, one type of coupler which is employed to connect the gearless electric propulsion motor to the propeller shaft transmits torque to the propeller shaft through pneumatic air bags. These pneumatic air bags, with adaptable air pressure, isolate structure-born noise transfer and serve also to remove and/or influence discrete frequencies radiation. The propeller being another noise generator, HDW of course uses skew-back low-speed propellers. A new type of propeller motor will reduce the existing number of revolutions by nearly half and will also obviate the need for mechanical high-power switches, with their klacks and klicks when changing speed steps. The first of these motors has been undergoing sea trials for the past two and a half years. But quieting has it's price:

- technically in boat's volume and weight, and
- in costs, which are a design feature as well.

There has also been a tendency to reduce relative manning. This can be expressed as "tons of surface displacement per man of the crew." There have been several main reasons, partially compensating each other:

- increasing the comfort and standard of living deemed necessary for the crew corresponding to the social-political situation and understanding in a particular country (Sweden and Australia do a lot more for their sailors than others) and also in conjunction with increased mission durations.
- increasing the payload (with requirements going up faster than electronic cabinets managed to shrink)
- increased automation and by the reduction of onboard maintenance required during a mission and in total.

It is interesting to look at the cost of a few attack submarines planned or under construction in the western world. Since the U.S. newspapers recently gave such a nice round figure of 2 billion a copy for the SEAWOLF, this figure can be used. This is not meant to be critical of the cost of the SEAWOLF. Each country knows best what it requires for its defence needs. It is included for perspective only. HDW, and this is true for all European yards, simply does not have a single customer who can ever hope to purchase such a high-cost submarine. The niche in the 400 to 500 million DM *[Ed Note: about $230 - 285 million]* unit price range defines the submarine market of interest. The cost for the type 212, which is the next German Navy hybrid submarine, of about 500 million DM, is based on a 7-boat order first-of-class. The worldwide accepted cost-efficiency of German submarines -- and the resulting market success -- will allow for further investment in stealth technology, both in the mechanical and the electro-magnetic frequency spectra. The size of a submarine is considered an important part of the mechanical sector. And, of course, the German yards and their subcontractors will continue to increase the submerged endurance and minimize acoustic, magnetic, and thermal signatures at the same time.

These expressed intentions, nearly a promise, lead to the field of air-independent propulsion systems. In the past, three major constraints were existing in Germany and for its submarine designers: one was a tonnage limitation, another the *no nuclear* limitation, the third was money. The small tonnage was

suitable for boats operating in the shallow waters, the so-called "flooded meadows", of the Baltic; an extremely tricky acoustic environment with a constant mine threat. For the submarine design engineers it was a challenge creating features and superior performance for small, and later bigger, non-nuclear underwater torpedo transportation and totally amagnetic fighting machines, called submarines. The tonnage limitation was lifted to 1,800 tons after the first export successes of the 209s. It no longer exists. The *non-nuclear* and *money* limitations allowed us to concentrate on other options for AIP. The class 208 was planned for AIP but was never built.

Nuclear technology has been continuously developed in Germany for application to non-naval programs. HDW built, in the late 60's, a nuclear-powered commercial surface vessel, the OTTO HAHN, named after the first man to ever crack an atom. This vessel operated for several years around the world without accident or downtime. When the first core refuelling was due the reactor was replaced by diesels for the continuation of its commercial service. The German shipbuilding and nuclear industry could not expect to gain any new experience by extending the operation of the reactor at sea.

Depending on money and technology available one may choose from the menu of AIP options the solution deemed most suitable for one's submarines having most of their duty life in the next century. (By the way, AIP is not as new as many may think. From late 1944 until the end of 1945, U-boats were tested in Kiel by Professor Walter having air-independent peroxyde-turbine propulsion systems.) One can easily imagine how much analysis work, studies and submarine design work had to be invested during the last 20 years before deciding about the most likely technological configuration of the class 208. This boat remained on paper due to the third constraint: *money*. The different developments were discontinued and locked away at the end of the 70's. Meanwhile in Germany and for the Federal German Navy it has been decided to go for the H2/02 fuel cell system. It is important to note that during times when governmental funding of development was not available, private investment was going in and was proving that a H2/02 fuel cell submarine system could be built and safely operated by naval crews.

The land-based test facility was established at HDW in 1984 and allowed for testing the fuel cell system together with a submarine's most important system components, which was achieved by using a full-size (depot spare) class 205 propeller motor and a submarine battery having finished its scheduled life time. In 1988/89 a submarine of the class 205 was prepared for sea trials by cutting the boat and inserting the section with the energy conversion package. The LOX tank was put under the superstructure, which led to the lengthening of the latter, and the hydrogen storage tubes into pockets alongside the hull. The refuelling of the submarine was no problem at all, H2 and 02 being normal industrial gases as they are required for welding or other industrial purposes all over the world. During the sea trials, refuelling of U1 was done in Norway and Scotland from local suppliers. The results of the sea trials were that the fuel cell system was shown to be sailor-proof. The next German Navy submarine will be a hybrid diesel-electric fuel cell submarine, called class 212.

But it is possible also to modify and convert existing submarines into hybrid boats. Similar solutions for inserted sections are on the european drawing boards for closed cycle diesel (CCD) and sterling engine packages. The differences are in cost, in radiated noise, and to some extent in weight and volume penalty as a function of power output and energy amount brought onboard. For a modified class 209 one may expect more than triplication of the deep submerged endurance at a noise level identical (for fuel cells) or nearly identical (Sterling) or not too far above (CCD) the noise level *on battery only*. Much better performance can be achieved if a submarine design considers the new AIP technologies from the outset. As an example, one could imagine a 2500-ton hybrid submarine with a mission endurance of 70 days, 35 days of which the submarine could stay on station without snorting a single minute. This assumes that transit to and from the operational area is done more or less in the conventional way with intermittent snorting periods.

Clearly, the best technology in the world is worthless if it is not affordable. Consequently, investment is also going into construction techniques to continuously improve productivity and hopefully continue to produce submarines which old and new customers can afford.

HDW's new submarine construction site is complete today and has been in operation since August '89. The synchro-lift became operational in February '91. This facility contributes to a great saving in manhours not only in production but also in the transport of entire submarines and hull sections. An entire submarine, or individual hull sections, can be moved on cradles which slide on a fluid film in any desired direction in and outside the hall as well as on and from the synchro-lift. The submarine construction line in a huge hall is equipped with automated welding jigs. The welds are in the rod tip-down or hands-down position. Other stations are used for automatically welding ring frames and other parts of the hull. This automated welding equipment and technique has resulted in the expected reduction in construction manhours, higher quality welds with less rework, and greatly improved circularity.

The future submarines will be *battery-silent* throughout, they will have a multiple of today's submerged endurance due to AIP subsystems, they will continue to require a relatively small crew, and, we hope, they will be affordable to our own Navy and other friendly customers.

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SUBMARINE TACTICAL DEVELOPMENTS

Presentation at the Naval Submarine League's Ninth Annual Symposium, June 1991

by Captain F. W. Lacroix, USN
Commander Submarine Development Squadron Twelve

I am delighted to share with the membership of the Submarine League some thoughts about tactical development in a changing national security environment. To those of us operating in the Submarine Force, one of our greatest concerns is the ability of our ships and their tactics to support the military needs of the Nation.

First, I suppose, I should define what I mean by tactics, and the context of my discussion today. Webster has two interesting definitions. His first is "The technique or science of securing the objectives designated by strategy." I have always liked his second definition: "The art or science of using available means to achieve an end." Both of these get the point across, but the second definition clearly points out the relationship between strategy, tactics and **capabilities.**

In this sense, tactics is the art of the possible, bounded by the capabilities of the men, their training level, leadership and equipment. For the purposes of this discussion, I will focus on tactics as a function of our platforms and their equipment. This is also the viewpoint of the military planner, who must level the playing field and sidestep leadership and training to a large extent. The bottom line of tactics remains **mission success.** In his book on fleet tactics, Wayne Hughes sought to demonstrate that there is "in the art and science of naval warfare an identifiable body of tactical thought." Although he dealt with tactics at the fleet level rather than at the unit level, it is the evolution of that "identifiable body of thought" in a changing environment that is exactly the topic of this talk. Tactics will also continue to provide the basis for training -- with its glue -- **doctrine** -- the foundation of excursions. Tactics also compensate to a large extent for equipment deficiencies, and always have the focus of maximizing the probability of mission success while minimizing the risk with the platforms we have.

The pillars of tactical development remain history, technology, exercises and analysis, combined with intelligence and real world operational skills. As a first principle, we have to

understand that the last of these is perhaps the largest single contributor to tactics development in a rapidly changing environment. Operational skills of our current submariners form a large basis of tactics, as they gain experience daily and we turn it around rapidly to the rest of the fleet. The tactical development process involves all of these. It is also working on a short time horizon. The system developer has the more difficult task of finding the boundary between the technological frontier, the military requirement, the development risk and the procurement cost as we project twenty or more years into the future. The tactical development horizon is **certainly** less than a decade. Tactics have a way of becoming stale as intelligence, technology and capabilities continue their work. This short time horizon is a distinct **advantage** when developing tactics in a changing environment.

National Security concepts form the basis for our strategy and have a consequent fallout on our tactical development process. The Submarine Force Tactical Development Plan is an annually updated product which is proposed by the Development Squadron for the Force Commanders, and is reviewed and approved by the Assistant Chief of Naval Operations for Undersea Warfare. As you can imagine, in the past two years, it has had to respond to several changes -- some of previously unimaginable magnitude, others more subtle yet of heavy impact.

All of the changes in the national security environment are reflected in the Submarine Force. That is to be expected. But more importantly, three other aspects of the submarine have led to a natural evolution in the tactical world. First, of the entire arsenal of United States military capabilities, **no single instrument is truly as multi-mission as the attack submarine.** No aircraft, no surface ship, no land vehicle, no space platform, no other military unit brings the dimensions of military capability to the commander that the Submarine Force does. Secondly, if the numbers of the Force will decrease, there is a clear commitment that each individual submarine will bring more to the table. And thirdly, the inherent characteristics of the submarine, but particularly its ability to retain relative stealth in any mission and its endurance, afford an additional region of operations simply not available to other assets, **and I am convinced this is not yet fully appreciated or developed.** I like

to couple this with a note that the submarine, from a basic design viewpoint, has the highest *offense to defense* ratio. **Attack submarines play offense.**

So what is driving tactical change now? There is no simple answer, but predominant are:

- The changed perception of the nature of future conflict.
- The proximity of the lessons learned from Desert Storm.
- The changed concept of the manner in which forces themselves will be commanded and controlled.
- The continued modernization of the Soviet Submarine Force.
- The extent to which technology is becoming useable by regional powers.

How are we responding? We are relying on the broadest range of innovative thought combined with the traditional pillars of tactical development. All the while we are particularly sensitive to the inseparable relationship between technology and tactics. We see at once both the tactics leading the technology, and in other cases, the technology making available vastly expanded mission capability. And today as always, the **standout intellectual requirement for developing good tactics is knowledge of the systems, platform and environment.** As with intelligence, the more we know, the more options are available.

Only submariners have a deep enough total understanding of their platforms, of the sensor and weapons capabilities, to develop the broad range of integrated tactics. This carries with it the tremendous responsibility to avoid becoming conceptually bound by the past, or to assume that the missions and tasking will come to us. But rather that we keep the full court press on and force the most out of our capabilities. History is a necessary stop in tactical development. You only have to spend a few minutes in conversation with Admiral Tyree to realize that the Submarine Force has been in the position of searching for its place in a new military order before, particularly just before and after WWII. In a 1946 speech, COMSUBLANT listed 15 missions accomplished by submarines during the Second World War. Two of these missions, transport of fuel and action as a surface gunboat, have lost some of their appeal. The remainder remain valid and are accomplished by today's submarines. Five would be gathered into the category of Special Warfare, three into intelligence collection, two into strike warfare. The real

point here is that Winston Churchill was clearly wrong when he commented on "the undoubted obsolescence of the submarine" in 1939. As are those who would make the statement today.

After looking at history, as we examine carefully the extent to which our current tactics, defined by our operations, exercises, analysis and doctrine support emerging military needs or capabilities; we find that our cup is certainly better than half full. Two examples come to mind when confronted with critics of our Submarine Force capabilities.

There is a perception that U.S. nuclear submarines don't operate in shallow water, for example, and that this will be a significant limitation in regional conflict. From the operational viewpoint, of course, we have routinely operated in shallow water -- and in the even more restrictive environments of the Arctic, as in a Bearing Strait transit where we have both the ceiling and the floor to entertain us.

Over the past decade -- that era in which we have been criticized for being myopically focused on the deep water anti-Soviet ASW threat, we have routinely pursued tactical development in shallow water; The water depth has generally been restricted only by the requirement to provide, in peacetime, some measure of safety by having the submarines work in vertical strata, and a peacetime safe haven when we fire weapons. Naturally, neither of these would apply in wartime. A number of those exercises have been run by the Development Squadron. At least one a year also can be added from the Pacific. A great deal of this knowledge is directly transferrable between regions.

Another example is the diesel scenario, and the extent to which we **are** or **are not** prepared to engage that threat. Again, the tactical development bank has a large foundation already developed by one of my predecessors and by operational commanders in the Mediterranean and Pacific. These are good and proper tactics, but we do not underestimate this challenge and we are building on that solid base of prior tactical development efforts to further develop combination overt and covert anti-diesel tactics.

So where are we headed? Simply put, we are dramatically expanding the tactical base to leverage what we can do best in the broad array of military missions while continuing the development of tactics against the top-line ASW threats. In

ASW, General Billy Mitchell's comment of the 1920's, that the best defense against submarines is another submarine, remains true today. The Soviet Submarine Force, particularly in the face of the rate at which they are modernizing their inventory, remains the high-end tactical driver. We can't afford to slacken the pace as they become quieter and better.

In Anti Surface Ship Warfare, we have the developed tactics and have the capability to individually **and with the battle group** exercise sea control over a far broader area than ever before. During World War II, special warfare and small scale amphibious operations were an important and common submarine force mission, second only to anti-surface warfare in the number of missions completed. As many as 150 were conducted during the war, with probably the most famous having been the Makin Island raid of Carlson's raiders in August of 1942. In this raid, NAUTILUS and ARGONAUT delivered about 200 marines and supported their attack with the full range of capabilities from reconnaissance to gunfire support. Today we are undergoing somewhat of a rebirth of special warfare tactics, and the range of capabilities employed in these missions has expanded dramatically. Nothing is inconceivable in carrying out this mission, from rubber boats to helicopters. All attack submarine classes are mission capable.

Offensive mining is a traditional submarine mission. Technically, our mines are much more capable than those used in the 36 missions in WWII, but the essential strengths of submarines in this area have only gained in dominance. The Submarine Force can deliver mines more accurately than any other force and has demonstrated this, and can lay its field covertly in forward areas unaccessible by other platforms.

Intelligence, Surveillance, and Warning Missions remain bread and butter missions for the Submarine Force. All of the submarine strengths come to the fore here, and are being pushed even farther with the technology available. With endurance and stealth as the cornerstones. The value of stealth will only increase. The most difficult capability to export is not a radar or above water technology, but *below water* technology and the development of this capability in the Third World.

In submarine strike warfare, initiated by Commander Fluckey in his last war patrol on BARB in 1945, we have a natural combination in the modern submarine and the cruise missile.

Tomahawk is less a unique new weapon than it is an extension of the traditional naval mission of shore bombardment that projects the reach of ships and submarines hundreds of miles inshore. The new dimension introduced with the modern submarine strike role is the **stealth** with which the SSN can approach the target area, launch its weapons and withdraw. The key to the further development of submarine based strike capability will be the extent to which it is flexible, reliable, and timely, and therefore appealing to the campaign commander.

To get a feel for the enormous capability the Submarine Force represents, you simply have to reflect on the submarine firepower equivalent to the assets used in the 1986 Libya raid. This tactical capability exists **today**. Three submarines could provide the alternative to support aircraft, defense suppression aircraft, primary and backup strike aircraft as well as the two carrier battle groups.

As a submarine force, we are leveraging what we uniquely do. Strike rescue is another mission which has regained emphasis. This is an important mission: 86 submarines participated in strike rescue during WWII, and one of the 504 rescued pilots has a critical impact on our current funding. The importance of strike rescue is indisputable. Aviators sometimes talk of a line beyond which surface ships and helicopters cannot operate without surface and air control. The Yo-Yo line -- *you're on your own*. The only platform which can operate continuously forward along the coast of an enemy is the submarine. In many cases, the submarine moves the Yo-Yo line to the beach and beyond. We can currently link with other platforms to pinpoint downed aviators; our goal is to give the operational commander additional flexibility by having the ability to independently locate and rescue downed aviators.

The foregoing is just a taste of what's going on. You can see that these are clearly the most exciting times to have my job. We are striving to bring to the task force, battle group, or joint commander a truly responsive, effective military capability.

We are at the same time, markedly improving our submarines' tactical capabilities to use the environment. Actual satellite information showing the major oceanographic features can be transferred to a submarine. We have the capability now to provide this type image to ships and continue to press hard in the area of tactical use of oceanography. And, through the

Submarine Force Mission Program Library (SFMPL), we are maintaining at the force level the capability to quickly improve other tactical decision aids available to the Commanding Officer and his crew across a broad range of applications.

An important question is, what are the implications of Desert Storm on all of this?

There are many lessons which will be drawn from Desert Storm. Beyond the direct tactical and operational lessons are some less visible but very profound -- some are self evident, but some are not. High-tech yields enormous leverage, though cost is another issue. Weapons capabilities and performance in Desert Storm were truly impressive. We have come a long way from Wellington's complaint that it took a ton of lead to kill a Frenchman, or from WWII in which it took on the average 400 aerial bombs to hit one target. **We won't be able to retreat from this performance.** A parallel criteria could be expected to be applied to submarine ordnance effectiveness in a future conflict. The lessons from this conflict with the impact which I consider greatest, but which frankly I have not yet come to grips with, is PACE. The pace of mission accomplishment has always been a major measure of effectiveness (MOE) for the platform/unit commander. But the pace of the Desert Storm ground campaign has changed it into the MOE for a war. The month long air campaign will be forgotten, and with a traditionally impatient nation to begin with, the Submarine Force has to consider its ability to tactically support campaigns which have as a benchmark a **100 hour ground campaign** involving **500,000 men.** Clearly, a major key to keeping up with the pace will be the extent to which we develop robust communications and data fusion capability.

In closing, we have to keep in mind the purpose of all this. It is very straightforward. It is to develop in the present and next generation of submariners something called *tactical instinct.* As all commanders have noted, tactics get drastically simplified in combat and Eisenhower reminded us that every war will have surprises. Doctrine will satisfy the predictable, but only a sound set of tactical concepts, coupled with technical knowledge, training and the **ability to think** will ensure victory against the unanticipated. I can't overemphasize this. Nimitz said it clearly in a message to one of his fleet commanders:

Tactics are blind without thought --
The Lord gave us two ends to use
One to think with and one to sit with
The outcome depends on which we choose
Heads we win -- Tails we lose.

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REUNIONS

USS JOHN MARSHALL (SSN-611)
Deactivation Ceremony
Late November/Early December 1991
In Norfolk, Virginia
Former crew members and all interested in attending;
contact: Commanding Officer
USS JOHN MARSHALL, (SSN-611)
FPO New York 09578-2322

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USS THOMAS A. EDISON (SSBN-610)
21 - 24 May, 1992

This will be the first reunion ever held for the EDISON, which is now decommissioned. All past crew members please contact:
Jack B. Ensminger
P.O. Box 174
Waynesboro, PA 17268-0174

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PEOPLE IN SUBMARINES

Presentation at the Naval Submarine League's Ninth Annual Symposium, June 1991

by Captain Skip Bowman

It is indeed an honor and a pleasure to bring you good news about the most precious resource in the Submarine Force, our people. Intelligent, carefully selected and dedicated, the men and women who man and support our submarines and tenders, will be the most significant factor in the continued success of the Submarine Force, as well as that of the Navy.

Things have changed pretty dramatically over the past few years. Plans laid in the 80's to provide a modicum of selectivity for CO, XO, and Department Head assignments are coming to fruition just as reductions in force structure are taking us from some 180 crews in the mid-eighties to about 130 crews in the mid-nineties.

As you remember, back in the 60's and 70's, the number of submarines increased faster than we could bring people into the program. As a result, Department Head tour lengths and CO/XO tour lengths were in excess of three and four years respectively. Back-to-back sea tours were the norm and little opportunity for shore duty existed. This climate set the stage for spiraling downward retention, a snowball effect as each officer who left exacerbated the situation for those who stayed. Every officer was needed to fill follow-on sea billets.

Then in December 1980 -- the Renaissance. Submariners saw a huge pay raise with significant increases in basic pay, a new continuous submarine pay, variable housing allowance and other special bonus incentives. I was the XO detailer during this time. The pay changes mattered. On road trips I was careful not to suggest that submariners could be bought, but it sure looked like we could be rented for a few years longer. As more and more quality guys stayed in, the submarine career path improved for officers and enlisted, and the spiraling downward retention was halted. More people went ashore. Sea tours were shortened. Overall Submarine Force morale improved and retention was on the upswing.

Furthermore, with improved retention, we were now able to place the right people in the right places such as in NROTC units, the Naval Academy, and in Recruiting Commands, and

our officer **recruiting** improved. The retention snowball began rolling the other direction.

The combination of these factors allowed us to put into place selectivity plans for the late 80's and 90's based on a force of around 100 attack boats and 40 strategic submarines.

However, the sweeping political changes in Europe and the political and fiscal pressures here at home to reduce spending are requiring the Navy to reshape its force structure and the way we do business. Instead of 100 attack submarines and 40 strategic submarines, we are streamlining our force to current plans of about 80 attack submarines and 18 TRIDENTs. If we contrast where we are heading today with the projections merely 2 years ago, there is an obvious effect on Commander command opportunity. The force downsizing is providing us with command selectivity somewhat earlier than we had planned and is providing us with needed selectivity down to the Department Head level.

Our officer recruiting **goals** have traditionally been based on recruiting enough Ensigns to meet Department Head requirements nine years later when the Ensigns have grown into Lieutenant Commanders. These goals also, therefore, had to consider the expected officer **retention** from commissioning day to the 9 year point.

In September 1979, just prior to the Renaissance that we just discussed, submarine officer retention was hovering around 29% overall. Our officer recruiting goals through the 80's were based on an assumed improvement in retention to 35%. I am delighted to report to you that even that 35% grossly underestimated the actual officer retention which has reached an historic high of **49%**.

Enlisted retention is also healthy and is predicted to stay that way. 1991 first term nuclear retention is 48 percent, compared to 21 percent in 1978.

I attribute this improved retention to a better operating tempo for our submarines, an improved quality of life for our sailors, and a leadership that puts the welfare of our people and their families first. Furthermore, continued strong support for incentive programs such as submarine pay, selective reenlistment bonus, and nuclear officer incentive pays have supported retaining our quality people. Our people know that we are taking care of them, they are happy, and they are staying in.

Throughout these 80's, submarine officer community planners had been wringing their hands, lamenting "Woe is me, we're not making goal and we'll never get the sea tour lengths and sea-shore rotation down to something reasonable -- much less will we have sufficient folks to provide needed selectivity at the CO, XO, and Department Head levels."

Aha! With perfect 20-20 hindsight, and now cranking in the greatly improved retention with the smaller submarine force size, the actual goals for the years shown would have been much smaller -- and in fact we actually **have been** making goals, and then some, for the past 9 years.

This *delta* between the actual officer accessions and the revised goal, accounting for unexpectedly high retention and the declining submarine force size, represents officers recruited in excess of planned selectivity and sea tour length reduction. We clearly can establish tour lengths now exactly where we want them **and** choose the very best to continue on to command. That's good news -- great news in fact -- and that's where we are today.

Before departing the topic of officer recruiting, I'm also proud to report that we're continuing to bring in the cream of the crop -- these future submarine leaders are extremely attractive to the civilian community and yet we are still able to bring them in. Of note, the average SAT scores for new submarine Ensigns for this year was 1260. This SAT performance ranks our newest officers with the student bodies of the top national universities as reported in the 1991 survey of American colleges and universities conducted by U.S. NEWS and WORLD REPORT.

We are also meeting or exceeding recruiting goals for our submarine white hats. Nearly all enlisted submarine personnel have completed high school with sound math and science backgrounds. Many have also completed numerous college courses or have even earned college degrees. We are taking advantage of the changes in submarine force structure to be as selective as possible in who we bring in as nuclear submariners.

No longer, now, is every warm body required to march lockstep to Department Head, XO and CO. No more back-to-back sea tours with no hope for a breather. No more 4 1/2 year Department Head tour and 4 year XO tours. While we still have manning shortfalls ashore on the staffs and in training

commands, we have sufficient officers to fully man our sea billets and be selective in whom we send.

All of this says that we now have selection flexibility to send only the best of the qualified officers to Department Head, Executive Officer, or Commanding Officer. Command and Executive Officer screening boards, composed of senior submariners, began actually screening submariners to select the best 3 years ago. This year we had our first ever Department Head screening board. All of these screening boards select officers based on their potential for future service based on an officer's documented performance record.

In future years there will be more officers who will not screen to be Executive Officer or Commanding Officer. Remembering that we stopped recruiting the General Submarine Officers in 1985, we will still need these officers who do not screen to fill the billets that the senior diesel/General Submarine Officers used to fill. We have developed a viable career path for these talented officers to utilize their services until they are eligible for retirement.

As we get leaner and meaner, our submariners are standing out more and more from the crowd. Our officers are successful and are recognized for their success. Our promotion opportunity when compared to other communities is better. When we assign these officers outside the submarine community, such as to Joint Duty, their reputation, professionalism and performance on the job result in requests for another submariner when it is time to rotate that officer from that command.

On the enlisted side, our submarine sailors lead the pack in selection to First Class Petty Officer and Chief Petty Officer and get there earlier than their contemporaries. Ashore, these submariners enjoy the same reputation as the officers.

For the submarine career path for officers today, we have tour lengths right where we want them and are enjoying increased opportunity for shore duty. Our Commander Command and Major Command opportunity is higher than any other unrestricted line community. Our officers are being assigned to diverse and career broadening assignments. Today we have 106 submariners at Post Graduate School, 4 submariners pursuing Olmstead Scholarship Program degrees, and 5 officers involved in the MIT Woods Hole Oceanographic Institute. Twenty-eight percent of all submariners before the

last XO screening board had masters degrees. Submariners are assigned to Carrier and Cruiser/Destroyer Group Staffs, to overseas and Washington Joint Duty assignments, and in the Material Acquisition field. At the same time, we are sending top people to the assignments we traditionally have filled, such as Instructors, to Submarine Staffs, and in the Nuclear Propulsion Program.

The quality of the enlisted personnel manning our submarines is the best ever experienced by the community. Ashore, our submariners fill key instructor billets at Nuclear Power School, Prototype and Submarine School, as well as vital billets in our Tenders. Submarine expertise is highly sought in recruiting and other special programs.

Now I want to tell you some more about the type of people we are bringing in and the demands we place upon them.

In the officer class of 1991, just finishing the Naval Academy and college and enroute to Nuclear Power School, we have an amazing assortment of people.

I already told you their SAT scores -- but that's expected of *Nucs*. Equally important, we have officers who were varsity team leaders for their universities in Football, Baseball, Wrestling, Lacrosse, Gymnastics, Track and Crew.

Besides being leaders in Midshipmen organizations at the Naval Academy or at NROTC Units, they were leaders at their universities in various clubs, societies, and in fraternities. They received awards for their outstanding performance and for their participation in the community. They were Little League coaches, involved in Boy Scouts of America and helped out with the Special Olympics Program.

These new officers are great guys, not geeks who only studied to get good grades. They earned top grades, because they wouldn't have been accepted into our business otherwise, but they were active as well. In all respects, these guys are super -- you would be proud to go to sea with every single one.

The same high quality individuals join the enlisted ranks of our submarine force. Just last month I had the opportunity to address the graduating enlisted and officer classes and their families at the Navy Nuclear Power School. After my talk, the mother of one of the graduating students approached me and asked what she could do to prepare her 7 year old now so he can become part of this program when he finishes high school.

This type of question highlights the superior reputation our community enjoys and the true patriotism felt by our young people. I looked these kids in the eyes and shook every one of their hands. These guys are ready to hit it. They're excited and fired up.

After completing the training pipeline, they go onboard our submarines and excel. MM1(SS) Mark Spoon, Leading Auxiliarmen on USS TUNNY, typifies our high quality submarine sailors. Last month he was recognized as the Pacific Fleet Sailor of the Year. Closer to home, in Washington, ET1(SS) Richard Vandermark, recently attached to USS BERGALL and currently assigned as the Assistant Submarine Enlisted Community Manager, was selected as this year's OPNAV Sailor of the Year.

These guys know they face a tough road. The submarine officer qualification process has not become any easier. From the day he steps into the classroom at Nuclear Power School until he completes his command tour, our new submariner is subjected to the *fire hose* treatment with which you are all familiar, but which acts to teach us to think quickly and decisively when all is not going according to Hoyle. For the officers and nuclear rating enlisteds it begins with:

- Nuclear Power School: Six months of concentrated study, equivalent to a Masters Degree in Nuclear Engineering, covering theoretical reactor principles. Subjects include: Calculus, Physics, Heat Transfer, Electrical Engineering, Material Science, Reactor Operations and Reactor Plant Systems.

Truly a difficult and concentrated, but necessary program. Then,

- Prototype Training: Six months of hands-on training on an operating land based reactor. Here, our officer and enlisted personnel learn those watchstanding principles and routines which will serve them well as they report to their ships.

Then for the officers,

- Submarine Officer Basic Course: A streamlined version of what you and I went through, with 13 weeks of study in Submarine Basics, concentrating on extensive use of the Diving Trainer and Attack Center.

And it doesn't stop when he reports to his first submarine. Usually he will begin with qualification as

- Engineering Officer of the Watch: A repeat of what he did at Prototype but on the ship's specific plant and in less time.

Then qualification in,

- Submarines: To include demonstrating expertise as Diving Officer of the Deck surfaced and submerged.

At about the two year point onboard, our now Lieutenant tackles

- Engineer Officer Qualification: An in depth review of nuclear principles culminating with a
  - -- two day exam at Naval Reactors which includes a four hour written exam and three oral interviews.
  - -- This qualification certifies that the officer has the technical knowledge to serve as Chief Engineer on a nuclear powered warship.

And finally for junior officers assigned to our strategic missile boats, qualification on

- Strategic Weapons Systems: A new breed of cat for the Nucs. With the shifting to an all nuclear wardroom, this qualification prepares our guys for assignment as Strategic Weapons Officer, that job that in the past was expertly and professionally filled by our General Submarine Officers, and is now being filled by nuclear trained officers.

These rigorous requirements are in addition to his watchstanding and Division Officer requirements, as well as many hours a week of continuing training.

On the enlisted side, things have not changed much since you were there. Submarine sailors are still getting checked out on every ship system, completing watchstation practical factors at sea and as always, striving toward the award of the coveted Silver Dolphins.

As you can see, we still demand a lot from our people. These capable, highly trained warriors complete these requirements enthusiastically and are ready to take on challenging missions that we could only dream about. The Submarine Force has taken on new roles and missions across the spectrum from monitored peace to full war, including special warfare team insertion, search and rescue of downed aircrews, strike warfare (both land and ship), offensive mining, and drug interdiction.

Thirteen of our attack submarines were on station in support of Operation Desert Shield and Desert Storm, providing a significant array of multi-mission capabilities to operational battle group commanders. Prior to and during hostilities, eight attack submarines were involved in surveillance and reconnaissance operations. They also escorted and provided indication and warning for the carrier battle groups as they transited to the Persian Gulf arena. Throughout the entire operation, submariners provided invaluable intelligence in support of the United Nations embargo of Iraq. After hostilities began, an additional five submarines operated under the tactical command of Army General H. Norman Schwarzkopf. Two of these submarines, USS PITTSBURGH commanded by Chip Griffiths and USS LOUISVILLE skippered by Frank Stewart, conducted submarine launched cruise missile attacks against Iraq. These missions resulted in the first submarine missiles being launched in war in the history of the Submarine Force.

Today, 28 of our attack submarines are on station in support of national objectives around the world and are providing their broad range of capabilities to operational commanders.

Our strategic submarines have completed over 2900 patrols in executing the most successful military mission in our nation's history. Today, over 15 strategic submarine crews are on patrol.

All of these guys, attack boat sailors and strategic submariners, come and go, day after day, month after month -- without hoopla or fanfare -- without CNN interviews with wives and children over missed birthdays, Christmases, anniversaries, and funerals. Submariners have helped keep the real peace for the last 30 years -- we have to remember this deterrent force when anyone speaks of the downfall of the Soviet System in Eastern Europe.

Let me refer to a letter sent to COMSUBPAC nearly 50 years ago:

> *We, who survived WWII and were privileged to rejoin our loved ones at home, salute those gallant officers and men of our submarines, both those who returned home with us and those who lost their lives in that long struggle. We shall never forget that it was our submariners that held the lines against the enemy while our fleet replaced losses and repaired wounds.*
>
> *C. W. Nimitz, Fleet Admiral, USN*

Our heritage has depended on continuing to select gallant officers and men for the Submarine Force. I am here today to tell you that the officers and men of today's Submarine Force continue to serve in the proud tradition of the gallant men in World War Two. They continue to serve with pride and determination.

■

SUBMARINE: Steel Boats, Iron Men

The NSL is pleased to offer its members VHS copies of **Submarine: Steel Boats, Iron Men** at a special price. The sixty minute film, produced by Varied Directions, Inc. with the assistance of the NSL, gives the public its first look inside a nuclear submarine in twenty years. A film team caught the Commanding Officer and crew of the USS HYMAN G. RICKOVER in action. Also included are interviews with some of the most honored submarine commanders, and an overview of the development and strategic use of the submarine in both world wars.

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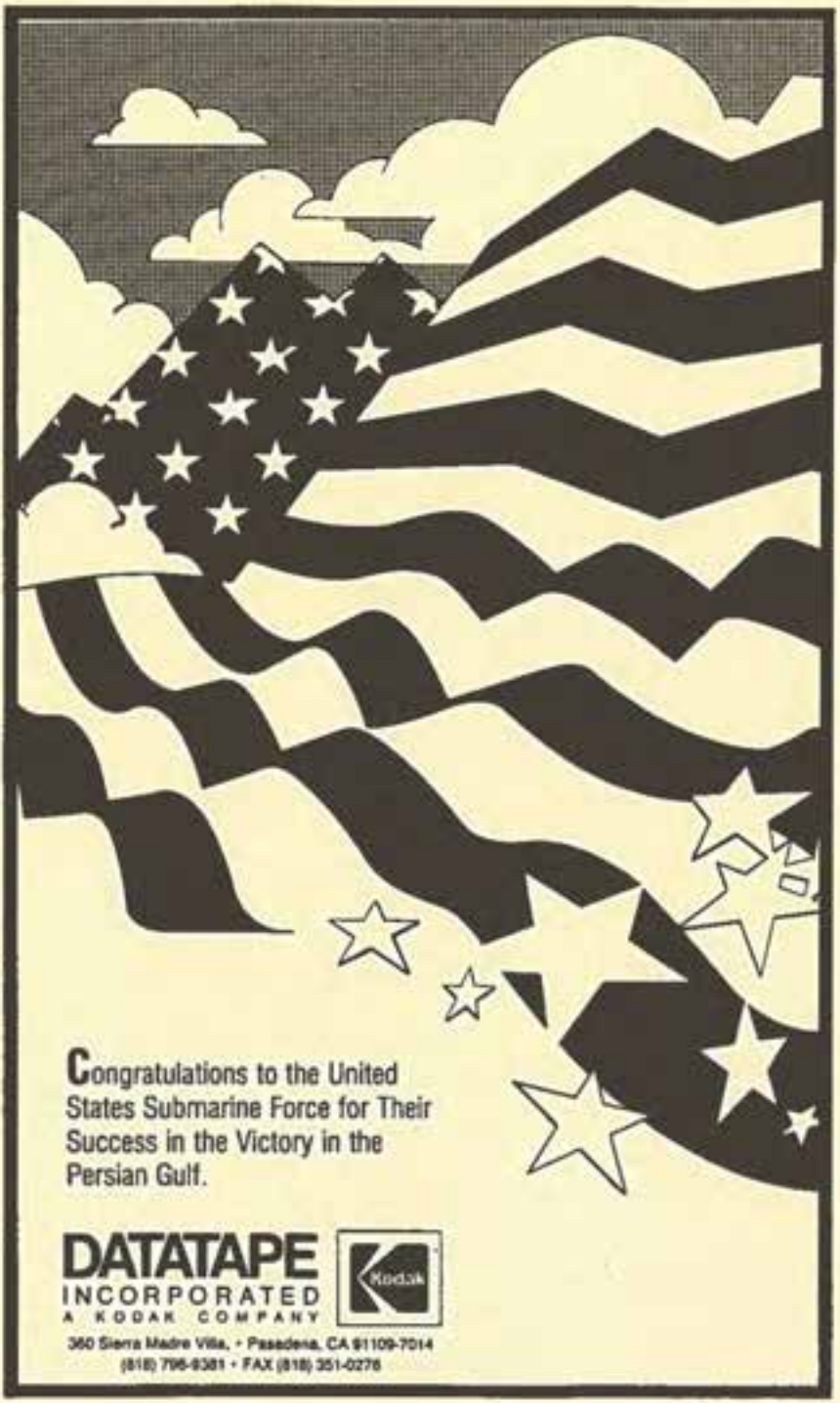
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SUBMARINE ARCTIC OPERATIONS REQUIREMENTS, CHALLENGES, PROGRESS

Presentation at the Naval Submarine League's Ninth Annual Symposium, June 1991

by Captain George B. Newton, USN(Ret.)

Driven by Cold War pressures in the early 1980s, under the CNO, Admiral James Watkins, the Navy committed itself to developing a robust and viable Arctic Warfare capability. Before then, submarines made periodic deployments to the Arctic but they did not participate in extensive Navy-wide R&D efforts. Since then, the Navy and the Submarine Force efforts to improve and to understand Arctic performance requirements better have been very fruitful. Significant advances in knowledge and Arctic technology have been made. Progress continues steadily, and yet, because the Submarine Force knows so much more, it also has become more sensitive to what it doesn't know. The thought of knowledge begetting more knowledge clearly applies to the Arctic. However, when one says "Submarine Arctic Operations," the response from those not deeply involved has usually been: "Why?"

First, there is the requirement of national security. Admittedly, with the Soviet Union in domestic chaos it is difficult for the general public to comprehend that the Soviets remain as strong as ever militarily. The Soviets continue to modernize their Submarine Force with quieter and higher quality platforms. Further, in recent years they have deployed fewer SSN/SSBN/SS units out of area, and have shown a tendency towards more extended operations close to their own shores. While the United States has a fairly good understanding of the individual capability of their new submarines, it remains somewhat a mystery as to the ultimate national/naval strategy to be supported by these added submarines.

One need only look at a world globe to see that the extremes of the USSR land mass extend from 30°E Longitude to 170°W, or 160 degrees, which is almost 45 percent of the circumference about the North Pole. In various political forums the Soviets have viewed (quite incorrectly) the Arctic as *their* ocean. They continue to exploit the Arctic aggressively as an area for naval deployment as well as for scientific development. To keep pace with such activity and to be ready for whatever

the current activity might lead to, the U.S. must continue regular Arctic operations for training and tactical development, as well as for research into future Arctic capable system improvements.

The collection of Arctic environmental data is also important, for embedded within the U.S. Navy's military research requirements in the Arctic is the need for a better understanding of the Arctic environment by the world as a whole. Thus, environmental data from the Arctic, made available for both military and civilian use, is the object of increasing Navy interest and investment.

The Arctic area is not as yet the subject of any treaty accepted by the U.S., quite unlike the Antarctic Treaty, which creates a level of restraint and cooperation between nations involved in Antarctica. However, there is a requirement that we exercise our right to freedom of the seas. This is perhaps more important than one appreciates at first glance, because various Arctic nations have expressed expansive ideas about who should control (parts of) the Arctic.

As mentioned earlier the USSR unofficially has stated the Arctic Ocean is their sea. More formally, they claim the Arctic is divided into pie-shaped sectors originating at the North Pole with the sides extending south to the extreme eastward and westward limits of their national boundaries around the pole. This is called the *Sector Principle*, and is similar to one of the tenets of the Antarctic Treaty. This concept would enable the USSR to claim over 1/3 of the ocean. Canada would get the next largest piece of the Arctic, while the U.S., Denmark, and Norway would be able to claim very small sectors.

Canada, on the other hand, subscribes to the *Archipelagic Principle*. This concept allows a nation to draw its claimed territorial waters around contiguous islands in an archipelago. This concept precludes the right of innocent passage in those waters by vessels of other nations without their first receiving diplomatic approval.

Other concepts of territorial water definition, such as the *Straight Baseline Principle*, have been suggested. In this concept nations draw lines connecting the seaward extremes of their continental shores and adjacent islands over which they have sovereignty, and lay claim to all water within these lines. Again the USSR and Canada could claim the majority of the Arctic.

For example, Libya's claim to the Gulf of Sidra south of *the line of death* is based on this principle.

On the contrary, the U.S. concepts of the Arctic simply support and exercise rights to the twelve mile limit and a 200 mile economic zone, concepts which are generally accepted in the world's temperate oceans. (The U.S. has also negotiated positively with Canada over passage through the Canadian archipelago.)

Diplomatically, people often make comparisons between the similarity of the Antarctic and the Arctic, and suggest that they should exist under similar international protocols. This is difficult to accept when one sees the Antarctic Treaty as one addressing a very remote continent with almost no economically (easily) exploitable resources; while the Arctic is an ocean with vast potential to provide needed natural resources in the near term. Truly, the Arctic Ocean is more like the Mediterranean, -- a large, rich sea surrounded by several nations who seek and need to exploit these resources for their own benefit.

In this vein it is interesting to note that only one treaty, the Treaty of Barcelona signed in 1924, has ever been collectively ratified which relates to the international nature of the Mediterranean. Because of a similar competition among nations for natural resources, the Arctic Ocean area will probably see no significant international agreement in the near future.

From this discussion on *territory*, perhaps it is easier to see that the requirement for freedom of the seas is of more importance when one addresses the Arctic.

Fourth on the list of why the Arctic is important to the U.S., is the need to foster or ensure the well-being of high latitude people. This tenet is in keeping with the principles of a caring democratic nation, and although not directly connected to the Submarine Force, is certainly one of the prime reasons our nation supports a military organization.

Finally, there is the need to oversee and preserve our rightful access to the use or preservation (as appropriate) of the natural resources in the Arctic Ocean. These resources start with the obvious fossil fuels, but also include land based minerals, ocean life and seabed resources within the U.S. economic zone.

Next, let us examine the challenges facing the submarines in the Arctic. The unique facets of submerged operations under

ice must be added to the already lengthy list of operational sensitivities one must possess in order to conduct submerged operations in the open ocean, -- things for which the submariner continuously trains.

One must consider the bathymetry of the Arctic Ocean initially. First of all, the ocean is bigger than most appreciate. Its surface area is five times that of the Mediterranean. Hardly can the Arctic be identified as small. Second, the ocean possesses more critical shallow areas than the rest of the world's oceans. It should be noted that the 50 fathom curve includes some very important areas -- most notable the Bering Strait, where a submarine must traverse about 1000 nautical miles in water 50 fathoms deep (and frequently less) in order to complete entry or exit to the Arctic Ocean from the Pacific. In fact during this transit, the submarine spends days within twenty feet of the bottom, while concurrently within twenty feet of ice keels above the sail.

Next is the 200 fathom curve, which is generally treated as the limit of the continental shelf. It is important to note that ocean areas of tactical significance lie within this curve. For comparison, 36% of the Arctic Ocean and its adjoining seas are considered to be continental shelf areas, while the average for the temperate, ice free oceans is 15%.

Let us shift from concern for shallow water to the Arctic sea ice. It is large and thick, and its presence is limited to deep water areas. It is also dynamic; it is in constant motion pushed by the wind at speeds up to 0.8 knots.

The annual ice cover is that ice which grows and melts each year. Ultimately at the end of the winter growing season, it increases the size of the Arctic sea ice pack by over 40% and effectively covers the entire ocean. Its thickness normally reaches 6 feet, but because it is more easily set in motion, the collision of two ice floes can result in ice ridges 20 feet tall and ice keels which extend into the water over 100 feet. Ninety-five percent of the annual ice cover is over shallow, easily mineable water.

When one summarizes both Arctic bathymetry and ice cover into a single picture, one can clearly see submarine Arctic operations assume an extremely challenging and unique character. The submariner must think constantly *overhead* as

well as *underneath*. In essence he must be capable of conducting warfare in a tunnel.

How does the submarine safely do this?

Submarines possess an under-ice sonar suite that enables them simultaneously to look ahead for ice keels that may be positioned in the SSN's path, to take soundings of the bottom and to profile the ice overhead for surfaceable features. The suite's functional make up has not been significantly altered since the early 1960s. However, numerous improvements have been made to components and subsystems to eliminate performance shortfalls. A second (and perhaps less important) under-ice system is the precision bubble that enables the submariner to know the trim angle on the ship with high accuracy. This system is routinely used when operations are conducted near the ice canopy and/or near the bottom. The submariner under the ice knows that for a 1° change in trim angle on a SSN-637 class, the ship's stern rises or lowers approximately 25 feet. During SSN passages of some of the shallow areas of the Arctic, such as the Bering Strait, every six inches of depth change is critical.

Other than when operating near the ice canopy, the ahead looking sonar is employed when in the vicinity of icebergs. Iceberg areas in the Arctic Ocean and its adjacent seas are found in Baffin Bay, Davis Strait, off Ellesmere Island, near Franz Josef Land and the Denmark Strait. We think we can appreciate just how massive icebergs are, but usually underestimate their size. A survey on one iceberg actually encountered a few years ago in the Arctic showed its peak to be 300 feet above the water and its draft to be approximately 1000 feet.

Another environmental factor which influences the submarine's capability to operate in the Arctic Ocean is the large variation in salinity, -- a phenomenon most frequently encountered in the warm months. This variation is caused by the large input of fresh water into the Arctic from melting sea ice and from fresh water (river) run-off from the Asian and North American continents the year around. It is surprising to know that the Arctic basin receives approximately 30% of the world's fresh water continental run-off.

Salt water salinity is nominally 34 to 36 parts per thousand. Salinity directly affects sea water density. It is approximately this range of salinity variation for which a submarine is de-

signed. Any salinity below the lowest design limit causes the submarine to sink to a deeper depth (if it dispels no variable ballast), finally reaching a point where the water density is sufficient to support the ship.

As this low salinity water enters the Arctic basin, it is lighter than the sea water already there. Thus it effectively forms a surface wedge above normal density (heavier) sea water. Further, because of the ice cover, there is little subsequent ocean mixing, which is strongly influenced by the sun's heating and wind action. When a submarine under the ice attempts to come shallow for whatever reason, and encounters this low salinity water, its ascent is quickly stopped. The SSN then settles back to more dense water. Such a situation either delays the ascent significantly (while internal ballast is adjusted), or in worst case (if the need to come shallow is critical), forces the submarine to compromise its presence by expelling main ballast. In any case these effects just create another thing the submariner must think about while doing his job.

The salinity variation, when coupled with the ice cover, influences another aspect of Arctic submarining. They create a unique sound velocity profile (SVP). The water directly under the ice is usually the coldest in the water column. It is also the least saline. But temperature and salinity both increase as depth increases. These factors cause a positive SVP to exist, a condition which is much less frequently encountered in the open ocean. There is no deep sound channel, just a surface 1/2 channel. Therefore in the Arctic, in order to maximize the SSN's acoustic effectiveness, being shallow is better. This is contrary to the open ocean. Here is one more different thing the submariner must consider when contemplating optimum detection or best counter detection depths.

The anomalies of Arctic acoustics lead to one real operational requirement. Here in the Arctic, -- almost more than anywhere else, there is a strong need for the use of tactical oceanography. And yet, we know less about the Arctic than any other ocean when it comes to oceanography and bathymetry.

At this point it is only fitting to acknowledge other elements outside the USN Submarine Force that have contributed to our Navy's ever improving Arctic ASW and operational capabilities.

The first of these are the ice camps which are staged by the Navy to conduct submarine-related R&D during each ice

exercise. Like all things related to the Arctic, they are expensive to establish and maintain; and are time dependant and fragile in the face of mother nature. Second is the emerging warfare capability of our own maritime patrol aircraft. Their Arctic ASW performance has been considerably enhanced by repeated participation in Arctic exercises. The ASW skills of the maritime patrol aircraft now are able to nicely complement those of the submarine, which still must be considered the ultimate Arctic ASW platform. Lastly, the Royal Navy of the United Kingdom has been active in the Arctic through the last decade, performing R&D work, sometimes in concert with our submarines. They, too, have developed an Arctic operational capability and technological understanding in parallel with our submarine force.

In summary, our Navy has made real progress in Arctic operations over the last decade. Arctic capability specifically designed into warfare systems has been confirmed to be effective. Significant understanding has been gained in the Navy's under-ice tactics. Submarines can now employ tactics to mitigate the effect of the Arctic environment and to optimize their ASW capability under the ice. By virtue of an increased operating tempo in the Arctic, the Submarine Force has gained more operational platform experience and personnel training than ever before. The reservoir of the Navy's Arctic submarining skills is now quite full and broadly distributed within the force.

In conclusion, the Navy is constantly improving its Arctic Warfare capability. Progress over the last decade has been both measurable and noteworthy. The goal -- to be every bit as effective when operating under the ice as when in the open ocean, is clearly achievable. Understanding and thus exploiting the environment remains the key. For as the Navy, R&D project teams and the Submarine Force learn during every ice exercise, the Arctic is the most complex and dynamic ocean (acoustic) environment on earth!

■

BUILDING A SURVIVABLE SUBMARINE FORCE

by LT Wade H. Schmidt, USN

The United States Navy's attack submarine force is comprised of multi-purpose nuclear powered attack submarines. Fiscal constraints probably will reduce the number of submarines which can be built and supported. Proof of this is that Congress funded only one SSN-21 SEAWOLF Class submarine in the FY91 Budget and the Navy requested two. The SSN-21 is the most awesome offensive submarine the world has ever seen, but with the number which probably will be built, the SSN-21 and the follow-on submarines will need to be three times more **survivable** than the SSN-688 Class submarines.
[Ed Note: In repeated Congressional testimony the incumbent OP-02s have stated that SSN-21 will be 3 times as effective as the Improved 688s. Additionally, they have stated that SEAWOLF will be over 10 times quieter than I-688, have twice the tactical speed, be more survivable and have a significant margin for growth.]

Obviously, as the number of submarines decreases, each one becomes a larger proportion of the United States Navy's offensive and defensive capabilities. The fleet submarine has become a national asset. This is in great contrast to the fleet submarines of the post-World War II era and earlier. The costs of construction have risen drastically. The most capable submarine cost $6.7 million to build in 1946. The SSN-21 is projected to cost in the billions to build today. The current nuclear powered multi-purpose submarines are much too valuable to allow the loss of even one that could possibly have been saved. The Submarine Force is presently relying heavily on tactics for bringing a submarine out of an engagement successfully. While investing in the men and their ability to fight the ship is essential, there are many other possibilities within reach of current technology for improving the survivability of our submarines.

The U.S. Submarine Force began World War Two with 111 submarines, many of which were obsolete, lost 52 submarines during the four years of war, and commissioned 203 submarines from 7 December 1941 to 1 October 1945. It is obvious that in

any future war, the United States could not build as many nuclear submarines in the same amount of time, and losing 52 submarines would decimate the current submarine force. Therefore the U.S. Navy must do everything which is technically feasible to protect its submarines and increase their survival rate in wartime. There are many alternatives for protecting our submarines. Some of these alternatives can be developed and installed on current submarines with minor modifications to the submarine, some alternatives require major structural changes to current submarines, and other alternatives would require whole new submarine designs.

Defenses requiring minor modifications:

(1) a hard kill anti-torpedo device
(2) an anti-aircraft capability

Defenses requiring major structural changes:

(1) stronger hulls
(2) increased number of watertight compartments

Defenses requiring new submarine designs:

(1) double hulls
(2) build smaller submarines

This list is not all inclusive, but represents alternatives which have been tried or are in use in other navies. Deeper discussion on each of these alternatives is required.

A Hard Kill Anti-Torpedo Device

The research and development for a definitive hard kill anti-torpedo weapon would be costly and may not be an efficient use of resources, and some people would say that the capability is not even needed by a modern submarine force. Many others may say, however, that this is a capability which has been overlooked for too long and must be developed by the Navy at any cost. The Navy could spend a billion dollars on this countermeasure and if the result was one submarine surviving a torpedo attack, the cost would be well worth the lives of the crew and the cost of building a replacement submarine. Currently, the U.S. Submarine Force has developed outstanding torpedo evasion maneuvers and has put all the defensive capabilities of our modern submarines in its speed and acoustic countermeasures. As submarine torpedoes become faster and more effective, these defensive capabilities will be less useful. Not to mention the simple truth that the best tactics, speed, and

countermeasures in the world will not defend the submarine against a well placed shot from an anti-submarine cruise missile delivered torpedo.

Anti-Aircraft Capability

A weapon which will at least give the submarine a good possibility of damaging a helicopter or patrol aircraft is another useful device. There is no weapon currently deployed by any navy which can shoot down a helicopter from a submarine, yet the helicopter remains the primary ASW tool of the surface fleet. Private companies in France and West Germany are currently developing a submarine-launched optically-guided anti-aircraft missile, which uses fiber-optics and could be operational in as little as five years. An optically guided anti-aircraft weapon is only one alternative. A simpler and less costly option might be an encapsulated version of the Stinger missile. A Stinger missile variant could be designed to travel some distance underwater prior to surfacing and engaging the aircraft. A submarine detected or close to detection by a helicopter has the option to evade by running away at high speed. This may lead to a solid track for the helicopter and any surface ships or enemy submarines in the area. The enemy would then be able to deploy weapons in the path of the evading U.S. submarine. Imagine the drastic change in tactics by patrol aircraft and helicopters if the submarine they are trying to find has the capability to shoot back. Of course, the same rule for costs of development outweighing the cost of replacing a submarine and her crew apply here just as with the torpedo hard kill device.

Stronger Hulls

This is one area which the U.S. Navy has developed in conflicting directions. The 688 Class had a thinner hull, and therefore a shallower diving depth, but the SSN-21 will be made of higher strength steel to allow for a regain in the operational depth limitations. The SSN-688 hull was designed to be as light as possible to maximize the speed capability of the submarine. While speed is one weapon which any submariner would take to his advantage, another equally advantageous capability would be the greater use of tactical oceanography by allowing a larger envelope of operations, i.e. a thicker skin would allow a deeper depth and give the Commanding Officer the opportunity to

exploit the sound conditions to the maximum benefit. The depth versus speed trade-off would greatly expand the volume of water in which our submarines can operate, thereby greatly decreasing the detectability and significantly increasing the resources required to find the submarine. The average depth of the oceans is four thousand meters, and the depth limit of our attack submarines allows them the use of only a small fraction of the oceans. While a larger volume of ocean to maneuver in is a great advantage, further studies would be needed to determine if the decrease in speed would put the submarine at a significant disadvantage. Going back to the discussion on the anti-torpedo device shows that developing a hard kill torpedo device could reduce the need for higher speeds. This would allow a stronger, albeit slower submarine hull. Given an anti-torpedo device in conjunction with stronger hulls, the loss of speed should increase the ability of a submarine to fight and survive. Another advantage rarely discussed would be the greater ability to withstand the smaller anti-submarine weapons in use today (i.e. hedgehogs, RBU's depth charges, etc.).

Increased Number of Watertight Compartments

The U.S. Navy has made one change since the World War Two GATO Class which has decreased the survivability of our submarines. The SSN-688 Class has only two watertight compartments compared to eight in the GATO Class and five in the STURGEON Class. Realistically this means that uncontrollable flooding will cause certain loss of the crew and the submarine. In the SSN-688 the chance of flooding has been drastically reduced by careful design of the seawater piping, valves, and systems. Ideally the submarine should be able to survive a compartment being flooded and still make it home for repairs, but at the very least a submarine must be able to stay afloat so that the crew has a chance of survival or possibly even repairing the submarine. This capability is almost an afterthought for surface ships designs, watertight integrity allows for major sections to be flooded and the ship can at the least stay afloat and be towed home and may even be able to limp home as the USS SAMUEL B. ROBERTS showed us. A LOS ANGELES Class submarine could not perform this feat.

The older STURGEON Class is much better designed in this respect, allowing complete flooding of any one of three compartments or a large portion of either of the two major compartments with a good possibility of survival of the crew and the submarine. The best design would be the equivalent of the GATO Class which would allow complete flooding of any one compartment without the loss of the entire ship. These watertight compartments do not have to withstand the pressures at the maximum depth limits. Every submarine officer is trained to bring the ship to a shallower depth in the event of flooding. This means that the bulkheads would only have to be capable of withstanding the pressures of a few hundred feet of water and this would greatly increase the survivability of future submarines.

Double Hulls

There are also major advantages to be gained by double hull construction. First and foremost would have to be the added protection of another sheet of non-load bearing steel at a distance from the real hull. This gives significant advantage in regard to RBU's and hedgehogs, but of course the advantage decreases as the size of their warheads increase. The second advantage to the double hull design would be the greater area for installing exterior weapons and equipment such as counter-measures, vertical launch tubes, and sonar equipment. The ability to change the exterior arrangement without major pressure hull cuts would greatly reduce the costs of research, development, and testing of new weapons and sensors. The third advantage of a double hull would be the larger reserve buoyancies normally associated with double hull submarines. While this is inherently in the design and size of the submarine, double hull submarines lend themselves to higher reserve buoyancies without much effort. A larger reserve buoyancy allows the submarine crew more time on the surface to try to save the ship or at least to get out of the sinking submarine. Lastly, the double hull submarine would allow for a much simpler designed smooth exterior and allow the development of submarines closer to the best length-to-beam ratios and teardrop shapes. This in turn would make up for some of the speed loss due to the extra weight of the steel in the second

hull and possibly the weight of a thicker hull and more watertight bulkheads.

Build Smaller Submarines

Reducing the size of the submarine will give rise to three major advantages. The most significant advantage would be the reduction in the target strength of the submarine. The current submarines, being bigger than some smaller new class, naturally present active sonars with large targets and thus an increased probability of detection from these sonar systems. The larger target and easier detection also applies to the active sonar installed in every anti-submarine torpedo. The anechoic coating being installed on our submarines reduces the target strength of the submarine, but attaching the coating to a much smaller submarine could make that submarine virtually undetectable to active sonar systems. This would enable the bold submariner to sneak into an active sonar area which other submarines would have to avoid.

Conclusions

The SSN-21 is the most capable offensive submarine that the United States Navy has ever built and it is undeniably needed as the mainstay of the United States Submarine Force of the future. But more thought needs to be given to the defensive capabilities of our follow-on submarines. There are numerous highly capable submarines and anti-submarine weapons in the possession of the many nations around the world. Our submarine commanders should be able to effectively defend their ship, take the submarine in harm's way, and then return to the United States. Enhancing the defensive capabilities of the submarine will help to ensure that this is the outcome of future submarine combat patrols.

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SLCM MODERNIZATION

by Jon Boyes and Bill Ruhe

In the next several decades, restructured naval forces will play an important role in *regional conflicts*. Moreover, submarines are expected to be key players in regional uses of force -- to solve political problems and provide a proper defense of U.S. interests. Crisis situations are expected to evolve in many locations worldwide, and with increasing frequency, and forces using missiles will be particularly important in such situations.

Moreover, dependence on aircraft carriers -- *the cornerstone of our forward deployed Navy* -- for regional defense, may at times be restricted, particularly against countries with long submerged endurance, high performance submarines. (The German 209s, now widely proliferated to many foreign navies, proved difficult for modern British ASW forces to destroy in the Falkland Islands War of 1982.) This potential constraint to the unrestricted use of aircraft carriers could place a high premium on a U.S. Submarine Force with modernized weapons -- mainly Submarine Launched Cruise Missiles (SLCMs).

Up to now, U.S. submarines and their weapons have been structured to meet the major war threat posed by the Soviets. However, the marked downgrading of this threat plus the ascendancy of Third Power political crises -- in the present unipolar world -- may affect U.S. defense interests and call for a Submarine Force modified to better fight the relevant conflicts.

The use of SLCMs -- all weather weapons -- in conjunction with and in coordination with missiles used by other forces is now recognized as a major factor in quickly achieving decisiveness in regional hostilities, as was demonstrated in Iraq.

Importantly, with budgetary constraints a reality for at least the next decade, in order to have submarines which can use their missiles efficiently in regional wars, there are basically two directions to be taken in submarine force restructuring -- build submarines specially configured for the Third Power environment or *modernize* the existing weapons. Significantly, it is impractical to modernize the structure of the submarine force by building a new, responsive submarine -- because of the great time that it takes to realize a force of new submarines. At

best, a new submarine might be operational in the second decade hence. Whereas, modifications to weapons appear to be achievable in the near-term of this present decade. Having a modernization program for torpedoes suggests retention of ADCAP torpedoes as presently configured to meet regional ASW threats and the acquisition of a low-cost antiship torpedo. On the other hand, modernization of submarine missiles is not so easily rationalized -- and needs first, a definition of what they comprise and then the low-cost ways to achieve their modernization.

The nuclear SLCM is solely a Tomahawk variant. It can fly 1,500 miles at 450 knots and deliver a medium yield device with about 60 meter accuracy. Its role in *regional conflicts* is likely to be minimal, except that regional forces with a nuclear capability may be deterred from the use of their nuclear weapons because of the potential use of nuclear SLCMs. In addition, its presence in the U.S. inventory constitutes a hedge-type capability if a major war against a nuclear power is threatened.

The submarine launched non-nuclear cruise missiles may be either short range Harpoons or longer range Tomahawks. Both have variants for either the land attack or antiship mission. Moreover both are operational on many of today's U.S. attack submarines.

Recognizing that there are marked differences between these two kinds of non-nuclear SLCMs, it is valuable to define each weapon so that their *modernization* can be related to costs and capabilities for the next decade.

The Harpoon SLCM is a torpedo-tube launched encapsulated weapon which after ejection submerged, flies at 510 knots to over 60 miles. It is turbojet powered, weighs 1,530 pounds with its 13,000-pound thrust booster attached, and delivers a 507-pound penetration blast warhead with proximity and time-delay fuzing. It uses inertial navigation and a radar altimeter for mid-course guidance and an active radar for terminal homing on its target in the antiship variant. The Harpoon modified for the Iraq war for a land attack mission used the DSMAC scene-matching system with a TV seeker to home on its target. The Harpoon is 13.5 inches in diameter and is 182 inches long with its booster attached. Its present cost is about $1.0 m. per unit.

The conventional Tomahawk SLCM is a turbofan-driven

cruise missile with a 1,000 pound Bullpup warhead. It flies at 480 knots to at least 750 miles, hugging the sea or terrain over which it travels, using TERCOM (Terrain contour matching) along with inertial navigation for its midcourse guidance and DSMAC for its terminal homing in the land attack variant, or radar homing in Tomahawk's antiship variant. With a small frontal-area radar cross-section its stealth characteristic is good. Tomahawk is 21 inches in diameter and is 246 inches long and weighs 2,650 pounds with booster. Its present cost is estimated to be over $2.0 m. per unit.

Since Submarine Force restructuring for efficient response to regional conflicts is likely to involve shallow water operations and be severely constrained by budget limitations, a low-cost *modernization* of both Harpoon and Tomahawk is indicated and in a near time-frame. The development of new weapons requires too many years of work before they become operational, making this approach an impractical solution for *the next decade.*

Modernization of the inventory of Harpoons for the new environment of regional hostilities might be best accomplished by merely providing a more destructive warhead for its antiship variant. Against ships in regional wars -- ships which for the most part are likely to be using shallow water areas of the seas -- the Harpoon's range of 60 miles, plus its other characteristics, except for its warhead, seem satisfactory and responsive to submarine needs for Third Power engagements. Thus, an antiship Harpoon with a warhead which produces great heat when it explodes in addition to its blast effects to both damage a ship and to spread the heat widely **inside** the targeted ship, seems appropriate. The Exocets used in the Falklands War, although not cruise missiles, nevertheless demonstrated that a small warhead of only 364 pounds of explosives did far more damage with the heat it generated from unexpended rocket fuel than by its blast effects. In fact, an **unexploded** Exocet whose rocket fuel burned after the weapon had penetrated the outer skin of the destroyer SHEFFIELD actually sank the warship -- due to the intense hot fires which raged out of control.

The 507 pound HE penetration warhead of the Harpoon is only marginally appropriate against merchant ships and Third Power warships -- none of which are likely to have heavy deck or side armor. In fact, providing a very-hot explosion makes

extra good sense against warships with aluminum superstructures. The aluminum may burn after a missile-hit. Fire has also proved more destructive of merchant ships than blast effects. Significantly, attrition of merchant ships can be expected in regional conflicts, as was seen in the Spanish Civil War of 1936.

In commenting on the naval portion of the just completed Iraq War, Norman Friedman in the May 1991 issue of the Proceedings generalized as to the use of antiship missiles against Iraqi ships and craft. He stated that "modern antiship missiles...hit and often disable their targets -- but rarely sink them." He further noted that, "The next generation of patrol boats and ships will probably have more distributed and more survivable systems. Hits may fail to even disable them, let alone sink them."

Modernization of antiship missiles calls for warheads which will sink or at least disable today's ships -- not yesterday's.

Tomahawk's most pressing need for modernization is in its mid-course guidance system. The Iraq war illustrated first, the failure to have TERCOM data for the area in which Tomahawk might be used. Then, time consuming flights of surveillance satellites were needed to collect the elevation data necessary for digitizing into the TERCOM computer system. This also took additional time getting the data in its proper form for programming the Tactical Land Attack Missiles (TLAMs) for particular land targets. At the outbreak of hostilities in future regional scenarios, there is likely to be **no** TERCOM data available for that particular, unexpected area of conflict, and **no** practical amount of time to derive the necessary elevation data to make the Tomahawk TLAM usable. Hence, a modification to present land attack Tomahawks which would substitute a GPS (Global Positioning Satellite) miniature navigation system for mid-course guidance would be the single most valuable modernization feature for the land attack SLCM. Such a guidance system with a small CEP, can destroy many targets efficiently even without activating a DSMAC terminal homing feature. However, utilizing the DSMAC system as well as the GPS positioning system should produce terminal accuracies to within a few feet of aim point, at ranges of many hundreds of miles. (In the Iraq war, a Tomahawk flew over 500 miles with inertial and TERCOM guidance and then with DSMAC terminal-homing reportedly flew into a cave with an 8-foot diameter mouth, and

exploded the ammunition stored within the cave.) Significantly, the GPS guided SLCM with forward looking radar altimeter and inertial guidance can be programmed far more simply and carry out its mission with less dependence on computerized programs which are susceptible to computer down-time for their reliability.

Thus, for the conventional land attack Tomahawk the only major modernization item will be a substitution of a GPS guidance system for the present TERCOM system. A secondary modification should involve the warhead, since a 1,000 pound Bullpup warhead is far too limited in destructive power for the high cost of the weapon. Hence, trading off range to gain additional warhead weight and destructiveness is indicated. In addition, a modification to provide a means for attack evaluation is desirable. This might involve, at best, only the triggering of a signal to be received by a satellite when the Tomahawk had locked on to its DSMAC target. Another type of evaluation signal might be generated by the explosion of the weapon.

The antiship Tomahawk SLCM which uses the Harpoon's mid-course and terminal homing guidance in its present configuration, can best be modernized by changing its Bullpup warhead to a heat generating warhead -- by blowing unexpended fuel or by providing a special heat-generating fuel as part of the blast warhead, Importantly, for the likely conflicts of this decade, a range of 500 miles for an antiship weapon appears to be excessive. Thus trading off range for increased warhead weight is logical.

With the building of a new submarine or the modification of existing submarines likely to be accomplished in the far term rather than the near, and be extremely costly, it appears that the utilization of present submarines with *better* weapons is indicated as the low-cost approach to a responsive U.S. Submarine Force structure. The 688s which have 12 vertical launch tubes are particularly well configured to fight the wars of this decade. They can eschew operating in shallow waters by projecting missile power into such waters as well as by projecting missile power across coastal seas into coastal land areas and the objectives they might contain -- airfields, command and control centers, shipyard facilities, ships in port, communication complexes, bridges, railroads, etc. For submarines limited to

just four torpedo tubes for launching missiles, only small salvoes of missiles can be rapidly employed. But, for many point targets, up to four missiles should be sufficient to do the job. However, for area targets, large salvoes of missiles should produce a best chance of effectively neutralizing or suppressing their activity. This would be true for communication complexes, ammunition dumps, airfields, oil storage areas, railroad yards, etc.

The significance of these suggested ways to make the U.S. attack Submarine Force responsive to regional threats by modernizing its weapons, is that such options offer a low-cost, practical near-term approach for ensuring a front-line role in regional conflicts. They also provide the wherewithal to fight coastal, shallow-water wars using existing submarines.

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NSL ACTIVE DUTY PRIZE ESSAY CONTEST

Categories:
- Senior Active Duty (05 & above)
- Junior Active Duty (04 & below)

Prizes:
- $300.00 for winner in each category.

Judging:
- Final determination in January 1992.
- Judging by NSL Editorial Review Committee.
- Award to best essays dealing with:
  Future Submarine Roles and Missions

Rules:
- Essays must be *individual* efforts of about 2500 words or less; entrants by more than one author are not eligible for judging.
- Submissions to NSL must be clearly marked as entries for the NSL ACTIVE DUTY PRIZE ESSAY CONTEST.
- Essay entrants will not be published prior to judging except with prior concurrence of the author.
- Winning entries will normally be published in the Submarine Review.

SUBMARINE-ASW LITERARY AWARD PROGRAM

United States Naval Institute
Annapolis, MD 21402-1382
23 August, 1991

Vice Admiral Bernard M. Kauderer, USN(Ret.)
Naval Submarine League
Post Office Box 1146
Annandale, VA 22003

Dear Admiral Kauderer

I am pleased to be writing at the direction of the Naval Institute's Board of Control to offer to sponsor a writing award at the Naval Submarine League's annual awards ceremony. The award would consist of $500.00 for the author of the best article published during a one year period on the subject of submarines and ASW.

We invite the Naval Submarine League to select a winner from any publication, based on the criteria you deem appropriate. We would provide the funding for the award, and would welcome the opportunity to provide a suitable individual to present it.

The Board of Control authorized this offer as an important complement to our own efforts in support of our mission to advance knowledge in the naval and maritime services. Our Membership and Communications Director, Claudia Zacharias, will be coordinating this program. She will call within the next week to answer any questions you may have.

We look forward to joining with the Naval Submarine League to sponsor this exciting and worthwhile award.

Sincerely

CAPT James A. Barber, Jr., USN(Ret.)
Executive Director, USNI

PROCEDURE

NSL has gratefully accepted the generous offer of USNI to sponsor a Submarine/ASW writing award. We have established the following criteria:

- All articles published during the preceding fiscal year (April 1 thru March 30) are eligible for consideration.
- Articles published in the Submarine Review will be eligible automatically; all other published articles must be submitted to NSL with a request for consideration; articles must be received at NSL on or before May 15.
- Articles will be judged by the NSL Editorial Review Committee, using the same criteria now used for our annual Literary Award Program (Interest, Usefulness and Readability).
- The winner will be announced at the annual Business Meeting in June.

SUBMERGED UNREP FOR SSNs

In glancing through the April 1991 SUBMARINE REVIEW, I had a look at Mr. Thompson's interesting article on *Submerged Unrep for SSNs*. In it he says that "...The German WWII method of using "milch cows" for refuelling and resupplying on the surface is clearly unsatisfactory..." Actually, the Germans went further than this and on several occasions conducted submerged transfers of fuel. The technique involved the two U-boats meeting on the surface, where the supplying boat streamed a 96m hawser, hose and telephone cable. The buoy was taken aboard the receiving boat, the hawser made fast and the connections made, whereupon both boats submerged to periscope depth, with the supplying boat towing the receiving boat. With practice this part of the drill was reduced to some 9 minutes. They then went down to about 35m where speed was increased to 4kts and the transfer of fuel took place, which lasted about 4 hours! Both boats then surfaced together and the tow was dropped. This procedure was first tried by U-460 (a Type XIV "milch cow") supplying U-445 (a Type VIIC) on 7 December 1942, and was later tested officially in late 1943, using the captured Dutch boat UD-4 (ex-RNethN 0-26) as the supplying boat, since there were few Type XIVs left. However, the idea seems to have then been dropped.

Of course, this rudimentary procedure differed from Mr. Thompson's proposal, since he, very sensibly, bases his idea on an entirely submerged meeting and transfer, whereas the Germans had, perforce, to start and finish the proceedings on the surface. Nevertheless, the germ of the idea was there!

David Miller
Twickenham, England

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IN THE NEWS

Submarine news over the past several months centered about the SEAWOLF building program. The general status of the program, as an indicator of both the health of the Defense Department's big-ticket acquisitions in a tight budget era, and the seriousness of the defense industrial base problem, has gotten some notice. The specific situations regarding weld problems and the contract court battle have been covered in some detail. In addition, the general direction of the U.S. Navy's submarine plans have been interpreted in the press and comments have been offered about Soviet submarine news. An old standby subject has re-surfaced with the question of building diesel-electric submarines in a U.S. yard for a foreign government.

The light point in the news (for those not directly involved) was covered by The Washington Post on August 7th in an article titled "Schaefer's Revenge: A Sub Snub" in which the paper recounted the decision of Maryland's Governor to pass up the August 10th launching of USS MARYLAND (SSBN-738). According to the paper, the Governor was "still plenty miffed over the way the ship's builder, General Dynamics Corporation, recently chose Virginia over Maryland as the site of its new national headquarters."

General Status of SEAWOLF:

Forbes magazine, in it's September 30th issue ran an article "SEAWOLF at Bay" with the sub-head "Good news about the collapse of the Soviet empire is bad news for defense contractors. Now the SEAWOLF submarine program, vital to both General Dynamics and Tenneco, is in trouble." Forbes described five specifics for its diagnosis:

(1) "...does the Navy need the program now that the U.S.S.R. is going out of business?"

(2) "...a messy contract dispute, now in the courts."

(3) "...the widely reported problem with weld cracking on the first SEAWOLF being built at GD's Electric Boat."

(4) "...a complex battle management and surveillance computer system called BSY-2, or 'Busy Two' ..and its technology is still miles from being completed." and

(5) "...a paper submarine called Centurion. This is a smaller attack sub than SEAWOLF, and therefore would be cheaper."

The Forbes article closed with "The case for slashing spending on submarines isn't as cut and dried as it might appear to those who get their news from TV or newspaper headlines. ... Until it is clear that the Soviet admirals have sharply reduced their sub launchings, no congressman is his or her right mind will walk completely away from building U.S. nuclear subs. Even Senator John McCain (R-Ariz), a leading critic of SEAWOLF, accepts that he doesn't have the votes to cancel SEAWOLF. But there is little doubt the program will be stretched out."

The New York Times, on June 28th, had already reported that "Electric Boat said today that it would lay off more than 800 employees as part of a reorganization. ... Electric Boat said it hoped to avoid additional layoffs until the second half of 1992 ... and warned that it would have to cut its work force of 2,200 in Groton and North Kingston, R.I., by about half in the next five years because of reduced military spending."

Navy Times of August 15th reported "Construction of the first two SEAWOLF submarines could be delayed by more than a year because of welding cracks in the first submarine's pressure hull and legal difficulties surrounding the contract to build the second, Navy officials said." After describing those situations, the paper finished its report with "The SEAWOLF program has suffered major cutbacks during the past two years. Navy plans had called for ordering three submarines per year. The August 1990 Major Warship Review cut this to three submarines every two years, but the Navy's 1992 budget request cut this further, to one boat per year through 1996. But even as 1991 SEAWOLF contract plans are being tossed back and forth, the contract for the 1992 submarine is ready to become a new controversy. Both the House and Senate armed services committees' 1992 Pentagon budget bills told the Navy to compete the third SEAWOLF contract to the yard that is not building the first two."

The same trade paper, in a September 2nd article about the court case, reported that "... Navy and industry officials continue to study a proposal by Senator John A. Warner, R-VA, to make either Newport News, ...or Electric Boat... the

SEAWOLF builder, with the other yard serving as a primary subcontractor that would build major portions of the submarine."

Defense Week, in its Reporter's Notebook page of August 26th, noted that Tom Clancy, author of The Hunt for Red October appeared on Morton Kondracke's TV show on August 17th and said "I'd trash the SEAWOLF, the SSN-21. ... it's an evolutionary development of the submarines we already have in place right now."

The SEAWOLF Court Case:

Hartford Courant of July 12th noted that "A federal judge in Norfolk adjourned the long-awaited SEAWOLF submarine trial without a ruling Thursday, but left open the possibility that he would order the Navy to rebid its contract for the second SEAWOLF, which went to Electric Boat of Connecticut."

On August 1st, Wall Street Journal reported "A federal judge threw out the Navy's choice of General Dynamics Corporation to build the next SEAWOLF-class attack submarine, ordering new bids to be submitted under rules favoring arch-rival Tenneco Inc. Judge Robert Doumar ruled that Donald Yockey, the Pentagon's top acquisition official, exceeded his authority, *completely ignored* congressional intent, and *wholly without rational basis* made sure that the Navy last May awarded the contract to General Dynamics' Electric Boat Division in Groton, Conn."

That same day Reuters said that Electric Boat "is considering appealing.."

The Washington Times, on August 7th, stated that "The Navy has asked a federal judge to stay his injunction ordering General Dynamics Corporation not to begin work on the Navy's second SEAWOLF attack submarine. .. Pentagon spokesman Pete Williams told reporters the Navy wanted time to study last week's decision..."

The Washington Post of the next day reported on Judge Doumar's ruling allowing the ordering of SEAWOLF building supplies.

The reopening of the bidding was reported in the Washington Times on the 15th: "The Navy -- acting under protest -- reopened bidding yesterday for the disputed second SEAWOLF nuclear submarine contract. In a response to a July 31 federal court order, the Navy said yesterday that if it loses its appeal, it

would accept new bids ... But in a move counter to the order, the Navy said it would continue to use price as the chief factor in choosing a winner."

SEAWOLF Welding Problem:

The Washington Post, on August 2nd, covered the breaking story on the SEAWOLF welds by speculating about a delay in production. Their piece started "General Dynamics Corporation has discovered welding flaws so severe in the hull and internal structures of the Navy's first SSN-21 attack submarine that the partially completed submarine will have to be disassembled and rebuilt... The Navy ... emphasized yesterday that General Dynamics engineers discovered the flaws and reported them promptly... a Navy spokesman said the 353-foot SEAWOLF is the first to use a hull made entirely of high-pressure HY-100 steel. He said construction of the submarine has also relied on a new welding material to join the steel into plates, hull subsections and large cylindrical sections."

In reporting on potential repair methods, Hartford Courant of August 6th stated that "Electric Boat is considering two approaches to solving its problem with microscopic cracks in hull sections of the Navy's first SEAWOLF attack submarine -- tearing down and reworking sections already welded, or starting from scratch using new steel."

A more far-reaching description of the problem was provided by Defense News on the 12th. "Welding problems that General Dynamics Corp. has encountered in constructing the first SEAWOLF bode ill for the Navy's plan to make future submarines from a stronger grade of steel, according to Pentagon officials and industry experts." "The higher strength steel such as HY-100 and HY-130 has less tolerance for cracking." The article further commented that "On top of technical problems with high strength steel, there are few suppliers of HY-130." They then explained that "The Navy plans to construct the first three SEAWOLFs from HY-100 and successive submarines from even stronger steel known as HY-130."

Art Buchwald's column which appeared in the Washington Post on August 13th was titled "Some Nasty Cracks" and parodied both the impact of the problem and the cost of the SEAWOLF program.

General Submarine News:

The Defense News of Monday July 15th carried two feature articles about U.S. Navy submarines. On page one, the lead story was headlined "House Panel Balks at Navy Sub Plan." The article itself started "Concern that the U.S. Navy will prematurely commit to a propulsion system that may constrain development of its next-generation Centurion attack submarine is fueling congressional opposition to the Navy's advanced research effort. Lawmakers are concerned about approving funding for an advanced submarine propulsion system when plans for a future attack submarine program are ill-defined." The article quoted a congressional source as saying "If the Navy tells us they want funding for a next generation propulsion plant, they ought to be able to tell us what the next generation submarine is.." The substance of the news piece was "The House Appropriations defense subcommittee eliminated $19.8 million earmarked for future submarine propulsion systems from the Navy's $89.8 million 1992 budget request for advanced nuclear power systems, citing the lack of a viable submarine design concept."

On page 19 of the same issue of Defense News, a piece titled "Shifting Threats Demand Sub Options" discussed the Navy's work toward setting such a design concept. The lead paragraph states: "The U.S. Navy earlier this year announced that it has begun an effort, known as the Centurion study, to define a new nuclear-powered attack submarine (SSN) to serve as a more affordable complement to the SEAWOLF (SSN-21) attack submarine. The new SSN will replace the LOS ANGELES (SSN-688) class attack submarines when they begin to retire around 2006." It went on to put forth the concern: "A key issue to address regarding the Centurion program is whether it adequately considers the uncertainty of the future international security environment and the difficulty this creates for planners attempting to define an SSN that won't enter service until after the turn of the century."

Also about the Centurion program, Aerospace Daily, on July 18th, in a piece about the new A-X aircraft offerings from industry, quoted Gerald A. Cann, Assistant Secretary of the Navy for Research, Development and Acquisition as saying, "The only other fiscal year 1992 Navy new start, the Centurion submarine, intended to follow the SEAWOLF, is *in the embryo*

stage," Cann said. He said he was "still trying to get OP-02 (Undersea Warfare) to lay out *carefully crafted requirements that can be used in conceptual studies.*" The Cann discussion of Centurion was further described: "The issue in sub development", Cann said, "is to get great capability but to simultaneously drive down cost *to the point where you can buy more than one submarine a year.* My general view is that if you can't do that, you've got a serious problem."

Secretary of the Navy Lawrence Garrett was asked about Centurion in an interview which appeared in Defense News on August 19th. His answer to a question about the relationship of Centurion to SEAWOLF was as follows: "We need to continue to build the SSN-21 and we intend to do that over the next decade until we develop a submarine that will complement those submarines that have gone into the fleet over time. Each submarine is an evolutionary design but from an operational point of view, each complements the others. The reason we got on with the development of the Centurion is that I believe we as a nation need to continue to evolve this technology to keep the upper hand in submarine platform technology. At the same time we need to build more than one submarine per year. We need to take the technology, continue to evolve it and incorporate it into a platform that is a very capable submarine."

A new Congressional Research Service report entitled "Navy SEAWOLF and Centurion Attack Submarine Programs: Issues for Congress" was reported upon by Defense News, also in their August 19th edition. The article leads off with "In calling for 14 attack submarines to be continuously deployed in the future, the U.S. Navy has significantly changed how it determines its overall submarine force levels..." It went on to explain that "Keeping 14 submarines operating continuously equates to an overall force level of 80 attack submarines, far below the Navy's previous inventory objective of 100 SSNs that was established in the mid-1980s, ... However, this is more than the future inventory of 70 SSNs projected under current submarine constructions plans."

Soviet Submarine News:

Jane's Defence Week of June 29th reported that "The Soviet Union is developing a new ballistic missile submarine as a follow-on to the DELTA IV, according to U.S. intelligence sources and naval analysts." The article continued, "It is unclear

what stage its development has reached. U.S. intelligence analysts believe it will be several months before they have a clear understanding of the submarine project and exactly how the Soviets plan to proceed." It was added that "It is generally thought that a new submarine would be a follow-on to the DELTA IV class rather than the larger TYPHOON class." In addition, "The new submarine is expected to be of double-hulled construction. If of a totally new design, this implies the Soviets are going to continue serious production of strategic missile submarines," said one naval analyst. He said "the Soviets are continuing to spend heavily in strategic missile modernization as well as modernization of the submarine fleet, prompting concerns that a change in Soviet strategic policy is on the horizon. The new submarine is likely to carry a follow-on from the SS-N-23 ballistic missile. Former CIA Director William Webster revealed in February that existing TYPHOONs were already being modified to accept a new missile."

In a report from Moscow, the Washington Post of July 28th told of a statement by Admiral Konstantin Makarov, the Soviet Navy's deputy chief and chief of the Navy's general staff, to the effect that "The Soviet Union faces a greatly increased threat from U.S. and Western naval forces and sea-based missiles that more than offsets gains from arms reduction treaties..." Makarov told the Sovyetskaya Rossiya newspaper that "the threat to the country's security had almost doubled with the *massive deployment* of sea-based cruise missiles."

In a third piece on the Soviet Navy, and a further report on their SSBN force, Navy News & Undersea Technology, on August 5th described the revelations of a pair of Soviet experts about the nuclear weapons command and control procedures aboard their nuclear missile submarines. "While skippers of American SSBNs have the ability to launch their Poseidon and Trident missiles without further assistance, Soviet commanders must receive a coded message to enable a launch," said Bruce Blair with the Brookings Institution. The experts continued that "The codes are entered into the onboard weapon system computer in order to remove the blocking system that protects unsanctioned launch."

Other Foreign Submarine News:

The most significant bit of news about foreign submarines actually happened in the United States. Defense News

reported on August 5th that "U.S. Navy officials are expected to meet this week to form an opinion on whether a U.S. shipyard should be allowed to construct two diesel-electric submarines for Egypt. The request conflicts with long-standing U.S. policy and traditional Navy aversions, according to U.S. Navy sources. At issue are two Type 209 diesel submarines designed in Germany, which would be assembled and outfitted by Ingalls Shipbuilding, Pascagoula, Miss."

An editorial in that same paper on Monday, August 12th, urged that "The U.S. State Department and the Navy should approve a request by a major U.S. shipbuilder for permission to assemble two Type 209 diesel-electric submarines for Egypt."

A page 4 piece in the Defense News of August 26th reported that "officials of the U.S. Navy have categorically rejected a bid by Ingalls Shipbuilding to construct two diesel submarines for Egypt."

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SUBMARINE TECHNOLOGY FOR THE 21st CENTURY

By Stan Zimmerman
Arlington, VA: Pasha Publications Inc., 1990
pp 175, Price: $250.00

reviewed by Ken Cox and Tom Maloney

Stan Zimmerman, editor of Navy News and Undersea Technology, in the promotional material for Submarine Technology for the 21st Century opens with the intriguing question: "As we move into the Twenty-First Century what will be the fate of navies around the world?" He opines that submarines are one of the least expensive vessels to manufacture, man and maintain, and that an increasing number of countries are developing manufacturing capabilities for submarines. He contends that his 175 page soft-cover book examines the technological advances, looks at what is under development in laboratories around the world, and projects what submarines will be able to do in the next century. In the book, it is claimed that one will learn: who is developing which new technology; how can each new technology be used to improve a submarine's performance; where can one look to get involved in this technological revolution; what are the submarines of the Twenty-First Century likely to look like; and what is happening in foreign markets, who is building submarines, what technologies are they developing and how can one get involved outside the U.S. market. How well this book accomplishes these objectives is the purpose of this review.

In the Forward, the tone is set by statements to the effect that the flowering of American submarine technology in the period between 1955 and 1965 created a plateau the Navy has rested on ever since. Zimmerman cites an unidentified source who believes that the loss of the USS THRESHER in 1963 was responsible for "bringing innovation to a virtual standstill, restoring to primacy the submariner's traditional sense of caution." and concludes that the "pace of submarine development in this century has been ... glacial in its pace. (sic)" While this lead-in is thought-provoking, nowhere in this compendium is that opening thesis confirmed.

For whatever reason, perhaps its journalistic heritage, the book evidences a clear anti-nuclear propulsion bias. Statements such as "The basic power plant in today's American nuclear submarine is no different than the system used aboard the first mass-produced class, the SKATE" demonstrate either a lack of technical depth, or very liberal literary license. The discussion of thermodynamic efficiency and reactor *delta-T* in Chapter Two is so badly in error as to reveal a complete lack of technical understanding and competent editing. While the presentation of the evolution and status of air-independent propulsion (AIP), lumped in with superconductivity and magnetohydrodynamics (MHD), are interesting, they do not support the conclusion that we are standing at the brink of a propulsion revolution and that "AIP by itself holds the promise of becoming a cheap equalizer to today's nuclear attack submarines with their noisy pumps and props."

The author states "Evidence is growing the Soviets have fielded an MHD drive for their hunter-killer nuclear subs, and that it is mounted on a teardrop-shaped pod atop the vertical rudder," such evidence apparently from Captain John Moore RN(Ret.), unnamed U.S. naval officers and other *sources.* Doubters are dismissed with rather shallow rebuttals. All credible engineering analysis and other information known to the reviewers conclusively substantiates that the pod seen on some Soviet SSNs does not contain MHD propulsion, as stated by the Soviets themselves.

In Chapter Three, Submarine Hulls, Their Design and Materials, the author makes the statement that "Submariners sometimes refer to their vessels as 'sewerpipe,' a euphemism for life inside a steel cylinder." This derisive term is long out of vogue and detracts from what is purported to be a serious technical document. Nevertheless, the collection of information on materials is one of the better sections of the book and represents a concerted effort to assemble in one place much of the material on the subject available in the unclassified literature. The description on "Managing the Envelope Through Automation," although plagued with technical errors, is provocative reading.

Still in Chapter Three, the author's unquestioning endorsement of projects not conceived, or as yet not supported by the U.S. Navy, is exemplified in the discussion of Deep Flight -- "a

pair of mini-submarines expected to be the world's first undersea fliers." These untried vehicles are extolled as offering the potential "to make a radical change in the direction of undersea warfare" and, with other similarly technically immature innovations, "to transform the realm of underwater combat." Perhaps so, but to these readers, the author's enthusiasm for such projects does not appear to stem from technical considerations.

The lengthy treatment of anechoic or acoustic tiles seems to be embedded with disparaging remarks on the U.S. Navy's tardy and reluctant action "to install some kind of coating on STURGEON class submarines." In stating that "the initial Improved 688-class sub, the SAN JUAN, is the first U.S. submarine to be equipped with tiles: and "The United States only recently began applying tiles to its submarines," the author is clearly unaware that a very effective, and clearly visible, hull treatment has been installed on a number of U.S. SSNs, starting in the early 1980s. This modification has been most cost-effective, yielding a large dB per dollar improvement; regrettably, the rate of installation was limited by funding cuts.

The chapter on submarine-launched weapons offers nothing startling. It indicates a lack of understanding of certain fundamental characteristics of submarine torpedoes and replays the now familiar litany of the World War Two torpedo problems. The chapter offers an unfounded statement on why the Mark 8 torpedo was employed by the British in the Falklands/Malvinas Islands campaign by HMS CONQUEROR and provides a shopping list of torpedoes and cruise missiles easily available elsewhere. However, the points made about the possibilities of submarines being equipped with anti-aircraft missiles are worthy of further consideration.

The penultimate chapter on The Information Contest, or as it is called in the book, the Rule of the One-Eyed Man, covers perhaps the most important topic that an insight on the 21st Century should address, that of sensors and combat systems. Unfortunately, either for lack of information or space, the book gives short shrift to this area rather than a serious treatment of the subject. Again, errors of fact abound. It is stated, for example, that "no U.S. attack submarine at present uses a self-noise monitoring system" and it is implied that such a system could be purchased from the French.

In the wrap-up chapter, Zimmerman forecasts that the proliferation of advanced submarine-launched weapons, the advent of affordable air-independent propulsion, the spread of stealth technologies and the swift advances in electronic combat equipment all foreshadow more capable and less expensive combat submarines in the future. More capable, yes; less expensive, no, if the Royal Navy's UPHOLDER Class SSK is any harbinger of what might be expected in a high-tech non-nuclear attack submarine.

While various forms of AIP have been experimented with by various nations since the end of the Second World War, it would seem that fiscal reality is slowing what only last year appeared to be a whirl-wind drive toward those systems. One only has to consider the increasing average age of post-1960 conventional submarines in Third World inventories to realize that, while the desire exists, the hard currency for new, high-tech submarines is lacking, as is a clear consensus on the efficacy and practicality of AIP. The decision of the Australians to forego the option of the Sterling Engine for their COLLINS class SSKs being built by the Swedes is a case in point.

If this book had been subjected to a rigorous technical scrub and editing, many of the numerous factual errors could have been avoided. Statements such as the description of "tonals" being the minute variations between the blades on a submarine propeller which allow sonarmen to distinguish between individual submarines of the same class should not have survived even a cursory review. However, more damaging to the book's credibility than simple errors of fact are comments such as "When individual platforms cost between $300 million and $2 billion, a submarine's survival is almost as important to the national treasury as it is to the crew." This and other similar remarks have no place in a publication titled Submarine Technology. It is regrettable that Mr. Zimmerman has chosen not to engage in an open technical discussion of the very complex and unforgiving choices faced by the submarine designers, but instead, has relied heavily on anecdotal information, unsubstantiated assertions and sarcasm.

In summary, does Submarine Technology for the 21st Century live up to its billing? Yes, but only in the most superficial way. The book suffers from the absence of a solid base of technical understanding, as well as the lack of a

bibliography, an incomplete index and the use of "sources" rather than references. This is not technology. Much of the material is readily available in recent defense magazine articles, symposia proceedings and promotional literature; however, the compilation in one location is useful to those attempting to gain a familiarity with emerging submarine technology and seeking a reference book. For the serious technologist, at $250 per copy, the book is overpriced for its inherent value.

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SUBMARINE COMMANDER

by Paul R. Schratz
The University Press of Kentucky 1988
ISBN O-8131-1661-9

Reviewed by Daniel A. Curran

Paul Schratz, the person, is the main subject of Submarine Commander. After years of reading Captain Schratz's columns and articles on national policy and international affairs in the Proceedings, the Naval Academy Shipmate and in other publications, it is a pleasure to learn something about the man in an entertaining book about his submarine adventures.

The book provides more than just good reading. Three sections in the book are pertinent today: ATULE's problems with sea mines in the Japanese, Korean and Chinese waters; the immediate post-war period in occupied Japan; and the submarine operations in the Korean conflict for which PICKEREL and her crew earned the Submarine Combat insignia.

The problems ATULE faced against the Japanese antisubmarine mines and later PICKEREL against the North Korean mines are sobering when one considers the type of underwater weapons a nuclear submarine might face today. The sections on demilitarized Japan, including the shore duty and the transport of the Japanese submarine I-203 (SASORI) from Japan to Hawaii, provide insight into the problems facing the inspection teams in post-Desert Storm Iraq. PICKEREL's Korean War adventures are very close to the situations in which a submarine might find itself in a modern low intensity situation.

Sea mines, those inexpensive, easily deployed *weapons that wait*, have received renewed prominence in Desert Storm where both PRINCETON and TRIPOLI, multimillion dollar ships,

were put out of action by simple devices costing thousands of dollars. (Or perhaps hundreds?) In the previous Gulf crisis SAMUEL B. ROBERTS struck a moored mine. In these two military actions three ships were damaged by mines and one ship, STARK, was hit by a missile. Billions have been and are being spent for anti-missile defense while substantially less is being invested in minehunting.

The post-World War II period in Japan is another interesting section. What to keep and what to dismantle and destroy was a situation the Allies faced in both Germany and Japan. One wonders if some of the Japanese submarine technology might have been adaptable to our submarines as the snorkel and some of the torpedo ideas were adopted from German technology. The history of demilitarizing Japan and Germany could be the subject of a book in itself now that many of the records have been declassified.

The Korean War, the forgotten war in U.S. history, provided some more influences than those mentioned by Captain Schratz at the end of the book. As the United States reexamines its global commitments today, historians should look back at the activities of submarines like PICKEREL, LIONFISH and others and the types of missions assigned to them in the light of modern threats and technology.

Paul Schratz's narrative covers the time period from the day before the Japanese attack on Pearl Harbor when he was serving in USS WICHITA at Iceland, through duty in USS MACKERAL in the Atlantic just after the start of the war, and 7 war patrols in USS SCORPION, STERLET and ATULE, to the end of the Korean War as Commanding Officer in USS PICKEREL; with a brief respite reactivating BURRFISH. Besides Schratz's personal story, the book gives another good view of the history of U.S. submarines from the beginning of World War II up to the start of the nuclear submarine era as seen by an operational sailor. Certainly the submerged trip of 21 days and 5,200 miles from Hong Kong to Honolulu by PICKEREL was a prelude of things to come with NAUTILUS, SKATE, SEADRAGON, TRITON and others.

Submarine Commander belongs on our bookshelves because Paul R. Schratz is an entertaining writer and because he gives us some lessons to be learned in modern submarine warfare.

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